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**FIELD STUDY OF DISPOSED WASTES
FROM ADVANCED COAL PROCESSES**

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Progress Report**

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1.0 OBJECTIVES

The Department of Energy/Morgantown Energy Technology Center (DOE/METC) has initiated research on the disposal of solid wastes from advanced coal processes. The objective of this research is to develop information to be used by private industry and government agencies for planning waste disposal practices associated with advanced coal processes. To accomplish this objective, DOE has contracted Radian Corporation and the North Dakota Energy & Environmental Research Center (EERC) to design, construct, and monitor a limited number of field disposal tests with advanced coal process wastes. These field tests will be monitored over a three year period with the emphasis on collecting data on the field disposal of these wastes.

There has been considerable research on the characteristics and laboratory leaching behavior of coal wastes -- a lesser amount on wastes from advanced coal processes. However, very little information exists on the field disposal behavior of these wastes. Information on field disposal behavior is needed (a) as input to predictive models being developed, b) as input to the development of rule of thumb design guidelines for the disposal of these wastes, and c) as evidence of the behavior of these wastes in the natural environment.

2.0 SUMMARY OF PREVIOUS WORK

This study is organized into four major Tasks. Tasks 1 and 2 were devoted to planning the Task 3 field study. Task 4 uses the results of the field testing to produce an Engineering Design Manual for the utilities and industrial users who manage wastes from advanced coal combustion technologies.

Task 1 identified and rated test design options. A Test Design Manual was prepared and submitted to METC in 1988. Specific test procedures suitable for each design option were identified under Task 2. These test methods were documented in a

Test Procedures Manual, submitted to METC in 1988. Also under Task 2, test sites were selected and site access was negotiated. Sites in Illinois and North Dakota were delayed at this stage, and the North Dakota site was dropped from consideration. Task 2 was completed and Final Test Plans were submitted to METC for three sites in 1988.

Task 3 progress for each of the test sites is summarized below.

2.1 Colorado

The test cell was constructed in June, 1989 with CFBC ash from a low sulfur western coal. The ash has low lime and sulfate content. Core samples were collected in June and December 1989, in March, June and December of 1990, in June 1991, and most recently in June 1992. No groundwater or porewater samples have been recovered; one surface runoff sample was collected. At this time the three year monitoring period at the Colorado site is completed; further field monitoring at this site is under discussion with the DOE and other parties. A site assessment report, based on the initial three years of monitoring, is scheduled for completion by the end of 1992.

The strength of core samples from the Colorado site is low to moderate (200 psi to 900 psi), with permeabilities of 2×10^{-3} to 3×10^{-4} . Laboratory leachates show moderate concentrations of calcium, sulfate, and other common ions. Trace element concentrations in test leachates are low compared to regulatory limits. No leachate has been generated from the test cell at this site.

2.2 Ohio

Two test cells were constructed, in February and April of 1989, using LIMB ash from an Ohio coal with 2.4% sulfur. The ash has a high lime and sulfate content. Test case 1 (north cell) was constructed with 25% moisture; test case 2 (south cell) was constructed with 38% moisture to optimize compaction. The wastes expanded,

heaved, and fractured during the first year, particularly in the south cell. Mineralogical changes in the wastes with hydration and weathering are the primary cause. Core strength is low to moderate (<100 psi to 2000 psi) and highly variable because of fracturing. Field measurements of permeability vary from 3×10^{-3} to 5×10^{-5} cm/sec. Permeabilities are lowest in the north cell.

Large amounts of water were bound in the wastes in the first year as the waste saturated and hydrated. Starting in the second year, leachate appears to have migrated out of the south cell into one downgradient well as evidenced by elevated concentrations of chloride in one downgradient well. The leachate at the bottom of the test cell contains up to several thousand mg/L of sulfate, chloride, potassium, and sodium, with somewhat lower concentrations of calcium and silicon. Trace metal concentrations are generally low compared to regulatory limits, but a few samples of leachate from the ash contain arsenic at concentrations of up to 0.35 mg/L.

Core samples were first collected in June, 1989, and quarterly and annual core sampling events have taken place according to schedule since that time. Water samples have been collected on a quarterly basis since October, 1989. Final core sampling for the three year monitoring period took place in August, 1992. Further monitoring, on a limited basis, is under discussion with the DOE and Ohio Edison.

2.3 Illinois

The first Illinois test cell was completed in April, 1991, with BFBC ash from a Illinois coal with 3.1% sulfur. A large excess of limestone is used in the combustor; the ash is high in lime relative to most FBC wastes, containing up to 30% CaO. The ash also contains abundant sulfate, but has relatively low concentrations of typical coal ash constituents compared to other wastes included in this study as a result of the high relative amounts of limestone used in the feed. The two test cells planned for the second Illinois test case will evaluate the effects of added coal ash on cementitious reac-

tions in the waste. Laboratory studies to define the optimum mix of FBC waste and coal fly ash are completed, and cell construction is planned for late fall of 1992.

The initial cell was instrumented and sampled in June 1991. Water samples and additional cores were collected in August and November, 1991, and February and May, 1992. No expansion has been noted at the site. The wastes are solidified with unconfined compressive strength between approximately 150 and 550 psi, although some fracture zones may be present in the waste and may reduce overall strength. The permeability measured on cores recovered from the test cell ranges from 1×10^{-6} to 2×10^{-4} ; field permeability measurements range from a high of 3×10^{-3} near the surface to a low of 2×10^{-5} at depth in the test cell.

3.0 OBJECTIVES FOR THE CURRENT REPORTING PERIOD

The specific objectives for the reporting period of July, 1992 to September, 1992 were as follows:

- Collect third annual core samples at the Ohio site in August, 1992. Make final field measurements on site and collect water samples to complete the three year monitoring period;
- Collect the fifth quarterly water samples from the first Illinois test case in August, 1992. Make field measurements and collect data from the data logger;
- Analyze chemistry of all core and water samples collected;
- Begin construction of the second Illinois test case;
- Continue production of a video presentation on the project;
- Load all EERC data on the second annual cores from Colorado and Ohio and the first two sets of quarterly samples from Illinois into the project database;
- Finalize plans with METC for continued monitoring at the Colorado and Ohio sites beyond the initial three year period, and

- Complete the Preliminary Assessment reports on the Ohio and Colorado sites for the DOE, pending receipt of DOE comments on the initial drafts.

4.0 ACTIVITIES FOR THE REPORTING PERIOD

4.1 Colorado Ute Site

The results of chemical analyses of the third annual core samples, which were collected from the Colorado site June 17 and 18, 1992 have been reported. The data on the total inorganic carbon content and deionized water leachate composition of the core samples are shown in Table 1.

Figures 1 and 2 present a comparison of the deionized water leachate chemistry from 1990 and 1992 core samples. In both these figures depth trends of leachable calcium and sulfate, which are major constituents of the FBC waste, are shown on the left, while the concentrations of the soluble minor species chloride, potassium, and sodium are shown on the right. Data from both years shows a spike in sodium and sulfate concentrations immediately below the base of the test cell. The 1992 data also shows a less pronounced spike in chloride concentrations just below the base of the test cell. It is not clear whether these trends in soil leachate composition are related to the migration of pore fluids from the FBC wastes into the underlying soils. Sodium concentrations in test leachates of the FBC waste are generally under 10 mg/L; it appears unlikely that migration of leachate with this composition could be responsible for the 200-300 mg/L leachable sodium found in the interval between 9 and 10 feet of depth. Potassium concentrations range from 25-50 mg/L in the FBC waste, but are generally less than 3 mg/L in the underlying soils, suggesting that material transport has been limited.

1990 Colorado Site Cores

Figure 1. ASTM Deionized Water Leachates from 1990 Annual Cores Collected in December 1990. Results from Two Separate Cores are Shown.

1992 Colorado Site Cores

Figure 2. ASTM Deionized Water Leachates from 1992 Annual Cores Collected in June 1992. Results from Two Separate Cores are Shown.

Results from deionized water leachates of background soils are shown in Figure 3. Calcium and sulfate concentrations in these samples show a range of variability similar to that seen in the soils beneath the test cell. Potassium and chloride results indicate some leaching from surface zones into deeper soils, but the concentrations in the 10-12 foot interval are lower than in the leachates from the 1992 cores. Sodium results were not recorded for these samples. If the increased leachable sodium and chloride concentrations beneath the test cell are a result of pore fluid migration, the affected zone extends only to about 15 feet in depth; only 7 feet below the ash/soil contact. Permanent groundwater is found more than 100 feet below this zone.

4.2 Ohio Site

The third annual set of core samples and the final water samples of the three year monitoring period were collected from the Ohio site in late August, 1992. Analytical results for the water samples from the final event are presented in Table 2. Results of the core analyses have been reported from the labs, but are not yet loaded into the database. These final core analyses will be reported in the next Quarterly Report.

4.2.1 Statistical Analysis of Results

As previously discussed, the chloride concentration in groundwater samples from the shallow well downgradient of the south cell (OHMW-06) appears to have been impacted by leachate from the test cell. Statistical analyses were performed on chemical data from the three monitoring wells screened at the top of the saturated zone to check whether the concentrations of chloride, or other species, were significantly greater in downgradient wells.

The intent of the analysis was to compare average downgradient concentrations of 12 selected analytes to their respective average upgradient concentrations.

Background Soils

Figure 3. Concentrations of calcium, sulfate, chloride, and potassium in deionized water leachates of background soil cores upgradient and downgradient of the Colorado test cell. Sodium results are not available for these cores. Calcium and sulfate concentrations show considerable variability with depth; potassium, and chloride concentrations vary less.

Average concentrations that can be shown to be statistically different between upgradient and downgradient wells are evidence that some analytes may be leaching from the test cells into the groundwater.

The downgradient data come from two separate test cells, North and South. The upgradient data come from between the two test cells, and are used as background for both. The data were collected from wells installed at different depths below the water table. In order to better represent the actual conditions of the groundwater table, comparisons were made between data that were collected from wells screened at similar depths. For this initial analysis, data from downgradient monitoring wells OHMW-03 downgradient from the north cell and OHMW-06 downgradient from the south cell are compared to data from upgradient monitoring well OHMW-08. All three monitoring wells are screened at the top of the saturated zone. Groundwater at the top of the saturated zone is expected to experience the greatest effects from any leachate discharged by the test cells. Future analysis may be performed on data from other wells screened at other depths.

The data, which were collected quarterly over a period of two and a half years, were combined for the statistical comparisons. Because only two samples, upgradient and downgradient, were collected for each location during each quarter, the data could not be compared on a quarterly basis. The small number of samples collected produces a large confidence interval around the measured values, so that statistically valid conclusions about changes in analyte concentrations between upgradient and downgradient wells are not possible on a quarter-by-quarter basis. Therefore, average concentrations from the downgradient wells are over the two and a half year period compared to average concentrations from the upgradient wells.

The sections below discuss the conclusions of the statistical analysis and the statistical methods used.

4.2.2 Summary of Conclusions

The results of the statistical analyses concluded that five of the 12 analytes had significantly larger average downgradient concentrations than average upgradient concentrations in both the North and South cells. Two other analytes were significant in one cell (sodium in the South and sulfate in the North cell). Table 3 provides an overall summary of the analysis.

4.2.3 Statistical Methods

Comparison of two average concentrations is performed by means of a statistical test. There are several different types of statistical tests, depending on the numerical distribution of both the upgradient and downgradient data. When both sets of data follow a normal distribution, the averages can be compared using the Student's t-Test. Similarly, if both sets of data follow a log-normal distribution (i.e., the logs of the concentrations follow a normal distribution), then the log averages (average of the log concentrations) can be compared using the Student's t-Test. When both sets of data are determined to be neither normally nor log-normally distributed, then the Wilcoxon Rank Sum Test can be performed. The Wilcoxon Test ranks all of the concentrations from smallest to largest, then compares averages of the ranks.

As each of the three tests is performed, the final conclusion of the test depends on the confidence level chosen for the test. A 95% confidence level was chosen for this analysis. A 95% confidence level means that there is only a 5% chance of concluding that the average downgradient concentration is different from the average upgradient concentration when in fact, no difference exists. Table 3 presents those analytes whose average downgradient concentration is statistically larger than the average upgradient concentration. Discussion of these tests and their conclusions are presented below.

4.2.4 Student's t-Test

As stated previously, the data must be normally distributed before the Student's t-Test can be used accurately. The Shapiro-Wilk w Test is used to test normality of a data set. Data from two analytes, alkalinity from the North cell and filterable residue from the South cell, were determined to be normally distributed. Using the Student's t-Test, the average downgradient value of both of these analytes was determined to be significantly larger than the average upgradient value, with 95% confidence. Table 4 presents the analytes tested by the Student's t-Test, the number of analyses, the percentage of detected data, the mean concentration, and the standard deviation from both upgradient and downgradient data sets, and the conclusion of the t-Test.

4.2.5 Student's t-Test on Log-Normal Data

To test for log-normality, the Shapiro-Wilk w Test was performed on the natural logs of the concentrations of each analyte. Chloride from both North and South cells, magnesium from the South cell, potassium from both cells, and sulfate from the South cell were all found to be log-normally distributed. Of these, the average downgradient concentrations of chloride (both cells) and magnesium (South cell) were found to be statistically larger than the average upgradient concentrations of these analytes, with 95% confidence. Table 5 presents information similar to that of Table 4, but for the Log-normal t-Test.

4.2.6 Wilcoxon Test

The majority of the analytes tested did not follow a normal or a log-normal distribution, so conclusions were drawn using the Wilcoxon test. Those analytes that had significantly larger average concentrations downgradient than upgradient are alkalinity from the South cell, calcium from both cells, filterable residue from the North cell, magnesium from the North cell, sodium from the South cell, and sulfate from the North cell.

Table 6 presents the analytes tested by the Wilcoxon Test, and the conclusions of that test.

Since the current statistical analysis examines only average concentrations over the entire 2 1/2 years of monitoring from August, 1989 to February, 1992 it cannot fully address trends of increasing downgradient concentrations. Since there is only a single well at a given depth downgradient of each test cell, the data set is too small to allow detailed statistical treatment of trends. In addition, since no groundwater samples were collected before the test cells were constructed, there is no baseline data which can be used to unambiguously demonstrate that the test cells are the cause of the differences in composition between the upgradient and downgradient groundwater.

Figures 4 and 5 show the concentration trends of the seven major species which were identified statistically as having significantly higher concentrations in the shallow groundwater downgradient of the test cells than in the upgradient groundwater. Each graph follows the concentration of a single species over 3 years of sampling from August, 1989 to August, 1992 in monitoring wells screened over the top ten feet of the saturated zone. The wells are OHMW-3, downgradient of the north cell; OHMW-6, downgradient of the south cell, and OHMW-8, upgradient of both cells.

These graphs suggest that some of the statistically significant compositional differences are not associated with leachate from the landfill test cells. For instance, the magnesium concentration downgradient from the north cell is significantly higher than the upgradient concentration, but there is no evidence that the concentration of magnesium downgradient from the north cell has increased over time. The calcium concentration downgradient from the north cell follows a similar pattern. None of the analytes identified as statistically more abundant downgradient from the north cell appear to reflect the effects of leachate migration. Downgradient from the south cell, only chloride, and possibly calcium and magnesium, show long term increases in concentration which are potentially associated with the test cell.

Figure 4. Concentration Trends for Major Cations in Groundwater at the Ohio Site Over Time.

Figure 5. Concentration Trends for Major Anions in Groundwater at the Ohio Site Over Time.

4.2.7 Leachate Migration

On several occasions, water has been noted seeping from the ground in the area of the downgradient toe of the south cell. The water from this seep was collected on one occasion and analyzed along with groundwater and porewater samples, as sample OH281. The seep water was found to closely resemble the high pH, high TDS porewaters sampled by the lysimeters at the base of the south cell. The water collected from this seep probably represents a good "composite" sample of the leachate exiting the base of the test cell. Because of the close proximity of this seep to OHMW-06 and the other wells downgradient from the south cell, there is a possibility that this surface water has percolated down along the well casing, short-circuiting the normal flow path through the soils, and causing the apparent rise in concentrations of some analytes in OHMW-06.

Figure 6 compares the composition of groundwater from the upgradient well OHMW-8 (sample ID OH319), from well OHMW-6 (sample ID OH317), and from the seep (sample ID OH 281). Concentrations are shown in millequivalents/liter to better illustrate the relationships of the molar concentrations of the major analytes. Simple mixing of water from the seep with water of an upgradient composition cannot account for the composition of the water in OHMW-6 downgradient. The major anions, chloride and sulfate are present in approximately the same relative amounts in both samples, suggesting that there has been relatively little chemical separation of these two species. Since there is very little chloride in the background groundwater at the site, the ratio of chloride concentrations in the seep to that in monitor well OHMW-6 indicates an approximate 1:1 mixing ratio for porewater from the base of the south cell with the shallow groundwater immediately downgradient.

Cation concentrations in monitor well OHMW-6 appear to be derived from the composition of the seep water through a combination of mixing, cation exchange, and or dissolution/precipitation reactions. Potassium concentrations are very low in the

Upgradient Well OHMW-08

South Cell Seep

OHMW-6

Figure 6. Comparison of major analyte compositions of seepage from the south cell and water from the top of the saturated zone immediately downgradient of the south cell. The differences in composition between water from these two sources, particularly the difference in potassium and magnesium concentrations, indicates that there is no direct flow from the surface seepage into the monitor well.

background groundwater at the site and in monitor well OHMW-6, whereas potassium is the most abundant cation in the seep water. Potassium in the leachate from the seep appears to be exchanged largely for calcium and magnesium as it moves through the soils between the test cell and OHMW-6. Based on mixing alone, the expected potassium concentration in OHMW-06 is approximately 15 meq/L; the actual concentration is about 1 meq/L. The missing potassium is replaced by approximately 9 meq/L calcium and 4 meq/L magnesium in excess of what simple mixing would predict. The mechanism for this exchange is not clear. The high potassium concentration in the seep water may cause potassium ions to replace calcium or magnesium ions on exchange sites of clays. Precipitation reactions which could reduce potassium concentrations in exchange for calcium or magnesium are possible but involve silicate minerals typically found in hydrothermal systems and are not kinetically attractive under the near-surface conditions at the test site.

4.2.8 Porewater Chemistry

The concentrations of most dissolved species in water sampled by lysimeters at the Ohio site have decreased over time in both test cells at all depths in the waste, although concentrations of soluble species have remained high in the porewater in soils immediately underlying the test cells. Two new lysimeters installed and sampled for the first time this quarter indicate that dissolved solids concentrations of up to 10,000 mg/L are present at the base of south cell, and as high as 34,000 mg/L at the base of the north cell. Water from lysimeter OHLY-26 (south cell, 6.5 feet below top of waste) has a similar composition to that of OHLY-10, which it replaces. No samples were recovered this quarter from the lysimeters installed in the soils just beneath the south cell.

Lysimeters OHLY-24 and OHLY-27 (north cell, 10.5 feet and 8 feet below top of waste, respectively) are the first samples recovered from depth in the north cell in some time. Detailed chemical analyses of these samples indicate that soluble constitu-

ents such as sodium, potassium, and chloride leached from the upper portions of the waste continue to be concentrated at the base of the landfill, and are not simply flushed through along with the water percolating down to the saturated zone. Samples from depth in the north cell continue to have a higher dissolved solids load than samples from the south cell.

4.3 Illinois Site

The fifth set of quarterly water samples was collected in August, 1992. The analytical results for water samples are shown in Table 7. Downgradient wells appear to have a higher variability in major element concentrations than do the upgradient wells. No clear compositional trends can be distinguished at this time.

4.3.1 Water Chemistry

Most of the lysimeters from the Illinois site remain dry. Water has been recovered from a few of the near-surface lysimeters installed in the test cell, but not enough data is available to show changes with depth or time. Not enough water has been recovered from any of the lysimeters to permit full analysis; no anions data is available for any of the samples reported here. The Illinois porewater samples are distinct from most of the samples recovered from the Ohio site in that calcium is present in only very small amounts. A few Ohio samples also were characterized by low calcium concentrations. Sodium, potassium, and silicon are the major dissolved species found in the Illinois porewater samples. Presumably, sulfate concentrations of several thousand mg/L are also present in these porewater samples to maintain chemical equilibrium with gypsum and ettringite, as was observed in the low-calcium samples from the Ohio site.

4.3.2 Physical Data

Meteorological data for the Illinois test site are shown in Table 8. Figure 7 shows four graphs which present the changes in air temperature, relative humidity, precipitation and solar radiation over approximately seven and a half months beginning June 6, 1991. A great deal of daily variation is seen in all of these parameters. Humidity at the site is generally high, ranging from approximately 45 to 85 percent. Average annual rainfall at the site is 42 inches, while the 1991 data show a total rainfall of 27.6 over seven and a half months. The data show greater than three inches of rain on two separate days, consistent with the midwestern pattern of short, intense rain storms. Average air temperatures range from nearly 30°C to -15°C, and average daily temperature fluctuations are pronounced.

The moisture of the ash in the test cell was measured in neutron probe access tubes in situ. These data are shown in Table 9 and Figure 8. The ash is generally quite dry, with percent moisture on a dry basis ranging from approximately 10 to 50%. The moisture of the ash has increased slightly over time, but shows very little significant change with depth.

Thermistor data for the Illinois test cell are shown in Table 10 and Figure 9 presents these data graphically. Two clusters of thermistors, each monitoring five different depths, are located in the northeast and southwest quadrants of the North cell. Temperatures reflect seasonal changes, with the shallowest thermistors (12" depth) showing the greatest differences between summer and winter months, and more pronounced daily variation. There is a fairly good correlation between air temperature and shallow thermistor data. Both show a great deal of short-term fluctuation, varying by greater than 20° Celsius over the course of a few days. Therefore, it is difficult to determine if any of the shallow thermistor data reflect changes due to hydration reactions. Some of the deeper thermistors register short-term temperature variations which may be indicative of some exothermic reactions, but the variation is closely tied to the surface and air

Figure 7. Meteorological Data for the Illinois Sites from June 3, 1991 to January 14, 1992.

Figure 8. Neutron Tube Data from the Illinois Test Site. Data has been converted to percent moisture on a dry basis using ASTM moisture measurements for calibration.

Figure 9. Thermistor Data from the Illinois Test Site Showing Ash Temperatures for Five Depths in Two Different Cell Locations.

temperature changes and appear to reflect damping of air temperature variability. Temperature excursions caused by exothermic hydration reactions should correlate more closely with rainfall, and should not tend to decrease uniformly with depth. In general, the thermistors in the southwest quadrant of the test cell fluctuate more than those in the northeast quadrant.

4.3.3 Test Case 5 Laboratory Work

Initial laboratory testing of mixtures of the Midwest Grain FBC waste and fly ash is completed. Final tests for length change during curing and for freeze/thaw durability were completed in July. The mix design proportions and length change data are presented in Tables 11 and 12, respectively. While some expansion occurred for all samples, expansion was limited to approximately 1%, which should not pose any structural problems for landfill purposes. The greatest expansion (1.26%) took place in the mixture with 12% water over optimum moisture content (OMC), while the least expansion (0.77%) took place in the mix with 6% water over OMC.

Bench scale mixing tests of FBC/fly ash mixtures also took place in July. For these tests approximately 50 kg combined FBC waste and fly ash were hydrated and mixed with varying amounts of water in an electric mortar mixer. The first mixture tested FBC hydration with excess water; 40 lbs. of FBC ash were added to 62 lbs. of water and allowed to react. The mix temperature reached approximately 75°C after 10 minutes. Approximately 31 lbs. of excess water were next removed, and 51 lbs. of dry fly ash and an additional 11 lbs. of FBC waste were added to produce a final mixture with a 30% moisture content and a slump of 3 inches under standard test procedures¹. This mixture was much more fluid than previous mixes with 30% moisture content, suggesting that less of the water in this mix was chemically bound in the waste through hydration

¹Slump of mixtures was measured using ASTM Method C-143. A form in the shape of a 12 inch high cylindrical cone is filled with the material to be tested; when the cone is removed the material slumps an amount dependant on the fluidity of the mix. An average concrete mix has a slump of 2-4 inches.

reactions. Apparently the FBC hydration did not proceed to completion at the cooler temperatures at which this mixture was prepared.

The second test consisted of adding 31 lbs. of water to 31 lbs. of FBC waste. The temperature of the mixture reached 100°C within 10 minutes, and generated a considerable amount of steam. After the mixture cooled down to about 80°C, 31 lbs. of dry fly ash was added. After the fly ash was thoroughly mixed in, the mixture had a slump of 2 inches and a moisture content of approximately 50% (assuming steam loss to be small compared to the total water content). Clearly, much more water was chemically bound to the solids in this second mixture than in the first.

For the third mixture, 40 lbs. each of dry FBC waste and dry fly ash were blended together first, then 32 lbs. water was added to this mixture. The electric mortar mixer did not provide adequate mixing of the water and dry solids for this test; a shovel was used to help provide complete mixing. The mixture quickly reached 100°C and steamed vigorously. The moisture content of this mixture, again assuming steam losses to be relatively small, was approximately 40%; the mixture visually appeared to be somewhat drier than OMC.

From these test we concluded that temperatures at or near 100°C were required to obtain complete hydration of the FBC waste during mixing in a single step process, and that a standard rotary cement mixer probably did not provide sufficient mixing action to blend FBC/fly ash mix formulations at very low slump or OMC. This information was used to develop specifications for the mixing equipment needed for constructing the Illinois Test Case 5 test cells.

During this quarter construction plans for Test Case 5 work were finalized, applications for permits and permit modifications were filed, and construction equipment procurement was begun.

5.0

ACTIVITIES PLANNED FOR THE NEXT QUARTER

The following activities are planned for the period of October, 1992 through December 1992:

- The scope of continued monitoring at the Ohio site will be finalized, and additional monitoring will take place as necessary;
- The sixth quarterly water samples from the first Illinois test case will be collected in November; other field measurements will also be made at that time;
- Chemical analysis of Illinois site core and water samples will continue;
- Construction of the second Illinois test case will begin;
- Radian will continue production of a short video presentation on the advanced coal wastes test program;
- EERC data will continue to be loaded onto the project database and reported as available. Complete results for the Colorado and Ohio sites will be provided with the final site reports; and
- Preliminary Case Reports on the Colorado and Ohio test cases will be finalized, pending receipt of comments from METC.

Table 1

Chemical Characteristics of Deionized Water Leachates of 3rd Annual Ash and Soil Samples from Colorado

Parameter	Site ID / Location ID				
	Sample ID				CO / 92JUNCO02 92JUNCO02-10.5 10 - 10.5
	Beg. Depth - End Depth (ft.)				
	CO / 92JUNCO02 92JUNCO02-.5 0 - .5	CO / 92JUNCO02 92JUNCO02-1 .5 - 1	CO / 92JUNCO02 92JUNCO02-10 9.75 - 10		
Units	0 - .5	.5 - 1	9.75 - 10		

Anions					
Chloride	mg/L	0.75 (0.026)	0.90 (0.026)	42 (0.13)	63 (0.13)
Sulfate	mg/L	440 (1.0)	230 (0.50)	1200 (2.5)	1000 (2.5)
Bulk chemistry					
CaCO3 Equivalents	mg CO3/g	57.9 (0.5)	26.3 (0.5)	3 (0.5)	ND (0.5)
Elements by ICPEs or AA					
Aluminum	mg/L	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Arsenic	mg/L	ND (0.0040)	ND (0.0040)	ND (0.0040)	ND (0.0040)
Barium	mg/L	0.069 (0.010)	0.077 (0.010)	ND (0.010)	0.011 a (0.010)
Beryllium	mg/L	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)
Boron	mg/L	ND (0.60)	ND (0.60)	ND (0.60)	ND (0.60)
Cadmium	mg/L	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)
Calcium	mg/L	150 (1.0)	62 (1.0)	370 (1.0)	190 (1.0)
Chromium	mg/L	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Cobalt	mg/L	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Copper	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Iron	mg/L	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Lead	mg/L	ND (0.0030)	0.0065 a (0.0030)	ND (0.0030)	ND (0.0030)
Magnesium	mg/L	25 (1.0)	19 (1.0)	55 (1.0)	87 (1.0)
Manganese	mg/L	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Molybdenum	mg/L	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Nickel	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	0.021 a (0.020)
Potassium	mg/L	3.5 a (3.0)	3.4 a (3.0)	ND (3.0)	ND (3.0)
Selenium	mg/L	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Silicon	mg/L	1.9 a (1.0)	1.5 a (1.0)	1.5 a (1.0)	3.5 a (1.0)
Silver	mg/L	0.013 a (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Sodium	mg/L	6.1 (1.0)	15 (1.0)	110 (1.0)	190 (1.0)
Strontium	mg/L	4.4 (0.0030)	3.3 (0.0030)	2.8 (0.0030)	3.3 (0.0030)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-1

Table 1

(Continued)

Parameter	Units	Site ID / Location ID Sample ID			
		Beg. Depth - End Depth (ft.)			
		CO / 92JUNC002 92JUNC002-.5 0 - .5	CO / 92JUNC002 92JUNC002-1 .5 - 1	CO / 92JUNC002 92JUNC002-10 9.75 - 10	CO / 92JUNC002 92JUNC002-10.5 10 - 10.5
Elements by ICPEs or AA, cont.					
Tin	mg/L	ND (0.60)	ND (0.60)	ND (0.60)	ND (0.60)
Vanadium	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Zinc	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)

Table 1

(Continued)

Site ID / Location ID					
Parameter	Units	Sample ID			
		Beg. Depth - End Depth (ft.)			
		CO / 92JUNC002 92JUNC002-12 11.5 - 12	CO / 92JUNC002 92JUNC002-14 13.5 - 14	CO / 92JUNC002 92JUNC002-16 15.5 - 16	CO / 92JUNC002 92JUNC002-19 18.5 - 19

Anions					
Chloride	mg/L	NA	(0.13)	NA	22 (0.052)
Sulfate	mg/L	NA	(0.25)	NA	130 (0.10)

Bulk chemistry					
CaCO3 Equivalents	mg CO3/g	ND	(0.5)	ND (0.5)	ND (0.5)

Elements by ICPEs or AA					
Aluminum	mg/L	NA	(0.20)	NA	ND (0.20)
Arsenic	mg/L	NA	(0.0040)	NA	ND (0.0040)
Barium	mg/L	NA	(0.010)	NA	0.011 a (0.010)
Beryllium	mg/L	NA	(0.0020)	NA	ND (0.0020)
Boron	mg/L	NA	(0.60)	NA	ND (0.60)
Cadmium	mg/L	NA	(0.0010)	NA	ND (0.0010)
Calcium	mg/L	13	(1.0)	NA	8.2 (1.0)
Chromium	mg/L	ND	(0.010)	NA	ND (0.010)
Cobalt	mg/L	ND	(0.010)	NA	ND (0.010)
Copper	mg/L	ND	(0.020)	NA	ND (0.020)
Iron	mg/L	0.15 a	(0.050)	NA	0.061 a (0.050)
Lead	mg/L	0.0045 a	(0.0030)	NA	ND (0.0030)
Magnesium	mg/L	7.4	(1.0)	NA	4.1 a (1.0)
Manganese	mg/L	ND	(0.010)	NA	0.012 a (0.010)
Molybdenum	mg/L	ND	(0.050)	NA	ND (0.050)
Nickel	mg/L	ND	(0.020)	NA	ND (0.020)
Potassium	mg/L	ND	(3.0)	NA	ND (3.0)
Selenium	mg/L	ND	(0.0050)	NA	ND (0.0050)
Silicon	mg/L	2.4 a	(1.0)	NA	3.2 a (1.0)
Silver	mg/L	ND	(0.010)	NA	ND (0.010)
Sodium	mg/L	71	(1.0)	NA	52 (1.0)
Strontium	mg/L	0.24	(0.0030)	NA	0.093 (0.0030)

				D2-3	

) = Detection Limit	ND = Not Detected	NA = Not Analyzed	a = < 5X Det. Limit
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() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-3

Table 1

(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID			
		Beg. Depth - End Depth (ft.)			
		CO / 92JUNCO02	CO / 92JUNCO02	CO / 92JUNCO02	CO / 92JUNCO02
		92JUNCO02-12	92JUNCO02-14	92JUNCO02-16	92JUNCO02-19
		11.5 - 12	13.5 - 14	15.5 - 16	18.5 - 19

Elements by ICPEs or AA, cont.					
Tin	mg/L	NA	ND	NA	ND
Vanadium	mg/L	NA	ND	NA	ND
Zinc	mg/L	NA	ND	NA	ND

Table 1

(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID		Beg. Depth - End Depth (ft.)	
		CO / 92JUNCO04 92JUNCO04-.5 0 - .5	CO / 92JUNCO04 92JUNCO04-1.5 1 - 1.5	CO / 92JUNCO04 92JUNCO04-10 9.75 - 10	CO / 92JUNCO04 92JUNCO04-10.5 10 - 10.5
Anions					
Chloride	mg/L	NA	NA	40	51
Sulfate	mg/L	NA	NA	1800	1400
Bulk chemistry					
CaCO ₃ Equivalents	mg CO ₃ /g	23.2	31.5	6	0.6
Elements by ICPE or AA					
Aluminum	mg/L	NA	NA	ND	ND
Arsenic	mg/L	NA	NA	ND	ND
Barium	mg/L	NA	NA	ND	ND
Beryllium	mg/L	NA	NA	ND	ND
Boron	mg/L	NA	NA	ND	1.2
Cadmium	mg/L	NA	NA	ND	a
Calcium	mg/L	NA	NA	500	ND
Chromium	mg/L	NA	NA	ND	430
Cobalt	mg/L	NA	NA	ND	ND
Copper	mg/L	NA	NA	ND	ND
Iron	mg/L	NA	NA	ND	ND
Lead	mg/L	NA	NA	0.0092	ND
Magnesium	mg/L	NA	NA	110	73
Manganese	mg/L	NA	NA	ND	ND
Molybdenum	mg/L	NA	NA	ND	ND
Nickel	mg/L	NA	NA	ND	ND
Potassium	mg/L	NA	NA	ND	ND
Selenium	mg/L	NA	NA	0.0074	0.011
Silicon	mg/L	NA	NA	ND	a
Silver	mg/L	NA	NA	ND	1.8
Sodium	mg/L	NA	NA	170	ND
Strontium	mg/L	NA	NA	3.3	160
					2.7

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-5

Table 1

Site ID / Location ID
Sample ID

Elements by ICPES or AA, cont.

Tin	mg/L
Vanadium	mg/L
Zinc	mg/L

Table 1

(Continued)

Parameter	Site ID / Location ID				
	Sample ID				
	Beg. Depth - End Depth (ft.)				
Units	CO / 92JUNCO04 92JUNCO04-12 11.5 - 12	CO / 92JUNCO04 92JUNCO04-14 13.5 - 14	CO / 92JUNCO04 92JUNCO04-16 15.5 - 16	CO / 92JUNCO04 92JUNCO04-19 18.5 - 19	

Anions					
Chloride	mg/L	NA	43 (0.13)	NA	26 (0.052)
Sulfate	mg/L	NA	400 (0.50)	NA	68 (0.10)
Bulk chemistry					
CaCO3 Equivalents	mg CO3/g	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Elements by ICPEs or AA					
Aluminum	mg/L	NA	ND (0.20)	NA	ND (0.20)
Arsenic	mg/L	NA	ND (0.0040)	NA	ND (0.0040)
Barium	mg/L	NA	ND (0.010)	NA	ND (0.010)
Beryllium	mg/L	NA	ND (0.0020)	NA	ND (0.0020)
Boron	mg/L	NA	1.1 a (0.60)	NA	1.1 a (0.60)
Cadmium	mg/L	NA	ND (0.0010)	NA	ND (0.0010)
Calcium	mg/L	NA	38 (1.0)	NA	3.7 a (1.0)
Chromium	mg/L	NA	ND (0.010)	NA	ND (0.010)
Cobalt	mg/L	NA	ND (0.010)	NA	ND (0.010)
Copper	mg/L	NA	ND (0.020)	NA	ND (0.020)
Iron	mg/L	NA	ND (0.050)	NA	ND (0.050)
Lead	mg/L	NA	0.0055 a (0.0030)	NA	0.051 a (0.050)
Magnesium	mg/L	NA	31 (1.0)	NA	0.0031 a (0.0030)
Manganese	mg/L	NA	0.018 a (0.010)	NA	2.5 a (1.0)
Molybdenum	mg/L	NA	ND (0.050)	NA	ND (0.010)
Nickel	mg/L	NA	ND (0.020)	NA	ND (0.050)
Potassium	mg/L	NA	ND (3.0)	NA	ND (0.020)
Selenium	mg/L	NA	0.0063 a (0.0050)	NA	3.4 a (3.0)
Silicon	mg/L	NA	4.9 a (1.0)	NA	ND (0.0050)
Silver	mg/L	NA	ND (0.010)	NA	4.5 a (1.0)
Sodium	mg/L	NA	130 (1.0)	NA	ND (0.010)
Strontium	mg/L	NA	0.48 (0.0030)	NA	42 (1.0)
					0.056 (0.0030)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-7

Table 1

Parameter	Site ID / Location ID			
	Sample ID			
	Beg. Depth - End Depth (ft.)			
	CO / 92JUNC004	CO / 92JUNC004	CO / 92JUNC004	CO / 92JUNC004
	92JUNC004-12	92JUNC004-14	92JUNC004-16	92JUNC004-19
	11.5 - 12	13.5 - 14	15.5 - 16	18.5 - 19
Units				

Elements by ICPEs or AA, cont.				
Tin	NA	ND	NA	ND
		(0.60)		(0.60)
Vanadium	NA	ND	NA	ND
		(0.020)		(0.020)
Zinc	NA	0.028 ±	NA	0.028 ±
		(0.020)		(0.020)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-8

Table 1

(Continued)

Parameter	Units	Site ID / Location ID		
		Sample ID	Log Date	
		CO / 92JUNCO02 92JUNCO02-2 6/17/92	CO / 92JUNCO02 92JUNCO02-3 6/17/92	CO / 92JUNCO02 92JUNCO02-4 6/17/92
				CO / 92JUNCO02 92JUNCO02-5 6/17/92
Anions				
Chloride	mg/L	8.3	21	36
Sulfate	mg/L	850	860	590
		(0.026)	(0.052)	(0.13)
		(2.5)	(1.0)	(1.0)
Bulk chemistry				
CaCO ₃ Equivalents	mg CO ₃ /g	12.5	9.72	8.93
		(0.5)	(0.5)	(0.5)
Elements by ICPEs or AA				
Aluminum	mg/L	2.1	2.2	3.3
Arsenic	mg/L	ND	0.0073 a	0.0056 a
Barium	mg/L	ND	0.016 a	ND
Beryllium	mg/L	ND	ND	ND
Boron	mg/L	ND	ND	ND
Cadmium	mg/L	ND	ND	ND
Calcium	mg/L	400	360	280
Chromium	mg/L	ND	ND	ND
Cobalt	mg/L	ND	ND	ND
Copper	mg/L	ND	ND	ND
Iron	mg/L	ND	ND	ND
Lead	mg/L	ND	ND	ND
Magnesium	mg/L	3.6 a	ND	ND
Manganese	mg/L	ND	ND	ND
Molybdenum	mg/L	ND	ND	ND
Nickel	mg/L	ND	ND	ND
Potassium	mg/L	14 a	ND	ND
Selenium	mg/L	0.0081 a	22	0.13 a
Silicon	mg/L	ND	0.012 a	ND
Silver	mg/L	ND	2.2 a	26
Sodium	mg/L	6.3 a	ND	0.014 a
Strontium	mg/L	1.3	5.4	1.8 a
		(0.0060)	(1.0)	(0.010)
			1.7	5.8
			(0.0030)	(1.0)
				1.5
				(0.0030)
				12.4
				(0.5)
				33
				(0.13)
				600
				(0.50)
				1.1
				(0.20)
				ND
				(0.0040)
				0.022 a
				(0.010)
				ND
				(0.0020)
				ND
				(0.60)
				ND
				(0.0010)
				310
				(1.0)
				ND
				(0.010)
				ND
				(0.010)
				ND
				(0.020)
				ND
				(0.050)
				ND
				(0.0030)
				ND
				(1.0)
				ND
				(0.010)
				0.075 a
				(0.050)
				ND
				(0.020)
				37
				(3.0)
				ND
				(0.0050)
				5.1
				(1.0)
				ND
				(0.010)
				6.5
				(1.0)
				2.1
				(0.0030)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-1

Table 1
(Continued)

Parameter	Units	Site ID / Location ID		
		Sample ID	Log Date	
Elements by ICPEs or AA, cont. Tin Vanadium Zinc		CO / 92JUNCO02 92JUNCO02-2 6/17/92	CO / 92JUNCO02 92JUNCO02-3 6/17/92	CO / 92JUNCO02 92JUNCO02-4 6/17/92
	mg/L	ND	ND	ND
	mg/L	ND	0.042 a	0.042 a
	mg/L	ND	0.033 a	ND
			(0.60) (0.020) (0.020)	(0.60) (0.020) (0.020)
				ND ND 0.12

Table 1

(Continued)

Site ID / Location ID									
Sample ID									
Log Date									

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

D2-3

Table 1
(Continued)

Parameter	Units	Site ID / Location ID		Sample ID	Log Date
		CO / 92JUNC002	CO / 92JUNC002		
		92JUNC002-6	92JUNC002-6.5	92JUNC002-7	92JUNC002-9
		6/17/92	6/17/92	6/17/92	6/17/92

Elements by ICPEs or AA, cont.					
Tin	mg/L	ND	NA	ND	ND
Vanadium	mg/L	0.058 a	NA	ND	ND
Zinc	mg/L	ND	NA	0.020 a	0.70
				(0.60)	(2.4)
				(0.020)	(0.080)
				(0.020)	(0.080)

Table 1

(Continued)

Parameter	Site ID / Location ID			
	Sample ID		Log Date	
	CO / 92JUNC002 92JUNC002-9.5 6/17/92	CO / 92JUNC004 92JUNC004-2 6/18/92	CO / 92JUNC004 92JUNC004-3 6/18/92	CO / 92JUNC004 92JUNC004-4 6/18/92
Units				

Anions				
Chloride	mg/L	ND	(0.13)	
Sulfate	mg/L	1300	(2.5)	
Bulk chemistry				
CeCO3 Equivalents	mg CO3/g	5.3	(0.5)	
Elements by ICPEs or AA				
Aluminum	mg/L	ND	(0.80)	
Arsenic	mg/L	ND	(0.0040)	
Barium	mg/L	0.080	(0.040)	
Beryllium	mg/L	ND	(0.0080)	
Boron	mg/L	ND	(2.4)	
Cadmium	mg/L	ND	(0.0010)	
Calcium	mg/L	1400	(4.0)	
Chromium	mg/L	0.056	(0.040)	
Cobalt	mg/L	ND	(0.040)	
Copper	mg/L	ND	(0.080)	
Iron	mg/L	ND	(0.20)	
Lead	mg/L	ND	(0.0030)	
Magnesium	mg/L	ND	(4.0)	
Manganese	mg/L	ND	(0.040)	
Molybdenum	mg/L	ND	(0.20)	
Nickel	mg/L	ND	(0.080)	
Potassium	mg/L	ND	(12)	
Selenium	mg/L	ND	(0.0050)	
Silicon	mg/L	ND	(4.0)	
Silver	mg/L	ND	(0.040)	
Sodium	mg/L	ND	(4.0)	
Strontium	mg/L	3.9	(0.012)	

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

02-5

Table 1

Site ID / Location ID	Sample ID	Log Date
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Elements by ICPEs or AA, cont.

tin

Vanadium

zinc

() = Detection Limit ND = Not Detected NA = Not Analyzed @ = < 5X Det. Limit

Table 1

(Continued)

Site ID / Location ID							
		Sample ID		Log Date			
Parameter	Units	CO / 92JUNC004 92JUNC004-5 6/18/92	CO / 92JUNC004 92JUNC004-6 6/18/92	CO / 92JUNC004 92JUNC004-7 6/18/92	CO / 92JUNC004 92JUNC004-9 6/18/92		

Anions							
Chloride	mg/L	22	(0.052)	16	(0.052)	28	(0.26)
Sulfate	mg/L	510	(0.50)	440	(2.5)	1100	(2.5)
Bulk chemistry							
CaCO3 Equivalents	mg CO3/g	11.3	(0.5)	8.7	(0.5)	11	(0.5)

Elements by ICPEs or AA							
Aluminum	mg/L	3.3	(0.20)	3.3	(0.20)	1.8	(0.20)
Arsenic	mg/L	ND	(0.0040)	ND	(0.0040)	0.0056 a	(0.0040)
Barium	mg/L	0.013 a	(0.010)	ND	(0.010)	0.016 a	(0.010)
Beryllium	mg/L	ND	(0.0020)	ND	(0.0020)	ND	(0.0020)
Boron	mg/L	ND	(0.60)	0.86 a	(0.60)	1.1 a	(0.60)
Cadmium	mg/L	ND	(0.0010)	ND	(0.0010)	ND	(0.0010)
Calcium	mg/L	230	(1.0)	210	(1.0)	510	(2.0)
Chromium	mg/L	ND	(0.010)	ND	(0.010)	0.011 a	(0.010)
Cobalt	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.020)
Copper	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.040)
Iron	mg/L	ND	(0.050)	ND	(0.050)	ND	(0.10)
Lead	mg/L	ND	(0.0030)	ND	(0.0030)	ND	(0.0030)
Magnesium	mg/L	ND	(1.0)	ND	(1.0)	1.2 a	(2.0)
Manganese	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.020)
Molybdenum	mg/L	ND	(0.050)	ND	(0.050)	0.080 a	(0.10)
Nickel	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.040)
Potassium	mg/L	27	(3.0)	14 a	(3.0)	34	(6.0)
Selenium	mg/L	0.016 a	(0.0050)	0.020 a	(0.0050)	0.016 a	(0.0050)
Silicon	mg/L	2.3 a	(1.0)	1.7 a	(1.0)	3.1 a	(2.0)
Silver	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.020)
Sodium	mg/L	6.8	(1.0)	3.0 a	(1.0)	6.8	(2.0)
Strontium	mg/L	1.1	(0.0030)	0.79	(0.0030)	2.5	(0.0030)
						3.8	(0.0060)

() = Detection Limit ND = Not Detected MA = Not Analyzed a = < 5X Det. Limit

(Continued)

Elements by ICPEs or AA, cont.

Table 1

(Continued)

Site ID / Location ID
Sample ID
Log Date

CO / 92JUNCO04
92JUNCO04-9.5
6/18/92

Parameter -----
Units -----

Anions

Chloride	mg/L	26	(0.13)
Sulfate	mg/L	1500	(2.5)

Bulk chemistry

CaCO ₃ Equivalents	mg CO ₃ /g	10.8	(0.5)
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Elements by ICPE or AA

Aluminum	mg/L	ND	(0.20)
Arsenic	mg/L	ND	(0.0040)
Barium	mg/L	0.016	a (0.010)
Beryllium	mg/L	ND	(0.0020)
Boron	mg/L	ND	(0.60)
Cadmium	mg/L	ND	(0.0010)
Calcium	mg/L	490	(1.0)
Chromium	mg/L	ND	(0.010)
Cobalt	mg/L	ND	(0.010)
Copper	mg/L	ND	(0.020)
Iron	mg/L	ND	(0.050)
Lead	mg/L	ND	(0.0030)
Magnesium	mg/L	59	(1.0)
Manganese	mg/L	ND	(0.010)
Molybdenum	mg/L	ND	(0.050)
Nickel	mg/L	ND	(0.020)
Potassium	mg/L	ND	(3.0)
Selenium	mg/L	0.0060	a (0.0050)
Silicon	mg/L	1.5	a (1.0)
Silver	mg/L	ND	(0.010)
Sodium	mg/L	130	(1.0)
Strontium	mg/L	3.6	(0.0030)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

Table 1
(Continued)

Site ID / Location ID
Sample ID
Log Date

CO / 92JUNCO04		
92JUNCO04-9.5		
6/18/92		

Parameter	Units	
-----	-----	
Elements by ICPEs or AA, cont.		
Tin	mg/L	ND (0.60)
Vanadium	mg/L	ND (0.020)
Zinc	mg/L	ND (0.020)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

Table 2

Chemical Characteristics of Liquid From Ohio, Event 12

Parameter	Units	Site ID / Location ID			
		Sample ID		Log Date	
		OH / OHMW01 OH331	OH / OHMW02 OH332	OH / OHMW03 OH333	OH / OHMW04 OH334
		8/24/92	8/24/92	8/24/92	8/24/92
Anions					
Chloride	mg/L	190	44	46	240
Fluoride	mg/L	1.1	0.44 a	0.44 a	1.1
Sulfate	mg/L	820	940	930	87
Elements by ICPEs or AA					
Aluminum	mg/L	ND	ND	ND	0.12 a
Arsenic	mg/L	ND	ND	ND	0.0057 a
Barium	mg/L	0.026 a	0.042 a	0.028 a	ND
Beryllium	mg/L	ND	ND	ND	ND
Boron	mg/L	1.2	0.34 a	0.18 a	0.99
Calcium	mg/L	10.9	193	197	9.4
Chromium	mg/L	ND	ND	ND	ND
Cobalt	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	0.26 a	0.22 a	0.34 a	0.54
Lead	mg/L	ND	ND	ND	ND
Magnesium	mg/L	6.0	142	172	4.6
Manganese	mg/L	ND	0.18	0.21	0.017 a
Molybdenum	mg/L	ND	ND	ND	ND
Nickel	mg/L	ND	ND	ND	ND
Potassium	mg/L	8.9 a	7.2 a	5.7 a	ND
Selenium	mg/L	ND	ND	ND	ND
Silicon	mg/L	3.878	5.887	6.728	3.504
Silver	mg/L	ND	ND	ND	ND
Sodium	mg/L	780	146	99.5	566
Strontium	mg/L	0.41	1.2	0.60	0.20 a
Tin	mg/L	ND	ND	ND	ND
Vanadium	mg/L	ND	ND	ND	ND
Zinc	mg/L	ND	ND	ND	ND

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-1

(Continued)

	() = Detection Limit	MD = Not Detected	NA = Not Analyzed	a = < 5X Det. Limit	C1-2
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Table 2

(Continued)

Site ID / Location ID									
Parameter	Units	OH / OHMW05		OH / OHMW06		OH / OHMW06		OH / OHMW07	
		OH335	8/24/92	OH336	8/24/92	OH340 Dup of OH336	8/24/92	OH337	8/24/92

Anions									
Chloride	mg/L	170	(0.52)	420	(1.3)	420	(1.3)	7.9	(0.026)
Fluoride	mg/L	1.0	(0.10)	0.14 a	(0.10)	0.13 a	(0.10)	0.31 a	(0.10)
Sulfate	mg/L	160	(1.0)	550	(0.50)	560	(0.50)	250	(0.25)

Elements by ICPEs or AA									
Aluminum	mg/L	0.13 a	(0.10)	0.12 a	(0.10)	ND	(0.10)	0.10 a	(0.10)
Arsenic	mg/L	ND	(0.0050)	ND	(0.0050)	ND	(0.0050)	ND	(0.0050)
Barium	mg/L	0.041 a	(0.010)	0.048 a	(0.010)	0.050	(0.010)	0.054	(0.010)
Beryllium	mg/L	ND	(0.0020)	ND	(0.0020)	ND	(0.0020)	ND	(0.0020)
Boron	mg/L	1.0	(0.10)	0.20 a	(0.10)	0.23 a	(0.10)	0.30 a	(0.10)
Calcium	mg/L	18.7	(0.20)	258	(0.20)	258	(0.20)	95.0	(0.20)
Chromium	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Cobalt	mg/L	ND	(0.010)	0.026 a	(0.010)	0.027 a	(0.010)	ND	(0.010)
Copper	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.020)	ND	(0.020)
Iron	mg/L	0.28 a	(0.10)	5.1	(0.10)	3.6	(0.10)	0.37 a	(0.10)
Lead	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Magnesium	mg/L	10.2	(0.20)	86.7	(0.20)	89.6	(0.20)	0.21 a	(0.20)
Manganese	mg/L	0.019 a	(0.010)	3.4	(0.010)	3.4	(0.010)	ND	(0.010)
Molybdenum	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.020)	0.046 a	(0.020)
Nickel	mg/L	ND	(0.040)	ND	(0.040)	ND	(0.040)	ND	(0.040)
Potassium	mg/L	6.4 a	(5.0)	20.0 a	(5.0)	19.8 a	(5.0)	8.0 a	(5.0)
Selenium	mg/L	ND	(0.010)	ND	(0.0050)	ND	(0.0050)	ND	(0.010)
Silicon	mg/L	4.625	(0.234)	5.7	(0.234)	5.887	(0.234)	6.401	(0.234)
Silver	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Sodium	mg/L	507	(5.0)	171	(5.0)	184	(5.0)	122	(5.0)
Strontium	mg/L	0.49	(0.050)	1.0	(0.050)	1.1	(0.050)	0.60	(0.050)
Tin	mg/L	ND	(0.10)	ND	(0.10)	ND	(0.10)	ND	(0.10)
Vanadium	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Zinc	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.020)	ND	(0.020)

() = Detection Limit ND = Not Detected MA = Not Analyzed a = < 5x Det. Limit

C1-3

Table 2

Site ID / Location ID	Sample ID	Log Date
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Table 2

(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID		Log Date	
		OH / OHM08 OH338	OH / OHBLMK OH339	OH / OHLY01 OH341	OH / OHLY11 OH343
		8/24/92	8/24/92	8/30/92	8/30/92
Anions					
Chloride	mg/L	4.2	0.16	8.3	180
Fluoride	mg/L	0.29 a	ND	0.44 a	ND
Sulfate	mg/L	340	ND	1100	1400
Elements by ICPEs or AA					
Aluminum	mg/L	0.13 a	0.11 a	ND	ND
Arsenic	mg/L	ND	ND	0.022 a	ND
Barium	mg/L	0.024 a	ND	0.044 a	0.035 a
Beryllium	mg/L	ND	ND	ND	ND
Boron	mg/L	0.41 a	ND	6.3	ND
Cadmium	mg/L	NA	NA	ND	ND
Calcium	mg/L	87.2	ND	551	454
Chromium	mg/L	ND	ND	ND	0.011 a
Cobalt	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	0.39 a	0.45 a	ND	ND
Lead	mg/L	ND	ND	ND	ND
Magnesium	mg/L	44.8	ND	54.8	ND
Manganese	mg/L	0.15	ND	ND	ND
Molybdenum	mg/L	0.039 a	ND	0.15	0.63
Nickel	mg/L	ND	ND	ND	ND
Potassium	mg/L	6.1 a	ND	56.8	448
Selenium	mg/L	ND	ND	ND	ND
Silicon	mg/L	6.167	0.257 a	36.628	46.3
Silver	mg/L	ND	ND	0.014 a	ND
Sodium	mg/L	104	ND	19.5 a	120
Strontium	mg/L	1.6	ND	0.95	3.9
Tin	mg/L	ND	ND	ND	ND
Vanadium	mg/L	ND	ND	0.015 a	0.070

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5x Det. Limit

C1-5

Table 2

(Continued)

		Site ID / Location ID			
		Sample ID		Log Date	
Parameter	Units	OH / OHM08 OH338	OH / OHBLNK OH339	OH / OHLY01 OH341	OH / OHLY11 OH343
		8/24/92	8/24/92	8/30/92	8/30/92

Elements by ICPEs or AA, cont.					
Zinc	mg/L	ND	ND	0.023 a	ND
		(0.020)	(0.020)	(0.020)	(0.020)
Field measurements					
Conductivity	umhos/cm	800	5.5 a	1725	3125
Redox (Eh)	mV	-66.0	NA	-25.4	-168.9
TDS	mg/L	851	ND	2617	3391
Temperature	deg. C	14.4	28.1	19.7	20.7
Total Alkalinity	meq/L	5.12	5	8.24	1.2
pH	pH units	8.12	6.99	7.20	9.00
		(0.03)	(0.03)	(0.03)	(0.03)
		()	()	()	()

Table 2

(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID		Log Date	
		OH / OHLY12 OH344	OH / OHLY14 OH345	Oh / OHLY15 OH346	OH / OHLY17 OH347
		8/30/92	8/30/92	8/30/92	8/30/92
Anions					
Chloride	mg/L	20	100	54	NA
Fluoride	mg/L	0.26 a	0.11 a	0.10 a	NA
Sulfate	mg/L	470	1400	930	NA
Elements by ICPEs or AA					
Aluminum	mg/L	ND	ND	ND	ND
Arsenic	mg/L	0.0056 a	0.019 a	0.012 a	ND
Barium	mg/L	0.065	0.032 a	0.039 a	0.041 a
Beryllium	mg/L	ND	ND	ND	ND
Boron	mg/L	0.52	0.15 a	ND	ND
Cadmium	mg/L	ND	ND	ND	ND
Calcium	mg/L	223	508	254	214
Chromium	mg/L	ND	ND	0.012 a	ND
Cobalt	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	ND	ND	0.16 a	0.19 a
Lead	mg/L	ND	ND	ND	ND
Magnesium	mg/L	1.7	0.53 a	0.29 a	0.29 a
Manganese	mg/L	ND	ND	ND	ND
Molybdenum	mg/L	0.11	0.44	0.30	0.56
Nickel	mg/L	ND	ND	ND	ND
Potassium	mg/L	30.0	301	246	384
Selenium	mg/L	ND	ND	ND	ND
Silicon	mg/L	22.472	38.170	55.597	22.566
Silver	mg/L	ND	ND	ND	ND
Sodium	mg/L	11.0 a	74.9	93.8	114
Strontium	mg/L	1.0	4.4	3.5	2.7
Tin	mg/L	ND	ND	ND	ND
Vanadium	mg/L	0.018 a	0.071	0.040 a	0.061

() = Detection Limit ND = Not Detected MA = Not Analyzed a = < 5x Det. Limit

C1-7

Table 2

(Continued)

Parameter	Site ID / Location ID											
	Sample ID											
	Log Date											
	OH / OHLY12 OH344 8/30/92	OH / OHLY14 OH345 8/30/92	OH / OHLY15 OH346 8/30/92	OH / OHLY17 OH347 8/30/92								
Units												

Elements by ICPEs or AA, cont.												
Zinc	mg/L	0.023	a	(0.020)	0.030	a	(0.020)	0.023	a	(0.020)	ND	(0.020)
Field measurements												
Conductivity	umhos/cm	1050		(5)	2625		(5)	1925		(5)	2300	(5)
Redox (Eh)	mV	-144.3		()	-85.6		()	-123.7		()	-223.3	()
TDS	mg/L	983		(1)	3030		(1)	1973		(1)	NA	()
Temperature	deg. C	21.5		()	20.5		()	20.7		()	20.2	()
Total Alkalinity	meq/L	1.04		(0.03)	.52		(0.03)	.64		(0.03)	NA	()
pH	pH units	9.28		()	8.31		()	8.95		()	10.67	()

Table 2

(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID		Log Date	
		OH / OHLY24 OH349	OH / OHLY21 OH350	OH / OHLY25 OH351	OH / OHLY26 OH352
		8/30/92	8/30/92	8/30/92	8/30/92
Anions					
Chloride	mg/L	870	29		2700
Fluoride	mg/L	0.36 a	0.17 a		1.1
Sulfate	mg/L	1700	1800		1600
Elements by ICPEs or AA					
Aluminum	mg/L	ND	ND		0.51 a
Arsenic	mg/L	0.016 a	0.068 a		ND
Barium	mg/L	0.033 a		0.034 a	ND
Beryllium	mg/L	ND	ND		ND
Boron	mg/L	0.23 a	11.1		ND
Cadmium	mg/L	ND	ND		ND
Calcium	mg/L	664	746		24.2
Chromium	mg/L	ND	ND		ND
Cobalt	mg/L	ND	ND		ND
Copper	mg/L	ND	ND		ND
Iron	mg/L	0.12 a	ND		ND
Lead	mg/L	ND	ND		ND
Magnesium	mg/L	40.6	60.4 a		ND
Manganese	mg/L	0.067	ND		ND
Molybdenum	mg/L	0.091 a	0.72		2.0
Nickel	mg/L	ND	ND		ND
Potassium	mg/L	595	238		3790
Selenium	mg/L	ND	ND		ND
Silicon	mg/L	30.041	41.908		338.72
Silver	mg/L	ND	ND		ND
Sodium	mg/L	401	235 a		679
Strontium	mg/L	2.8	5.7		1.5
Tin	mg/L	ND	ND		ND
Vanadium	mg/L	ND	ND		0.059 a

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-9

Table 2
(Continued)

Parameter	Units	Site ID / Location ID			
		OH / OHLY24 OH349 8/30/92	OH / OHLY21 OH350 8/30/92	OH / OHLY25 OH351 8/30/92	OH / OHLY26 OH352 8/30/92
-----	-----	-----	-----	-----	-----
Elements by ICPEs or AA, cont.					
Zinc	mg/L	ND	(0.020)	ND	(0.50)
				0.027	a (0.020)
					ND (0.10)
Field measurements					
Conductivity	umhos/cm	3590	(5)	2350	(5)
Redox (Eh)	mV	-118.2	(1)	-109.9	(1)
TDS	mg/L	5259	(1)	2321	(1)
Temperature	deg. C	15.2	(1)	17.0	(1)
Total Alkalinity	meq/L	1.04	(0.03)	1.12	(0.03)
pH	pH units	8.84	(1)	8.69	(1)
					11000 (5)
					-362.0 (1)
					9894 (1)
					17.4 (1)
					29.32 (0.03)
					12.04 (1)

Table 2

(Continued)

Site ID / Location ID
Sample ID
Log Date

Parameter	Units	OH / ONLY27 OH353 8/30/92	
Anions			
Chloride	mg/L	7100	(26)
Fluoride	mg/L	0.45 a	(0.10)
Sulfate	mg/L	9800	(50)
Elements by ICPEs or AA			
Aluminum			
Arsenic	mg/L	ND	(2.0)
Barium	mg/L	ND	(0.025)
Beryllium	mg/L	ND	(0.20)
Boron	mg/L	ND	(0.040)
Cadmium	mg/L	ND	(2.0)
Calcium	mg/L	ND	(0.0050)
Chromium	mg/L	282	(4.0)
Cobalt	mg/L	ND	(0.20)
Copper	mg/L	ND	(0.20)
Iron	mg/L	ND	(0.40)
Lead	mg/L	ND	(2.0)
Magnesium	mg/L	0.041 a	(0.010)
Manganese	mg/L	ND	(4.0)
Molybdenum	mg/L	ND	(0.20)
Nickel	mg/L	2.0	(0.40)
Potassium	mg/L	ND	(0.80)
Selenium	mg/L	14000	(100)
Silicon	mg/L	ND	(1.0)
Silver	mg/L	131.283	(4.672)
Sodium	mg/L	ND	(0.20)
Strontium	mg/L	3550	(100)
Tin	mg/L	12.6	(1.0)
Vanadium	mg/L	ND	(2.0)
		ND	(0.20)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-11

Table 2

(Continued)

Site ID / Location ID
Sample ID
Log Date

Parameter	Units	OH / ONLY27 OH353 8/30/92
-----	-----	-----
Elements by ICPEs or AA, cont.		
Zinc	mg/L	ND (0.40)
Field measurements		
Conductivity	umhos/cm	32000 (5)
Redox (Eh)	mV	-266.5 ()
TDS	mg/L	34440 (1)
Temperature	deg. C	16.2 ()
Total Alkalinity	meq/L	7.76 (0.03)
pH	pH units	11.45 ()

Table 3

Summary of Statistically Significant Analytes

Analyte	Cells Where Significant
Alkalinity	North, South
Calcium	North, South
Chloride	North, South
Filterable Residue	North, South
Magnesium	North, South
Sodium	South
Sulfate	North

Table 4

Ohio Groundwater Data Comparison By Cell - T-Test Results

Analyte	Background						Downgradient					
	Cell	Analyses	Percent Detected in Background	Mean (mg/kg)	Standard Deviation (mg/kg)	Total Number of Analyses	Percent Detected Downgradient	Mean (mg/kg)	Standard Deviation (mg/kg)	Distribution Type	P-Value for T-test	Conclusion
Alkalinity	N	8	100	5.554	0.810	8	100	9.88	0.327	Normal	0.000000	S
Filterable residue	S	8	100	985.125	253.245	8	100	1428.25	475.787	Normal	0.020433	S

Table 5

Ohio Groundwater Data Comparisons By Cell - Log-Normal T-Test

Analyte	Cell	Background			Downgradient					P-Value for	
		Total Number of Analyses	Percent Detected in Background	Log Mean	Log Standard Deviation	Total Number of Analyses	Percent Detected Downgradient	Log Mean	Log Standard Deviation	Lognormal T-test	Lognormal T-test Conclusion
Chloride	N	10	100	1.28817	0.11954	10	100	3.96381	0.31755	0.00000	S
Chloride	S	10	100	1.28817	0.11954	10	100	5.02046	0.88431	0.00000	S
Magnesium	S	10	100	3.97002	0.09847	10	100	4.43259	0.21099	0.00002	S
Potassium	N	10	100	2.15837	0.25039	10	100	1.78863	0.08334	0.99949	NS
Potassium	S	10	100	2.15837	0.25039	10	100	2.24007	0.24978	0.23724	NS
Sulfate	S	10	100	6.18223	0.20292	10	100	6.24266	0.17457	0.24230	NS

Table 6

Ohio Groundwater Data Comparison By Cell - Wilcoxon Test Results

Analyte	Cell of Analyses	Background				Downgradient				P-Value for Wilcoxon Test		Conclusion
		Total Number	Percent Detected in Background	Rank Mean	Expected Rank	Total Number of Analyses	Percent Detected Downgradient	Rank Mean	Expected Rank			
		Analyses	Background	Mean	STD	Analyses	Downgradient	Mean	STD	Distribution Type	Wilcoxon Test	
Alkalinity	S	8	100.000	4.5000	9.5219	8	100.000	12.5000	9.5219	Neither	0.00240	S
Arsenic	N	12	75.000	12.7917	16.8897	12	66.667	12.2083	16.8897	Neither	0.56970	NS
Arsenic	S	12	75.000	12.2500	16.9706	12	75.000	12.7500	16.9706	Neither	0.44210	NS
Calcium	N	10	100.000	5.5000	13.0283	10	100.000	15.5000	13.0283	Neither	0.00060	S
Calcium	S	10	100.000	5.8500	13.1989	10	100.000	15.1500	13.1989	Neither	0.00125	S
Filterable residue	N	8	100.000	5.0000	9.5219	8	100.000	12.0000	9.5219	Neither	0.00565	S
Magnesium	N	10	100.000	5.5000	13.1289	10	100.000	15.5000	13.1289	Neither	0.00065	S
Molybdenum	N	10	100.000	13.6000	12.0852	10	80.000	7.4000	12.0852	Neither	0.98965	NS
Molybdenum	S	10	100.000	13.2000	12.0852	10	90.000	7.8000	12.0852	Neither	0.97950	NS
Selenium	N	12	66.667	13.0000	15.8909	12	66.667	12.0000	15.8909	Neither	0.63380	NS
Selenium	S	12	66.667	13.0417	15.8868	12	66.667	11.9583	15.8868	Neither	0.64545	NS
Sodium	N	10	100.000	15.5000	13.0283	10	100.000	5.5000	13.0283	Neither	0.99940	NS
Sodium	S	10	100.000	7.4500	13.1339	10	100.000	13.5500	13.1339	Neither	0.01700	S
Strontium	N	10	100.000	15.5000	13.1639	10	100.000	5.5000	13.1639	Neither	0.99935	NS
Strontium	S	10	100.000	15.5000	13.1939	10	100.000	5.5000	13.1939	Neither	0.99930	NS
Sulfate	N	10	100.000	5.5000	13.2088	10	100.000	15.5000	13.2088	Neither	0.00070	S

Table 7

Chemical Characteristics of Liquid From Illinois, Event 5

Site ID / Location ID					
Parameter	Units	Sample ID		Log Date	
		IL / ILBLNK	IL / ILLY01	IL / ILLY05	IL / ILMW01
		IL097	IL099	IL103	IL091
		8/18/92	8/22/92	8/22/92	8/18/92

Anions					
Chloride	mg/L	0.70 (0.026)	NA	NA	20 (0.13)
Fluoride	mg/L	ND (0.10)	NA	NA	0.26 a (0.10)
Sulfate	mg/L	ND (0.050)	NA	NA	430 (0.50)

Elements by ICPEs or AA					
Aluminum	mg/L	ND (0.10)	ND (0.10)	ND (0.50)	ND (0.10)
Arsenic	mg/L	ND (0.0050)	ND (0.010)	ND (0.0050)	ND (0.0050)
Barium	mg/L	ND (0.010)	ND (0.010)	ND (0.050)	0.024 a (0.010)
Beryllium	mg/L	ND (0.0020)	ND (0.0020)	ND (0.010)	ND (0.0020)
Boron	mg/L	ND (0.10)	ND (0.10)	ND (0.50)	1.3 (0.10)
Cadmium	mg/L	ND (0.0010)	ND (0.00050)	ND (0.0050)	ND (0.00050)
Calcium	mg/L	ND (0.20)	0.32 a (0.20)	ND (1.0)	176 (0.20)
Chromium	mg/L	ND (0.010)	0.014 a (0.010)	0.055 a (0.050)	ND (0.010)
Cobalt	mg/L	ND (0.010)	ND (0.010)	ND (0.050)	ND (0.010)
Copper	mg/L	ND (0.020)	ND (0.020)	ND (0.10)	ND (0.020)
Iron	mg/L	ND (0.10)	ND (0.10)	ND (0.50)	1.1 (0.10)
Lead	mg/L	ND (0.0050)	ND (0.020)	ND (0.050)	ND (0.050)
Magnesium	mg/L	ND (0.20)	ND (0.20)	ND (1.0)	99.2 (0.20)
Manganese	mg/L	ND (0.010)	ND (0.010)	ND (0.050)	1.3 (0.010)
Molybdenum	mg/L	ND (0.020)	0.053 a (0.020)	ND (0.10)	ND (0.020)
Nickel	mg/L	ND (0.040)	ND (0.040)	ND (0.20)	ND (0.040)
Potassium	mg/L	ND (5.0)	188 (5.0)	727 (25.0)	6.7 a (5.0)
Selenium	mg/L	ND (0.0050)	ND (0.050)	ND (0.10)	ND (0.0050)
Silicon	mg/L	ND (0.234)	138.291 (0.234)	560.64 (1.168)	6.821 (0.234)
Silver	mg/L	ND (0.010)	ND (0.010)	ND (0.050)	ND (0.010)
Sodium	mg/L	ND (5.0)	103 (5.0)	278 (25.0)	121 (5.0)
Strontium	mg/L	ND (0.050)	ND (0.050)	ND (0.25)	1.6 (0.050)
Tin	mg/L	ND (0.10)	ND (0.10)	ND (0.50)	ND (0.10)
Vanadium	mg/L	ND (0.010)	ND (0.010)	ND (0.050)	ND (0.010)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-1

Table 7

(Continued)

Parameter	Units	Site ID / Location ID			
		Sample ID	Log Date	Sample ID	Log Date
		IL / ILBLNK IL097	8/18/92	IL / ILLY01 IL099	8/22/92
				IL / ILLY05 IL103	8/22/92
				IL / ILLW01 IL091	8/18/92

Elements by ICPEs or AA, cont.					
Zinc	mg/L	ND	(0.020)	0.022 a	(0.020)
				ND	(0.10)
				ND	(0.020)
Field measurements					
Conductivity	umhos/cm	2.5	(5)	3825	(5)
Redox (Eh)	mV	-23.5	()	-232.3	()
TDS	mg/L	7	(1)	NA	()
Temperature	deg. C	28.1	()	17.9	()
Total Alkalinity	meq/L	.032	(0.03)	NA	()
pH	pH units	6.98	()	10.88	()
				11.13	()
				4350	(5)
				-247.1	()
				NA	()
				17.7	()
				14.7	()
				12.24	(0.03)
				6.75	()
				1240	(5)
				6.5	()
				1420	(1)
				14.7	()
				12.24	(0.03)
				6.75	()

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-2

Table 7

(Continued)

Parameter	Site ID / Location ID			
	Sample ID		Log Date	
	IL / ILMW02	IL / ILMW03	IL / ILMW04	IL / ILMW05
Units	IL092	IL093	IL094	IL095
	8/18/92	8/18/92	8/18/92	8/18/92
Anions				
Chloride	14	20	17	18
Fluoride	0.20 a	0.18 a	0.30 a	0.30 a
Sulfate	1600	1900	350	380
	(0.052)	(0.13)	(0.052)	(0.052)
	(0.10)	(0.10)	(0.10)	(0.10)
	(5.0)	(5.0)	(0.50)	(0.50)
Elements by ICPEs or AA				
Aluminum	ND	ND	ND	ND
Arsenic	ND	(2.0)	(0.10)	(0.10)
Barium	ND	(0.030)	(0.0050)	(0.0050)
Beryllium	ND	(2.0)	0.015 a	0.015 a
Boron	ND	(0.050)	ND	ND
Cadmium	0.43 a	(0.10)	1.4	1.4
Calcium	ND	(0.0030)	ND	ND
Chromium	443	(500)	156	164
Cobalt	ND	(0.20)	ND	ND
Copper	ND	(0.50)	ND	ND
Iron	ND	(0.25)	ND	ND
Lead	ND	(1.0)	0.79	0.79
Magnesium	ND	(0.030)	ND	ND
Manganese	256	(100)	86.7	91.7
Molybdenum	4.6	(0.50)	0.35	0.38
Nickel	ND	(0.020)	ND	ND
Potassium	ND	(0.50)	ND	ND
Selenium	ND	(50.0)	6.8 a	6.3 a
Silicon	6.868	(0.030)	ND	ND
Silver	ND	(0.234)	7.008	7.055
Sodium	74.9	(0.050)	ND	ND
Strontium	1.0	(100)	167	171
Tin	0.17 a	(0.050)	1.6	1.7
Vanadium	ND	(NA)	ND	ND
		(0.50)	(0.10)	(0.10)
		(0.010)	(0.010)	(0.010)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-3

Table 7

(Continued)

		Site ID / Location ID			
		Sample ID		Log Date	
Parameter	Units	IL / ILMW02 IL092 8/18/92	IL / ILMW03 IL093 8/18/92	IL / ILMW04 IL094 8/18/92	IL / ILMW05 IL095 8/18/92

Elements by ICPEs or AA, cont.					
Zinc	mg/L	ND	(0.50)	ND	(0.020)
Field measurements					
Conductivity	umhos/cm	2050	(5)	1385	(5)
Redox (Eh)	mV	12.7	(1)	13.1	(1)
TDS	mg/L	3400	(1)	1379	(1)
Temperature	deg. C	14.7	(1)	13.7	(1)
Total Alkalinity	meq/L	10.6	(0.03)	14.92	(0.03)
pH	pH units	6.64	(1)	6.63	(1)

() = Detection Limit ND = Not Detected NA = Not Analyzed @ = < 5X Det. Limit

Table 7
(Continued)

Site ID / Location ID
Sample ID
Log Date

Parameter	Units	IL / ILMW05		IL / ILMW06		IL / ILMW07		IL / ILMW08	
		IL098	8/18/92	IL096	8/18/92	IL109	8/18/92	IL110	8/18/92

Anions									
Chloride	mg/L	17	(0.052)	23	(0.13)	36	(0.26)	12	(0.026)
Fluoride	mg/L	0.28 a	(0.10)	0.17 a	(0.10)	0.41 a	(0.10)	0.24 a	(0.10)
Sulfate	mg/L	380	(0.50)	2200	(25)	230	(0.50)	1300	(5.0)

Elements by ICPEs or AA									
Aluminum	mg/L	ND	(0.10)	ND	(0.10)	ND	(0.10)	ND	(0.10)
Arsenic	mg/L	ND	(0.0050)	ND	(0.0050)	ND	(0.0050)	ND	(0.0050)
Barium	mg/L	0.015 a	(0.010)	0.013 a	(0.010)	0.027 a	(0.010)	0.014 a	(0.010)
Beryllium	mg/L	ND	(0.0020)	ND	(0.0020)	ND	(0.0020)	ND	(0.0020)
Boron	mg/L	1.5	(0.10)	1.2	(0.10)	1.7	(0.10)	0.14 a	(0.10)
Cadmium	mg/L	ND	(0.0010)	ND	(0.00050)	ND	(0.0010)	ND	(0.00050)
Calcium	mg/L	160	(0.20)	373	(0.20)	121	(0.20)	376	(0.20)
Chromium	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Cobalt	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Copper	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.020)	ND	(0.020)
Iron	mg/L	0.69	(0.10)	ND	(0.10)	1.7	(0.10)	ND	(0.10)
Lead	mg/L	ND	(0.010)	ND	(0.10)	ND	(0.010)	ND	(0.10)
Magnesium	mg/L	89.5	(0.20)	235	(0.20)	68.8	(0.20)	262	(0.20)
Manganese	mg/L	0.37	(0.010)	1.5	(0.010)	0.37	(0.010)	1.9	(0.010)
Molybdenum	mg/L	ND	(0.020)	ND	(0.020)	ND	(0.020)	ND	(0.020)
Nickel	mg/L	ND	(0.040)	ND	(0.040)	ND	(0.040)	ND	(0.040)
Potassium	mg/L	6.5 a	(5.0)	17.4 a	(5.0)	5.5 a	(5.0)	ND	(5.0)
Selenium	mg/L	ND	(0.0050)	ND	(0.010)	ND	(0.0050)	ND	(0.010)
Silicon	mg/L	7.101	(0.234)	7.522	(0.234)	7.569	(0.234)	7.662	(0.234)
Silver	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)
Sodium	mg/L	168	(5.0)	173	(5.0)	153	(5.0)	60.9	(5.0)
Strontium	mg/L	1.7	(0.050)	2.9	(0.050)	1.3	(0.050)	0.47	(0.050)
Tin	mg/L	ND	(0.10)	ND	(0.10)	ND	(0.10)	ND	(0.10)
Vanadium	mg/L	ND	(0.010)	ND	(0.010)	ND	(0.010)	ND	(0.010)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-5

Table 7

(Continued)

		Site ID / Location ID			
		Sample ID		Log Date	
Parameter	Units	IL / ILMW05 IL098 8/18/92	IL / ILMW06 IL096 8/18/92	IL / ILMW07 IL109 8/18/92	IL / ILMW08 IL110 8/18/92

Elements by ICPEs or AA, cont.					
Zinc	mg/L	ND	0.028 a (0.020)	ND	(0.020)
Field measurements					
Conductivity	umhos/cm	1340	2190 (5)	1135 (5)	2000 (5)
Redox (Eh)	mV	10.0 ()	21.4 ()	2.5 ()	8.4 ()
TDS	mg/L	1419 (1)	3195 (1)	1108 (1)	3014 (1)
Temperature	deg. C	13.9 ()	13.8 ()	14.8 ()	14.5 ()
Total Alkalinity	meq/L	15.08 (0.03)	15.96 (0.03)	12.84 (0.03)	11.44 (0.03)
pH	pH units	6.68 ()	6.50 ()	6.82 ()	6.71 ()

Table 7

(Continued)

Site ID / Location ID
Sample ID
Log Date

IL / ILM09
IL111
8/18/92

Parameter	Units	
Anions		
Chloride	mg/L	12 (0.026)
Fluoride	mg/L	0.23 a (0.10)
Sulfate	mg/L	2600 (10)
Elements by ICPEs or AA		
Aluminum	mg/L	ND (0.10)
Arsenic	mg/L	ND (0.010)
Barium	mg/L	0.011 a (0.010)
Beryllium	mg/L	ND (0.0020)
Boron	mg/L	0.41 a (0.10)
Cadmium	mg/L	ND (0.00050)
Calcium	mg/L	432 (0.20)
Chromium	mg/L	ND (0.010)
Cobalt	mg/L	0.017 a (0.010)
Copper	mg/L	ND (0.020)
Iron	mg/L	ND (0.10)
Lead	mg/L	ND (0.10)
Magnesium	mg/L	607 (0.20)
Manganese	mg/L	6.9 (0.010)
Molybdenum	mg/L	ND (0.020)
Nickel	mg/L	ND (0.040)
Potassium	mg/L	6.4 a (5.0)
Selenium	mg/L	ND (0.020)
Silicon	mg/L	5.747 (0.234)
Silver	mg/L	ND (0.010)
Sodium	mg/L	83.6 (5.0)
Strontium	mg/L	1.5 (0.050)
Tin	mg/L	ND (0.10)
Vanadium	mg/L	ND (0.010)

() = Detection Limit ND = Not Detected NA = Not Analyzed a = < 5X Det. Limit

C1-7

Table 7

(Continued)

Site ID / Location ID
Sample ID
Log Date

Parameter	Units	IL / ILM009 IL111 8/18/92
-----	-----	-----
Elements by ICPEs or AA, cont.		
Zinc	mg/L	0.027 a (0.020)
Field measurements		
Conductivity	umhos/cm	3050 (5)
Redox (Eh)	mV	23.9 ()
TDS	mg/L	5564 (1)
Temperature	deg. C	15.6 ()
Total Alkalinity	meq/L	13.24 (0.03)
pH	pH units	6.45 ()

Table 8

**Illinois Meteorological Data
Daily Sums and Averages**

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
6/03/91	28.08	58.68	6.08	49.58	0.00	507.92
6/04/91	21.59	49.66	11.27	58.88	0.00	332.42
6/05/91	20.28	46.25	11.54	69.46	0.00	489.71
6/06/91	20.03	48.01	9.25	44.25	0.00	511.50
6/07/91	20.98	49.51	6.00	63.38	0.00	464.79
6/08/91	20.64	55.12	4.77	160.04	0.00	465.75
6/09/91	22.03	60.74	3.42	224.92	0.00	400.79
6/10/91	23.86	58.28	6.64	248.58	0.00	337.67
6/11/91	22.63	70.11	8.13	230.25	0.00	273.75
6/12/91	24.85	65.08	2.18	212.71	0.00	483.21
6/13/91	26.43	63.99	3.02	165.63	0.00	442.00
6/14/91	28.04	63.47	10.00	223.75	0.00	454.13
6/15/91	25.22	78.15	11.63	214.92	.59	308.58
6/16/91	23.86	68.97	7.29	32.13	0.00	396.29
6/17/91	22.47	63.87	2.78	112.17	0.00	499.83
6/18/91	23.27	61.85	5.08	57.08	0.00	483.54
6/19/91	24.39	60.92	6.33	53.75	0.00	472.21
6/20/91	24.88	64.03	4.18	91.08	0.00	460.29
6/21/91	25.22	72.60	15.51	163.33	0.00	372.83
6/22/91	20.82	84.92	8.33	48.58	.19	119.29
6/23/91	22.00	74.04	10.84	52.79	0.00	343.08
6/24/91	23.36	64.80	7.15	93.21	0.00	398.75
6/25/91	24.15	64.58	6.83	144.04	0.00	445.83
6/26/91	26.04	70.67	8.75	221.54	0.00	415.04
6/27/91	26.19	65.16	13.98	222.13	0.00	470.54
6/28/91	24.56	66.44	8.69	218.13	0.00	446.17
6/29/91	26.76	69.02	8.92	220.88	0.00	435.50
6/30/91	28.37	65.44	7.31	207.50	0.00	460.71
7/01/91	26.24	71.65	6.25	265.21	.17	352.42
7/02/91	24.73	76.02	5.39	231.08	.95	284.67
7/03/91	24.77	63.59	7.72	187.50	0.00	436.13
7/04/91	22.71	61.75	5.85	164.13	0.00	433.08
7/05/91	25.00	63.07	6.33	252.13	0.00	464.21
7/06/91	27.05	63.09	9.07	246.13	0.00	427.63
7/07/91	28.60	65.24	11.87	220.42	0.00	402.21
7/08/91	24.95	59.66	9.48	37.21	0.00	486.71
7/09/91	20.37	72.19	8.50	92.88	.07	124.38
7/10/91	23.13	72.66	4.89	79.54	.02	198.46
7/11/91	24.78	76.08	7.62	193.75	3.14	187.75
7/12/91	26.05	67.80	10.66	109.29	.06	387.33
7/13/91	22.56	69.82	10.25	35.04	0.00	515.75
7/14/91	21.45	63.69	10.01	50.83	0.00	484.13
7/15/91	21.87	60.69	5.40	199.58	0.00	467.79
7/16/91	23.03	61.42	8.40	196.00	0.00	449.21
7/17/91	23.75	62.14	7.55	157.21	0.00	440.17
7/18/91	24.56	63.13	9.85	230.54	0.00	435.13
7/19/91	25.77	66.47	11.35	223.00	0.00	423.96

Table 8

(Continued)

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
7/20/91	26.85	67.34	14.77	219.67	0.00	407.29
7/21/91	28.09	68.53	11.53	216.08	0.00	372.83
7/22/91	28.47	64.20	12.76	211.04	.09	405.83
7/23/91	24.15	55.96	11.89	50.33	.03	415.21
7/24/91	19.76	63.72	11.89	150.33	.02	264.96
7/25/91	19.41	56.88	7.05	92.21	0.00	435.29
7/26/91	18.96	58.41	8.15	47.67	0.00	413.29
7/27/91	20.81	55.40	9.32	148.25	0.00	412.88
7/28/91	23.01	54.75	11.36	177.79	0.00	372.21
7/29/91	19.78	70.83	6.76	125.25	0.00	244.04
7/30/91	18.93	62.55	6.05	227.83	0.00	400.96
7/31/91	21.35	67.57	6.91	165.13	0.00	301.75
8/01/91	25.04	62.13	8.62	137.13	0.00	425.83
8/02/91	26.56	60.86	8.39	217.54	0.00	404.17
8/03/91	25.88	70.63	9.99	90.63	0.00	190.08
8/04/91	22.63	68.60	9.95	44.75	0.00	274.42
8/05/91	18.98	73.74	13.12	103.08	.49	110.88
8/06/91	20.39	75.75	11.69	124.92	1.43	65.25
8/07/91	24.11	74.84	11.96	175.92	.56	217.54
8/08/91	24.35	73.01	13.29	121.04	.16	261.42
8/09/91	20.18	69.62	10.61	40.29	.03	307.46
8/10/91	19.88	61.69	7.63	36.17	0.00	406.88
8/11/91	20.47	57.17	6.62	66.58	0.00	391.96
8/12/91	20.90	56.98	10.29	51.50	0.00	405.83
8/13/91	21.13	59.89	6.71	84.38	0.00	396.54
8/14/91	21.04	61.55	4.41	164.50	0.00	357.75
8/15/91	17.50	69.90	6.00	287.00	0.00	336.00
8/16/91	28.23	50.74	7.00	220.50	0.00	459.08
8/17/91	22.37	70.58	4.90	144.67	.22	356.38
8/18/91	22.15	66.78	2.70	182.04	0.00	286.58
8/19/91	19.05	61.49	3.74	30.25	0.00	389.38
8/20/91	18.67	65.03	4.03	30.96	0.00	425.83
8/21/91	20.38	63.62	3.31	156.21	0.00	297.08
8/22/91	22.39	68.88	2.68	107.08	0.00	305.71
8/23/91	24.03	54.45	3.04	124.17	0.00	357.42
8/24/91	25.19	62.12	2.66	147.08	0.00	351.33
8/25/91	25.42	63.55	3.00	226.21	0.00	342.83
8/26/91	24.81	62.44	2.48	202.58	0.00	327.54
8/27/91	25.05	68.04	3.60	199.83	0.00	358.33
8/28/91	25.33	67.08	2.96	222.13	0.00	312.71
8/29/91	23.80	78.11	2.89	190.04	.58	86.38
8/30/91	25.72	70.68	1.79	80.13	.05	242.67
8/31/91	25.58	66.31	3.94	105.17	.08	293.13
9/01/91	21.15	68.70	5.20	61.25	0.00	166.75
9/02/91	23.20	68.06	3.88	172.54	.45	242.63
9/03/91	22.61	73.50	3.03	176.75	1.26	113.42
9/04/91	20.76	62.53	4.38	37.54	0.00	356.17
9/05/91	18.83	56.78	3.13	135.04	0.00	362.17

Table 8**(Continued)**

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
9/06/91	20.49	60.43	2.29	205.83	0.00	342.54
9/07/91	21.63	58.79	3.30	215.79	0.00	339.50
9/08/91	20.71	73.57	6.94	216.08	.34	101.33
9/09/91	26.10	70.85	7.33	214.21	.39	308.33
9/10/91	23.12	71.15	4.91	80.92	.59	296.75
9/11/91	22.48	73.50	3.56	134.96	.04	243.13
9/12/91	25.78	68.10	4.22	207.46	0.00	310.13
9/13/91	25.11	69.18	2.83	147.13	0.00	251.21
9/14/91	25.46	69.21	3.87	217.75	0.00	257.67
9/15/91	25.37	73.45	6.21	207.63	.85	191.38
9/16/91	21.12	60.33	5.95	168.92	.24	290.08
9/17/91	17.68	59.17	3.78	237.00	0.00	275.42
9/18/91	13.31	63.79	4.79	51.67	.12	24.53
9/19/91	6.77	54.74	3.55	43.46	0.00	287.50
9/20/91	6.59	55.17	2.80	55.54	0.00	300.25
9/21/91	10.54	46.51	4.71	136.42	0.00	308.25
9/22/91	13.98	70.22	6.61	176.04	.27	41.54
9/23/91	10.70	55.94	2.69	40.04	0.00	307.13
9/24/91	12.18	60.68	3.10	66.08	0.00	194.67
9/25/91	13.69	52.06	4.95	137.08	0.00	240.25
9/26/91	10.11	44.88	3.88	32.50	0.00	310.71
9/27/91	8.37	61.80	3.40	89.38	0.00	125.67
9/28/91	13.69	58.32	5.64	74.25	0.00	284.54
9/29/91	16.28	58.55	2.82	144.79	0.00	280.54
9/30/91	17.19	57.23	3.33	196.88	0.00	255.54
10/01/91	17.32	54.44	4.43	138.88	0.00	262.79
10/02/91	19.50	61.35	7.23	211.17	1.24	186.42
10/03/91	16.83	71.54	4.39	138.96	.46	150.83
10/04/91	15.73	72.42	6.43	89.00	3.26	24.21
10/05/91	8.83	62.40	6.58	61.38	.09	229.92
10/06/91	5.74	59.60	5.64	66.04	0.00	262.21
10/07/91	7.21	52.79	5.73	178.29	0.00	265.54
10/08/91	15.12	50.59	8.54	220.88	0.00	254.33
10/09/91	16.88	56.75	4.95	189.42	0.00	239.21
10/10/91	12.52	48.75	4.51	86.83	0.00	190.17
10/11/91	14.10	47.97	4.58	82.04	0.00	253.33
10/12/91	9.86	54.92	3.82	29.79	0.00	253.00
10/13/91	8.98	56.42	5.34	146.75	0.00	188.21
10/14/91	9.78	56.70	4.55	77.08	.13	202.63
10/15/91	4.50	53.61	3.86	32.67	0.00	244.08
10/16/91	6.96	48.85	4.77	144.29	0.00	229.67
10/17/91	14.32	43.65	6.86	215.38	0.00	222.00
10/18/91	10.14	50.60	4.69	45.38	.04	136.00
10/19/91	3.35	55.13	4.39	92.04	0.00	218.13
10/20/91	3.02	56.24	2.96	247.75	0.00	206.04
10/21/91	8.64	57.82	4.60	218.21	0.00	208.13
10/22/91	17.21	51.97	7.38	218.08	0.00	200.63
10/23/91	17.94	63.26	7.51	213.13	1.49	96.50

Table 8
(Continued)

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
10/24/91	20.43	71.88	7.87	216.79	.02	89.21
10/25/91	14.79	72.94	6.98	92.71	.10	78.83
10/26/91	15.23	70.56	5.47	84.50	.23	29.63
10/27/91	11.94	70.48	6.88	60.63	0.00	33.54
10/28/91	16.45	70.60	3.25	152.04	.24	16.75
10/29/91	15.94	73.75	7.85	159.13	.22	56.88
10/30/91	2.29	73.07	4.90	27.21	.50	29.42
10/31/91	6.34	72.80	7.16	82.21	.06	22.08
11/01/91	6.90	70.22	7.03	219.38	.62	36.83
11/02/91	-4.37	56.83	6.83	78.96	0.00	118.79
11/03/91	-7.95	53.57	7.53	121.00	0.00	118.13
11/04/91	-7.65	55.53	5.53	125.42	0.00	185.00
11/05/91	-.88	58.30	7.55	215.83	0.00	89.54
11/06/91	-2.99	62.30	5.05	32.38	0.00	85.08
11/07/91	-9.08	55.76	4.00	29.71	0.00	195.92
11/08/91	-11.16	53.65	1.69	103.54	.09	194.42
11/09/91	-8.24	57.16	3.41	218.50	0.00	185.21
11/10/91	-1.88	57.27	4.56	167.71	0.00	150.33
11/11/91	.59	66.66	5.37	61.92	0.00	37.88
11/12/91	1.21	70.30	6.33	171.67	.03	38.83
11/13/91	6.03	65.93	8.75	224.68	0.00	210.05
11/14/91	10.94	74.30	8.50	216.00	.21	0.00
11/15/91	11.77	73.32	8.60	224.57	.34	29.71
11/17/91	10.46	71.63	7.90	208.77	.41	25.77
11/18/91	16.67	65.68	7.01	221.75	0.00	150.46
11/19/91	14.44	69.43	6.70	142.25	.11	61.83
11/20/91	6.44	68.02	3.83	37.96	.10	66.38
11/21/91	2.50	62.75	3.51	143.88	0.00	162.38
11/22/91	4.89	63.40	3.16	202.96	.03	87.92
11/23/91	-1.42	67.23	6.90	203.58	.06	34.21
11/24/91	-6.65	64.39	6.10	73.96	0.00	63.79
11/25/91	-9.09	61.70	5.05	37.71	0.00	158.71
11/26/91	-1.80	58.21	6.17	183.42	.03	120.42
11/27/91	5.14	66.81	6.33	214.79	.12	98.83
11/28/91	8.46	69.12	6.54	130.04	.20	20.96
11/29/91	14.78	66.46	7.00	222.38	.76	78.83
11/30/91	3.58	58.91	5.38	76.92	0.00	41.50
12/01/91	-4.36	54.38	5.55	29.21	0.00	82.08
12/02/91	-1.41	60.80	7.69	44.83	0.00	14.67
12/03/91	-7.09	67.01	7.23	67.46	0.00	50.08
12/04/91	-14.43	58.13	6.86	105.38	0.00	116.13
12/05/91	-1.90	64.33	6.93	170.50	.43	120.38
12/06/91	-1.50	64.79	6.21	146.67	0.00	133.96
12/07/91	8.65	65.85	7.70	219.88	0.00	65.42
12/08/91	10.63	64.00	7.10	157.83	.58	96.71
12/09/91	1.95	63.01	2.97	100.67	0.00	128.92
12/10/91	2.88	59.55	5.20	155.88	0.00	134.25
12/11/91	5.74	62.53	3.15	117.13	0.00	82.13

Table 8

(Continued)

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
12/12/91	11.15	62.93	6.98	181.13	.77	37.75
12/13/91	2.18	62.55	3.37	130.25	0.00	129.71
12/14/91	-.52	46.14	5.19	69.13	0.00	132.75
12/15/91	-3.53	46.48	5.54	92.83	0.00	127.42
12/16/91	-1.64	54.24	5.91	198.92	0.00	126.42
12/17/91	1.00	52.66	4.88	55.29	0.00	132.63
12/18/91	-7.85	46.87	5.38	45.08	0.00	132.46
12/19/91	-5.07	52.03	9.03	211.33	0.00	96.38
12/20/91	.25	59.25	8.70	192.96	.50	12.88
12/21/91	.20	62.07	5.75	133.58	0.00	95.96
12/22/91	1.99	75.04	7.16	222.42	.12	24.29
12/23/91	2.15	63.27	5.02	34.00	.23	61.88
12/24/91	-1.33	58.57	2.83	143.25	0.00	129.67
12/25/91	-2.23	60.11	2.63	212.13	0.00	126.96
12/26/91	-.84	58.21	3.07	208.71	0.00	110.13
12/27/91	.30	63.38	7.87	74.71	.01	42.88
12/28/91	1.60	62.63	6.94	44.67	0.00	71.50
12/29/91	.69	64.16	7.03	25.46	0.00	40.58
12/30/91	-.09	60.43	6.34	112.75	0.00	25.67
12/31/91	-.32	60.59	6.89	184.67	0.00	17.71
1/01/92	.83	63.14	6.24	174.04	.03	21.25
1/02/92	4.46	64.85	4.25	192.67	.05	17.63
1/03/92	3.35	63.96	2.62	92.71	0.00	38.17
1/04/92	1.39	65.66	4.89	96.08	0.00	21.79
1/05/92	1.34	67.02	7.40	192.00	0.00	20.21
1/06/92	3.02	66.09	1.95	90.75	0.00	35.75
1/07/92	4.28	65.64	5.63	190.42	0.00	29.96
1/08/92	4.80	65.44	8.34	213.21	.18	19.83
1/09/92	.69	65.36	6.59	47.46	0.00	29.79
1/10/92	-2.08	56.58	6.35	91.92	0.00	139.13
1/11/92	2.75	55.50	8.88	220.88	0.00	139.13
1/12/92	2.65	61.12	8.87	219.17	.02	25.79
1/13/92	1.80	63.16	5.34	70.08	.03	28.04
1/14/92	-6.85	60.18	3.03	37.79	0.00	149.00
1/15/92	-12.68	54.43	4.76	72.71	0.00	131.21
1/16/92	-10.37	48.95	6.87	202.54	0.00	143.29
1/17/92	-3.26	47.31	5.65	39.42	0.00	120.92
1/18/92	-13.47	41.88	5.01	21.88	0.00	142.75
1/19/92	-6.92	52.88	5.18	193.21	0.00	154.29
1/20/92	-.63	54.74	5.60	123.00	0.00	148.50
1/21/92	.30	55.82	4.14	217.63	0.00	152.33
1/22/92	2.22	61.45	5.82	212.21	.16	41.96
1/23/92	.88	57.75	5.40	59.33	.01	31.46
1/24/92	-5.10	46.82	6.15	97.38	0.00	161.04
1/25/92	-1.99	57.87	5.36	111.96	.06	68.04
1/26/92	-3.86	57.84	5.34	149.50	0.00	147.08
1/27/92	-.33	54.03	5.75	114.33	0.00	155.88
1/28/92	-1.75	54.40	6.39	148.54	0.00	43.46

Table 8

(Continued)

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
1/29/92	-.35	57.87	8.90	225.29	0.00	109.33
1/30/92	1.73	57.21	4.13	119.00	0.00	108.96
2/01/92	-.01	59.11	4.53	35.92	0.00	101.29
2/02/92	-1.63	56.30	5.61	141.46	0.00	170.71
2/03/92	1.72	54.73	5.14	218.71	0.00	161.29
2/04/92	7.03	47.84	4.03	207.67	0.00	119.88
2/05/92	2.61	54.75	5.15	29.33	0.00	99.25
2/06/92	-1.39	53.87	4.72	144.42	0.00	185.00
2/07/92	-.81	54.68	3.78	150.21	0.00	92.92
2/08/92	-1.01	45.03	4.64	22.46	0.00	97.04
2/09/92	-7.20	46.73	3.62	24.08	0.00	163.25
2/10/92	-6.63	44.57	6.11	135.33	0.00	147.42
2/11/92	-.17	43.35	8.33	222.63	.04	18.46
2/12/92	.08	47.75	6.19	46.00	0.00	154.54
2/13/92	-3.73	58.54	7.73	88.92	0.00	58.63
2/14/92	-1.04	60.68	5.45	101.50	.07	59.38
2/15/92	.48	58.16	8.05	141.88	.74	24.33
2/16/92	1.59	63.96	6.25	65.71	.04	26.54
2/17/92	3.64	57.18	7.72	190.50	0.00	86.67
2/18/92	4.51	55.16	8.68	161.83	.29	114.54
2/19/92	7.05	61.47	8.89	206.29	.03	77.17
2/20/92	1.93	47.18	6.42	40.67	0.00	31.00
2/21/92	5.41	77.30	4.23	87.82	.01	29.26
2/22/92	8.33	76.03	6.77	50.67	0.00	0.00
2/23/92	7.73	81.36	7.33	61.08	0.00	94.08
2/24/92	4.73	86.28	6.80	66.21	.32	33.17
2/25/92	-.74	83.61	3.64	23.13	0.00	78.29
2/26/92	1.49	75.95	6.49	143.50	0.00	156.83
2/27/92	1.64	86.02	4.34	90.38	0.00	67.92
2/28/92	6.40	74.16	5.92	117.83	0.00	216.38
2/29/92	1.91	72.15	4.20	127.79	0.00	257.38
3/01/92	10.93	63.20	6.10	214.29	0.00	256.46
3/02/92	12.91	67.76	4.06	202.88	0.00	185.13
3/03/92	10.93	78.56	6.01	103.75	0.00	240.00
3/04/92	13.25	78.90	7.02	152.42	0.00	198.54
3/05/92	13.79	85.46	6.51	202.29	.02	59.17
3/06/92	12.13	88.33	6.10	204.75	.48	78.54
3/07/92	10.99	85.82	7.24	98.38	.01	44.67
3/08/92	11.44	82.03	6.37	208.67	0.00	156.46
3/09/92	12.04	81.42	6.50	179.63	.14	115.96
3/10/92	-5.47	83.72	3.36	23.42	0.00	153.63
3/11/92	-4.69	77.27	6.61	136.33	.01	211.92
3/12/92	-4.08	75.14	5.39	35.58	0.00	287.67
3/13/92	-3.27	78.52	4.25	111.67	0.00	238.83
3/14/92	.18	87.63	5.22	30.46	.05	125.08
3/15/92	-.01	78.84	4.10	31.25	0.00	290.63
3/16/92	2.38	75.65	4.66	166.63	0.00	288.75
3/17/92	8.29	66.30	6.39	98.29	0.00	260.63

Table 8

(Continued)

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
3/18/92	1.29	87.52	6.30	55.67	1.07	26.21
3/19/92	1.77	78.83	4.15	32.00	.03	290.63
3/20/92	4.75	78.20	3.90	40.83	0.00	219.92
3/21/92	6.32	79.07	6.39	198.29	.16	132.04
3/22/92	.40	81.14	3.54	26.92	0.00	215.25
3/23/92	2.25	70.15	4.25	129.13	0.00	314.92
3/24/92	7.10	58.10	5.49	218.13	0.00	313.71
3/25/92	7.43	60.40	6.57	144.13	0.00	146.88
3/26/92	4.28	56.56	5.28	94.25	.24	245.17
3/27/92	1.73	50.50	4.16	48.29	0.00	343.33
3/28/92	5.55	50.73	6.84	163.42	.04	167.92
3/29/92	6.26	66.22	8.48	142.58	.13	68.79
3/30/92	4.25	66.57	3.67	26.46	0.00	141.29
3/31/92	3.18	65.89	4.01	74.83	.01	158.71
4/01/92	1.06	47.20	5.43	28.25	.01	185.42
4/02/92	.19	56.57	4.75	29.17	0.00	365.88
4/03/92	4.69	49.32	6.36	204.33	0.00	111.42
4/04/92	6.05	48.26	5.57	36.04	0.00	344.79
4/05/92	6.18	45.60	6.46	192.54	0.00	363.67
4/06/92	9.57	42.81	6.37	215.13	0.00	223.08
4/07/92	12.73	43.48	6.86	102.33	0.00	167.54
4/08/92	11.03	53.39	5.09	135.29	.01	308.00
4/09/92	11.91	53.13	5.51	46.33	0.00	241.58
4/10/92	16.08	63.11	8.07	202.63	.30	232.04
4/11/92	11.32	65.07	5.87	74.25	.29	78.50
4/12/92	5.05	52.03	5.63	45.38	0.00	356.00
4/13/92	6.47	47.05	8.38	137.92	0.00	104.50
4/14/92	12.09	52.82	8.42	92.50	0.00	178.96
4/15/92	16.04	60.44	8.27	198.79	.16	237.17
4/16/92	16.05	76.42	7.10	151.00	.26	166.21
4/17/92	8.40	84.73	7.60	88.04	.12	56.25
4/18/92	15.75	84.14	7.38	170.00	.73	174.75
4/19/92	18.08	80.16	7.30	211.21	.18	200.17
4/20/92	16.25	86.75	7.44	214.38	.60	157.38
4/21/92	5.75	82.43	7.57	220.25	0.00	138.46
4/22/92	5.80	79.91	6.28	169.21	0.00	348.92
4/23/92	11.76	79.08	5.80	86.42	0.00	159.63
4/24/92	7.84	84.23	5.15	25.33	0.00	131.42
4/25/92	5.33	82.63	4.51	33.00	0.00	89.38
4/26/92	6.95	80.30	5.53	24.75	.01	169.08
4/27/92	6.85	71.55	4.70	30.17	0.00	407.08
4/28/92	7.70	61.35	5.61	161.79	.04	417.29
4/29/92	14.33	68.55	6.63	200.00	.03	306.54
4/30/92	18.48	60.55	4.23	211.25	0.00	397.67
5/01/92	23.14	45.32	7.40	220.29	0.00	412.88
5/02/92	19.65	43.71	5.20	113.79	0.00	318.17
5/03/92	13.38	44.42	3.42	27.75	0.00	431.92
5/04/92	11.15	52.35	5.15	49.88	.13	295.04

Table 8
(Continued)

Date	Air Temp. Degrees C	% Relative Humidity	Wind Speed (mph)	Wind Direction (degrees azimuth)	Rain (inches)	Solar Radiation (um/m2)
5/05/92	8.49	46.44	5.92	38.79	.05	362.88
5/06/92	8.02	49.04	4.27	55.75	0.00	444.21
5/07/92	10.58	49.95	3.37	124.88	0.00	440.29
5/08/92	13.55	52.66	2.79	60.92	0.00	431.88
5/09/92	16.51	50.33	3.94	106.46	0.00	433.54
5/10/92	20.50	44.44	6.06	209.46	0.00	425.63
5/11/92	20.78	52.33	8.11	218.08	.29	299.29
5/12/92	18.34	67.26	6.25	197.75	.02	251.00
5/13/92	17.23	40.28	5.18	29.92	0.00	438.13
5/14/92	11.48	60.30	5.40	158.92	.21	151.21
5/15/92	14.90	83.65	3.79	147.58	.01	407.71
5/16/92	21.63	70.58	6.24	188.08	0.00	389.29
5/17/92	20.72	68.41	7.43	147.13	0.00	186.79
5/18/92	18.37	66.52	6.64	49.88	0.00	449.08
5/19/92	17.01	74.30	7.21	72.38	0.00	422.00

Table 9

Illinois Moisture Data

Date	Months Since Construction	Test id	Cell	Quadrant	Depth (feet)	Matrix	% Moisture (wet basis)	% Moisture (dry basis)
8/16/91	4	ILNT-1	N	NW	1	Ash	25.73	34.65
8/16/91	4	ILNT-1	N	NW	2	Ash	26.19	35.48
8/16/91	4	ILNT-1	N	NW	3	Ash	22.63	29.25
8/16/91	4	ILNT-1	N	NW	4	Ash	11.04	12.41
8/16/91	4	ILNT-1	N	NW	5	Ash	12.14	13.82
8/16/91	4	ILNT-1	N	NW	6	Ash	23.36	30.48
8/16/91	4	ILNT-1	N	NW	7	Ash	25.60	34.40
8/16/91	4	ILNT-1	N	NW	8	Ash	25.95	35.05
8/16/91	4	ILNT-2	N	NE	1	Ash	26.27	35.64
8/16/91	4	ILNT-2	N	NE	2	Ash	26.27	35.64
8/16/91	4	ILNT-2	N	NE	3	Ash	23.65	30.97
8/16/91	4	ILNT-2	N	NE	4	Ash	21.44	27.30
8/16/91	4	ILNT-2	N	NE	5	Ash	24.19	31.91
8/16/91	4	ILNT-2	N	NE	6	Ash	24.58	32.59
8/16/91	4	ILNT-2	N	NE	7	Ash	25.26	33.79
8/16/91	4	ILNT-2	N	NE	8	Ash	26.51	36.08
8/16/91	4	ILNT-2	N	NE	9	Ash/Soil	23.38	30.51
8/16/91	4	ILNT-3	N	SE	1	Ash	29.02	40.89
8/16/91	4	ILNT-3	N	SE	2	Ash	26.29	35.67
8/16/91	4	ILNT-3	N	SE	3	Ash	23.29	30.36
8/16/91	4	ILNT-3	N	SE	4	Ash	19.75	24.61
8/16/91	4	ILNT-3	N	SE	5	Ash	24.21	31.94
8/16/91	4	ILNT-3	N	SE	6	Ash	23.14	30.10
8/16/91	4	ILNT-3	N	SE	7	Ash	22.90	29.70
8/16/91	4	ILNT-3	N	SE	8	Ash	21.97	28.16
8/16/91	4	ILNT-3	N	SE	9	Ash/Soil	24.14	31.82
8/16/91	4	ILNT-4	N	SW	1	Ash	26.78	36.58
8/16/91	4	ILNT-4	N	SW	2	Ash	23.29	30.36
8/16/91	4	ILNT-4	N	SW	3	Ash	12.94	14.86
8/16/91	4	ILNT-4	N	SW	4	Ash	9.73	10.78
8/16/91	4	ILNT-4	N	SW	5	Ash	20.26	25.40
8/16/91	4	ILNT-4	N	SW	6	Ash	24.46	32.38
8/16/91	4	ILNT-4	N	SW	7	Ash	23.19	30.19
8/16/91	4	ILNT-4	N	SW	8	Ash	22.14	28.43
8/16/91	4	ILNT-4	N	SW	9	Ash/Soil	23.94	31.47
11/13/91	7	ILNT-1	N	NW	1	Ash	29.49	41.82
11/13/91	7	ILNT-1	N	NW	2	Ash	28.88	40.61
11/13/91	7	ILNT-1	N	NW	3	Ash	27.11	37.20
11/13/91	7	ILNT-1	N	NW	4	Ash	19.68	24.51
11/13/91	7	ILNT-1	N	NW	5	Ash	12.74	14.60
11/13/91	7	ILNT-1	N	NW	6	Ash	24.18	31.89
11/13/91	7	ILNT-1	N	NW	7	Ash	25.93	35.01
11/13/91	7	ILNT-1	N	NW	8	Ash	26.52	36.10
11/13/91	7	ILNT-2	N	NE	1	Ash	29.54	41.92
11/13/91	7	ILNT-2	N	NE	2	Ash	29.99	42.84
11/13/91	7	ILNT-2	N	NE	3	Ash	27.45	37.83
11/13/91	7	ILNT-2	N	NE	4	Ash	25.43	34.10
11/13/91	7	ILNT-2	N	NE	5	Ash	26.94	36.88

Table 9

(Continued)

Date	Months Since Construction	Test id	Cell	Quadrant	Depth (feet)	Matrix	% Moisture (wet basis)	% Moisture (dry basis)
11/13/91	7	ILNT-2	N	NE	6	Ash	26.12	35.35
11/13/91	7	ILNT-2	N	NE	7	Ash	25.19	33.67
11/13/91	7	ILNT-2	N	NE	8	Ash	26.57	36.19
11/13/91	7	ILNT-2	N	NE	9	Ash/Soil	23.54	30.79
11/13/91	7	ILNT-3	N	SE	1	Ash	32.01	47.09
11/13/91	7	ILNT-3	N	SE	2	Ash	29.22	41.28
11/13/91	7	ILNT-3	N	SE	3	Ash	28.81	40.48
11/13/91	7	ILNT-3	N	SE	4	Ash	26.51	36.06
11/13/91	7	ILNT-3	N	SE	5	Ash	27.08	37.13
11/13/91	7	ILNT-3	N	SE	6	Ash	24.23	31.98
11/13/91	7	ILNT-3	N	SE	7	Ash	23.81	31.25
11/13/91	7	ILNT-3	N	SE	8	Ash	22.50	29.02
11/13/91	7	ILNT-3	N	SE	9	Ash/Soil	23.73	31.11
11/13/91	7	ILNT-4	N	SW	1	Ash	30.23	43.32
11/13/91	7	ILNT-4	N	SW	2	Ash	27.03	37.04
11/13/91	7	ILNT-4	N	SW	3	Ash	21.59	27.53
11/13/91	7	ILNT-4	N	SW	4	Ash	10.15	11.29
11/13/91	7	ILNT-4	N	SW	5	Ash	20.90	26.41
11/13/91	7	ILNT-4	N	SW	6	Ash	24.80	32.99
11/13/91	7	ILNT-4	N	SW	7	Ash	23.24	30.27
11/13/91	7	ILNT-4	N	SW	8	Ash	22.56	29.14
11/13/91	7	ILNT-4	N	SW	9	Ash/Soil	23.64	30.96
2/20/92	10	ILNT-1	N	NW	1	Ash	30.78	44.47
2/20/92	10	ILNT-1	N	NW	2	Ash	31.27	45.50
2/20/92	10	ILNT-1	N	NW	3	Ash	28.71	40.26
2/20/92	10	ILNT-1	N	NW	4	Ash	25.70	34.60
2/20/92	10	ILNT-1	N	NW	5	Ash	25.55	34.32
2/20/92	10	ILNT-1	N	NW	6	Ash	30.12	43.11
2/20/92	10	ILNT-1	N	NW	7	Ash	27.22	37.40
2/20/92	10	ILNT-1	N	NW	8	Ash	28.18	39.24
2/20/92	10	ILNT-2	N	NE	1	Ash	32.20	47.49
2/20/92	10	ILNT-2	N	NE	2	Ash	32.37	47.86
2/20/92	10	ILNT-2	N	NE	3	Ash	29.99	42.83
2/20/92	10	ILNT-2	N	NE	4	Ash	28.84	40.53
2/20/92	10	ILNT-2	N	NE	5	Ash	31.15	45.25
2/20/92	10	ILNT-2	N	NE	6	Ash	29.84	42.52
2/20/92	10	ILNT-2	N	NE	7	Ash	29.75	42.35
2/20/92	10	ILNT-2	N	NE	8	Ash	34.24	52.06
2/20/92	10	ILNT-2	N	NE	9	Ash/Soil	26.18	35.46
2/20/92	10	ILNT-3	N	SE	1	Ash	32.79	48.78
2/20/92	10	ILNT-3	N	SE	2	Ash	30.38	43.63
2/20/92	10	ILNT-3	N	SE	3	Ash	31.22	45.39
2/20/92	10	ILNT-3	N	SE	4	Ash	30.02	42.90
2/20/92	10	ILNT-3	N	SE	5	Ash	30.02	42.90
2/20/92	10	ILNT-3	N	SE	6	Ash	28.20	39.28
2/20/92	10	ILNT-3	N	SE	7	Ash	30.75	44.40
2/20/92	10	ILNT-3	N	SE	8	Ash	26.68	36.39
2/20/92	10	ILNT-3	N	SE	9	Ash/Soil	24.15	31.84
2/20/92	10	ILNT-4	N	SW	1	Ash	31.12	45.18

Table 9
(Continued)

Date	Months Since Construction	Test id	Cell	Quadrant	Depth (feet)	Matrix	% Moisture (wet basis)	% Moisture (dry basis)
2/20/92	10	ILNT-4	N	SW	2	Ash	27.12	37.21
2/20/92	10	ILNT-4	N	SW	3	Ash	24.52	32.49
2/20/92	10	ILNT-4	N	SW	4	Ash	18.01	21.97
2/20/92	10	ILNT-4	N	SW	5	Ash	21.33	27.12
2/20/92	10	ILNT-4	N	SW	6	Ash	25.28	33.84
2/20/92	10	ILNT-4	N	SW	7	Ash	23.12	30.08
2/20/92	10	ILNT-4	N	SW	8	Ash	21.96	28.14
2/20/92	10	ILNT-4	N	SW	9	Ash/Soil	23.49	30.71

Table 10**Illinois Thermistor Data
(Daily Average)**

Date	T1-12"	T2-36"	T3-54"	T4-72"	T5-90"	T6-12"	T7-24"	T8-42"	T9-60"	T10-78"
6/03/91	26.43	24.08	19.98	18.10	16.10	28.38	26.36	24.10	21.60	18.40
6/04/91	26.64	24.30	20.05	18.20	16.16	27.73	26.48	24.16	21.68	18.53
6/05/91	26.16	24.60	20.23	18.24	16.20	26.70	26.39	24.31	21.70	18.58
6/06/91	26.18	24.86	20.49	18.39	16.28	26.58	26.50	24.41	21.71	18.66
6/07/91	26.35	24.90	20.66	18.51	16.30	26.86	26.70	24.53	21.80	18.75
6/08/91	26.13	24.81	20.79	18.60	16.39	26.78	26.70	24.64	21.86	18.88
6/09/91	26.30	24.88	20.90	18.68	16.40	27.04	26.85	24.70	21.90	18.92
6/10/91	26.56	24.95	20.99	18.76	16.44	27.59	27.04	24.76	21.90	18.95
6/11/91	26.73	25.06	21.06	18.84	16.46	27.70	27.16	24.80	22.00	19.05
6/12/91	26.89	25.19	21.11	18.91	16.51	28.04	27.33	24.89	22.00	19.09
6/13/91	27.51	25.33	21.25	19.00	16.58	29.23	27.72	24.96	22.00	19.15
6/14/91	28.05	25.60	21.36	19.09	16.60	29.91	28.05	25.03	22.10	19.25
6/15/91	28.51	25.88	21.48	19.16	16.66	30.16	28.42	25.16	22.10	19.30
6/16/91	27.91	26.16	21.60	19.25	16.70	28.56	28.28	25.33	22.14	19.36
6/17/91	27.35	26.20	21.71	19.31	16.74	28.04	28.15	25.48	22.20	19.45
6/18/91	27.44	26.11	21.85	19.41	16.78	28.46	28.32	25.60	22.21	19.49
6/19/91	27.86	26.11	21.95	19.50	16.84	29.38	28.63	25.70	22.30	19.61
6/20/91	28.29	26.24	22.04	19.59	16.90	29.86	28.91	25.76	22.31	19.68
6/21/91	28.85	26.43	22.14	19.68	16.95	30.95	29.26	25.84	22.40	19.79
6/22/91	28.91	26.69	22.24	19.75	17.00	29.94	29.41	25.95	22.43	19.85
6/23/91	27.44	26.79	22.34	19.83	17.08	27.56	28.79	26.08	22.50	19.98
6/24/91	27.19	26.59	22.43	19.90	17.10	28.24	28.79	26.20	22.51	20.01
6/25/91	27.54	26.41	22.50	20.00	17.18	29.03	28.97	26.20	22.60	20.15
6/26/91	28.05	26.41	22.59	20.08	17.20	29.79	29.23	26.20	22.60	20.17
6/27/91	28.46	26.54	22.63	20.14	17.25	30.33	29.49	26.26	22.68	20.27
6/28/91	28.81	26.70	22.69	20.20	17.30	30.60	29.71	26.30	22.70	20.33
6/29/91	29.06	26.90	22.74	20.29	17.38	30.99	29.89	26.36	22.70	20.40
6/30/91	29.64	27.09	22.84	20.33	17.38	32.01	30.27	26.45	22.79	20.47
7/01/91	30.23	27.36	22.93	20.40	17.44	32.50	30.68	26.56	22.80	20.53
7/02/91	29.90	27.66	23.03	20.48	17.50	30.98	30.65	26.70	22.83	20.60
7/03/91	28.78	27.76	23.15	20.54	17.55	29.25	30.25	26.86	22.90	20.71
7/04/91	28.08	27.58	23.25	20.60	17.60	28.69	30.03	26.99	22.93	20.77
7/05/91	27.93	27.33	23.31	20.69	17.63	29.16	29.96	27.00	23.00	20.85
7/06/91	28.45	27.20	23.40	20.75	17.70	30.25	30.23	27.00	23.01	20.93
7/07/91	28.96	27.20	23.40	20.80	17.73	30.99	30.48	27.00	23.10	21.02
7/08/91	29.46	27.34	23.44	20.89	17.80	31.59	30.73	27.00	23.10	21.08
7/09/91	29.45	27.53	23.50	20.93	17.83	30.50	30.76	27.04	23.11	21.11
7/10/91	28.09	27.58	23.59	21.00	17.90	28.41	30.14	27.10	23.20	21.25
7/11/91	27.46	27.36	23.61	21.05	17.94	27.95	29.93	27.20	23.20	21.28
7/12/91	27.01	27.09	23.65	21.10	17.99	27.70	29.67	27.16	23.20	21.32
7/13/91	26.88	26.65	23.68	21.16	18.01	27.54	29.53	27.09	23.30	21.43
7/14/91	26.50	26.65	23.68	21.20	18.09	26.86	29.23	26.98	23.30	21.49
7/15/91	26.23	26.43	23.64	21.25	18.10	26.84	28.98	26.86	23.30	21.50
7/16/91	26.45	26.24	23.60	21.30	18.15	27.51	28.96	26.74	23.30	21.54
7/17/91	26.83	26.20	23.60	21.30	18.19	28.19	29.03	26.61	23.30	21.57

Table 10

(Continued)

Date	T1-12"	T2-36"	T3-54"	T4-72"	T5-90"	T6-12"	T7-24"	T8-42"	T9-60"	T10-78"
7/18/91	27.33	26.20	23.58	21.30	18.24	29.08	29.16	26.50	23.25	21.57
7/19/91	27.79	26.34	23.56	21.38	18.29	29.73	29.39	26.50	23.23	21.59
7/20/91	28.23	26.50	23.60	21.40	18.30	30.33	29.61	26.50	23.20	21.58
7/21/91	28.65	26.71	23.60	21.40	18.35	30.86	29.84	26.51	23.20	21.63
7/22/91	29.16	26.95	23.65	21.40	18.40	31.63	30.21	26.63	23.20	21.67
7/23/91	29.50	27.21	23.71	21.40	18.40	31.50	30.50	26.75	23.20	21.67
7/24/91	29.00	27.45	23.78	21.50	18.43	29.93	30.41	26.91	23.25	21.73
7/25/91	27.99	27.46	23.89	21.50	18.49	28.63	30.07	27.08	23.30	21.82
7/26/91	27.60	27.29	23.99	21.53	18.51	28.44	30.00	27.20	23.30	21.84
7/27/91	27.38	27.11	24.00	21.60	18.55	28.41	29.95	27.26	23.33	21.90
7/28/91	27.46	26.96	24.03	21.60	18.58	28.95	30.01	27.28	23.40	21.98
7/29/91	27.76	26.90	24.08	21.68	18.60	29.10	30.08	27.20	23.40	22.00
7/30/91	27.20	26.89	24.10	21.70	18.65	27.98	29.80	27.20	23.40	22.04
7/31/91	27.08	26.78	24.10	21.70	18.69	28.18	29.74	27.20	23.41	22.08
8/01/91	27.11	26.68	24.10	21.79	18.70	28.73	29.76	27.20	23.50	22.17
8/02/91	27.79	26.63	24.10	21.80	18.74	29.90	30.01	27.11	23.50	22.20
8/03/91	28.33	26.75	24.08	21.80	18.79	30.46	30.29	27.10	23.50	22.24
8/04/91	28.16	26.91	24.10	21.80	18.81	29.56	30.18	27.10	23.50	22.26
8/05/91	27.74	27.00	24.10	21.89	18.83	28.45	30.07	27.20	23.50	22.27
8/06/91	26.29	26.90	24.18	21.90	18.89	26.00	29.35	27.20	23.50	22.32
8/07/91	25.19	26.55	24.19	21.90	18.90	25.35	28.59	27.20	23.50	22.33
8/08/91	25.10	26.15	24.15	21.90	18.91	25.99	28.38	27.14	23.50	22.34
8/09/91	25.06	25.88	24.10	21.94	19.00	25.66	27.99	26.96	23.50	22.42
8/10/91	24.44	25.68	24.01	22.00	19.00	24.80	27.01	26.79	23.50	22.42
8/11/91	24.11	25.43	23.96	22.00	19.03	24.68	26.34	26.61	23.50	22.44
8/12/91	24.14	25.21	23.89	22.00	19.03	24.94	26.01	26.44	23.48	22.42
8/13/91	24.33	25.09	23.81	22.00	19.04	25.43	25.83	26.25	23.40	22.36
8/14/91	24.58	25.00	23.71	21.99	19.09	25.89	25.78	26.10	23.40	22.41
8/15/91	24.90	25.00	23.70	21.90	19.10	26.00	25.90	26.00	23.38	22.41
8/16/91	25.00	25.08	23.63	21.90	19.40	26.68	26.20	25.88	23.30	22.40
8/17/91	25.25	25.13	23.60	21.90	19.40	26.83	26.35	25.80	23.30	22.40
8/18/91	25.08	25.20	23.60	21.90	19.40	26.15	26.45	25.80	23.24	22.40
8/19/91	24.95	25.20	23.60	21.90	19.43	26.00	26.45	25.80	23.20	22.40
8/20/91	24.61	25.19	23.60	21.88	19.46	25.30	26.39	25.80	23.20	22.33
8/21/91	24.44	25.10	23.60	21.80	19.50	25.45	26.25	25.80	23.20	22.30
8/22/91	24.53	25.00	23.56	21.80	19.50	25.95	26.13	25.80	23.20	22.30
8/23/91	24.85	25.00	23.53	21.80	19.50	26.61	26.16	25.75	23.14	22.30
8/24/91	25.29	25.04	23.51	21.80	19.50	27.35	26.30	25.70	23.10	22.30
8/25/91	25.76	25.16	23.50	21.80	19.50	28.18	26.54	25.70	23.10	22.30
8/26/91	26.25	25.35	23.50	21.80	19.53	28.66	26.85	25.76	23.10	22.30
8/27/91	26.50	25.56	23.50	21.80	19.53	28.96	27.20	25.84	23.10	22.30
8/28/91	26.84	25.76	23.59	21.80	19.55	29.41	27.50	25.95	23.10	22.30
8/29/91	27.00	25.98	23.60	21.80	19.55	29.10	27.80	26.06	23.10	22.28
8/30/91	26.26	26.10	23.70	21.80	19.58	27.80	28.00	26.21	23.10	22.26
8/31/91	26.05	26.10	23.75	21.80	19.60	27.88	27.93	26.33	23.10	22.30
9/01/91	25.66	26.08	23.80	21.83	19.60	26.69	27.84	26.44	23.20	22.30

Table 10

(Continued)

Date	T1-12"	T2-36"	T3-54"	T4-72"	T5-90"	T6-12"	T7-24"	T8-42"	T9-60"	T10-78"
9/02/91	24.86	25.95	23.84	21.90	19.60	25.88	27.60	26.50	23.20	22.30
9/03/91	24.70	25.75	23.90	21.90	19.60	25.98	27.29	26.50	23.20	22.30
9/04/91	24.18	25.59	23.86	21.90	19.60	24.88	27.04	26.50	23.24	22.30
9/05/91	23.50	25.38	23.83	21.90	19.68	24.01	26.68	26.40	23.30	22.30
9/06/91	23.14	25.11	23.80	21.94	19.70	23.98	26.25	26.30	23.30	22.30
9/07/91	23.15	24.88	23.75	21.99	19.70	24.21	25.91	26.16	23.30	22.30
9/08/91	23.13	24.71	23.70	22.00	19.70	23.96	25.73	26.01	23.24	22.30
9/09/91	22.83	24.56	23.64	22.00	19.74	23.90	25.51	25.86	23.20	22.30
9/10/91	23.18	24.43	23.55	21.99	19.80	24.58	25.35	25.74	23.20	22.30
9/11/91	23.21	24.40	23.49	21.90	19.79	24.35	25.30	25.59	23.20	22.30
9/12/91	23.20	24.35	23.41	21.90	19.80	24.65	25.30	25.50	23.10	22.30
9/13/91	23.49	24.30	23.35	21.90	19.80	25.18	25.30	25.40	23.10	22.30
9/14/91	23.76	24.38	23.33	21.90	19.80	25.41	25.40	25.38	23.06	22.30
9/15/91	23.96	24.44	23.30	21.90	19.80	25.45	25.54	25.30	23.00	22.23
9/16/91	23.98	24.50	23.28	21.88	19.81	24.96	25.64	25.35	23.00	22.20
9/17/91	23.28	24.50	23.28	21.80	19.81	23.30	25.65	25.40	23.00	22.20
9/18/91	22.38	24.40	23.30	21.80	19.80	21.99	25.38	25.40	23.00	22.20
9/19/91	20.96	24.11	23.23	21.80	19.80	19.14	24.94	25.40	22.95	22.20
9/20/91	19.44	23.64	23.20	21.80	19.84	17.26	24.18	25.30	22.90	22.14
9/21/91	18.55	23.05	23.11	21.80	19.86	16.74	23.28	25.11	22.90	22.10
9/22/91	18.29	22.48	22.99	21.80	19.88	17.11	22.53	24.84	22.89	22.10
9/23/91	17.96	22.05	22.80	21.74	19.88	16.59	21.98	24.49	22.80	22.10
9/24/91	17.75	21.65	22.63	21.70	19.90	16.69	21.48	24.14	22.75	22.06
9/25/91	17.71	21.33	22.43	21.68	19.89	16.74	21.09	23.80	22.66	22.00
9/26/91	17.58	21.08	22.25	21.60	19.89	16.31	20.79	23.49	22.58	21.98
9/27/91	17.25	20.85	22.05	21.54	19.90	15.49	20.48	23.20	22.46	21.90
9/28/91	16.80	20.59	21.89	21.48	19.90	15.46	20.10	22.91	22.36	21.86
9/29/91	17.20	20.33	21.73	21.40	19.90	16.78	19.79	22.65	22.26	21.80
9/30/91	17.84	20.20	21.54	21.30	19.90	17.74	19.70	22.39	22.15	21.70
10/01/91	18.29	20.20	21.39	21.21	19.83	18.34	19.76	22.18	22.05	21.63
10/02/91	18.71	20.25	21.25	21.14	19.80	18.91	19.91	22.03	21.95	21.56
10/03/91	18.99	20.34	21.14	21.06	19.80	18.94	20.10	21.91	21.85	21.50
10/04/91	18.70	20.40	21.03	20.99	19.80	18.14	20.20	21.90	21.76	21.40
10/05/91	17.80	20.30	20.99	20.90	19.73	16.41	20.11	21.90	21.70	21.34
10/06/91	16.68	20.08	20.90	20.83	19.70	14.16	19.78	21.81	21.60	21.29
10/07/91	15.61	19.70	20.80	20.78	19.70	12.88	19.21	21.74	21.54	21.20
10/08/91	15.15	19.26	20.68	20.70	19.69	12.98	18.61	21.56	21.49	21.18
10/09/91	15.34	18.90	20.53	20.61	19.63	14.18	18.19	21.31	21.40	21.10
10/10/91	15.90	18.68	20.35	20.55	19.60	14.88	18.01	21.05	21.33	21.03
10/11/91	15.84	18.60	20.16	20.48	19.60	14.50	18.00	20.83	21.23	20.98
10/12/91	15.66	18.50	20.04	20.39	19.50	13.80	17.96	20.66	21.14	20.90
10/13/91	15.21	18.36	19.90	20.30	19.50	12.86	17.80	20.54	21.04	20.83
10/14/91	14.86	18.19	19.76	20.21	19.49	12.85	17.55	20.43	20.96	20.78
10/15/91	14.48	17.98	19.65	20.13	19.43	11.86	17.31	20.28	20.88	20.70
10/16/91	13.81	17.75	19.54	20.04	19.40	10.85	17.00	20.14	20.80	20.63
10/17/91	13.55	17.45	19.38	19.96	19.39	11.29	16.63	19.96	20.70	20.58

Table 10
(Continued)

Date	T1-12"	T2-36"	T3-54"	T4-72"	T5-90"	T6-12"	T7-24"	T8-42"	T9-60"	T10-78"
10/18/91	13.88	17.20	19.21	19.88	19.31	12.11	16.34	19.76	20.61	20.50
10/19/91	13.76	17.04	19.06	19.79	19.30	11.26	16.24	19.56	20.54	20.41
10/20/91	13.25	16.88	18.93	19.70	19.21	10.40	16.08	19.40	20.45	20.38
10/21/91	12.79	16.66	18.78	19.60	19.20	10.05	15.79	19.25	20.35	20.30
10/22/91	12.96	16.43	18.64	19.51	19.18	11.36	15.50	19.09	20.26	20.23
10/23/91	13.80	16.30	18.48	19.41	19.10	13.10	15.41	18.91	20.18	20.16
10/24/91	14.74	16.30	18.34	19.33	19.09	14.58	15.59	18.75	20.09	20.09
10/25/91	15.56	16.41	18.21	19.23	19.00	15.36	15.90	18.70	20.00	20.00
10/26/91	15.74	16.63	18.14	19.14	18.95	14.99	16.28	18.70	19.90	19.93
10/27/91	15.73	16.76	18.04	19.05	18.90	14.61	16.53	18.73	19.83	19.88
10/28/91	15.45	16.86	18.00	18.98	18.84	14.20	16.60	18.83	19.80	19.80
10/29/91	15.63	16.90	18.00	18.90	18.80	14.99	16.64	18.90	19.70	19.73
10/30/91	15.49	16.90	17.93	18.80	18.71	13.24	16.76	18.98	19.70	19.70
10/31/91	13.94	16.83	17.90	18.76	18.70	10.63	16.63	19.01	19.65	19.61
11/01/91	13.25	16.53	17.90	18.70	18.61	10.88	16.15	19.04	19.60	19.60
11/02/91	12.55	16.19	17.85	18.63	18.59	8.83	15.75	18.95	19.60	19.58
11/03/91	11.15	15.84	17.73	18.60	18.50	6.65	15.23	18.80	19.54	19.50
11/04/91	9.89	15.36	17.60	18.51	18.50	5.11	14.55	18.60	19.50	19.50
11/05/91	8.93	14.80	17.45	18.48	18.41	4.09	13.83	18.31	19.41	19.48
11/06/91	8.21	14.26	17.26	18.40	18.40	3.53	13.10	17.96	19.34	19.40
11/07/91	7.74	13.74	17.06	18.31	18.31	3.30	12.43	17.60	19.25	19.36
11/08/91	7.41	13.25	16.81	18.23	18.30	3.16	11.86	17.20	19.14	19.30
11/09/91	7.18	12.84	16.59	18.13	18.25	2.98	11.39	16.80	19.03	19.23
11/10/91	6.94	12.46	16.31	18.03	18.20	2.78	10.98	16.40	18.86	19.16
11/11/91	6.75	12.15	16.11	17.91	18.16	2.63	10.60	16.03	18.74	19.08
11/12/91	6.55	11.85	15.85	17.79	18.10	2.50	10.25	15.68	18.56	18.98
11/13/91	6.42	11.58	15.63	17.68	18.03	2.43	9.95	15.40	18.45	18.90
9/25/09	6.99	11.30	15.39	17.54	18.00	4.29	9.63	15.04	18.26	18.78
11/15/91	7.70	11.20	15.23	17.43	18.00	5.95	9.50	14.83	18.15	18.70
11/16/91	9.00	11.30	15.00	17.30	17.90	6.60	9.80	14.60	18.00	18.50
11/17/91	9.43	11.45	14.75	17.10	17.80	7.28	10.18	14.30	17.80	18.40
11/18/91	9.70	11.52	14.67	17.00	17.77	8.56	10.31	14.21	17.69	18.30
11/19/91	10.71	11.65	14.51	16.85	17.69	10.08	10.56	14.20	17.56	18.18
11/20/91	11.35	11.89	14.45	16.73	17.60	10.03	11.00	14.21	17.45	18.08
11/21/91	10.91	12.14	14.39	16.59	17.50	8.20	11.34	14.33	17.35	17.99
11/22/91	10.14	12.20	14.36	16.48	17.40	7.09	11.39	14.45	17.26	17.90
11/23/91	9.75	12.15	14.30	16.36	17.34	6.86	11.25	14.58	17.20	17.80
11/24/91	9.10	12.04	14.30	16.28	17.29	5.25	11.13	14.65	17.14	17.74
11/25/91	8.25	11.84	14.26	16.20	17.20	4.01	10.86	14.70	17.10	17.70
11/26/91	7.50	11.59	14.16	16.10	17.10	3.05	10.50	14.70	17.03	17.61
11/27/91	6.95	11.30	14.10	16.04	17.09	2.53	10.15	14.64	17.00	17.59
11/28/91	6.64	10.98	14.00	15.98	17.00	2.71	9.75	14.54	16.93	17.50
11/29/91	7.33	10.69	13.86	15.90	16.96	5.31	9.41	14.38	16.88	17.46
11/30/91	8.61	10.60	13.74	15.80	16.89	7.15	9.44	14.21	16.80	17.40
12/01/91	8.55	10.66	13.63	15.73	16.80	5.23	9.70	14.08	16.71	17.31
12/02/91	7.65	10.70	13.50	15.64	16.74	3.76	9.75	14.00	16.63	17.30

Table 10

(Continued)

Date	T1-12"	T2-36"	T3-54"	T4-72"	T5-90"	T6-12"	T7-24"	T8-42"	T9-60"	T10-78"
12/03/91	6.94	10.54	13.39	15.55	16.69	3.01	9.53	13.96	16.55	17.20
12/04/91	6.50	10.31	13.30	15.48	16.60	2.65	9.24	13.90	16.48	17.18
12/05/91	6.16	10.09	13.20	15.39	16.60	2.15	8.98	13.80	16.40	17.10
12/06/91	5.85	9.88	13.06	15.30	16.50	1.78	8.71	13.68	16.30	17.03
12/07/91	5.55	9.64	12.95	15.20	16.49	1.54	8.49	13.55	16.21	16.98
12/08/91	5.79	9.40	12.81	15.11	16.40	2.16	8.21	13.39	16.14	16.90
12/09/91	6.76	9.26	12.68	15.03	16.33	3.81	8.01	13.23	16.04	16.81
12/10/91	6.86	9.30	12.54	14.94	16.28	3.56	8.09	13.05	15.93	16.75
12/11/91	6.74	9.30	12.45	14.85	16.20	3.71	8.10	12.90	15.83	16.69
12/12/91	7.04	9.30	12.34	14.76	16.14	4.98	8.15	12.80	15.73	16.60
12/13/91	7.64	9.30	12.23	14.68	16.09	5.73	8.26	12.71	15.61	16.50
12/14/91	7.61	9.40	12.15	14.59	16.00	4.86	8.46	12.70	15.51	16.43
12/15/91	7.09	9.50	12.10	14.50	15.90	3.60	8.58	12.70	15.41	16.36
12/16/91	6.49	9.41	12.00	14.41	15.89	2.76	8.46	12.70	15.33	16.30
12/17/91	6.00	9.29	12.00	14.34	15.80	2.23	8.30	12.70	15.25	16.21
12/18/91	5.66	9.14	11.96	14.29	15.71	1.90	8.08	12.68	15.20	16.15
12/19/91	5.38	8.96	11.89	14.20	15.70	1.50	7.88	12.60	15.10	16.10
12/20/91	5.09	8.79	11.80	14.15	15.65	1.18	7.70	12.58	15.06	16.01
12/21/91	4.75	8.60	11.71	14.10	15.60	1.05	7.50	12.50	15.00	15.98
12/22/91	4.54	8.39	11.64	14.00	15.51	1.00	7.33	12.41	14.90	15.90
12/23/91	4.38	8.18	11.51	13.95	15.50	.86	7.15	12.33	14.83	15.83
12/24/91	4.49	7.98	11.43	13.89	15.40	.90	6.95	12.20	14.74	15.78
12/25/91	4.50	7.88	11.29	13.80	15.39	.95	6.83	12.06	14.65	15.70
12/26/91	4.41	7.79	11.16	13.70	15.30	1.00	6.73	11.95	14.55	15.61
12/27/91	4.40	7.70	11.05	13.63	15.24	1.05	6.65	11.84	14.45	15.55
12/28/91	4.38	7.60	10.96	13.56	15.20	1.10	6.59	11.71	14.35	15.49
12/29/91	4.54	7.50	10.84	13.48	15.14	1.16	6.50	11.61	14.25	15.40
12/30/91	4.76	7.50	10.75	13.40	15.10	1.48	6.46	11.51	14.15	15.31
12/31/91	4.85	7.50	10.68	13.30	15.01	1.73	6.40	11.43	14.04	15.24
1/01/92	4.83	7.50	10.60	13.23	14.98	1.83	6.48	11.34	13.94	15.16
1/02/92	4.88	7.45	10.51	13.15	14.90	2.30	6.50	11.30	13.84	15.09
1/03/92	5.20	7.40	10.46	13.09	14.84	3.08	6.53	11.20	13.74	15.00
1/04/92	5.48	7.49	10.40	13.00	14.80	3.33	6.65	11.20	13.65	14.91
1/05/92	5.50	7.51	10.36	12.93	14.73	3.15	6.76	11.13	13.58	14.84
1/06/92	5.50	7.60	10.30	12.88	14.68	3.18	6.86	11.10	13.50	14.76
1/07/92	5.63	7.60	10.30	12.80	14.60	3.66	6.91	11.10	13.40	14.70
1/08/92	5.88	7.60	10.26	12.74	14.60	4.04	7.01	11.18	13.35	14.60
1/09/92	6.05	7.68	10.20	12.70	14.50	4.09	7.14	11.20	13.30	14.54
1/10/92	5.91	7.70	10.20	12.61	14.49	3.36	7.24	11.20	13.24	14.50
1/11/92	5.59	7.70	10.20	12.60	14.40	2.74	7.30	11.20	13.20	14.41
1/12/92	5.40	7.70	10.10	12.50	14.38	2.54	7.20	11.29	13.15	14.40
1/13/92	5.41	7.64	10.10	12.50	14.30	2.96	7.11	11.30	13.10	14.30
1/14/92	5.46	7.60	10.10	12.41	14.29	2.88	7.10	11.30	13.10	14.30
1/15/92	5.30	7.59	10.08	12.40	14.20	2.36	7.10	11.30	13.00	14.20
1/16/92	5.05	7.50	10.00	12.34	14.20	1.60	7.05	11.30	13.00	14.20
1/17/92	4.78	7.45	10.00	12.30	14.13	1.09	6.95	11.20	12.96	14.15

Table 10
(Continued)

Date	T1-12"	T2-36"	T3-54"	T4-72"	T5-90"	T6-12"	T7-24"	T8-42"	T9-60"	T10-78"
1/18/92	4.56	7.36	9.96	12.29	14.10	.75	6.79	11.20	12.90	14.10
1/19/92	4.35	7.26	9.90	12.20	14.00	.33	6.64	11.19	12.89	14.10
1/20/92	4.15	7.15	9.88	12.20	14.00	.13	6.45	11.10	12.80	14.00
1/21/92	4.00	7.04	9.80	12.13	14.00	.10	6.30	11.04	12.79	14.00
1/22/92	3.89	6.94	9.79	12.10	13.95	.01	6.15	10.96	12.70	13.93
1/23/92	3.80	6.83	9.70	12.06	13.90	.08	6.03	10.89	12.68	13.90
1/24/92	3.80	6.70	9.60	12.00	13.90	.10	5.91	10.80	12.60	13.84
1/25/92	3.70	6.61	9.54	11.98	13.88	.10	5.80	10.73	12.51	13.80
1/26/92	3.70	6.54	9.49	11.90	13.80	.10	5.71	10.64	12.48	13.74
1/27/92	3.60	6.49	9.40	11.86	13.80	.10	5.65	10.56	12.40	13.70
1/28/92	3.60	6.40	9.35	11.80	13.71	.10	5.60	10.50	12.33	13.64
1/29/92	3.55	6.31	9.30	11.76	13.70	.15	5.50	10.40	12.26	13.60
1/30/92	3.50	6.28	9.23	11.70	13.65	.20	5.50	10.35	12.20	13.51
2/01/92	3.59	6.20	9.16	11.65	13.60	.20	5.40	10.30	12.11	13.50
2/02/92	3.74	6.20	9.10	11.60	13.60	.21	5.40	10.25	12.06	13.40
2/03/92	3.80	6.20	9.05	11.54	13.51	.30	5.31	10.20	12.00	13.39
2/04/92	3.96	6.19	9.00	11.50	13.50	.34	5.30	10.14	11.93	13.30
2/05/92	4.48	6.20	8.94	11.41	13.41	.43	5.30	10.10	11.86	13.29
2/06/92	4.79	6.24	8.90	11.40	13.40	.58	5.23	10.05	11.80	13.20
2/07/92	4.80	6.34	8.89	11.30	13.31	.90	5.21	10.00	11.71	13.19
2/08/92	4.64	6.40	8.84	11.30	13.30	.95	5.30	10.00	11.69	13.10
2/09/92	4.48	6.40	8.80	11.23	13.30	1.00	5.30	10.00	11.60	13.10
2/10/92	4.25	6.40	8.80	11.20	13.23	.85	5.30	10.00	11.55	13.01
2/11/92	4.03	6.38	8.80	11.18	13.20	.74	5.30	9.90	11.50	13.00
2/12/92	3.83	6.30	8.80	11.10	13.20	.70	5.30	9.99	11.44	12.90
2/13/92	3.70	6.21	8.75	11.10	13.10	.70	5.30	10.00	11.40	12.90
2/14/92	3.63	6.15	8.70	11.04	13.10	.70	5.26	10.00	11.35	12.80
2/15/92	3.59	6.09	8.70	11.00	13.09	.70	5.20	9.98	11.30	12.75
2/16/92	3.44	6.00	8.61	11.00	13.00	.70	5.20	9.90	11.29	12.70
2/17/92	3.41	5.89	8.59	10.93	13.00	.80	5.18	9.90	11.20	12.60
2/18/92	3.83	5.80	8.50	10.90	13.00	1.51	5.10	9.90	11.20	12.55
2/19/92	4.30	5.80	8.46	10.86	12.99	2.75	5.15	9.83	11.16	12.50
2/20/92	4.89	5.90	8.40	10.80	12.90	3.41	5.30	9.80	11.10	12.41
2/21/92	4.95	6.03	8.40	10.79	12.90	3.18	5.53	9.80	11.09	12.36
2/22/92	5.07	6.10	8.37	10.70	12.90	3.52	5.65	9.80	11.00	12.30

Table 11**Mix Design Proportions and Characteristics**

Mix Design	Dry (FBC) Weight, g	Dry (FA) Weight, g	Target Weight, g	Hydrated Weight, g	Additional Water, mL	Handling Consistency
Optimum	211.2	211.2	540.7	473.4	67.3	Compactible
Optimum +3%	250	250	655	559.6	95.4	Compactible
Optimum +6%	250	250	670	562.1	107.9	Plastic
Optimum +9%	250	250	685	560.4	124.6	Plastic
Optimum +12%	250	250	700	572	128	Flowable

Table 12**Length Measurements**

Mix Design	Expansion 3-day, %	Expansion 7-day, %	Expansion 14-day, %	Expansion 28-day, %
Optimum	0.222	0.336	0.583	0.955
Optimum +3%	0.242	0.349	0.585	0.967
Optimum +6%	0.139	0.197	0.373	0.774
Optimum +9%	0.243	0.323	0.584	0.932
Optimum +12%	0.169	0.238	0.483	1.259

END

**DATE
FILMED**

4 / 13 / 93