34-05

Carmen Johnson
34-05 3/20/12

COMPLIANCE DETERMINATION
R. J. REYNOLDS INDUSTRIAL LANDFILL
PERMIT NUMBER 34-05, FORSYTH COUNTY
RURAL HALL, NORTH CAROLINA

Prepared for:

R. J. Reynolds Tobacco Company
Winston-Salem, North Carolina

September 1997

A Common Sense Approach To A Cleaner Environment

GCI GEO-ENVIRONMENTAL CONSULTANTS, INC.

GEO-ENVIRONMENTAL
CONSULTANTS, INC.

Carmen Johnson
34-05 3/20/12

October 1, 1997

Mr. James Coffey
Solid Waste Section
State of North Carolina Department of Environment, Health and Natural Resources
Post Office Box 27687
Raleigh, North Carolina 27611-7687

Re: Ash Monofill Compliance Determination
R. J. Reynolds Industrial Landfill, Permit Number 34-05
Forsyth County, North Carolina
GCI Project No. 96042

Dear Mr. Coffey:

On the behalf of R. J. Reynolds, Geo-Environmental Consultants, Inc. (GCI) is pleased to present the attached Compliance Determination for the R. J. Reynolds Industrial Landfill, Permit Number 34-05. This submittal is in response to your request dated June 13, 1997. GCI is requesting that this submittal also serve as the official request for Permit Renewal.

If you have any questions concerning this submittal, please contact me at (704) 596-8788.

Sincerely,

GEO-ENVIRONMENTAL CONSULTANTS, INC.

Keith A. Anthony, PE
Senior Principal

Attachment

cc: George Lamb

OCT 1997
Received
Solid Waste
Section

Compliance Determination

R. J. REYNOLDS INDUSTRIAL LANDFILL

Permit Number 34-05, Forsyth County

RURAL HALL, NORTH CAROLINA

Prepared for:

R. J. Reynolds Tobacco Company
Winston-Salem, North Carolina

Prepared by:

GEO-ENVIRONMENTAL CONSULTANTS, INC.
11704 Reames Road
Charlotte, North Carolina 28269

GCI Project No. 96042

September 1997

NORTH CAROLINA PROFESSIONAL SEAL 11260 ENGINEER KEITH A. ANTHONY

9/30/97

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In August of 1996, GCI submitted a Preliminary Evaluation of the Flyash Landfill. This Preliminary Evaluation was requested by NCDEHNR in their letter of January 18, 1996. This submittal addressed issues pertaining to waste stream characterization, site characteristics, groundwater monitoring results, and a plan to address compliance with groundwater standards.

In their letter dated February 26, 1997, NCDEHNR notified owners of Flyash Landfills that the state was developing a modelling approach that would be used to evaluate all coal ash landfills and until that model was developed subsequent requested information was put on hold.

1.1.3 Utilization and Operation

The R. J. Reynolds Ash Management Area (RJRAMA) receives nonhazardous, inert industrial flyash (coal combustion ash) from the R. J. Reynolds facilities. Based on an approximate unit weight of ash at 50 lbs/ft^3 the facility receives approximately 5,300 cubic yards of ash monthly.

The facility is operated by a private excavation company under contract to R. J. Reynolds. Ash is deposited at the disposal area using dump trucks and spread using a bulldozer and front end loader. Due to the relatively incompressible nature of flyash in comparison to other solid wastes, specialized compaction equipment is not necessary. The flyash is compacted using several passes with the dozer and then graded to provide adequate drainage of stormwater runoff.

1.2 Regulatory Framework

1.2.1 State Regulations

A letter dated June 13, 1997, from the NCDEHNR (Appendix I) requests a submittal for a Compliance Determination of R. J. Reynolds Industrial Landfill, Permit Number 34-05, Forsyth County. The letter states that the submittal should include a final cap system designed to ensure compliance with the groundwater standards as demonstrated by modelling methods. This report addresses the four issues that the NCDEHNR is requesting information about in order to assess the Compliance Determination of the existing facility.

The four issues to be addressed are as follows:

1. *A construction and operational plan which limits development of the landfill to the lateral expansion of the waste "footprint" established as of January 1, 1998. The plan shall be developed in one-year phases and operated in such a manner that the landfill may be closed at any time.*

   The survey performed by Kale Engineering in July, 1996 showing the waste footprint and topography was utilized along with existing maps and/or surveys to develop this information. Waste volume calculations were performed in order to estimate the yearly footprints.

2. *The capacity of the landfill design plan shall not exceed five (5) years.*

2.0 SITE GEOLOGY AND HYDROGEOLOGY

2.1 Subsurface Exploration Activities

Subsurface exploration activities for this site were performed as part of Law Engineering's 1987 Permit Application for Phase 2. Included in that activity were seven soil test borings along with representative samples obtained for laboratory testing including grain size analysis, compaction tests, saturated hydraulic conductivity and Atterberg limits. Law Engineering's study indicated that remolded soil samples performed on the material located within ten (10) feet of the surface resulted in a permeability of approximately 5×10^{-7} cm/sec. Detailed results of this subsurface exploration can be found in the Phase 2 Permit Application.

As part of the subsurface investigation performed in GCI's 1993 Phase 3 Permit Application, representative samples were obtained for laboratory testing including three (3) undisturbed samples used for hydraulic conductivity testing indicating permeabilities from 3.6×10^{-4} cm/sec to 3.1×10^{-6} cm/sec for the residual soil profile. For computation purposes and to provide a conservative estimate of contaminant transport, GCI assumed a hydraulic conductivity of the mica schist bedrock of 1.5×10^{-5} cm/sec.

2.2 Geologic Description

The project site is located in the Piedmont Physiographic Province, an area underlain by metamorphic and ancient igneous rock. The bedrock directly beneath the project site generally consists of a grey mica schist with intermittent layers of biotite-muscovite gneiss. The residual soil profile in the area is generally characterized by clayey silt near the surface transitioning into sandy silts and silty sands at greater depths. The interface between the residual soils and bedrock interface is not sharply defined, with a transition zone of saprolite and/or weathered rock varying in thickness from 6 inches to 20 feet.

3.0 WASTE STREAM CHARACTERIZATION

3.1 Physical and Chemical Characteristics

Bituminous coal combustion ash is typically made up of Silica Oxide (SiO_2), Ferric Oxide (Fe_2O_3), and Alumina Oxide (AlO_3). The ash may also contain trace amounts of other oxides, alkalies, and volatile organic compounds. Flyash has been used for many years as a roadway base and sub-base fill material and has a soil classification similar to that of a silt or fine silty sand.

3.1.1 Mechanical Properties

The coal ash at the R. J. Reynolds Ash Management Area was tested extensively by KBK Enterprises in 1989 to develop an indication of its physical and mechanical properties. A complete copy of KBK Enterprises' report is included in Appendix II. The following is a summary of the results of the soil mechanics laboratory testing performed by KBK Enterprises:

Bailey Plant Mechanical Properties Test Data

Soil Classification - Silt, poorly graded
Maximum Dry Density - 65.5 pcf
Optimum Moisture - 46%
Compression Index - 0.07

Tobaccoville Plant Mechanical Properties Test Data

Soil Classification - Silt, poorly graded
Maximum Dry Density - 48.6 pcf
Optimum Moisture - 69.8%
Compression Index - 0.41

Whitaker Park Plant Mechanical Properties Test Data

Soil Classification - Silt, poorly graded
Maximum Dry Density - 63.0 pcf
Optimum Moisture - 43%
Compression Index - 0.25

At this time, RJR is no longer generating ash from the Bailey Plant. There are also times during the year when ash from the Whitaker Park Plant is reduced due to sale of the ash to various manufactures. Over 95% of the ash disposed of at the landfill is ash generated from the Tabaccoville Plant.

3.1.2 Chemical Properties

The coal combustion ash from the R. J. Reynolds facilities has been analyzed for EPA Priority Pollutant Metals using the Toxicity Characteristic Leach Procedure (TCLP). The TCLP test results for the coal combustion ash provide a "worst case" indication of leaching potential in a low pH environment. When the TCLP analysis for heavy metals is used in conjunction with fate transport modeling procedures, it provides a measure of the "worst case" condition for potential environmental impact. The TCLP analysis was used to provide the initial concentrations of metals for the MULTIMED analysis in the 1993 Phase 3 Permit Application, but is important to note that this low pH condition is never expected to occur at the RJRAMA. Results of the TCLP analyses as performed by Research and Analytical Laboratories, Inc. are included in Appendix III.

4.0 SITE CHARACTERIZATION

The attached drawings identify the permitted boundaries, property boundary, yearly waste footprints and projected closure contours on January 1, 2003. These drawings are identified in Appendix IV as:

Drawing 1 -	Site Plan
Drawing 2 -	Existing Topography
Drawing 3 -	Yearly Extent of Coal Ash Landfill
Drawing 4-	Proposed Final Grading of Coal Ash Landfill
Drawing 5-	Cross Sections

Also shown on the drawings are the monitoring wells PW-1, W-3 and W-4. Well construction records for monitoring wells W-3 and W-4 are included in Appendix V. Well construction records for water supply well PW-1 are not available to RJR.

The drawings are based on the various surveys performed by Kale Engineering. Projected contours and limits for the January 1, 2003 closure contours, were based on the landfill receiving 5,300 cubic yards per month from August 1, 1996, to January 1, 2003, for a total volume of 402,800 cubic yards.

The projected contours for January 1, 2003, are shown on Drawing 4. These contours represent a total volume from August 1, 1996 to January 1, 2003 of 410,400 cubic yards.

5.0 GROUNDWATER MONITORING

Groundwater monitoring for the Phase 2 area consists of two upgradient and one downgradient well. The recommended sampling interval is bi-annual with the sampling parameters consisting of the EPA Priority Pollutant Metals. These test results would be required to be in compliance with the NCDEHNR 2L Standards.

GCI evaluated the groundwater results for the Rural Hall Flyash Landfill by reviewing the monitoring data submitted by R. J. Reynolds for wells PW-1, W-3 and W-4. The latest sampling was performed on October 23, 1991 for PW-1, September 17, 1997 for W-4 and September 17, 1997 for W-3 by R. J. Reynolds. Results from these groundwater sampling analyses are provided in Appendix VI.

PW-1 and W-4 results were used to determine the natural levels of chemical components present in the groundwater. Levels of Cadmium, Iron, Lead, Manganese, Sulfate, Zinc and Dissolved Solids have been detected above the 2L standards in PW-1. Levels of Iron and Manganese have been detected above the 2L Standards in W-4. These elevated levels are considered to be background conditions of the soil and/or groundwater. The groundwater was addressed by Law Engineering in their Application for Construction Permit as flowing in a easterly direction towards Leak Creek. The results from this will be used to determine if the landfill is contaminating the groundwater in monitoring well W-3 which is downgradient of the filling operation.

Monitoring well W-3 has been tested on a semiannual basis since 1992 with the latest sampling on September 17, 1997, at which time, levels of Iron, Lead and Manganese were detected above the 2L Standards. These elevated levels of Iron and Manganese were within the same range of what has been detected in the background wells. The constituents exceeding the 2L Standards are shown in graphical form in Appendix VI.

The current Water Quality Plan, as previously submitted and approved by the State, has been followed with semi-annual data submittals to NCDEHNR. Since the implementation of this Water Quality Plan, RJR has not noticed any problems and has not received any comments from NCDEHNR addressing any potential concerns. At this time RJR understands that this Water Quality Plan will be reviewed in conjunction with the entire Compliance Determination submittal and would be open for any discussions concerning the current Water Quality Plan.

6.0 SURFACE WATER MONITORING

Leak Creek is currently being sampled biannually upstream and downstream of the existing landfilling activities on the R. J. Reynolds property (refer to Drawing 1 for existing stream sampling locations). Since 1990 there have been no detectable increases in the concentrations of constituents regulated by the NCDEHNR 2L Standards (refer to Appendix VII for laboratory sampling results for SS-1 and SS-2). Iron and Manganese have historically exceeded the 2L Standard in the surface water, but fall within the range of the background levels for the groundwater. Surface water monitoring will be continued on a biannual basis.

Through the adequate sedimentation and erosion control measures currently being utilized for this project, it is anticipated that there will be no effect on the surface water leaving the RJRAMA facility.

7.0 PROPOSED PLAN TO ENSURE LANDFILL COMPLIANCE WITH GROUNDWATER STANDARDS

Information used for determining the compliance with groundwater standards was obtained from the waste stream characterization, site geology, and the analysis performed for the Phase 3 Permit Application submitted in October 1993.

As part of the 1993 Phase 3 Permit Application, determination of expected contaminant levels at the compliance boundary were developed using the USEPA MULTIMED program. This program provides an indication of the fate transport of contaminants that are released from the project site and takes into consideration a variety of chemical and hydrogeologic features. Discussions and details about that modelling and its results are discussed below.

7.1 HELP Model Evaluation of Leachate Flow

To determine the expected leachate production volume from the R.J. Reynolds Ash Management Area, the Hydrologic Evaluation of Landfill Performance (HELP) Model was used to produce a leachate percolation analysis from the landfill bottom. A standard cross section with medium permeability final cover, 50 feet of compacted coal ash, 10 feet of clayey silt and a 4 foot sandy silt overburden layer (refer to Typical Landfill Section in Appendix VIII) was used for a series of HELP model runs depicting the average condition that will exist at the landfill. The average exfiltration rate from the bottom of the ash disposal area was computed to be 0.0023 in/yr by the HELP Model. This exfiltration rate from the HELP Model was then used as the infiltration rate for the MULTIMED model to compute contaminant fate transport.

7.2 MULTIMED Model Evaluation of Contaminant Transport

A typical cross section was used for the MULTIMED analysis at three different distances from the compliance boundary. To provide a "worst case" evaluation of contaminant transport through the underlying soil and rock, the highest TLCP initial concentration was used for three metals concentrations (i.e. Barium, Chromium, and Selenium) that are closest to the NCDEHNR 2L Standards. The chemical input parameters for the model were developed from the Application Manual for MULTIMED and soil properties were developed from the HELP Model user's manual and soil laboratory testing conducted as part of the subsurface investigation.

Chemical decay and dispersivity coefficients were allowed to be developed by the program with a slight increase in the absorption coefficient to account for the natural tendency of metals to absorb onto soil particles. The following table is a summary of the expected contaminant levels as computed by the MULTIMED model for the RJRAMA facility:

TABLE 1 MULTIMED MODEL RESULTS				
CONSTITUENT	**INITIAL CONCENTRATION (mg/1)**	**DISTANCE FROM COMPLIANCE BOUNDARY (ft)**	**COMPUTED CONCENTRATION AT COMPLIANCE BOUNDARY (mg/1)**	**NCDEHNR 2L STANDARD (mg/1)**
Selenium	.05	1200	2.6×10^{-12}	.05
Selenium	.05	500	6.1×10^{-6}	.05
Selenium	.05	100	.0024	.05
Chromium	.084	1200	4.4×10^{-12}	.05
Chromium	.084	500	1.0×10^{-5}	.05
Chromium	.084	100	.004	.05
Barium	.66	1200	3.4×10^{-11}	2.0
Barium	.66	500	8.0×10^{-5}	2.0
Barium	.66	100	.03	2.0

As indicated by the test results provided above, the expected contaminant levels at the compliance boundary are well within 2L Standards. It is important to note that the MULTIMED analysis was performed using estimated parameters for absorption and chemical dispersivity coefficients. The initial concentration levels for the constituents that were evaluated were developed from the TCLP test procedure that develops a "worst case" scenario of potential contaminant transport. The three undisturbed samples obtained as part of the 1993 Permit Application were used for the residual soils in the MULTIMED analysis. Laboratory results of these samples are included in Appendix IX.

The cross section that was evaluated during the MULTIMED analysis had no bottom liner and the primary buffer between the coal combustion ash and the groundwater was the residual soil profile and fractured mica schist bedrock. The relatively low expected contaminant levels are most likely due to the low permeability residual soils and the low initial concentration of contaminants in the coal ash material.

Since the Phase 3 site is immediately adjacent to the Phase 2 site and the waste characterization was performed on the actual ash being disposed of at the site, the fate transport modelling performed for the Phase 3 site can be reasonably correlated to the Phase 2 site.

8.0 OPERATIONAL PROCEDURES

R. J. Reynolds has successfully established and proven field techniques for managing the disposal, placement and compaction of coal ash over steep slopes, while minimizing site erosion from ash fill.

The coal ash is hauled into the project daily and disposed of in the staging areas located along the uppermost limits of each sub-area. As necessary, to keep the staging area clear, a bulldozer pushes the accumulation of material towards the downgradient end of the filling area, progressively compacting the material under the weight of the ash. Cover material is taken from the fill area to create more capacity. Borrow material is also obtained from sources outside of the permitted area.

Due to the self compressibility of the R. J. Reynolds coal ash, progressive end-dumping practices have proven to be the most effective means for disposing of the coal ash in a manner which maximizes the local stability of the fill areas and minimizes the overall area under disturbance at a given time. Temporary seeding measures are also being used to minimize short term erosion of denuded slopes within an active sub-area. Diversion ditches are maintained at all times around the perimeter of the filling operations to minimize surface water on the denuded areas. All fill areas shall be sloped to discharge stormwater without creating small pools of standing water. The contractor will diligently and continuously maintain all erosion control measures on a daily basis while a sub-area is active.

9.0 FINAL COVER AND FACILITY CLOSURE

The on-site soils are suitable for use as landfill cover material. As detailed in the permit, a final cover consisting of 2 feet of compacted soil will be placed and graded to assure positive drainage. Suitable on-site clayey material shall be compacted to ninety-five percent of the maximum dry density and obtain a maximum permeability of 1×10^{-6} cm/sec. Since the underlying soils have permeabilities in the range of 1×10^{-4} to 1×10^{-5} cm/sec, this type of final cover material will provide an overall reduction in infiltration through the coal ash fill material and reduce the potential for ponding of leachate in the bottom of the landfill. The cover material will be placed and compacted in six to eight inch loose lifts to a minimum depth of two feet. Drainage ditches will intercept run-on from off site as well as run-off from the landfill itself.

Temporary seeding measures will be implemented on denuded areas within active sub-areas as necessary to maintain site stability over large work areas. Permanent seeding will be implemented on all denuded areas brought to finish grades.

Sediment basins serving sub-areas which receive final closure will be maintained until such time that vegetative cover is established on the area which it serves. After vegetative cover has been established, the basins may be removed. The drainage swale, along with the rip rap erosion control measures, will remain in place after the completion of the coal ash filling project.

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APPENDIX I
NCDEHNR June 13, 1997 Letter

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Waste Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
William L. Meyer, Director

DEHNR

June 13, 1997

Mr. George Lamb
R. J. Reynolds Research & Development
P. O. Box 1487
Winston Salem, NC 27102

RE: Coal Ash Model, R. J. Reynolds Industrial Landfill, Forsyth County, Permit No. 34-05

Dear Mr. Lamb:

In a previous letter dated February 26, 1997, the Solid Waste Section (Section) notified all owners and operators of coal ash monofills that the Section would study the possibility of developing a simple, generic model to demonstrate compliance with the requirements of Rule .0503(2)(d)(ii)(A). The study has been completed and the conclusion reached that the development of such a model is not possible. This conclusion is based on the following reasons:

1. Infiltration through coal ash monofills is incompletely understood and dependent on several factors including the self-cementing properties of the ash (which is dependent on ash type), operation (geometry, disposal rate, compaction, intermediate cover, vegetation, mixing of ash types, fracture of shallow self-cementing horizons) and climate.

2. Leachate concentrations of metals to be expected in water leaving the ash pile are not known very well either. They might depend on the infiltration paths and on ash type. They probably evolve through the life of the landfill. And they may differ significantly from concentrations measured in a variety of laboratory studies.

3. Existing data on subsurface characteristics are insufficient for all ash monofills in North Carolina to allow construction of even simple models.

4. Existing groundwater detection monitoring systems at all of the sites do not provide enough useful information to calibrate or validate any model.

5. There is no data concerning the sorptive capability of saprolite in the Southeastern U.S.

Consequently the previously required submittal must include a final cap system designed to ensure compliance with the ground water standards as demonstrated by modelling methods acceptable to the Section.

The previously required submittal from the February 26, 1997 letter included the following:

P.O. Box 27687,
Raleigh, North Carolina 27611-7687
Voice 919-733-4996

NC
Reduce Reuse Recycle

FAX 919-715-3605
An Equal Opportunity Affirmative Action Employer
50% recycled/10% post-consumer paper

A construction and operational plan which limits development of the landfill to the lateral expansion of the waste "footprint" established as of January 1, 1998. The plan shall be developed in one-year phases and operated in such a manner that the landfill may be closed at any time.

The capacity of the landfill design plan shall not exceed five (5) years.

A water quality monitoring plan including additional wells located, sampled, and analyzed in a way that demonstrates compliance with 2L. Please contact Bobby Lutfy of the Section concerning monitoring and sampling parameters.

A closure plan including a final cap system.

The submittal of this information and acknowledgement of receipt by the Section prior to January 1, 1998, will constitute compliance with Rule .0503(2)(d)(ii). However; this does **not** constitute final determination by the Section that the design ensures that the ground water standards established under 15A NCAC 2L will not be exceeded in the uppermost aquifer at the compliance boundary. It should be noted that a lateral expansion beyond the 1998 footprint or a new landfill must meet all the permit requirements of Rules .0503-.0505, including a demonstration that the proposed design meets the requirements of Rule .0503(2)(d)(ii).

This letter serves as notification to the owner/operator that the information previously described as necessary to complete the final determination of compliance with Rule .0503(2)(d)(ii) shall be submitted to the Section thirty (30) days prior to January 1, 1998.

If there are any questions regarding this letter, please call Susan Leistiko at (919) 733-0692 extension 262.

Sincerely,

James C Coffey

James C. Coffey, Supervisor
Permitting Branch
Solid Waste Section

cc: Julian Foscue
Brent Rockett

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APPENDIX II
KBK Enterprises Report

KBK Enterprises, Inc.

PRELIMINARY EVALUATION OF TH
COAL ASH PRODUCED AT THE
BAILEY, TOBACCOVILLE, AND
WHITAKER PARK PLANTS

KBK ENTERPRISES INC

PRELIMINARY EVALUATION OF THE COAL ASH PRODUCED AT THE BAILEY, TOBACCOVILLE, AND WHITAKER PARK PLANTS

Prepared for:

R.J. Reynolds Tobacco Company

Prepared By:

KBK Enterprises, Inc.
777 Franklin Road
Marietta, Georgia 30067
(404) 426-5944

June 1989

DISCLAIMER

All data, information, and statements provided in this report are supplied to furnish F. J. Reynolds a preliminary determination of the suitability of the RJR ash for any application, KBK recommends that further testing and evaluation of the ash be performed. Therefore, KBK does not warrant this data nor the RJR ash for any application and suggests the material user perform an independent technical review of the RJR ash prior to utilization.

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SECTION 1.0

INTRODUCTION

In November, 1988, R.J. Reynolds Company (RJR) of Winston Salem, North Carolina contracted with KBK Enterprises Inc. (KBK) of Marietta, Georgia to provide preliminary testing and review of the fly ash generated at three (3) plants relative to structural fill applications such as real estate development. The three (3) plants to be sampled were:

1. Bailey Plant
2. Tobaccoville Plant
3. Whitaker Park Plant

To initiate the study, ash samples were collected by KBK in December, 1988. The following physical characterization tests were performed to allow preliminary review of the material quality:

1. Moisture Density Test (Standard Proctor)
2. Gradation Test (Sieve Analysis)
3. Consolidation Test
4. Loss on Ignition Test

In addition to the tests listed above, RJR supplied KBK with E.P. Toxicity test data on the fly ash from each plant. KBK reviewed the limited environmental data relative to permitting of structural fills.

End of Section

SECTION 2.0

BACKGROUND INFORMATION ON TESTS

2.1 Moisture/Density (Standard Proctor)

In designing and constructing a structural fill or embankment, the degree of compaction is one of the primary concerns in providing a final product that performs within the properties it has been designed to achieve. While the obvious effect of compaction is the densification of the soil or ash particles and the expulsion of air, the main purpose is to produce a soil mass with controlled engineered properties. A properly compacted soil or ash fill will perform to its designed strength with limited and predictable settlement, and with limited and predictable permeability.

For a given soil (or ash) there is a moisture content and compactive effort which achieves the highest degree of compaction or densification. The Standard Proctor Test (ASTM D698) is a widely used test for determining the moisture content of the soil which gives the highest dry unit weight or density of the soil. In this test, the soil sample's moisture content is plotted against the dry density unit weight and a parabola figure typically results (See test data, Appendix 1). The peak of the curve indicates the maximum dry density for the sample and the moisture content at which it occurs.

The maximum dry density of a sample is theoretically the highest degree of densification for the sample. Field compaction for a soil is usually referred to as a percentage of the maximum dry density. Generally when designing a structural fill, an engineer will use the properties of the soil mass determined if it is compacted to a percentage of maximum dry density; typically 90% for non-load bearing areas, 95% for pavement areas, and 98% to 100% for foundations of structures. The moisture/density curve can be used to determine the tolerances for moisture and compaction energy levels to obtain the required densities.

The moisture/density curve can also aid in determining the stability of a sample if it is too wet or too dry. A moisture/density curve which is very steep to the peak, indicates a material in which the moisture content greatly effects the densification. Therefore, to use this material, the moisture content would need to be tightly controlled, which in practice is very difficult to achieve.

2.2 Gradation Test

The Gradation Test is used to classify a soil sample by the soil particle sizes and the percentage of each size

within the whole sample. The percentage of coarse grained particles are found by using a mechanical sieve test (ASTM D422) while fine grain soils (smaller than No. 200) are found by using a dispersion test, or Hydrometer (ASTM D422). The results of the particle size test are graphed as a particle size distribution curve.

The soil can be classified by using the USDA Triangle Chart (figure 1) which is used for sands, silts, and clays. In using this chart particle sizes are defined as follows:

Sand - 0.05 - 2.0 mm
Silt - 0.002 - 0.05 mm
Clay - <0.002 mm

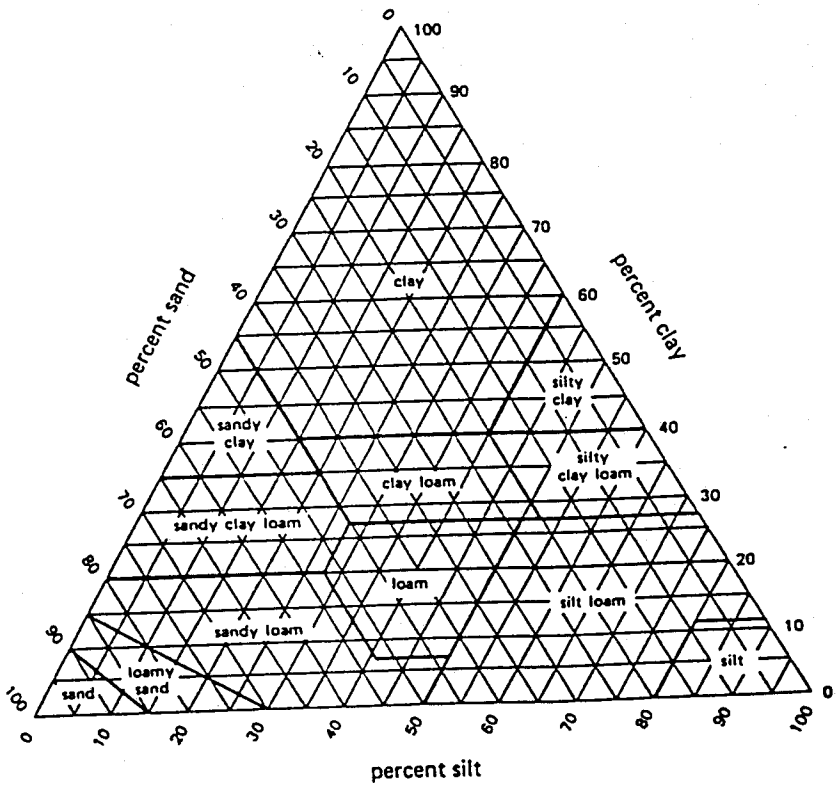


FIGURE 1.

The soil classification can be used to compare the soil sample to a familiar soil with a similar classification. This enables an evaluation to predict the field characteristics of a soil sample by the known characteristics of similar soil.

The Gradation Test can be used to approximately predict the soil's susceptibility to frost action capillary rise, and the soil's permeability. Typically, soils subject to frost action are well graded soils containing more than 3 percent of particles smaller than 0.02 mm.

Capillary rise of water through a soil can be determined using the effective particle size and the surface tension for the soil. Using a nominal surface tension of 0.075 g/cm, the capillary rise for each of the fly ash samples has been estimated to be between 6.5 and 12 feet (depending upon permeability), which is considered to be critical. A more accurate determination of capillary rise in a soil sample can be determined by performing ASTM D3152.

Permeability of a soil sample can be estimated by determining the soil classification. Typical permeability ranges for soils classified as Silt are between $1X10^{-5}$ and $1X10^{-7}$. Permeability can be greatly effected by the compacted dry density of the soil. A more accurate determination of the permeability of a soil sample can be determined by performing ASTM D2434.

2.3 Consolidation Test

If soils subjected to an increase in effective stress, the soils will decrease in volume or consolidate. The stress increase may be caused by structure foundations, embankments, or even lowering of the groundwater table. If the soil supports a structure and the settlement due to consolidation is excessive, damage may result. These settlements may be estimated if the soil's compressibility and stress loads are known.

The Consolidation Test (ASTM D2435) is used to determine the amount of consolidation which occurs to a soil sample when subjected to increasing increments of one dimensional loading for an extended period of time. The amount of consolidation for each load increment is expressed as a percentage of the constant stress and is plotted against the load pressure (See test data, Appendix 1). The slope of the line given by the graph of stress vs. load is the Compression Index (C_c). Using a variant of Boussineq's equation, C_c can be used to estimate the amount of settlement which would occur due to the loads for a building footing:

$$H = \frac{h_1 C_c}{I + e_1} \log_{10} \frac{P'_2}{P'_1}$$

While the Consolidation test gives a good overall estimate of settlement and bearing strengths additional testing can provide more precise data for non-cohesive materials such as fly ash. These tests include Standard Penetration Tests ASTM D3441 and ASTM D2850, and others. The more extensive testing would be of value where structural foundations are being designed for specific end uses.

2.4 Loss on Ignition

Bituminous coal fly ash is typically composed of Silica Oxide (SiO_2), Alumina Oxide (AlO_3), Ferric Oxide (Fe_2O_3), and various other oxides and alkalies. Volatiles such as carbon may also be present, and the content is dependent upon the efficiency of the combustion process and the fineness of the coal upon combustion. The carbon content of the fly ash is important in determining the characteristics of the ash when used as structural fill due to the carbon's potential to effect compaction and strength characteristics. Depending upon the structure of the carbon, it could have the potential to deteriorate over time and cause settlement.

The Loss on Ignition (LOI) Test is a procedure from ASTM C311 and is used to measure the amount of material which is ignited and consumed at a temperature of 750°C. The amount of material consumed is expressed as a percentage of the initial sample weight.

In addition to being a critical characteristic, related ash utilization potential L.O.I. test data can be helpful as an indicator of operational efficiency of a boiler. A consistently high L.O.I. can indicate loss of heat value of the fuel source.

Ash Source	% L.O.I
Bailey Plant	8.7%
Tobaccoville	25.41%
Whitaker Park	17.73%

End of Section

SECTION 3

BAILEY PLANT TEST DATA

3.1 Moisture Density

The fly ash from the Bailey Plant was found to have a maximum dry density of 65.5 (pcf) at a moisture content of 46.0%, also called the optimum moisture content (see Appendix 1). The moisture/density curve is considered to be moderate on the dry side of optimum and tapers off after 5% less than optimum. On the wet side of optimum moisture, the curve is moderate to steep. This would indicate that the density of the ash will not be significantly effected by less than optimum moisture, but could potentially become unstable if more moisture than optimum exists.

3.2 Gradation

The fly ash from the Bailey Plant was found to have approximately 12% of the particles classified as sand and the remaining 88% classified as silt (see Appendix 1). Using the USDA triangle chart, the ash sample is classified as Silt. Using the gradation curve, the sharply sloping curve further classifies the soil sample into a subcategory of poorly graded.

Bailey ash
- Silt, poorly graded
- Frost Action: susceptible
- Capillary Rise: critical
- Permeability: 10^{-5} to 10^{-7}, low

3.3 Consolidation

The fly ash from the Bailey Plant was tested for Consolidation using a sample compacted to a dry density of 62.7 pcf or 95.7% of Standard Proctor (see Appendix 1). The sample achieved a Compression Index of 0.07 at a saturation of 76.1% (yields a void ratio (e) = 1.387). Using the Boussineq's equation and practical assumptions, it is estimated that a 60 inch height fill of the fly ash material compacted to 95.7% would consolidate 1.80 inches when subjected to a load of 1500 psf. This amount of consolidation indicates that the fly ash would be acceptable (without detrimental settlement) as structural fill for pavement areas, and could possibly support designed footing loads if compacted to 100% of dry density. For footing design applications the test data should be expanded and duplicated.

3.4 Loss on Ignition

Sample analysis of the Bailey Plant fly ash indicates a Loss on Ignition of 8.7 percent. An L.O.I. greater than 4 percent greatly restricts most applications of fly ash as a concrete additive.

End of Section

SECTION 4

TOBACCOVILLE PLANT TEST DATA

4.1 Moisture Density

The fly ash from the Tobaccoville Plant was found to have a maximum dry density of 48.6 pcf and an optimum moisture content of 69.8% (see Appendix 1). The moisture/density curve is considered to be moderate on the dry side of optimum and tapers off after 5% less than optimum. On the wet side of the optimum, the curve is moderate to steep. This would indicate that the density of the soil will not be significantly effected by less than optimum moisture, but could potentially become unstable if more moisture than optimum exists.

4.2 Gradation

The fly ash from the Tobaccoville Plant was found to have approximately 17% of the particles classified as sand and the remaining 83% classified as silt (See Appendix 1). Using the USDA Triangle Chart, the ash sample is classified as Silt. Using the gradation curve, the sharply sloping curve further classifies the ash sample into a subcategory of poorly graded.

Tobaccoville ash
- Silt, poorly graded
- Frost Action: susceptible
- Capillary Rise: critical
- Permeability: 10^{-5} to 10^{-7}, low

4.3 Consolidation

The fly ash from the Tobaccoville Plant was tested for Consolidation using a sample compacted to a dry density of 45.8 pcf or 94.2% of Standard Proctor (see Appendix 1). The sample achieved a Compression Index of 0.41 at a saturation of 73.8% (yields a void ratio (e) = 1.960). Using the Boussineq's equation and practical assumptions, it is estimated that a 60 inch height fill of fly ash compacted to 94.8% would consolidate 9.55 inches when subjected to a load of 1500 pcf. This amount of consolidation indicates that the fly ash would not be acceptable as structural fill but could possibly be used for non-load, non-traffic bearing fill such as landscaped berms.

4.4 Loss on Ignition

Sample analysis of the Tobaccoville Plant fly ash indicates a Loss on Ignition of 25.41 percent.

End of Section

SECTION 5

WHITAKER PARK TEST DATA

5.1 Moisture Density

The fly ash from the Whitaker Park Plant was found to have a maximum dry density of 63.0 pcf and an optimum moisture content of 43.0% (see Appendix 1). The moisture/density curve is considered to be moderate to steep on the dry side of optimum and continues to lose density as moisture is reduced. On the wet side of optimum the curve is moderate to steep. This would indicate that the ash could potentially become unstable if compaction is attempted with the moisture above or below optimum. In field applications, controlling the moisture content this closely is very difficult. This in turn will make it difficult to achieve the desired density unless the compaction energy level can be increased without overstressing the ash.

5.2 Gradation

The fly ash from the Whitaker Park Plant was found to have approximately 15% of the particles classified as sand and the remaining 85% classified as silt (see Appendix 1). Using the USDA Triangle Chart, the ash sample is classified as Silt. Using the gradation curve, the sharply sloping curve further classifies the ash sample into a subcategory of poorly graded.

Whitaker Park ash
- Silt, poorly graded
- Frost Action: susceptible
- Capillary Rise: critical
- Permeability: 10^{-5} to 10^{-7}, low

5.3 Consolidation

The fly ash from the Whitaker Park Plant was tested for Consolidation using a sample compacted to a dry density of 62.3 pcf or 98.9% of Standard Proctor (see Appendix 1). The sample achieved a Compression Index of 0.25 at a saturation of 62.3% (yields a void ratio (e) = 1.59). Using the consolidation equation and assumptions, it is estimated that a 60 inch height fill of the fly ash material compacted to 98.9% would consolidate 6.31 inches when subjected to a load of 1500 psf. This amount of consolidation indicates that fly ash would be acceptable as structural fill for non-load bearing, low-traffic applications such as recreational fields, but would not be acceptable for pavement areas or building areas. Also, the fly ash should be compacted to a dry density at or near 100% of Standard Proctor for better control of the engineered properties of the fill.

5.4 Loss on Ignition

Sample analysis of the Whitaker Plant fly ash indicates a Loss on Ignition of 17.73 percent.

End of Section

SECTION 6.0

ENVIRONMENTAL REVIEW

6.01 General

Under the Resource Conservation and Recovery Act of 1976 (RCRA), Congress established the legal authority for the U.S. Environmental Protection Agency (EPA) to promulgate regulations to govern the management of solid and hazardous wastes. The regulations provide that coal combustion by-products are "conditionally exempt" from regulation as a hazardous waste. Congress directed EPA to study the scope of coal ash management practices and report on the existing practices and environmental impacts.

In EPA's draft Report to Congress the agency noted that few coal combustion ashes exhibit hazardous characteristics and that utilization of coal ash should be promoted where environmentally safe. Neither Congress nor EPA have altered the conditional exemption from RCRA regulation which coal ash enjoys partly due to the factual recognition that very few coal ashes present environmental hazards as a hazardous waste. Most coal ashes contain only trace concentrations of heavy metals and very rarely exhibit hazardous characteristics.

Without regulation as a hazardous waste under Subtitle C of RCRA, coal ash is regulated as a Subtitle D solid waste and is usually governed by a State environmental statute and a related regulatory program.

6.2 State Regulations

The North Carolina the regulation of solid waste falls under the authority of the North Carolina Department of Natural Resources and Community Development (DNR). Permits to dispose of solid wastes such as fly ash and bottom ash are issued by DNR. Conditional permits are issued for the utilization of coal ash in markets such as structural fill, flowable fill, certain backfills, ice control, pipe bedding and certain other limited uses.

In the North Carolina Department of Human Resources is responsible for the administration of National Pollutant Discharge System (NPDES) in North Carolina and the issuance and enforcement of permits for any activity which in the WCB's opinion could potentially effect surface and ground water sources. DHR maintains the EPA units for hazardous waste and drinking water standards, and has policies prohibiting degradation of groundwater supplies. Therefore the fly ash must be controlled as a solid waste under permits issued by the DHR. Recently, the DHR has taken favorable positions on the reuse of the fly ash as fill

material. The permits are issued with specified conditions and limitations designed to protect the environment and groundwater from degradation due to leachate from the fly ash. In most cases, the conditions of the permit are easily met with the proper design and construction of the fly ash fill.

6.3 E. P. Toxicity Test

Coal Ash typically contains traces, or concentrations of heavy metal substances which are regulated as Hazardous Waste by the EPA and state environmental regulatory agencies. Though almost all coal ashes do not contain large enough concentrations of heavy metals to be classified as Hazardous Waste, the concerns of leachate from coal ash fills possibly contaminating or degradating ground water supplies are of concern when analyzing and designing a coal ash fill. For this reason, the fly ash must be tested using the E.P. Toxicity Test to determine the concentrations of heavy metals leachate, and the fly ash fill project must be designed and constructed to minimize the potential for leachate to reach the ground water supply.

The E.P. Toxicity test involves subjecting a waste sample to an acid extraction which approximates a "worst case" leaching scenario for a land filled waste material. The chemical analysis for heavy metal concentrations then gives a measure of the potential environmental impact from the migration of metals present in the waste stream. Many other physical and chemical factors play an important role in determining the propensity for heavy metal migration in the open environment; however, the E.P. Toxicity test provides a good commonly used "yardstick".

6.2 RJR Data

For the proposes of this report, RJR supplied E.P. Toxicity test data for each of the three (3) plants. Table 6.1 lists the results of the data compared to the hazardous waste standards. Based on the analysis provided by RJR, the heavy metal concentrations are well below the standards for a hazardous waste and most parameters are below the drinking water standard which is one hundred times less than the hazardous waste limit.

It should be noted that with the exception of the Tobaccoville data, the analysis data provided is dated back to 1979 and appears to be incomplete for certain parameters.

Table 6.1

	Tobaccoville Ash	EPA Hazardous Waste Limits	Drinking Water Limits
Arsenic	<0.010	5.0	0.05
Barium	0.015	100.0	1.00
Cadmium	<0.010	1.0	0.01
Chromium	0.029	5.0	0.05
Lead	<0.010	5.0	0.05
Selenium	0.051	1.0	0.01
Silver	<0.016	5.0	0.05
Mercury	0.0003	0.2	0.002

	Bailey	EPA Hazardous Waste Limits	Drinking Water Limits
Arsenic	0	5.0	0.05
Barium	0.20	100.0	1.00
Cadmium	0	1.0	0.01
Chromium	0.02	5.0	0.05
Lead	0	5.0	0.05
Selenium	0.018	1.0	0.01
Silver	0.0	5.0	0.05
Mercury	0	0.2	0.002

	Whitaker Park	EPA Hazardous Waste Limits	Drinking Water Limits
Arsenic	0.10	5.0	0.05
Barium	0.02	100.0	1.00
Cadmium	0.15	1.0	0.01
Chromium	0.23	5.0	0.05
Lead	0	5.0	0.05
Selenium	0.005	1.0	0.01
Silver	0.0	5.0	0.05
Mercury	0	0.2	0.002

Note: In reviewing the data, the Tobaccoville data appeared to be up to date (4/89) and complete. But the available data for the Bailey and Whitaker Park plants dated back to 1979 and appeared incomplete on the constituents. It would be recommended that a complete analysis of the E.P. Toxicity for the Bailey and Whitaker Park ashes be preformed prior to further analysis of structural fill applications.

End of Section

SECTION 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 General

This preliminary study sought to evaluate the potential for utilization of fly ash from the Bailey Plant, Tobaccoville Plant and Whitaker Park Plant in structural fill applications. Three (3) samples, five gallons each, were collected by KBK in December, 1988 for testing. In addition RJR supplied environmental data in April, 1989. After review of the physical and chemical data several conclusions and recommendations are warranted when considering the fly ashes' utilization potential.

7.2 Bailey Plant

Of the three (3) ash samples tested, the Bailey Plant fly ash exhibited the most favorable characteristics for use as structural fill. The physical tests indicate that the fly ash can be used as fill for non-load, low traffic bearing embankments such as recreational fields, landscape areas, and landscape berms. The tests indicate potential that the fly ash can be used as structural fill for load bearing areas such as pavement areas or building foundations, but it is recommended that further testing be performed prior to proceeding with such projects. The Standard Penetration Tests (ASTM D3441) and Triaxial Sheer Test (ASTM D2850) should be performed to determine the bearing capacity of the fly ash in order that foundations and pavement structures can be properly designed. Also, the tests indicate that the fly ash is susceptible to frost action and capillary rise. Structural fill embankments should be designed to prevent frost action and capillary rise from occurring and causing any detriment in the engineered properties of the embankment.

The Loss on Ignition indicates a moderately low level of carbon; therefore, settlement due to deterioration would be limited.

As for the environmental suitability of the fly ash for structural fills, it is recommended that additional E.P. Toxicity data be collected. The RJR E.P. Toxicity data indicates the ash has relatively low levels of heavy metals, therefore, the issuance of a utilization permit is possible. Specific site suitability for the utilization project would be required for any large project or for landfill siting. It is recommended that E.P. Toxicity analysis on representative samples be collected annually at a minimum.

7.3 Tobaccoville Plant

Based on physical characteristics, the Tobaccoville Plant fly ash does not have the necessary properties to be used as structural fill for load bearing areas or for non-load bearing areas which would be subject to light traffic such as recreational fields. The fly ash may be used for non-load bearing, non-traffic applications such as landscaping berms.

Though the fly ash shows very limited promise as structural material for which this evaluation was intended, it does indicate potential for utilization in waste water treatment. The high carbon content and low leachability of the Tobaccoville fly ash are desirable properties for filter applications. Also, the material's ability to "absorb" water at almost 70% of its dry weight would indicate a potential for use of the fly ash for sludge stabilization. These types of applications are usually area and project specific and would require mix testing prior to use.

To determine the environmental suitability, the E.P. Toxicity should be current and a site specific evaluation would be required. E.P. Toxicity analysis should be repeated on an annual basis.

7.4 Whitaker Park

Because the Whitaker Park Plant fly ash shows a sensitivity to moisture when not at optimum, its value as a structural fill material is questionable. The physical tests indicate that the fly ash may be used only in non-load bearing applications such as recreational fields and landscape areas without closer analysis. While this material could have some potential for low load bearing traffic areas, additional physical tests and close placement supervision would be required.

The Loss on Ignition indicates a moderately low level of carbon, therefore, settlement due to deterioration would be limited.

As for the environmental suitability of the fly ash for structural fills, it is recommended that additional E.P. Toxicity data be collected. The RJR E.P. Toxicity data indicates the ash has relatively low levels of heavy metals, therefore, the issuance of a utilization permit is possible. Specific site suitability for the utilization project would be required for any large project or for landfill siting. It is recommended that E.P. Toxicity analysis on representative samples be collected annually at a minimum.

7.5 Combination Uses

In order to locate one ash utilization project or disposal site for the three (3) sources of ash, the engineering properties of each ash is important to the combined ash structural performance. The test data indicates distinguishable differences in each fly ash. The most important parameter in determining combined use potential is the consolidation characteristics. Since the expected settlement from each ash is different, a structural fill constructed using a combination of the three ashes could be subject to differential settlement.

It is recommended that the three (3) fly ash materials not be combined in a structural fill where differential settlement cannot be tolerated. Proper blending and mixing could overcome this condition; however, the costs would likely be prohibitive.

Where the ash is used as a structural fill embankment (or landfilled), the test data indicates that attention should be directed to moisture control within the fill area. The fine particle size and sensitivity to moisture addition could result in a loss of stability of the fill if water enters the ash. A common result of water intrusion into a unsupported fill of this type of fly ash is a slope failure or "blow out". It is recommended that surface water and ground water intrusion be avoided for ash fill sites.

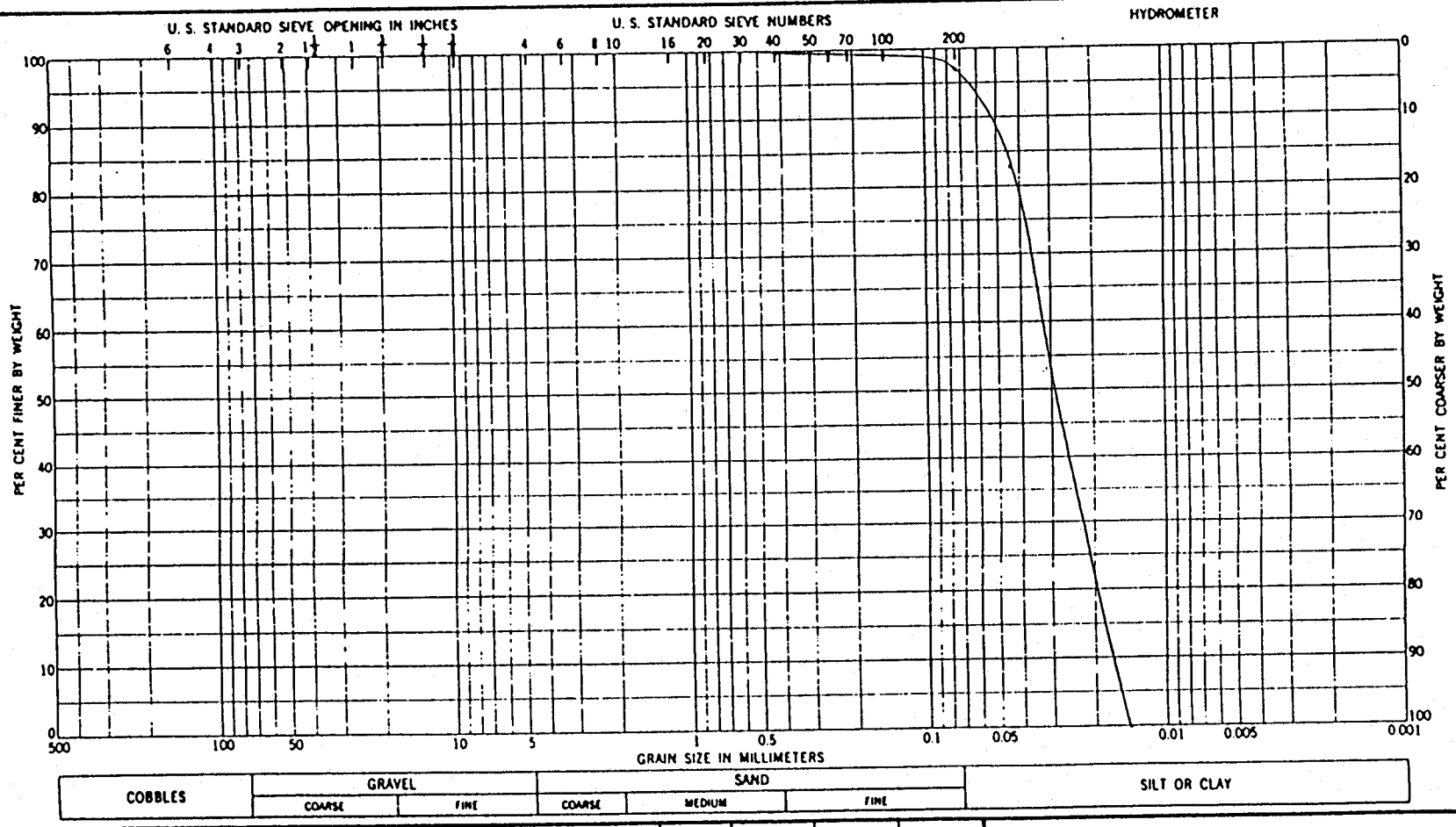
End of Section

APPENDIX 1
PHYSICAL CHARACTERIZATION TEST DATA

Project R.J. REYNOLDS

Job No. 32-82027

Date 12/20/88



Boring No.	Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	-	-	Coal Fly Ash, Bailey Plant.	-	-	-	-

GRADATION CURVES

ATEC Associates, Inc.
of Georgia
1190 Hayes Industrial Drive, N.E.
Marietta, Georgia 30062
404-427-9456

© Associates, Inc.
1300 Williams Drive
Marietta, Georgia 30066
404/427-9456

REPORT OF: MOISTURE DENSITY TEST
ASTM D-698, METHOD A, STANDARD

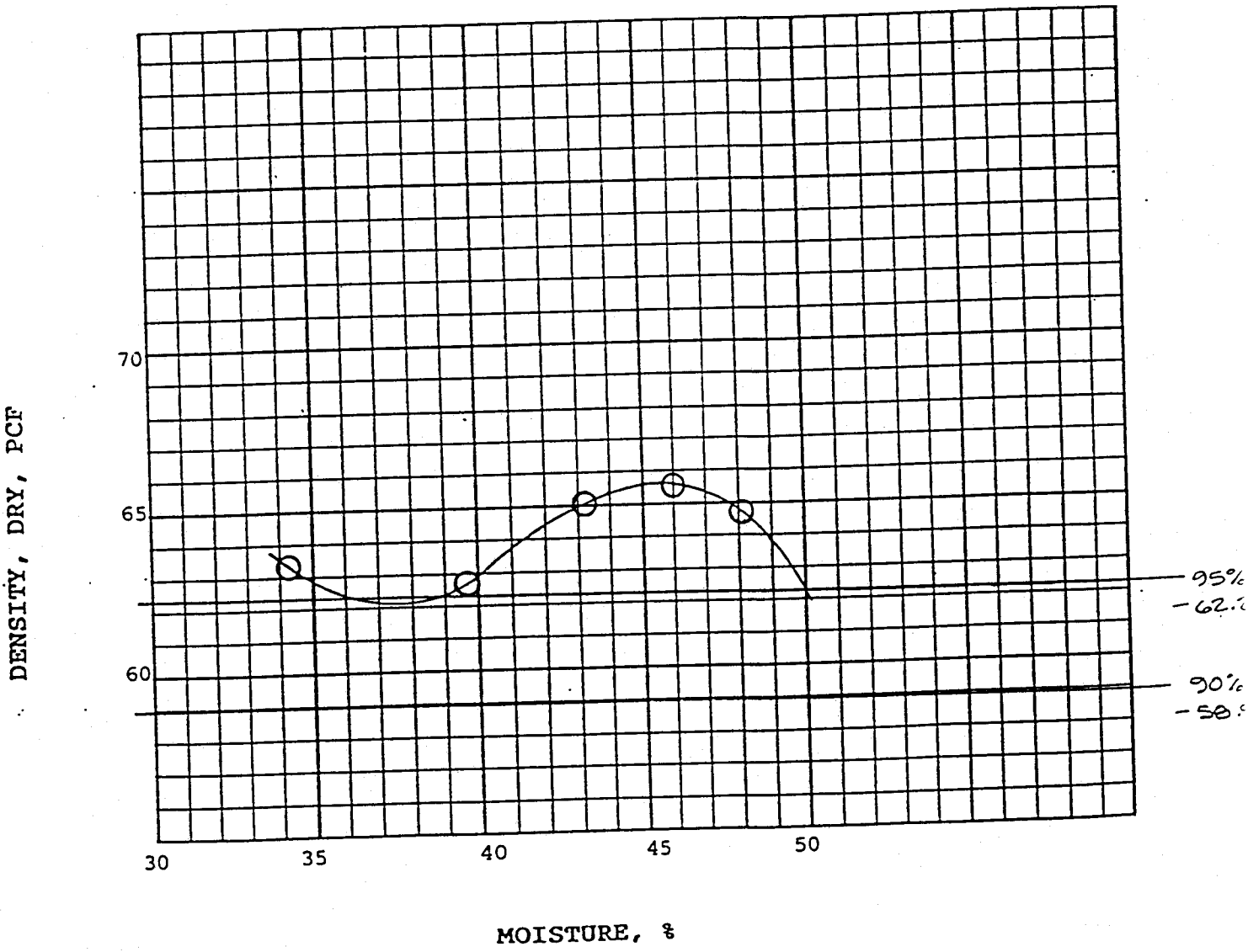
Date: 1/9/89

ct: R.J. REYNOLDS

Job No.: 32-82027

t: KBK Enterprises, Incorporated

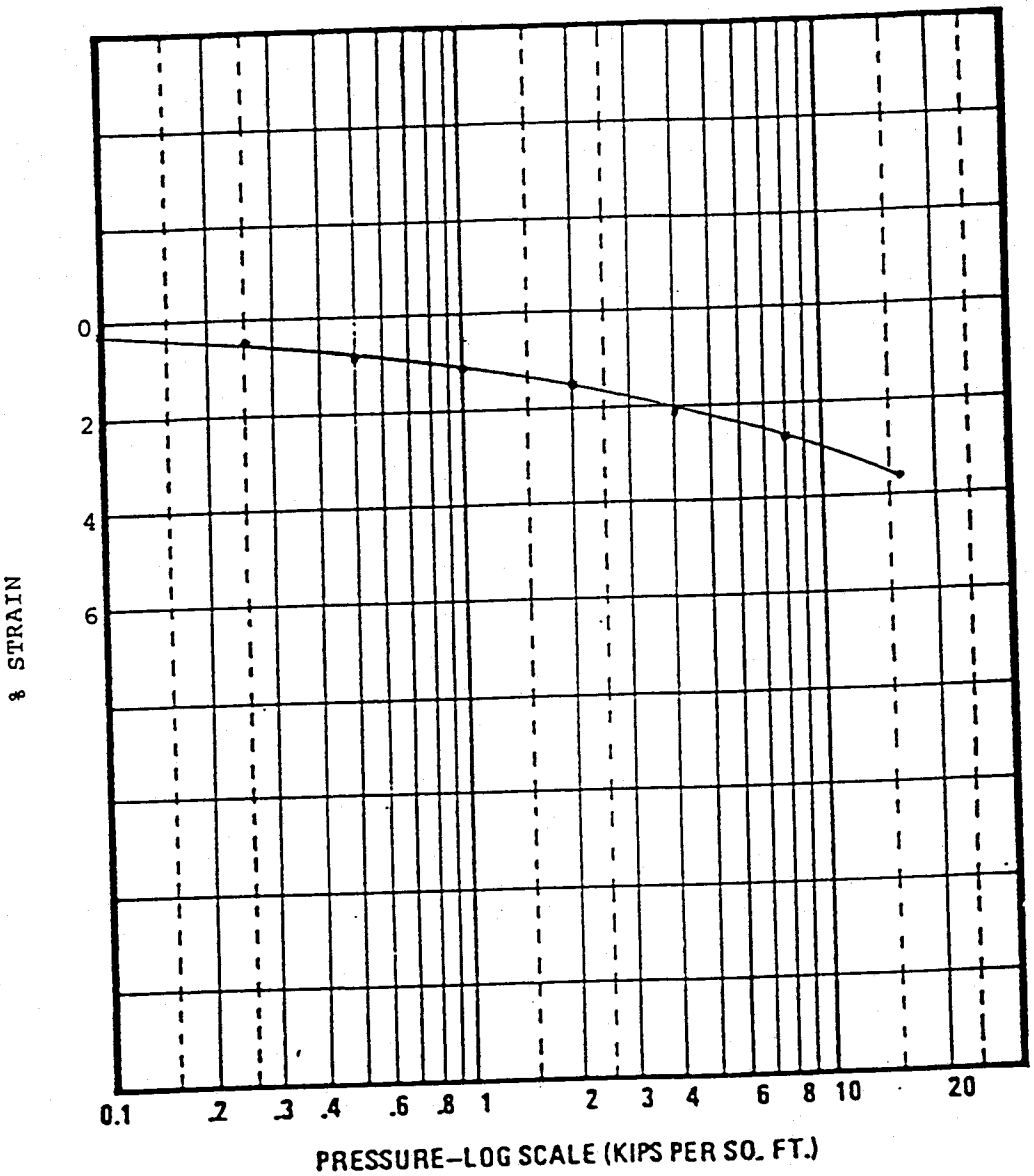
MATERIAL: Coal Fly Ash, Bailey Plant.
MAXIMUM DRY DENSITY: 65.5 PCF.
OPTIMUM MOISTURE CONTENT: 46.0%.



PROJECT R.J. REYNOLDS
CLIENT: KBK Enterprises, Inc.

DESCRIPTION Coal Fly Ash,
Bailey Plant.

COMPRESSION INDEX	0.07	
DRY UNIT WEIGHT (PCF)	62.7	-95.7%
WATER CONTENT (%)	43.1	-2.9%
SATURATION (%)	76.1	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	



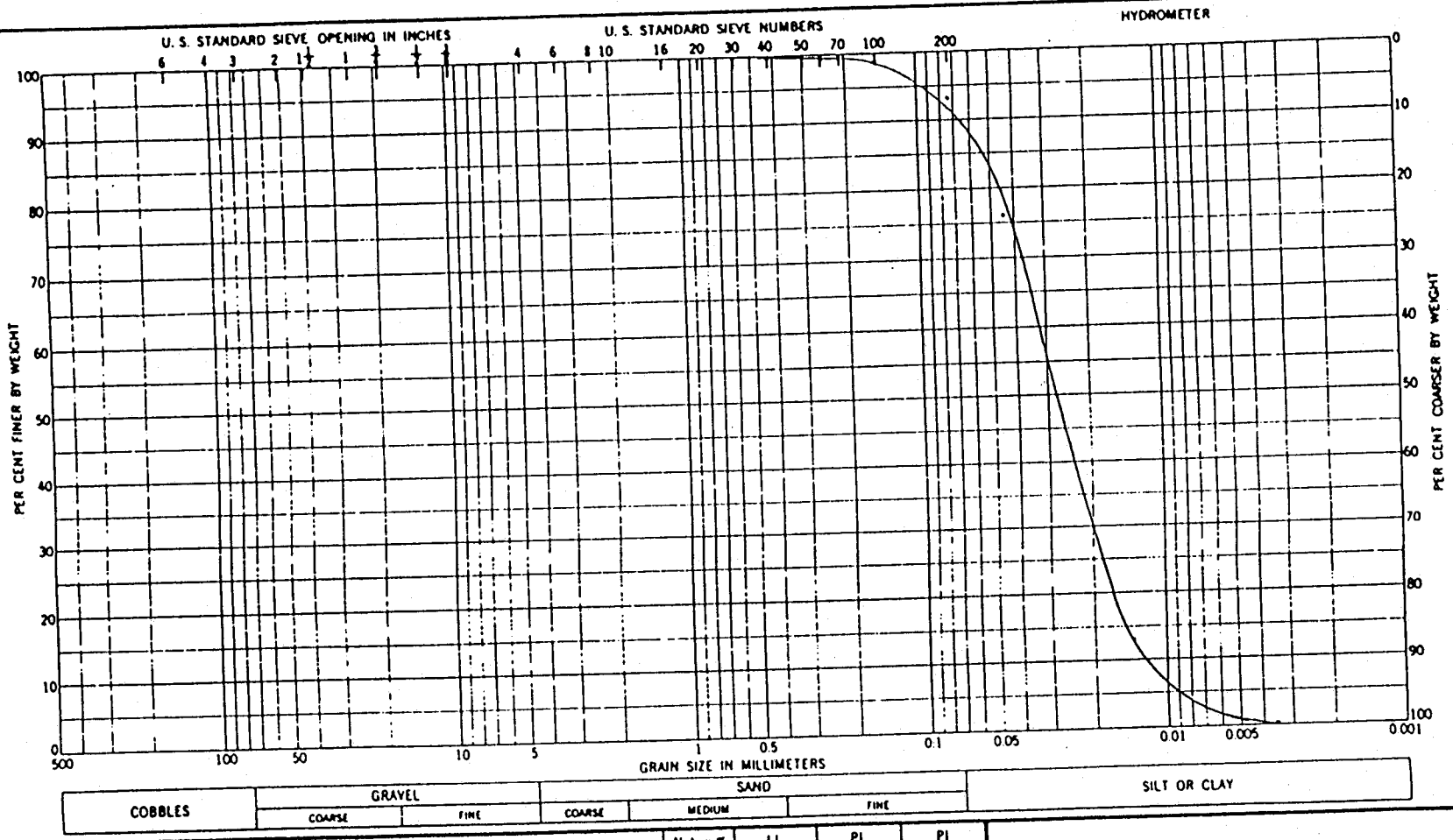
CONSOLIDATION TEST RESULTS

ATEC
ASSOCIATES, INC.

Project R.J. REYNOLDS

Job No. 32-82027

Date 12/20/88



Boring No	Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	-	-	Coal Fly Ash, Tobaccoville Plant.	-	-	-	-

GRADATION CURVES

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REPORT OF: MOISTURE DENSITY TEST
ASTM D-698, METHOD A, STANDARD

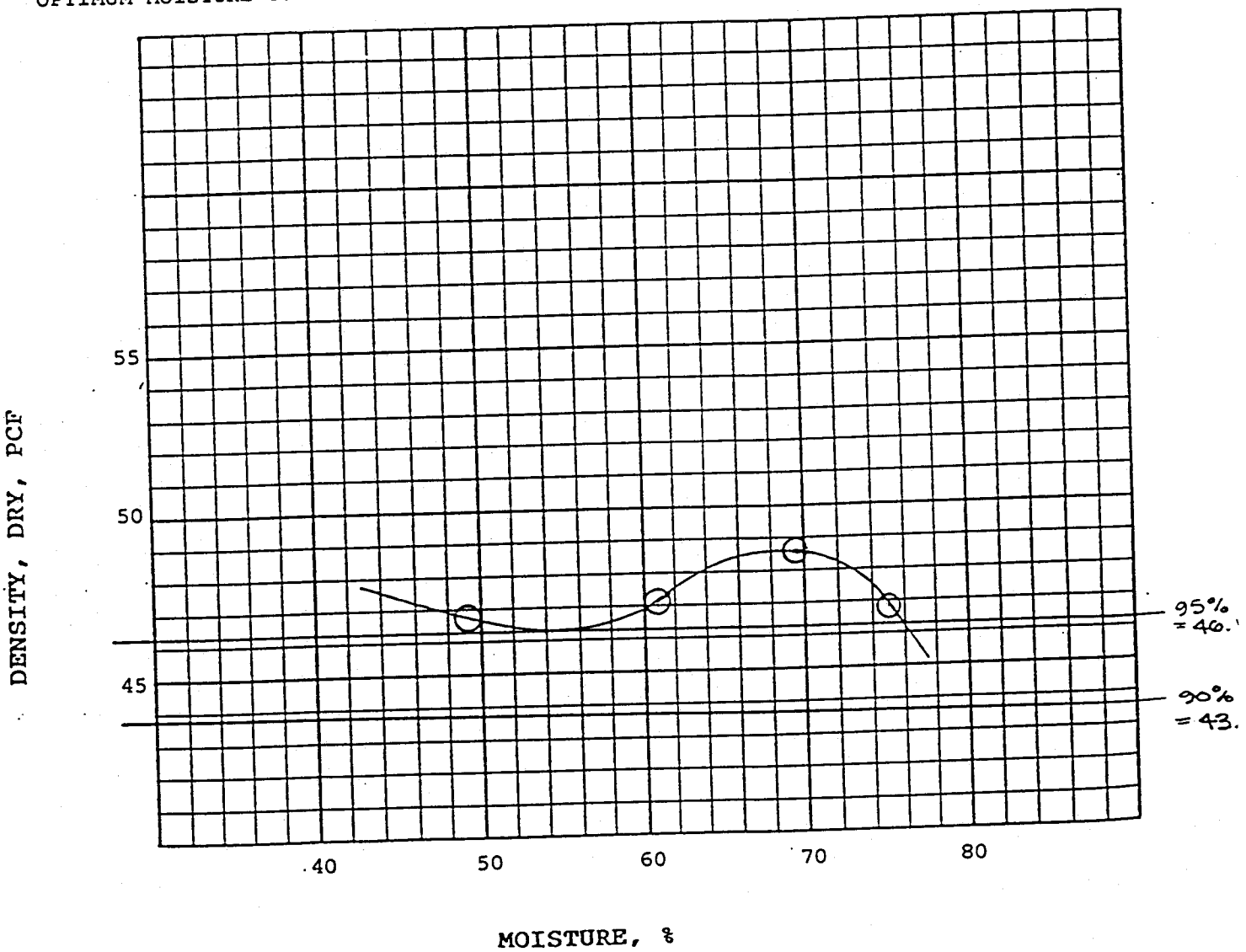
Date: 1/9/89

ect: R.J. REYNOLDS

Job No.: 32-82027

t: KBK Enterprises, Incorporated

MATERIAL: Coal Ash, Tobaccoville Plant.
MAXIMUM DRY DENSITY: 48.6 PCF.
OPTIMUM MOISTURE CONTENT: 69.8%.



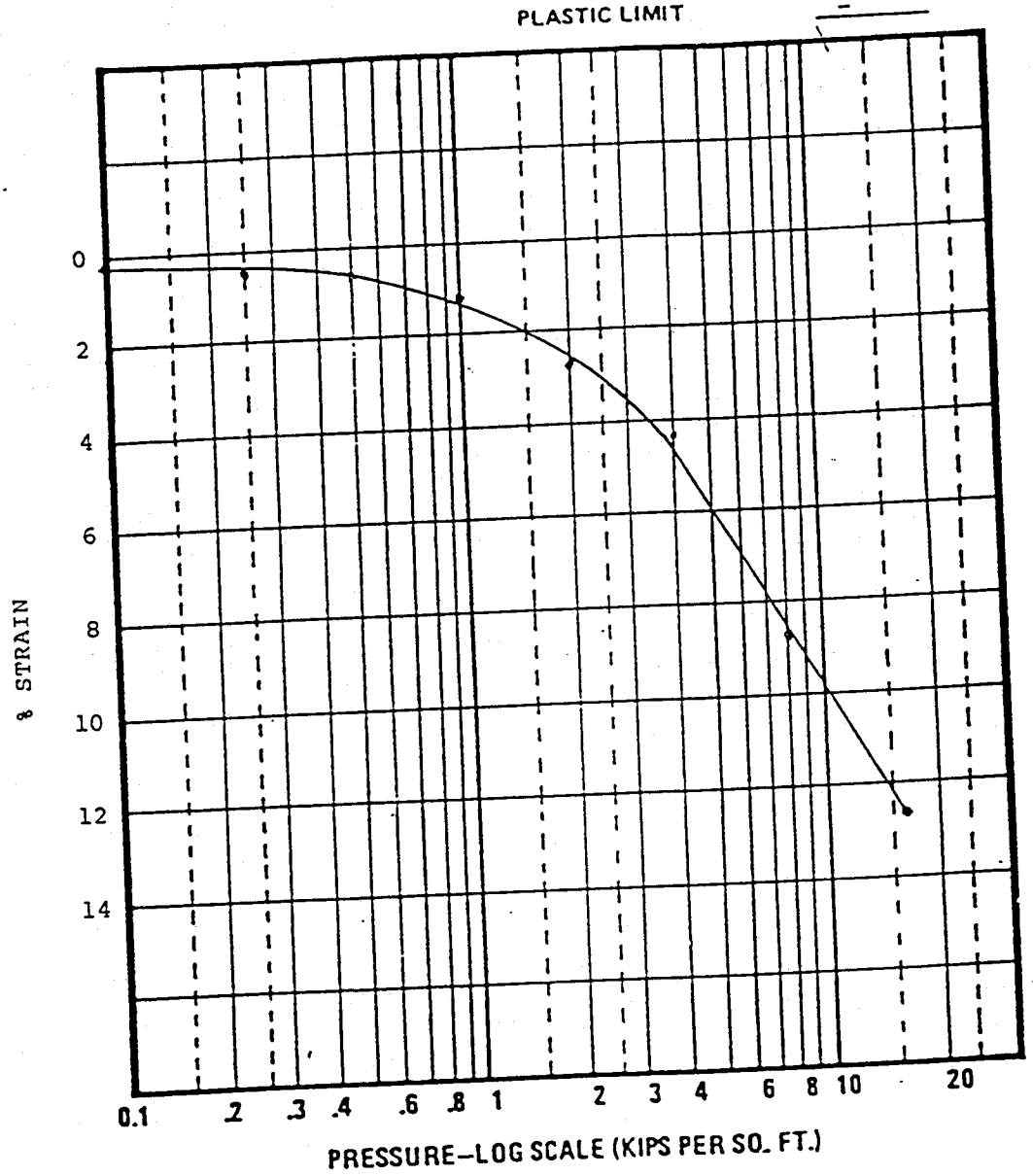
J.R

PROJECT R.J. REYNOLDS

CLIENT: KBK Enterprises, Inc.

DESCRIPTION Coal Fly Ash, Tobaccoville Plant

COMPRESSION INDEX	0.41	
DRY UNIT WEIGHT (PCF)	45.8	- 54.2%
WATER CONTENT (%)	68.9	- 0.9%
SATURATION (%)	73.8	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	



CONSOLIDATION TEST RESULTS

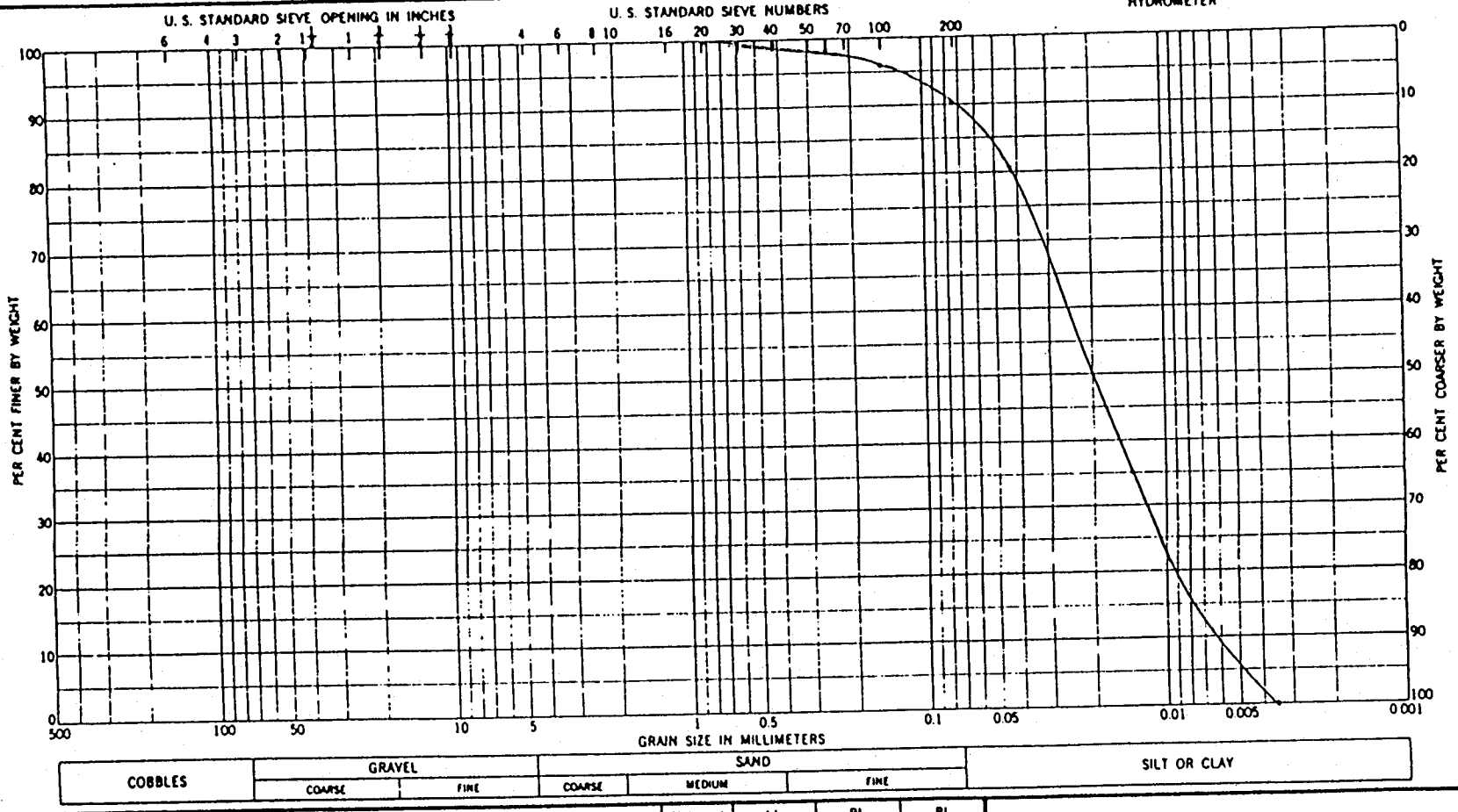
ATEC

ATEC ASSOCIATES, INC.

Project R.J. REYNOLDS

Job No. 32-82027

Date 12/20/88



Boring No.	Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
-	-	-	Coal Fly Ash, Whitacker Park.	-	-	-	-

GRADATION CURVES

ATEC Associates, Inc.
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404/427-9456

REPORT OF: MOISTURE DENSITY TEST

ASTM D-698, METHOD A, STANDARD

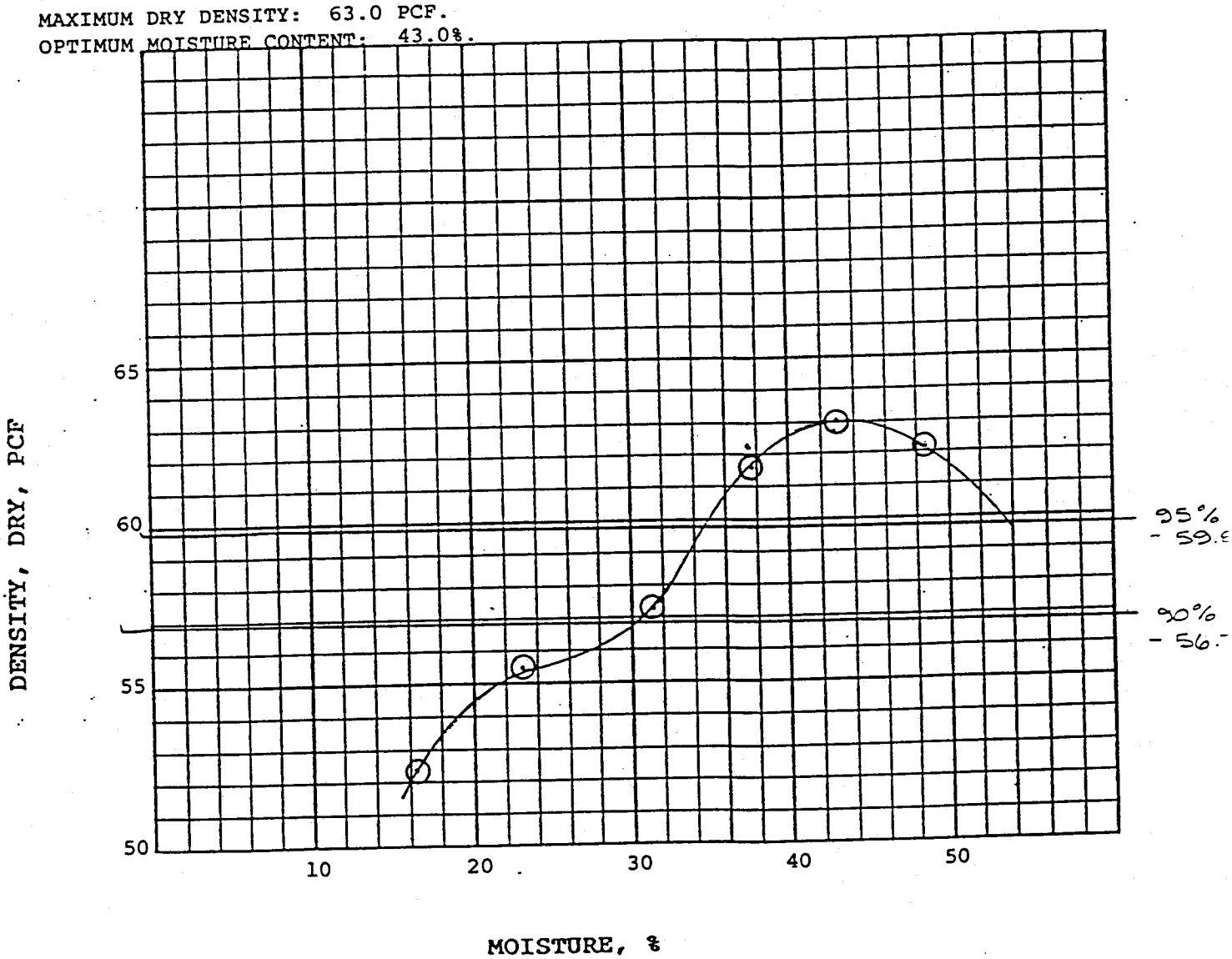
Date: 1/9/89

ect: R.J. REYNOLDS

Job No.: 32-82027

nt: KBK Enterprises, Incorporated

MATERIAL: Coal Fly Ash, Whitacker Park Plant.
MAXIMUM DRY DENSITY: 63.0 PCF.
OPTIMUM MOISTURE CONTENT: 43.0%.

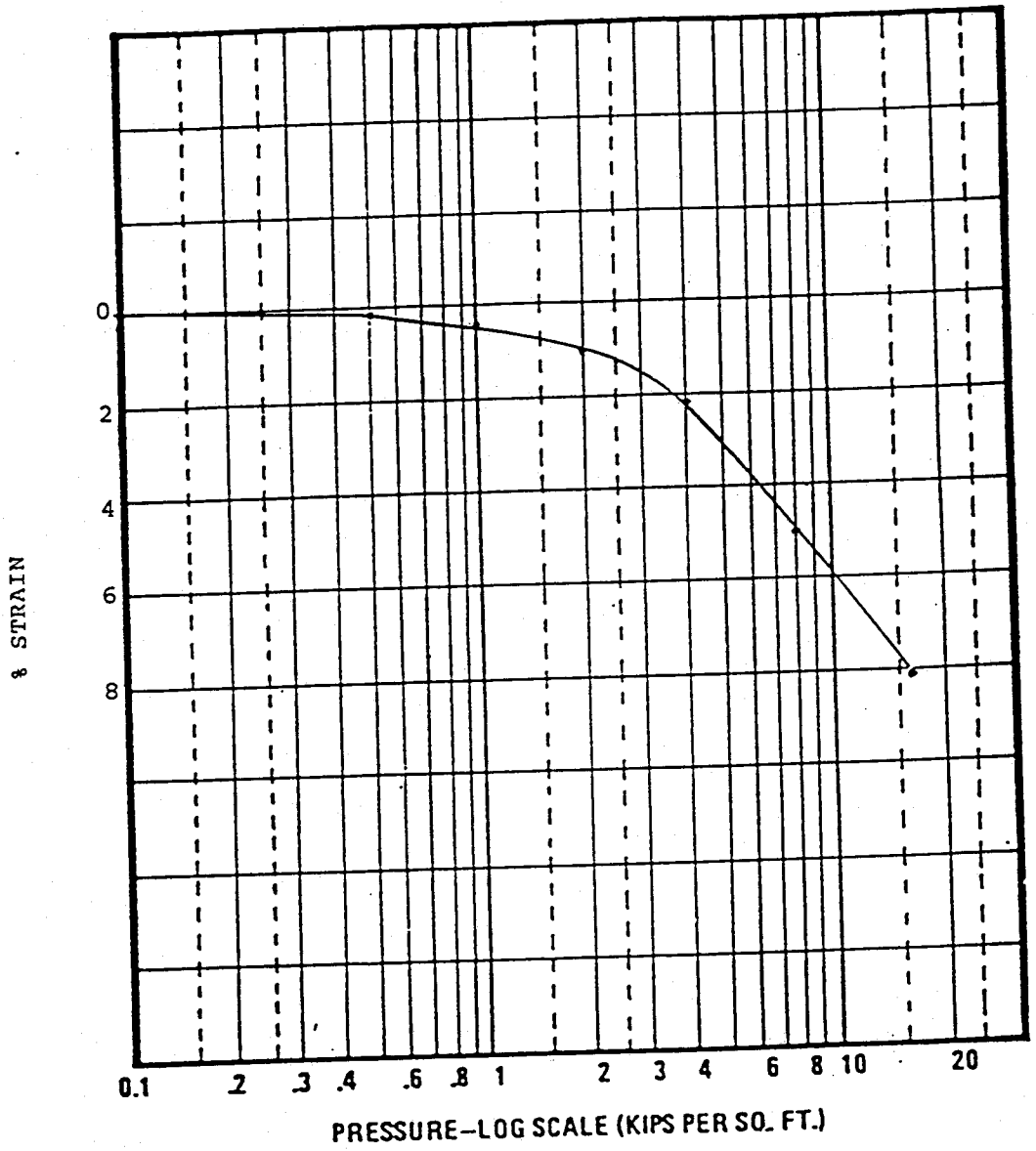


PROJECT R.J. REYNOLDS

CLIENT: KBK Enterprises, Inc.

DESCRIPTION Coal Fly Ash, Whitacker Park Plant

COMPRESSION INDEX	0.25	
DRY UNIT WEIGHT (PCF)	62.3	- 95.9%
WATER CONTENT (%)	38.9	- 4.1%
SATURATION (%)	62.3	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	



CONSOLIDATION TEST RESULTS

ATEC

ASSOCIATES, INC.

R.J. REYNOLDS TOBACCO COMPANY

	SAMPLE 1	SAMPLE 2	SAMPLE 3
PLANT	WHITAKER PARK	BAILEY POWER PLANT	TOBACCO-VILLE
MOISTURE CONTENT			
AVG.	1.3%	28.3%	39.0%
LOSS ON IGNITION			
AVG.	17.73%	8.7%	25.41%

TESTED BY JDP

DATE TESTED 1/3/89

SIGNED H.B. Flynt

APPENDIX 2
E.P. TOXICITY DATA

RESEARCH & ANALYTICAL LABORATORIES, INC.

N.C. CERT. #34

25 February 1985

R.J. Reynolds Tobacco Company
11th Floor Plaza Building
Winston-Salem, NC 27102

Attention: Mr. Bill Howard

Sample Number: 4844
Sample Date: February 4, 1985
Sample Received: February 4, 1985
Sample Analyzed: February 4-25, 1985
Report Date: February 25, 1985
Sample Source: #1 Fly Ash
Analysts: Vaden/Champion

PARAMETER	EP TOXICITY NUMBER	RESULTS (mg/l)	SPIKE I (mg/l)	% RECOVERY	SPIKE 2 (mg/l)	% RECOVERY	SPIKE 3 (mg/l)	% RECOVE
Arsenic	D-004	0.024	0.022	101%	0.044	102%	0.11	102%
Barium	D-005	1.7	1.0	100%	2.5	115%	5.0	97%
Cadmium	D-006	< 0.0050	0.040	111%	0.080	100%	0.10	100%
Chromium	D-007	< 0.010	0.10	100%	0.20	94%	0.30	100%
Lead	D-008	< 0.10	0.40	100%	1.25	100%	2.0	100%
Mercury	D-009	< 0.0050	0.010	107%	0.020	100%	0.030	104%
Selenium	D-010	< 0.0030	0.0060	108%	0.012	94%	0.025	89%
Silver	D-011	< 0.010	0.040	100%	0.080	100%	0.16	107%

P. O. Box 473 • 106 Short Street • Kernersville, North Carolina 27284 • 919/996-2841

RESEARCH & ANALYTICAL LABORATORIES, INC.

Analytical/Process Consultations

R.J. Reynolds Tobacco Company
P.O. Box 2959, P/LS-F1.4A
Winston-Salem, NC 27102
Attn: Bill Howard

Date Sample Collected : 03/22/89
Date Sample Received : 03/22/89
Date Sample Analyzed : 03/23/89
Date of Report : 04/10/89
Analyses Performed by : CS

Job Number : 00419 K

Lab Sample Number
52726

Parameter	Storet #	Results
Arsenic, Tot	RCRA(D-004)	<0.010 mg/l
Barium, Tot-	RCRA(D-005)	0.015 mg/l
Cadmium, Tot	RCRA(D-006)	<0.010 mg/l
Chrom. Tot-	RCRA (D-007)	0.029 mg/l
Lead, Tot	RCRA (D-008)	<0.10 mg/l
Selenium Tot	RCRA(D-010)	0.051 mg/l.
Silver, Tot	RCRA(D-011)	<0.016 mg/l...
Mercury, Tot	RCRA(D-009)	0.0003 mg/l

Clients Sample Source/Number TOBACCOVILLE FLY ASH

XC: CLM

EP TOX 1980

TABLE III

TOXICANT LEVEL IN EXTRACT

Sample Description	Date of Sample	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
Blank		0	0	0	0.02	0	0	0	0
Blank		0	0	0	0	0	0	0	0
Blank		0	0	0	0.01	0	0	0	0
Fly Ash #2 Silo	3/13/79	0	0.2	0	0.02	0	0	0.013	0
B.P.P. Wet Ash Hydrobin	3/15/79	0	1.0	0	0	0	0	0	0
B.P.P. Wet Ash Hydrobin	3/15/79	0	1.467	0	0	0	0	0	0.0
B.P.P. Fly Ash	3/16/79	0	0	0	0	0	0	0.032	0.0
B.P.P. Wet Ash Hydrobin	3/20/79	0	0.867	0	0.02	0	0	0	0.0
B.P.P. Fly Ash #2 Silo	3/22/79	0	0	0	0.01	0	0	0.007	0.0
B.P.P. Wet Ash Hydrobin	3/23/79	0	0.800	0	0.01	0	0	0	0.0
B.P.P. Fly Ash #2 Silo	3/23/79	0	0.200	0	0.02	0	0	0.018	0.0
B.P.P. Fly Ash #1 Silo	3/27/79	0	0	0	0.02	0	0	0	0.0
B.P.P. Wet Ash #1 Load	3/28/79	0	0.800	0	0.02	0	0	0	0.0
B.P.P. Wet Ash Last Load	3/28/79	0	0.867	0	0	0	0	0	0
B.P.P. Fly Ash #2 Silo	3/30/79	0	0.267	0	0.01	0	0	0	0.0
B.P.P. Wet Ash Hydrobin	4/2/79	0	0.800	0	0	0	0	0	0
B.P.P. Fly Ash #1 Silo	4/4/79	0	0	0	0	0	0	0	0
B.P.P. Wet Ash Hydrobin	4/5/79	0	1.200	0	0.01	0	0	0	0
B.P.P. Fly Ash #1 Silo	4/5/79	0	0.333	0	0	0	0	0	0.0
W.P.P. Precip. Dust	3/14/79	0.1	0.200	0.15	0.13	0	0	0	0.0
W.P.P. Boiler Ash	3/14/79	0	0.467	0	0.01	0	0	0	0.0
W.P.P. Precip. Dust	3/21/79	0.1	0	0.15	0.23	0	0	0.005	0.0
W.P.P. Boiler Ash	3/21/79	0	0.400	0	0	0.1	0	0	0.0
W.P.P. Precip. Dust	3/28/79	0	0.200	0.15	0.01	0	0	0.063	0.0
W.P.P. Boiler Ash	3/28/79	0	0.267	0	0.02	0	0	0	0.0
W.P.P. Precip. Dust	4/5/79	0	0	0.09	0.01	0	0	0.007	0
W.P.P. Boiler Ash	4/5/79	0	0.800	0	0	0	0	0	0.0

DATE

B.P.P. — BAILEY POWER PLANT

WPP — WHITAKER PARK PLANT

KBK Enterprises, Inc.
A SUBSIDIARY OF JTM INDUSTRIES, INC.

777 FRANKLIN ROAD, SUITE 700
MARIETTA, GEORGIA 30067
(404) 426-5944

3191 SOUTH VALLEY STREET, SUITE 208
SALT LAKE CITY, UTAH 84109
(801) 484-3131

APPENDIX III
TCLP Analyses

RESEARCH & ANALYTICAL LABORATORIES, INC.

Analytical/Process Consultations

R.J. Reynolds Tobacco Company
P.O. Box 2959, P/LS-F1.4A
Winston-Salem, NC 27102
Attn: Bill Howard

Date Sample Collected : 06/01/93
Date Sample Received : 06/03/93
Date Sample Analyzed : 06/04/93
Date of Report : 07/06/93
Analyses Performed by : SK -TB -DW

Job Number : 00419 K

Lab Sample Number
169452

Parameter	Storet #	Results
Arsenic, TCLP		<0.050 MG/L
Barium, TCLP		0.25 MG/L
Cadmium,TCLP		<0.010 MG/L
Chromium, TCLP		0.13 MG/L
Lead, TCLP		<0.10 MG/L
Mercury, TCLP		<0.002 MG/L
Selenium, TCLP		0.57 MG/L
Silver, TCLP		<0.010 MG/L
Arsenic,Tot	(01002)	46 MG/KG
Barium,Tot	(01007)	210 MG/KG
Cadmium,Tot	(01027)	0.79 MG/KG
Chromium,Tot	(01034)	37.3 MG/KG
Lead,Tot	(01051)	90 MG/KG
Mercury,Tot	(71900)	0.75 MG/KG
Selenium,Tot	(01147)	99.2 MG/KG
Silver,Tot	(01077)	<0.66 MG/KG
BTU		3169/LB

Clients Sample Source/Number : 602 UP FLY ASH
Time Collected (Hrs) :

RESEARCH & ANALYTICAL LABORATORIES, INC.

Analytical/Process Consultations

R.J. Reynolds Tobacco Company
P.O. Box 2959, P/LS-F1.4A
Winston-Salem, NC 27102
Attn: Bill Howard

Date Sample Collected : 06/01/93
Date Sample Received : 06/03/93
Date Sample Analyzed : 06/04/93
Date of Report : 07/06/93
Analyses Performed by : SK -TB -GL

Job Number : 00419 K

Lab Sample Number

169451

Parameter	Storet #	Results
Arsenic, TCLP		<0.050 MG/L
Barium, TCLP		0.66 MG/L
Cadmium,TCLP		<0.010 MG/L
Chromium, TCLP		<0.020 MG/L
Lead, TCLP		<0.10 MG/L
Mercury, TCLP		<0.002 MG/L
Selenium, TCLP		<0.10 MG/L
Silver, TCLP		<0.010 MG/L
Arsenic,Tot	(01002)	<0.62 MG/KG
Barium,Tot	(01007)	10.8 MG/KG
Cadmium,Tot	(01027)	<0.625 MG/KG
Chromium,Tot	(01034)	17.4 MG/KG
Lead,Tot	(01051)	<6.25 MG/KG
Mercury,Tot	(71900)	<0.12 MG/KG
Selenium,Tot	(01147)	<0.31 MG/KG
Silver,Tot	(01077)	<0.63 MG/KG
BTU		699/LB

Clients Sample Source/Number :	602 UP
Time Collected (Hrs) :	

RESEARCH & ANALYTICAL LABORATORIES, INC.

Analytical/Process Consultations

R.J. Reynolds Tobacco Company
P.O. Box 2959, P/LS-F1.4A
Winston-Salem, NC 27102
Attn: Bill Howard

Date Sample Collected : 06/01/93
Date Sample Received : 06/03/93
Date Sample Analyzed : 06/04/93
Date of Report : 07/06/93
Analyses Performed by : SK -TB -GL

Job Number : 00419 K

Lab Sample Number
169453

Parameter	Storet #	Results
Arsenic, TCLP		<0.050 MG/L
Barium, TCLP		0.47 MG/L
Cadmium,TCLP		<0.010 MG/L
Chromium, TCLP		0.084 MG/L
Lead, TCLP		<0.10 MG/L
Mercury, TCLP		<0.002 MG/L
Selenium, TCLP		<0.10 MG/L
Silver, TCLP		<0.010 MG/L
Arsenic,Tot	(01002)	14 MG/KG
Barium,Tot	(01007)	536 MG/KG
Cadmium,Tot	(01027)	<0.57 MG/KG
Chromium,Tot	(01034)	10.9 MG/KG
Lead,Tot	(01051)	14.4 MG/KG
Mercury,Tot	(71900)	0.52 MG/KG
Selenium,Tot	(01147)	21.5 MG/KG
Silver,Tot	(01077)	<0.57 MG/KG
BTU		1850/LB

Clients Sample Source/Number : TOBACCOVILLE UP
Time Collected (Hrs) :

RESEARCH & ANALYTICAL LABORATORIES, INC.
Analytical/Process Consultations

R.J. Reynolds Tobacco Company
P.O. Box 2959, P/LS-F1.4A
Winston-Salem, NC 27102
Attn: Bill Howard

Date Sample Collected : 06/01/93
Date Sample Received : 06/03/93
Date Sample Analyzed : 06/04/93
Date of Report : 07/06/93
Analyses Performed by : SK -TB -DW

Job Number : 00419 K

Lab Sample Number
169454

Parameter	Storet #	Results
Arsenic, TCLP		<0.050 MG/L
Barium, TCLP		0.44 MG/L
Cadmium,TCLP		0.015 MG/L
Chromium, TCLP		0.082 MG/L
Lead, TCLP		<0.10 MG/L
Mercury, TCLP		<0.002 MG/L
Selenium, TCLP		<0.10 MG/L
Silver, TCLP		0.012 MG/L
Arsenic,Tot	(01002)	15 MG/KG
Barium,Tot	(01007)	137 MG/KG
Cadmium,Tot	(01027)	<0.60 MG/KG
Chromium,Tot	(01034)	24.1 MG/KG
Lead,Tot	(01051)	22.2 MG/KG
Mercury,Tot	(71900)	<0.12 MG/KG
Selenium,Tot	(01147)	<6.02 MG/KG
Silver,Tot	(01077)	<0.60 MG/KG
BTU		2249/LB

Clients Sample Source/Number : BAILEY UP
Time Collected (Hrs) :

APPENDIX IV
Site Drawings

APPENDIX V
Well Construction Records

RH - MW - 003

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919) 733-5083

FOR OFFICE USE ONLY

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR ATEC ASSOCIATES INC.

DRILLER REGISTRATION NUMBER 696

STATE WELL CONSTRUCTION PERMIT NUMBER: _____

WELL LOCATION: (Show sketch of the location below)

Nearest Town: Rural Hall, NC

County: _____

(Road, Community, or Subdivision and Lot No.)

OWNER RJ Reynold's

ADDRESS 1100 Reynold's Blvd.
(Street or Route No.)

Winston Salem, NC 27102
City or Town State Zip Code

DATE DRILLED 12-7-89 USE OF WELL Monitor

TOTAL DEPTH 17' CUTTINGS COLLECTED ☒ Yes ☐ No

DOES WELL REPLACE EXISTING WELL? ☐ Yes ☐ No

STATIC WATER LEVEL: 14 FT. ☐ above ☒ below TOP OF CASING,

TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.

YIELD (gpm): NA METHOD OF TEST _____

WATER ZONES (depth): NA

CHLORINATION: Type _____ Amount _____

CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To 7 Ft.	2"	Sch 40	PVC
From		To Ft.			
From		To Ft.			

GROUT:

	Depth		Material	Method
From	0'	To 3 Ft.	NEAT CEMENT	TREMIC
From		To Ft.		

SCREEN:

	Depth		Diameter	Slot Size	Material
From	7	To 17 Ft.	2" in.	.10 in.	PVC
From		To Ft.	in.	in.	
From		To Ft.	in.	in.	

GRAVEL PACK:

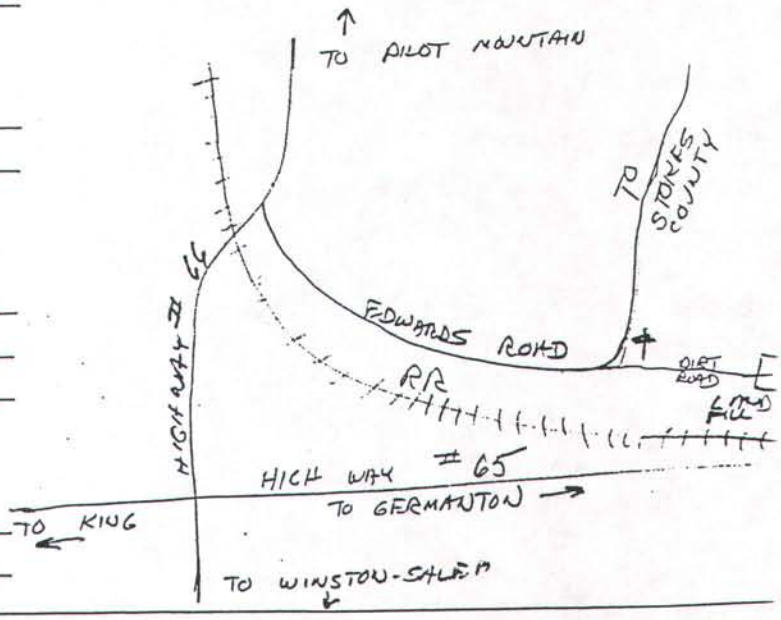
	Depth		Size	Material
From	5'	To 17 Ft.	TORPEDO	SAND
From		To Ft.		

Depth From	Depth To	DRILLING LOG Formation Description
0	9'	Weathered & Decomposed Rock
9'-	17'	Very hard granite with quartz seams

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)



REMARKS: _____

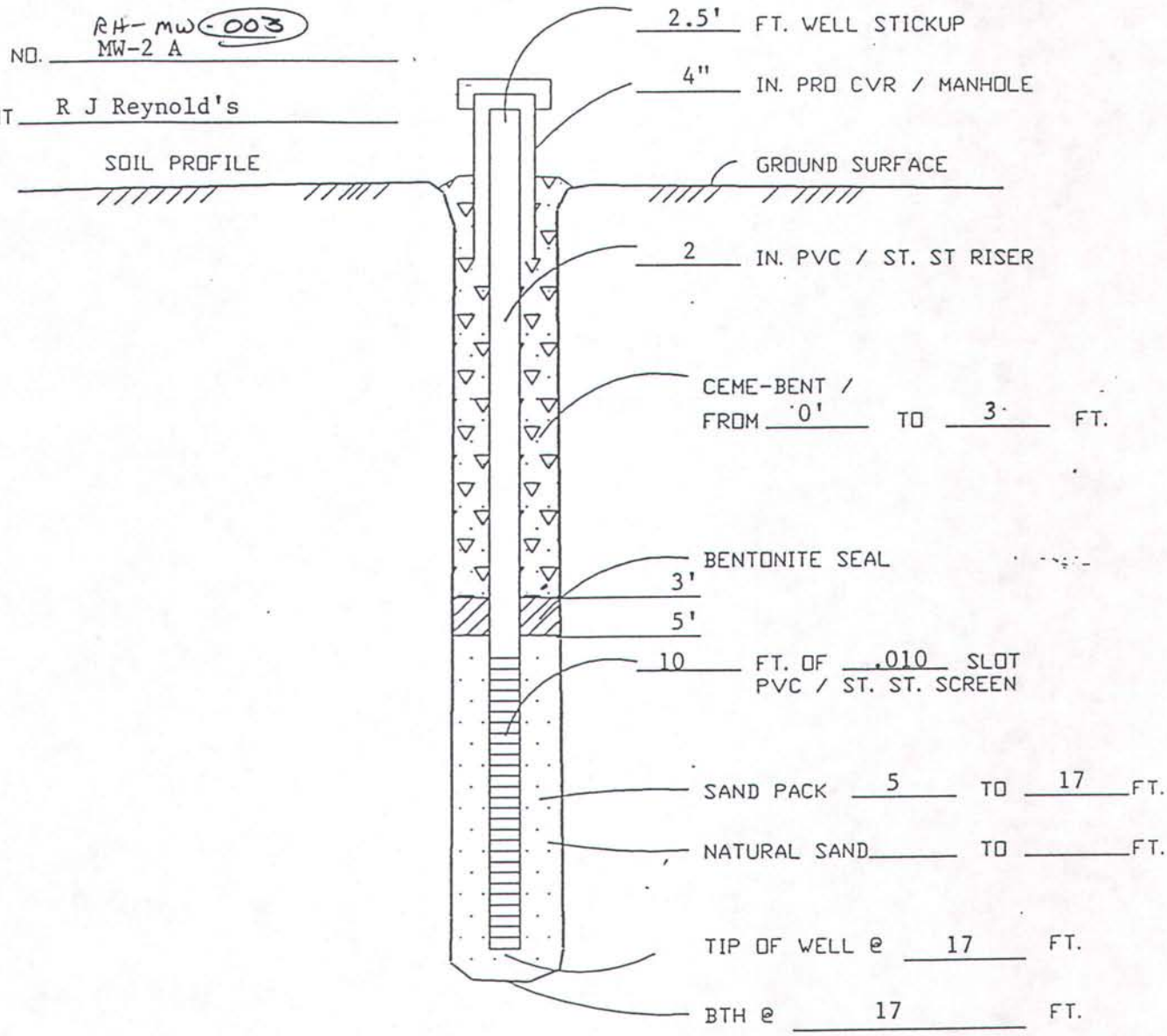
I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Donald Quintana 12-7-89

MONITORING WELL CONSTRUCTION FIELD DETAILS

WELL NO. RH-MW-003 MW-2 A

CLIENT R J Reynold's



NO. OF SPLIT SPOONS ____

MATERIALS USED		
RISER	9.5	FT.
SCREEN	10	FT.
SAND	3	BAGS
CEMENT	3	BAGS
BENT. PWDR.	1/4	BAGS
BENT. PELLETS	1/2	BKTS
/ PRO CVR IN.	4"	
INNER LOCK. CAP		
PADLOCK	/	
TOP CAP Locking	/	
GUARD POSTS	NO	
BOTTOM PLUG	2"	

DATE INSTALLED: 12-7-89

DATE DEVELOPED: 12-7-89

METHOD OF DRILLING: Core Rotary

METHOD OF DEVELOP: Bail

DURATION OF DEVELOP: 1 hour

GROUNDWATER LEVEL OBSERVATIONS

DURING DRILLING N.A. FEET

IN WELL

DATE	ELEV., (FT.)
12-7-89	14'

PROJECT NO. 91042

DRILLER S. Sweeting

INSPECTOR C.L. Martin

ATEC

NO SCALE

ATEC Associates, Inc.
of North Carolina
6814 Davis Circle
Raleigh, North Carolina 27612
(919) 782-2832. FAX # (919) 781-7558

RECORD OF SOIL EXPLORATION

CLIENT RJ Reynold's
PROJECT NAME Monitor well's
PROJECT LOCATION Rural HAll, NC
BORING METHOD Rotary Roller Bit
ROCK CORE DIA. _____ in.
SHELBY TUBE O.D. _____ in.

BORING NO. MW 2 A (W-3)
JOB NO. 35-91042 DATE 12-7-89
STATION
FOREMAN Sanford Sweeting
INSPECTOR CL Martin

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
								Weathered & Decomposed Rock To 9
			9'					Very hard granite with quartz seam's 9' To 17'
			17'					BTH 17'

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGER
DC – DRIVEN CASING
MD – MUD DRILLING
RC – ROCK CORING

GROUND WATER
NOTED ON RODS _____ FT.
AT COMPLETION _____ FT.
AFTER _____ HRS. _____ FT.

*THESE SHELBY TUBE SAMPLES OBTAINED IN BORING _____ DRILLED A FEW FEET FROM BORING _____
**STANDARD PENETRATION TEST

BORING LOG

GEO-ENVIRONMENTAL CONSULTANTS, INC.

DATE: June 8, 1993

Report No.: 93011

Client: R. J. Reynolds Tobacco Company

Project: R. J. Reynolds Coal Ash Management Area Forsythe County, NC

Location: See Drawing 5

Boring No.: W-4 (1 of 5) | Total Depth 193.0' | Elev: 1014±

Driller: D. Brown

Type of Boring: HSA/Air Hammer | Started: 5/17/93 | Completed: 5/17/93

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (Feet)	OVA (PPM)	WELL LOG	REMARKS
		Stiff, brown and red clayey SILT with trace mica, damp (MH)					
				5.0			
			6/6/7	6.5			
				10.0			
1004.4	10.0	Stiff, tan sandy SILT, with little mica, moist (ML)	5/5/4	11.5			
				15.0			
			7/7/9	16.5			
				20.0			
994.4	20.0	Stiff, brown micaceous sandy SILT, moist (ML)	6/8/10	21.5			
				25.0			Grout (0-127')
			8/8/9	26.5			
				30.0			
			8/10/12	31.5			
				35.0			
979.4	35.0	Dense, brown and grey micaceous silty SAND, trace of weathered rock fragments, moist (SM)	12/13/15	36.5			
				40.0			
			23/50-3"	40.6			
				45.0			

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

BORING LOG

GEO-ENVIRONMENTAL CONSULTANTS, INC.

Report No.: 93011

DATE: June 8, 1993

Client: R. J. Reynolds Tobacco Company

Project: R. J. Reynolds Coal Ash Management Area Forsythe County, NC

Boring No.: W-4 (4 of 5) | Total Depth 193.0' | Elev: 1014± | Location: See Drawing 5

Type of Boring: HSA/Air Hammer | Started: 5/17/93 | Completed: 5/17/93 | Driller: D. Brown

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (Feet)	OVA (PPM)	WELL LOG	REMARKS
871.4	143.0	Some possible fractures present					
	▼						Sand Pack (131-188.6')
							2" Sch 40 PVC Screen .01" Slot (138-188.1')
836.4	178.0	Chlorite schist, greenish grey, medium grained, schistosity well developed, dry					

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

BORING LOG

GEO-ENVIRONMENTAL CONSULTANTS, INC.

Report No.: 93011

DATE: June 8, 1993

Client: R. J. Reynolds Tobacco Company

Project: R. J. Reynolds Coal Ash Management Area Forsythe County, NC

Boring No.: W-4 (5 of 5) | Total Depth 193.0' | Elev: 1014± | Location: See Drawing 5

Type of Boring: HSA/Air Hammer | Started: 5/17/93 | Completed: 5/17/93 | Driller: D. Brown

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (Feet)	OVA (PPM)	WELL LOG	REMARKS
825.8	188.6	BORING TERMINATED @ 188.6 FEET.					

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

APPENDIX VI
Groundwater Sampling

The following groundwater sampling tables are identified as follows:

Rural Hall Supply Well	(PW-1)
Rural Hall Background Well	(W-4)
RHMW - 003	(W-3)

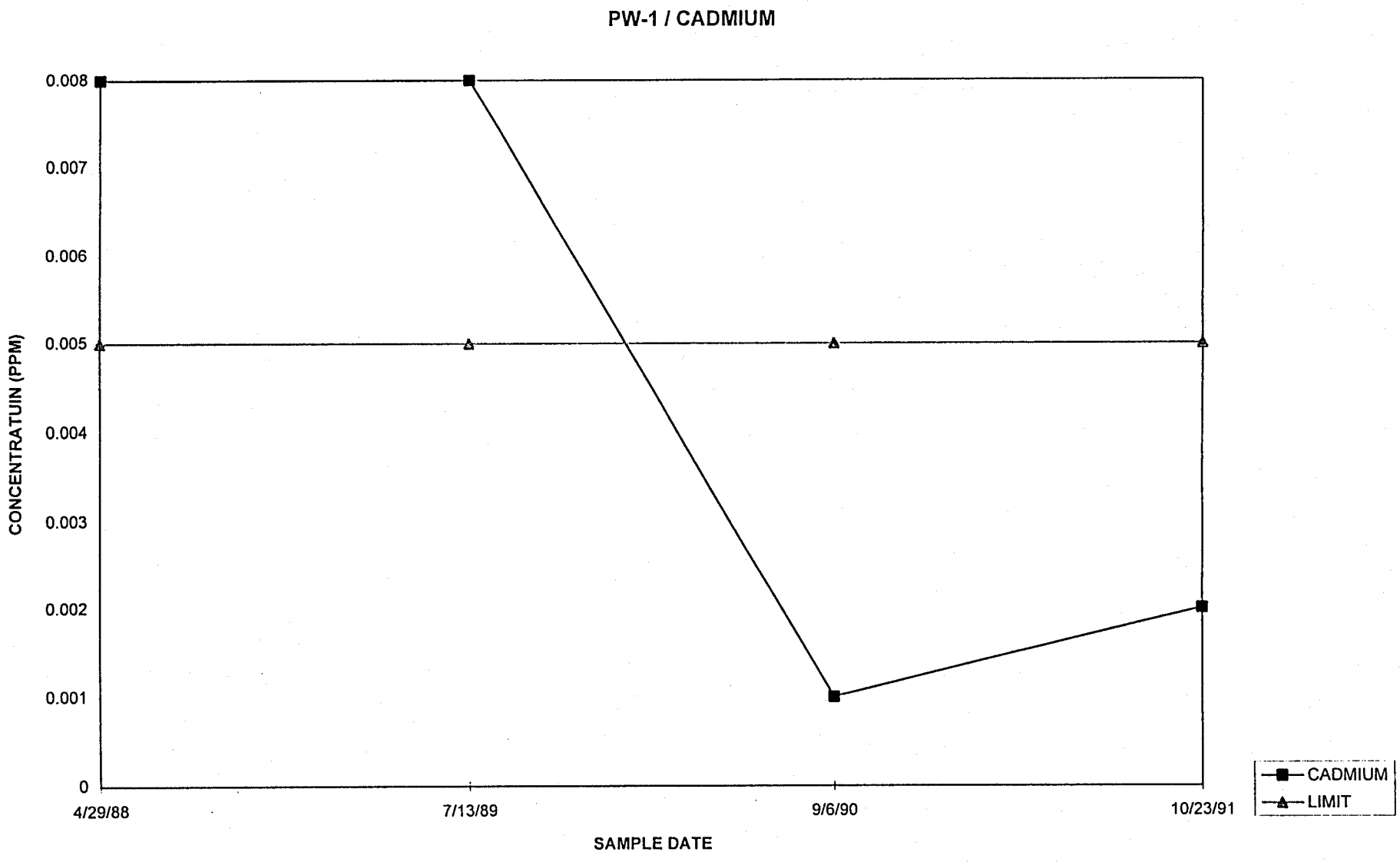
Also attached are graphs of the constituents which have recently been detected above the 2L Standards.

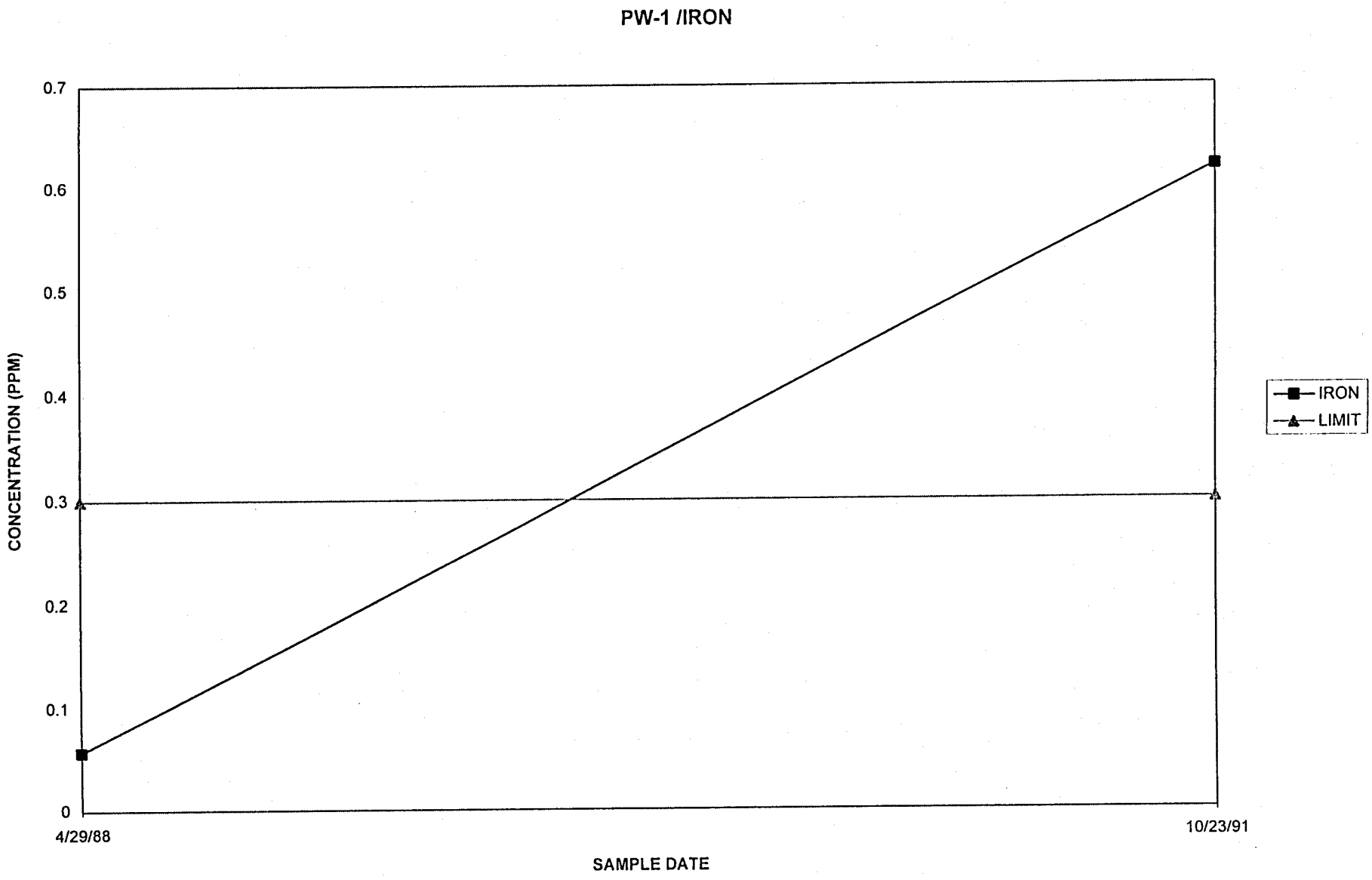
RURAL HALL FLYASH LANDFILL
MONITORING DATA
SUPPLY WELL (PW-1)

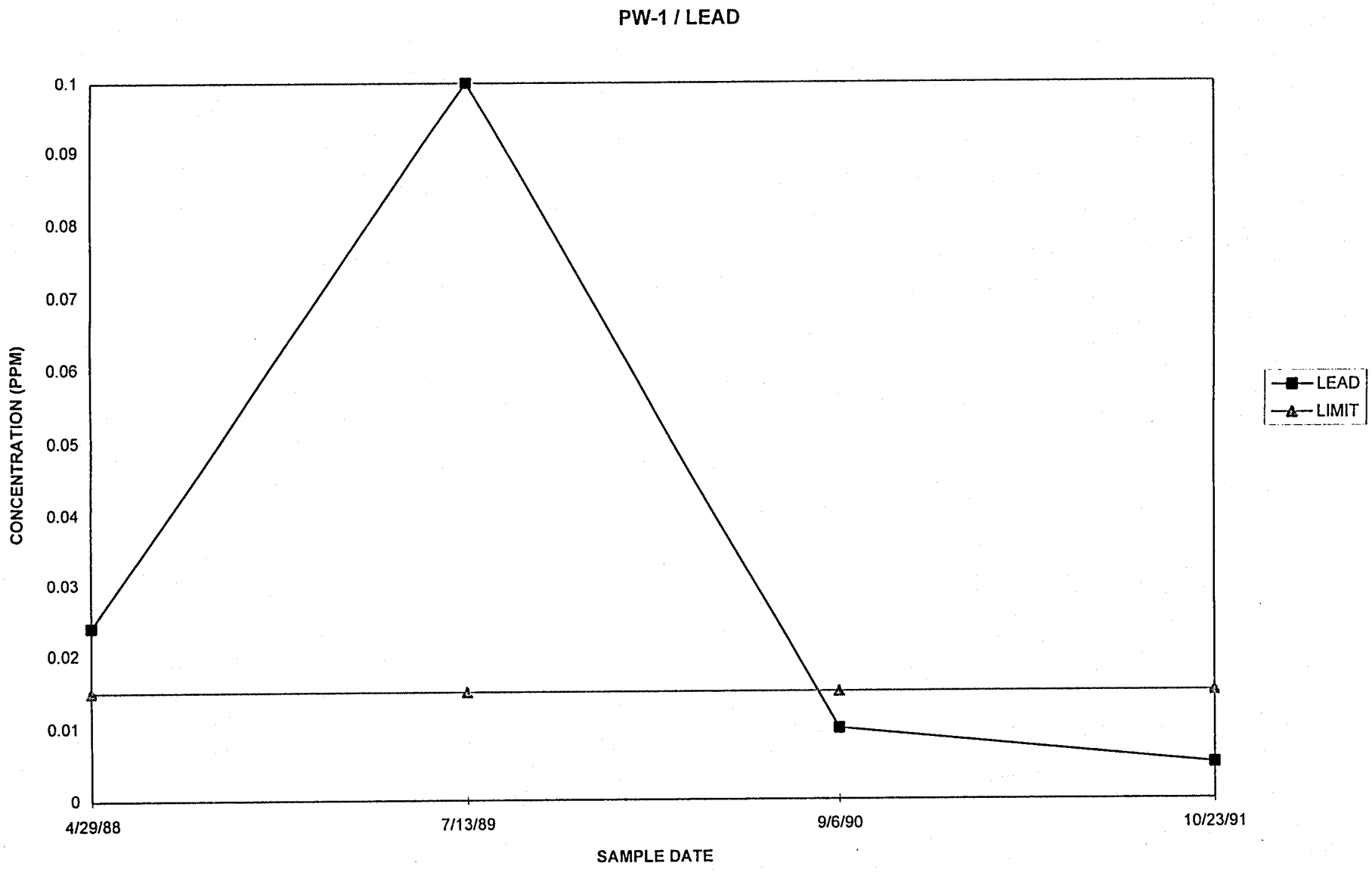
PARAMETER	Aluminum	Arsenic	Barium	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	NO-3-N
UNITS	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
LIMIT	N/A	0.050	2.000	0.005	1.000	0.050	0.300	0.015	0.050	0.0011	10.000
4/29/88	0.152	<0.011	0.059	0.008	0.057	<0.016	0.057	<0.024	0.314	<0.0002	1.520
7/13/89		<0.010	0.100	<0.008	<0.020			<0.100		<0.0002	
9/6/90		<0.010	0.090	<0.0010		<0.010		0.0099		<0.0002	
10/23/91	0.130	<0.010	<0.080	<0.002	<0.020	<0.040	0.620	<0.005	1.230	<0.0002	0.050

RURAL HALL FLYASH LANDFILL
MONITORING DATA
SUPPLY WELL (PW-1)

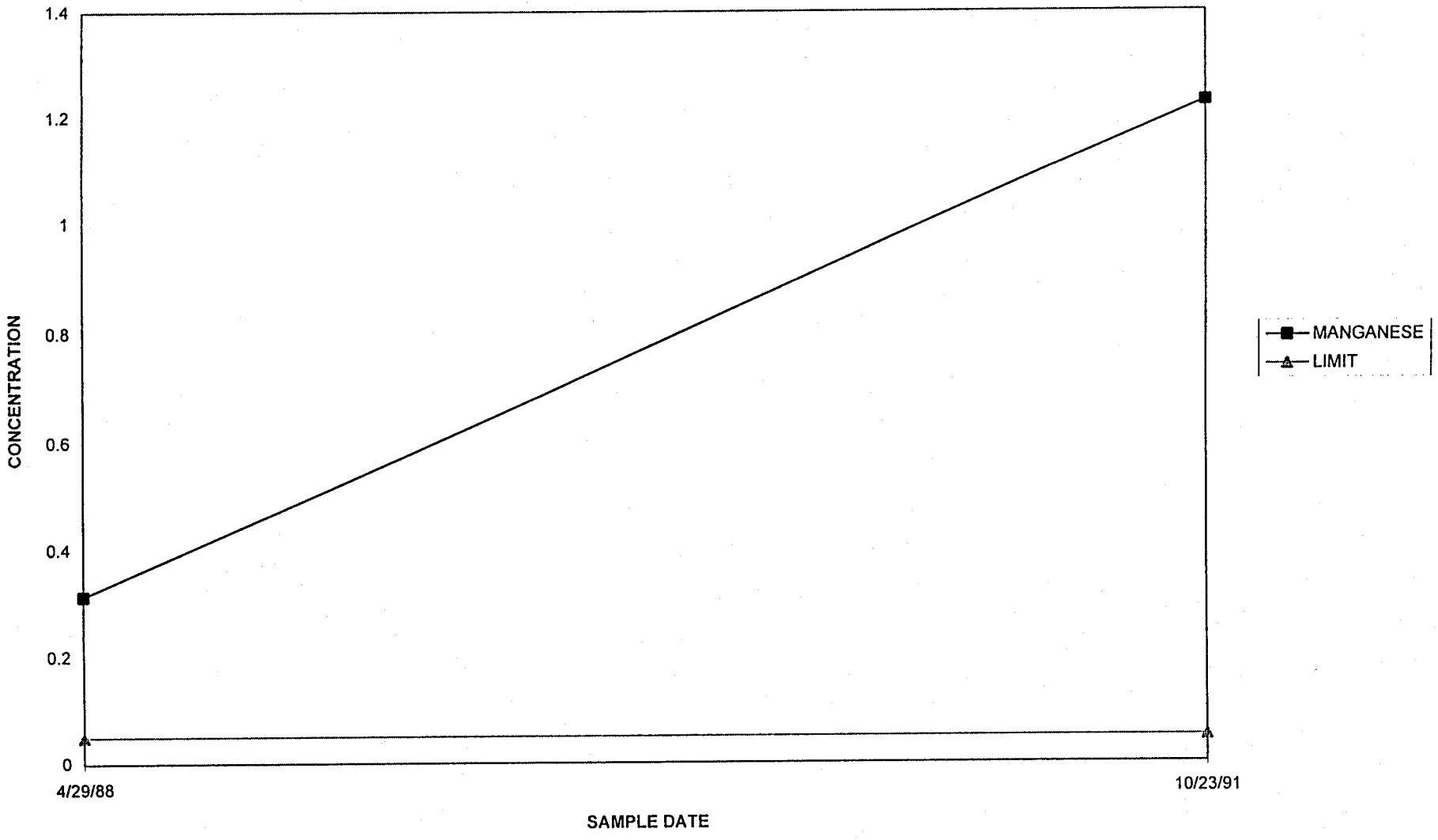
PARAMETER	Selenium	Silver	Sulfate	Zinc	pH	DS	Temp	TOC	Conductivity
UNITS	mg/1	mg/1	mg/1	mg/1	STD	mg/1	^{o}C	mg/1	ug/1
LIMIT	0.050	0.018	250.000	2.100	N/A	500	N/A	N/A	N/A
4/29/88	<0.005	<0.014	37.000	0.576	6.9	290		1.28	
7/13/89	<0.005	<0.006							
9/6/90	<0.005	<0.005			6.8				
10/23/91	<0.005	<0.010	460.000	3.310	6.410	850	15.1	8	1,247

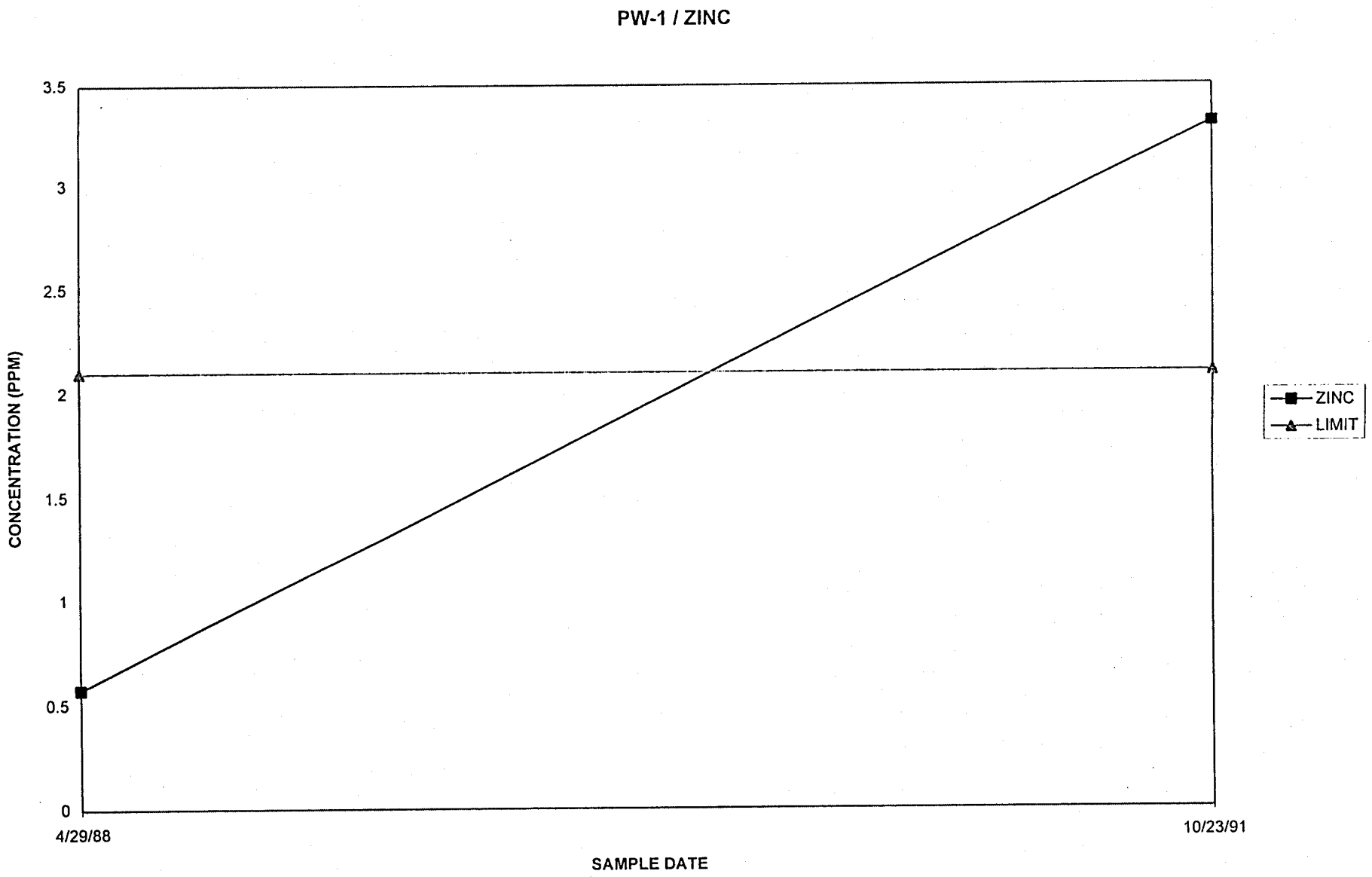

PW-1 / CADMIUM
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
CONCENTRATUIN (PPM)
4/29/88
7/13/89
9/6/90
10/23/91
SAMPLE DATE
CADMIUM
LIMIT

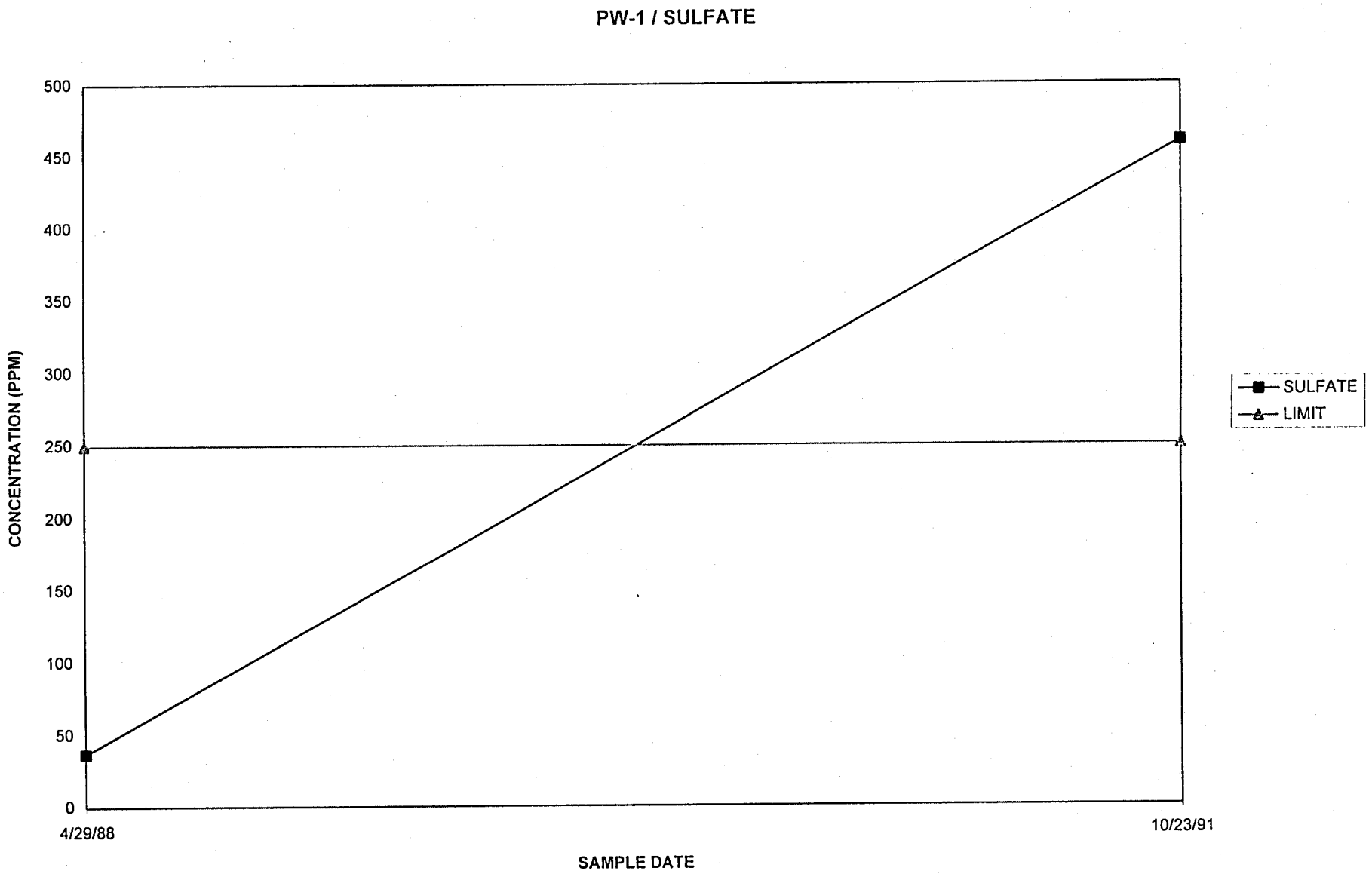

PW-1 /IRON
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
CONCENTRATION (PPM)
4/29/88
10/23/91
SAMPLE DATE
IRON
LIMIT

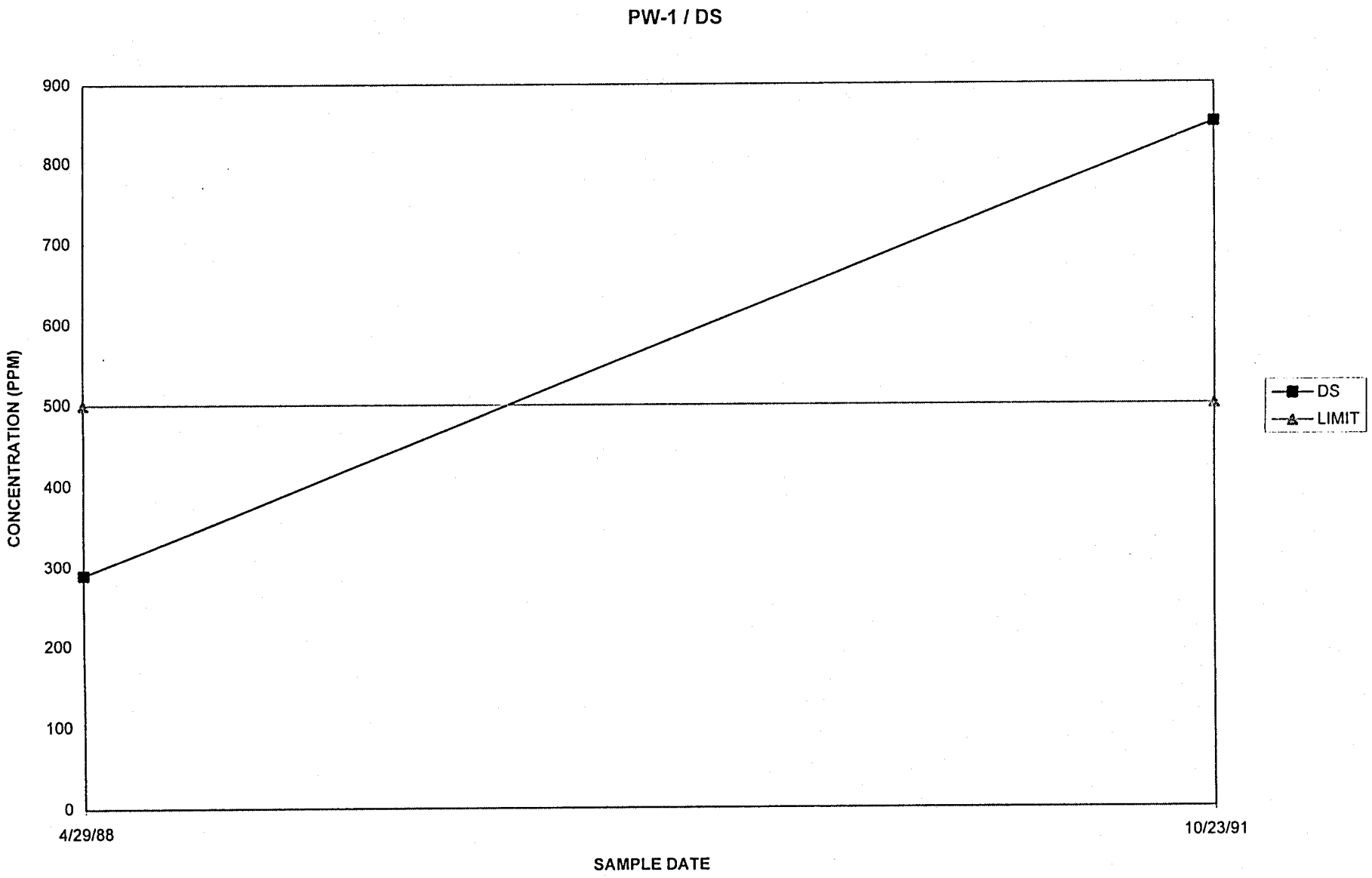

PW-1 / LEAD
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
CONCENTRATION (PPM)
4/29/88
7/13/89
9/6/90
10/23/91
SAMPLE DATE
LEAD
LIMIT

PW-1 / MANGANESE




PW-1 / ZINC
3.5
3
2.5
2
1.5
1
0.5
0
CONCENTRATION (PPM)
4/29/88
10/23/91
SAMPLE DATE
ZINC
LIMIT


PW-1 / SULFATE
500
450
400
350
300
250
200
150
100
50
0
CONCENTRATION (PPM)
4/29/88
10/23/91
SAMPLE DATE
SULFATE
LIMIT

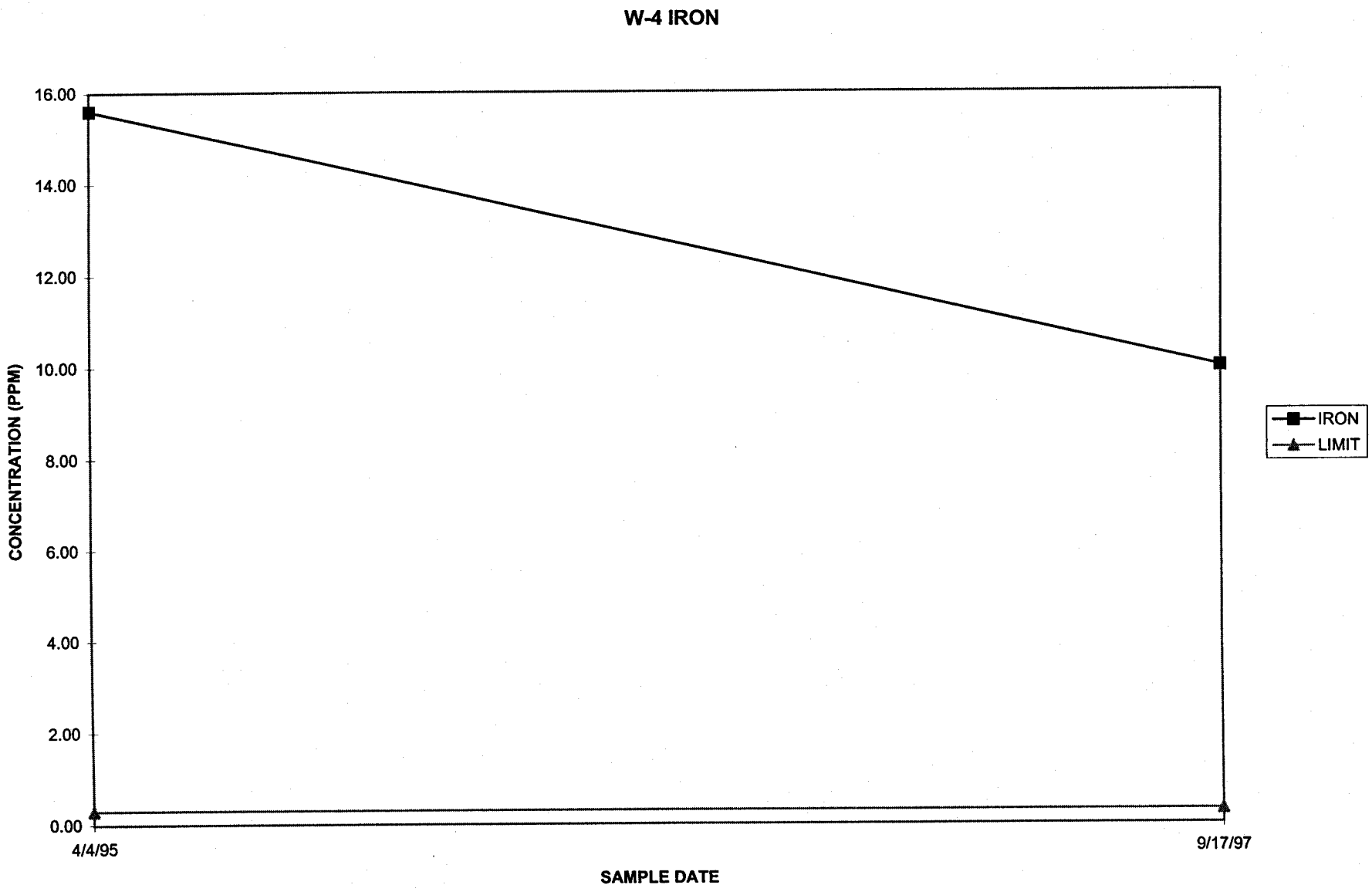

PW-1 / DS
900
800
700
600
500
400
300
200
100
0
CONCENTRATION (PPM)
4/29/88
10/23/91
SAMPLE DATE
DS
LIMIT

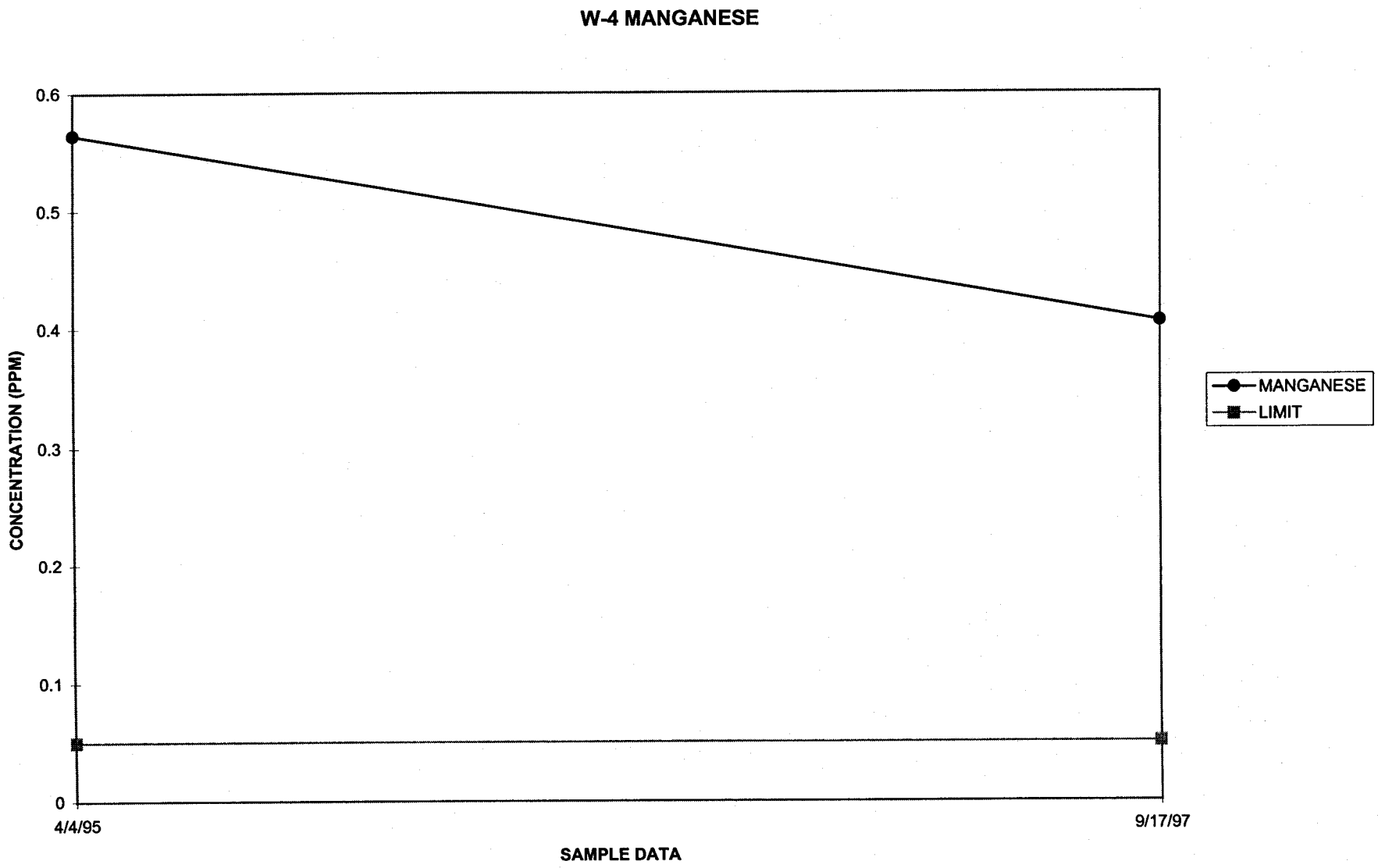
RURAL HALL FLYASH LANDFILL
MONITORING DATA
BACKGROUND WELL (W-4)

PARAMETER	Aluminum	Arsenic	Barium	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	NO-3-N
UNITS	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
LIMIT	N/A	0.050	2.000	0.005	1.000	0.050	0.300	0.015	0.050	0.0011	10.000
4/4/95	9.720	<0.010	<0.250	<0.002	<0.020	<0.020	15.600	0.007	0.564	<0.0002	1.000
9/17/97	4.420	<0.010	<0.250	0.002	<0.020	<0.020	10.000	0.006	0.406	<0.0002	0.550

RURAL HALL FLYASH LANDFILL
MONITORING DATA
BACKGROUND WELL (W-4)

PARAMETER	Selenium	Silver	Sulfate	Zinc	pH	DS	Temp	TOC	Conductivity
UNITS	mg/1	mg/1	mg/1	mg/1	STD	mg/1	^{o}C	mg/1	ug/1
LIMIT	0.050	0.018	250.000	2.100	N/A	500	N/A	N/A	N/A
4/4/95	<0.005	<0.010	7.880	0.058	6.07	231	19.0	136	234
9/17/97	<0.005	<0.010	8.860	0.190	7.500	212	18.0	3.19	366


W-4 IRON
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
CONCENTRATION (PPM)
4/4/95
9/17/97
SAMPLE DATE
IRON
LIMIT

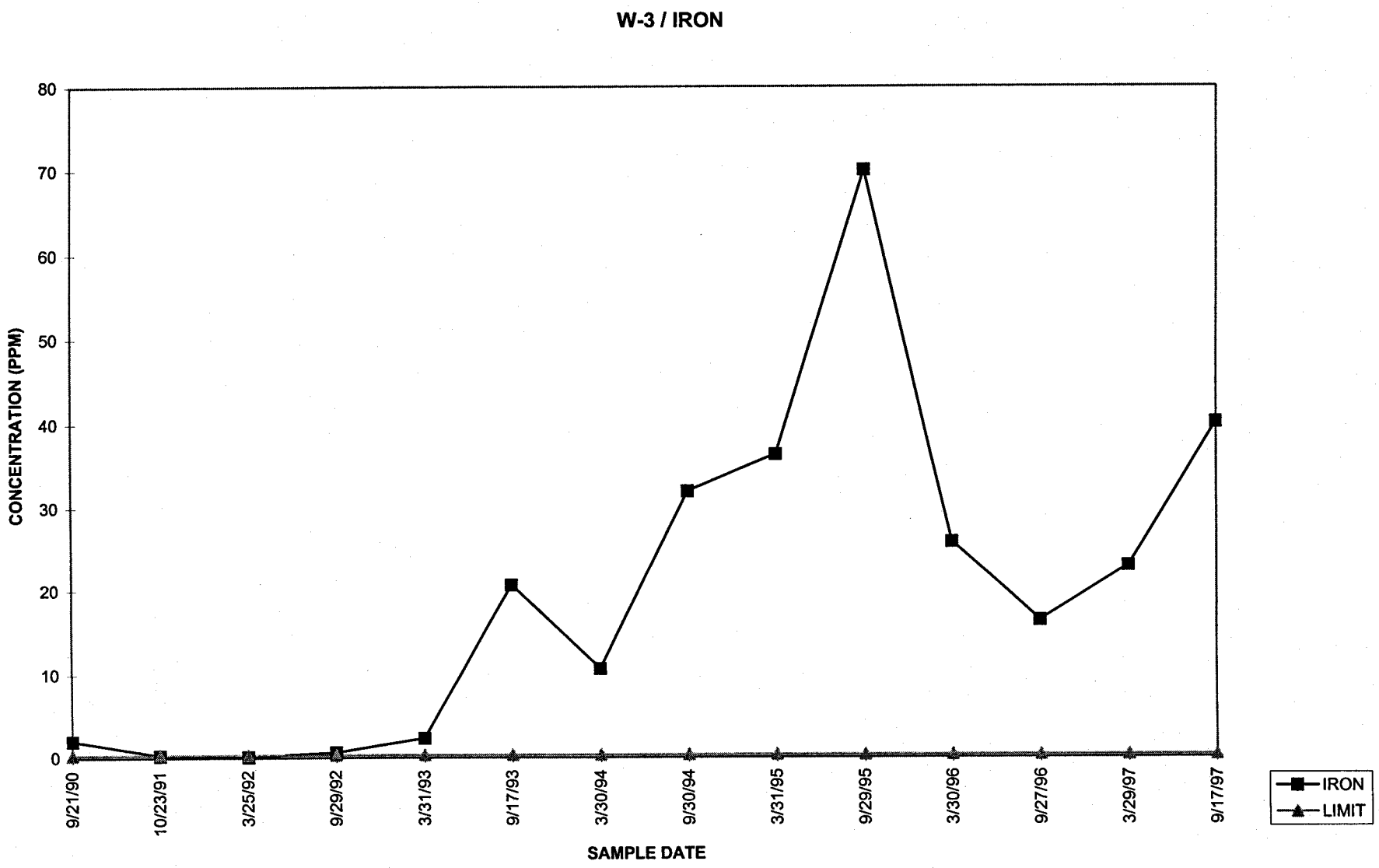

W-4 MANGANESE
0.6
0.5
0.4
0.3
0.2
0.1
0
CONCENTRATION (PPM)
4/4/95
9/17/97
SAMPLE DATA
MANGANESE
LIMIT

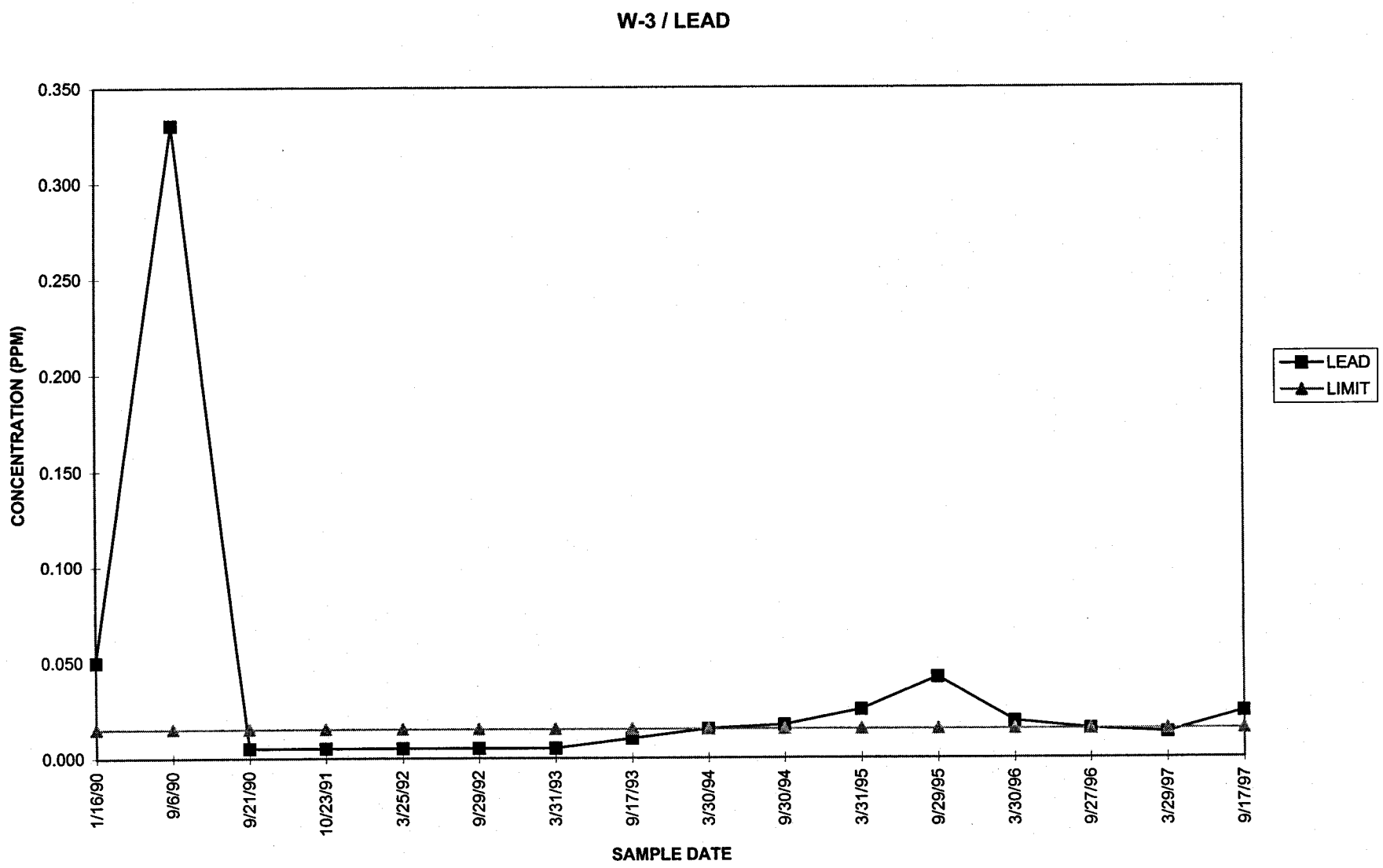
RURAL HALL FLYASH LANDFILL
GROUNDWATER MONITORING
RHMW-003 (MW-3)

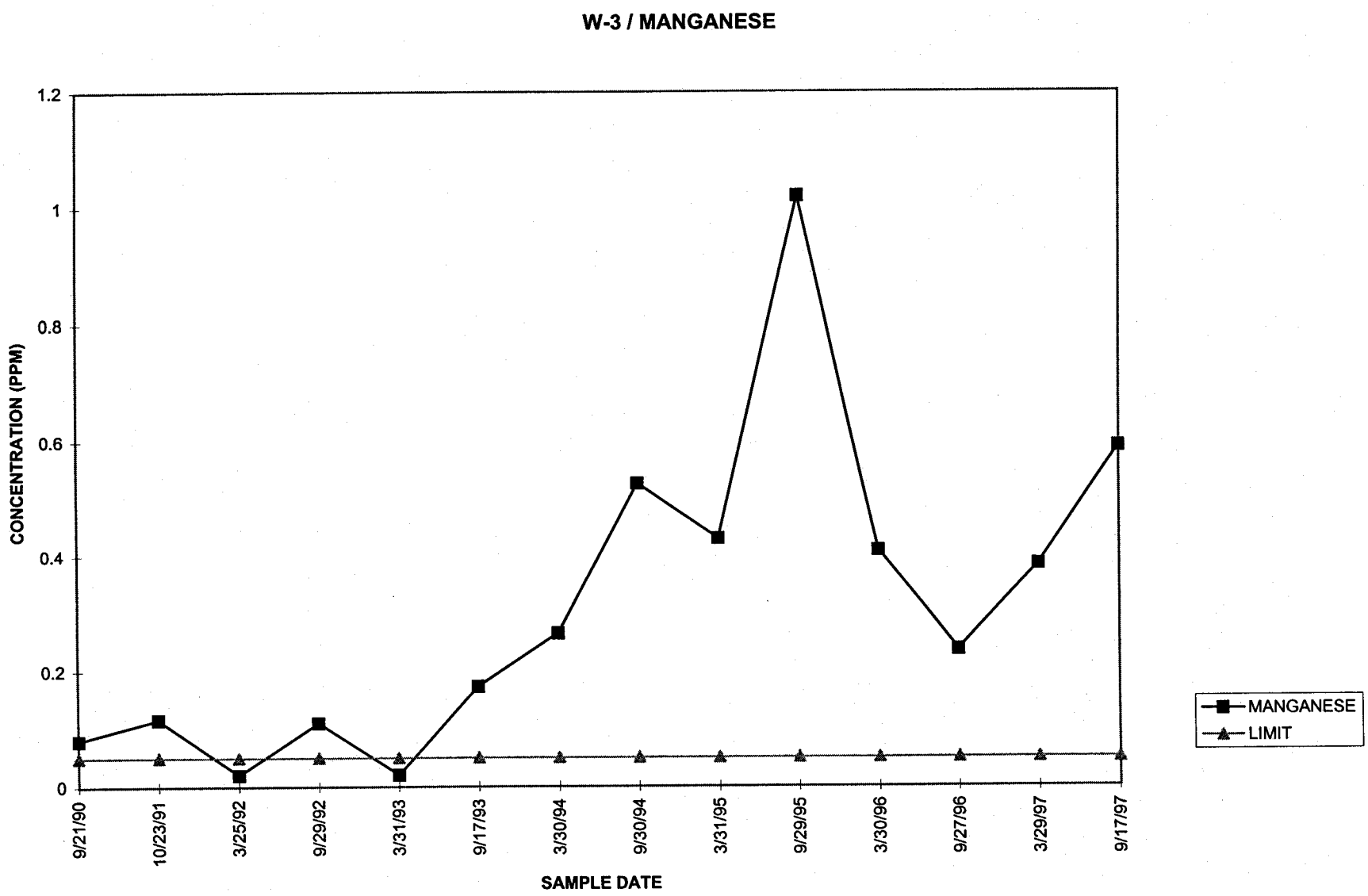
PARAMETER	Aluminum	Arsenic	Barium	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	NO-3-N
UNITS	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
LIMIT	N/A	0.050	2.000	0.005	1.000	0.050	0.300	0.015	0.050	0.0011	10.000
1/16/90		<0.010	0.300	<0.010		<0.020		<0.050		<0.0002	
9/6/90		<0.010	8.990	0.02		0.810		0.330		0.0005	
9/21/90	2.170	<0.010	0.134	0.0081	<0.020	<0.040	2.000	<0.005	0.080	<0.0002	0.670
10/23/91	0.213	<0.010	0.149	<0.002	<0.020	<0.040	0.240	<0.005	0.116	<0.0002	<0.050
3/25/92	<0.200	<0.010	0.119	<0.002	<0.020	<0.020	<0.100	<0.005	<0.020	<0.0002	6.810
9/29/92	0.670	<0.010	0.120	<0.002	<0.020	<0.040	0.580	<0.005	0.410	0.0003	0.232
3/31/93	1.170	<0.010	0.180	<0.002	<0.020	<0.020	2.300	<0.005	<0.020	<0.0002	<0.050
9/17/93	9.460	<0.010	0.444	0.0028	0.071	<0.020	20.700	0.010	0.173	<0.0002	0.250
3/30/94	4.420	<0.010	0.259	<0.002	0.024	<0.020	10.700	0.15	0.264	<0.0002	1.480
9/30/94	25.400	<0.010	0.485	<0.002	0.067	0.026	32.000	0.017	0.526	<0.0002	<0.050
3/31/95	31.300	<0.010	0.466	<0.002	0.055	0.027	36.400	0.025	0.430	<0.0002	0.280
9/29/95	55.400	<0.010	0.813	0.007	0.122	0.051	70.100	0.042	1.020	<0.0002	0.200
3/30/96	17.1	<0.010	0.436	0.002	0.046	0.020	25.9	0.019	0.409	<0.0002	1.25
9/27/96	11.2	<0.010	0.257	<0.002	<0.020	<0.020	16.4	0.015	0.235	<0.0002	0.110
3/29/97	16.4	<0.010	0.347	0.003	0.043	<0.020	23.0	0.013	0.384	<0.0002	0.120
9/17/97	32.2	<0.010	0.478	0.004	0.067	0.027	40.2	0.024	0.590	<0.0002	1.10

RURAL HALL FLYASH LANDFILL
GROUNDWATER MONITORING
RHMW-003 (MW-3)

PARAMETER	Selenium	Silver	Sulfate	Zinc	pH	DS	Temp	TOC	Conductivity
UNITS	mg/1	mg/1	mg/1	mg/1	STD	mg/1	^{o}C	mg/1	ug/1
LIMIT	0.050	0.018	250.000	2.100	N/A	500	N/A	N/A	N/A
1/16/90	<0.005	<0.050							
9/6/90	0.0059	<0.005			6.7				
9/21/90	<0.005	<0.010	8.500	<0.020	6.52	174	16.2	12	238
10/23/91	<0.005	<0.010	<10.000	<0.020	6.70	214	19.7	12	207
3/25/92	<0.005	<0.010	22.500	<0.020	6.12	136	13.1	10	307
9/29/92	<0.005	<0.010	20.000	<0.020	5.86	189	17.1	1	223
3/31/93	<0.005	<0.010	14.900	0.055	5.53	163	15.7	2	207
9/17/93	<0.005	<0.010	12.000	0.106	6.23	207	18.3	2	282
3/30/94	<0.005	<0.010	17.000	0.107	5.74	180	15.9	<5	180
9/30/94	<0.005	<0.010	<20.000	0.086	6.28	193	18.0	26.1	202
3/31/95	<0.005	<0.010	133.000	0.186	6.64	206	12.7	<5	220
9/29/95	<0.005	<0.010	139.000	0.183	5.42	302	15.4	1.32	245
3/30/96	<0.010	<0.010	19.5	0.100	5.61	217	13	3.41	285
9/27/96	<0.005	<0.010	59.8	0.094	7.81	215	18	1.10	243
3/29/97	<0.005	<0.010	21.1	0.051	6.57	223	12	7.86	153
9/17/97	<0.005	<0.010	88.9	0.280	6.9	262	16	1.29	366


W-3 / IRON
CONCENTRATION (PPM)
80
70
60
50
40
30
20
10
0
9/21/90
10/23/91
3/25/92
9/29/92
3/31/93
9/17/93
3/30/94
9/30/94
3/31/95
9/29/95
3/30/96
9/27/96
3/29/97
9/17/97
SAMPLE DATE
IRON
LIMIT


W-3 / LEAD
CONCENTRATION (PPM)
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
1/16/90
9/6/90
9/21/90
10/23/91
3/25/92
9/29/92
3/31/93
9/17/93
3/30/94
9/30/94
3/31/95
9/29/95
3/30/96
9/27/96
3/29/97
9/17/97
SAMPLE DATE
LEAD
LIMIT


W-3 / MANGANESE
CONCENTRATION (PPM)
1.2
1
0.8
0.6
0.4
0.2
0
9/21/90
10/23/91
3/25/92
9/29/92
3/31/93
9/17/93
3/30/94
9/30/94
3/31/95
9/29/95
3/30/96
9/27/96
3/29/97
9/17/97
SAMPLE DATE
MANGANESE
LIMIT

APPENDIX VII
Surface Water Sampling

RURAL HALL FLYASH LANDFILL
STREAM SAMPLING
RHSS-001 (SS-1)

PARAMETER	Aluminum	Arsenic	Barium	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	NO-3-N
UNITS	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
LIMIT	N/A	0.050	2.000	0.005	1.000	0.050	0.300	0.015	0.050	0.0011	10.000
4/29/88	<0.152	<0.011	0.118	0.008	<0.019	<0.016	0.086	<0.024	<0.014	<0.0002	0.220
9/6/90		<0.010	0.064	<0.001				<0.0025		<0.0002	
9/21/90	0.140	<0.010	<0.080	0.0048	<0.020	<0.040	0.200	<0.005	<0.020	<0.0002	0.520
10/23/91	0.109	<0.010	<0.080	<0.002	<0.020	<0.040	<0.100	<0.005	<0.020	<0.0002	0.150
3/25/92	4.150	<0.010	<0.080	0.0034	<0.020	<0.020	5.000	0.0158	0.064	<0.0002	0.250
9/29/92	<0.100	<0.010	<0.100	<0.002	<0.020	<0.040	0.160	<0.005	0.085	<0.0002	0.190
3/31/93	<0.200	<0.010	<0.100	<0.002	<0.020	<0.020	0.400	<0.005	0.077	<0.0002	1.340
9/17/93	0.240	<0.010	<0.125	<0.002	<0.020	<0.020	0.598	<0.005	0.028	<0.0002	0.450
3/30/94	0.220	<0.010	<0.120	<0.002	<0.020	<0.020	0.873	<0.005	0.030	<0.0002	0.250
9/30/94	1.300	<0.010	<0.250	<0.002	<0.020	<0.020	1.690	0.006	0.084	<0.0002	0.430
3/31/95	3.580	<0.010	<0.250	<0.002	<0.020	<0.020	2.440	<0.005	0.106	<0.0002	0.190
9/29/95	0.200	<0.010	<0.250	<0.002	<0.020	<0.020	0.358	0.007	0.038	<0.0002	0.500
3/30/96	0.279	<0.010	<0.250	<0.002	<0.020	<0.020	0.547	<0.005	0.014	<0.0002	0.185
9/27/96	0.125	<0.010	<0.250	<0.002	<0.020	<0.020	0.300	0.005	0.021	<0.0002	0.290
3/29/97	0.307	<0.010	<0.250	<0.002	<0.020	<0.020	0.552	<0.005	0.016	<0.0002	0.225
9/17/97	0.476	<0.010	<0.250	<0.002	<0.020	<0.020	0.835	<0.005	0.040	<0.0002	0.625

RURAL HALL FLYASH LANDFILL
STREAM SAMPLING
RHSS-001 (SS-1)

PARAMETER	Selenium	Silver	Sulfate	Zinc	pH	DS	Temp	TOC	Conductivity
UNITS	mg/1	mg/1	mg/1	mg/1	STD	mg/1	^{o}C	mg/1	ug/1
LIMIT	0.050	0.018	250.000	2.100	N/A	500	N/A	N/A	N/A
4/29/88	<0.005	<0.014	64.000	0.015	6.8	220		2.810	
9/6/90	<0.005	<0.005			7.9				
9/21/90	<0.005	<0.010	40.000	<0.020	7.18	352	11.6	12	490
10/23/91	<0.005	<0.010	108.000	<0.020	7.9	248	17.2	12	381
3/25/92	<0.005	<0.010	9.400	<0.020	5.80	185	11.3	14	126
9/29/92	<0.005	<0.010	84.000	<0.020	5.73	241	13.8	2	356
3/31/93	<0.005	<0.010	70.400	0.029	5.89	127	13.0	2	207
9/17/93	<0.005	<0.010	77.400	<0.020	7.07	251	20.9	3	360
3/30/94	<0.005	<0.010	30.600	<0.020	5.88	108	14.0	5	380
9/30/94	<0.005	<0.010	64.800	<0.020	7.05	255	19.1	30	332
3/31/95	<0.005	<0.010	48.900	0.246	7.75	211	13.9	<5	290
9/29/95	<0.005	<0.010	70.000	<0.100	5.16	264	13.9	3.74	458
3/30/96	<0.005	<0.010	31.3	<1.100	6.68	129	11	1.79	193
9/27/96	<0.005	<0.010	56.1	0.095	7.65	225	19	2.36	336
3/29/97	<0.005	<0.010	30.0	0.013	7.63	138	16	3.04	94
9/17/97	<0.005	<0.010	47.4	0.169	7.9	224	19	1.67	319

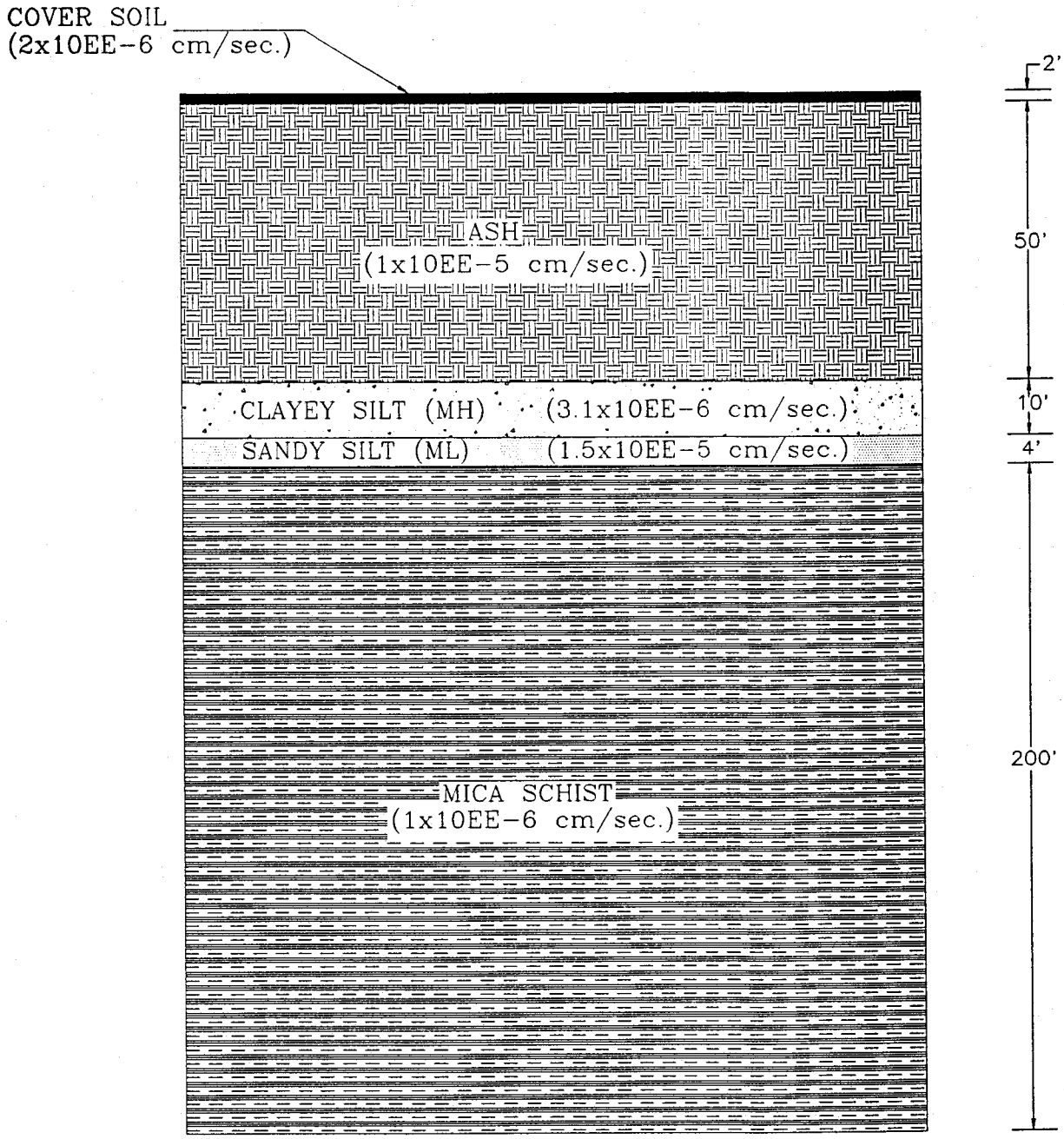
RURAL HALL FLYASH LANDFILL
STREAM SAMPLING
RHSS-002 (SS-2)

PARAMETER	Aluminum	Arsenic	Barium	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	NO-3-N
UNITS	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
LIMIT	N/A	0.050	2.000	0.005	1.000	0.050	0.300	0.015	0.050	0.0011	10.000
9/6/90		<0.010	0.070	0.001		0.021		<0.0050		<0.0002	
9/21/90	0.130	<0.010	0.094	0.0046	<0.020	<0.040	0.100	<0.005	<0.020	<0.0002	1.140
10/23/91	<0.100	<0.010	0.170	<0.002	<0.020	<0.040	0.820	<0.005	0.711	<0.0002	1.020
3/25/92	7.650	<0.010	<0.080	0.0021	<0.020	<0.020	8.070	0.0129	0.130	<0.0002	0.250
9/29/92	0.330	<0.010	<0.100	<0.002	<0.020	<0.040	<0.100	<0.005	<0.015	<0.0002	0.550
3/31/93	0.208	<0.010	<0.100	<0.002	<0.020	<0.020	0.675	<0.005	0.327	<0.0002	0.350
9/17/93	0.470	<0.010	<0.125	<0.001	<0.020	<0.020	1.270	<0.005	0.722	<0.0002	2.300
3/30/94	0.220	<0.010	<0.250	<0.002	<0.020	0.032	1.120	<0.005	0.117	<0.0002	0.320
9/30/94	0.120	<0.010	<0.250	<0.002	0.028	<0.020	0.470	<0.005	0.356	<0.0002	0.325
3/31/95	0.165	<0.010	<0.250	<0.002	<0.020	<0.020	0.526	<0.002	0.332	<0.0002	0.750
9/29/95	0.406	<0.010	<0.250	<0.002	<0.020	<0.020	1.02	0.006	0.598	<0.0002	1.030
3/30/96	0.426	<0.010	<0.250	<0.002	<0.020	<0.020	0.787	<0.005	0.250	<0.0002	0.190
9/27/96	0.061	<0.010	<0.250	<0.002	<0.020	<0.020	0.227	0.010	0.262	<0.0002	0.750
3/29/97	0.209	<0.010	<0.250	<0.002	<0.020	<0.020	0.644	<0.005	0.246	<0.0002	0.450
9/17/97	0.165	<0.010	<0.250	<0.002	<0.020	<0.020	0.428	<0.006	0.333	<0.0002	2.21

RURAL HALL FLYASH LANDFILL
STREAM SAMPLING
RHSS-002 (SS-2)

PARAMETER	Selenium	Silver	Sulfate	Zinc	pH	DS	Temp	TOC	Conductivity
UNITS	mg/1	mg/1	mg/1	mg/1	STD	mg/1	^{o}C	mg/1	ug/1
LIMIT	0.050	0.018	250.000	2.100	N/A	500	N/A	N/A	N/A
9/6/90	<0.005	<0.005			7.8				
9/21/90	<0.005	<0.010	47.000	<0.020	7.52	141	14.6	15	607
10/23/91	<0.005	<0.010	490.000	0.080	7.82	806	18.0	10	1280
3/25/92	<0.005	<0.010	13.100	<0.020	6.04	149	11.5	12	111
9/29/92	0.0073	<0.010	183.000	<0.020	6.07	474	15.1	3	778
3/31/93	<0.005	<0.010	70.040	<0.020	5.81	185	14.1	4	341
9/17/93	<0.005	<0.010	154.000	<0.020	7.48	523	22.2	4	754
3/30/94	<0.005	<0.010	40.000	0.165	5.99	143	14.4	<5	692
9/30/94	<0.005	<0.010	135.000	0.024	7.39	397	18.6	37.9	573
3/31/95	<0.005	<0.010	102.000	0.041	7.87	342	14.5	<5	496
9/29/95	<0.005	<0.010	155.000	<0.100	5.6	505	13.5	2.68	1,095
3/30/96	<0.005	<0.010	30.6	<1.100	6.53	198	12	2.99	282
9/27/96	<0.005	<0.010	147	0.047	7.59	409	20	3.19	613
3/29/97	<0.005	<0.010	72.8	0.010	7.83	255	16	2.47	224
9/17/97	<0.005	<0.010	160	0.153	7.8	562	18	2.43	826

APPENDIX VIII
HELP Model Computer Analysis



R.J. REYNOLDS TOBACCO CO.
ASH MANAGEMENT AREA
FORSYTH COUNTY, N.C.

TYPICAL LANDFILL SECTION

PROJECT #: 93011	DATE: 10-14-93	PROJECT MGR: C.D.H.
		DESIGN BY: N.A.
		DRAWN BY: C.N.I.
		SCALE: N.T.S.

GEO-ENVIRONMENTAL CONSULTANTS, INC.
GEOTECHNICAL/ENVIRONMENTAL ENGINEERS & SCIENTISTS
1016 McCLELLAND COURT, CHARLOTTE, NC 28206
PHONE (704)332-2060 FAX (704)334-0405

FIGURE

****
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RJRRUN1
RJ REYNOLDS PHASE III - SUBAREA B, SECTION 1 - RECHARGE
AUGUST 1993

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 24.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3210 VOL/VOL
WILTING POINT = 0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1800 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000001000000 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 600.00 INCHES
POROSITY = 0.4530 VOL/VOL
FIELD CAPACITY = 0.1900 VOL/VOL

WILTING POINT = 0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000010000000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER
THICKNESS = 120.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3210 VOL/VOL
WILTING POINT = 0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2500 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000001000000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 0.00
TOTAL AREA OF COVER = 248292. SQ FT
EVAPORATIVE ZONE DEPTH = 21.00 INCHES
UPPER LIMIT VEG. STORAGE = 9.0300 INCHES
INITIAL VEG. STORAGE = 4.0639 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 214.3200 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR GREENSBORO NORTH CAROLINA

MAXIMUM LEAF AREA INDEX = 2.00

START OF GROWING SEASON (JULIAN DATE) = 100
END OF GROWING SEASON (JULIAN DATE) = 302

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.50	39.90	48.00	58.30	66.50	73.50
77.20	76.30	69.90	58.40	48.50	40.20

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	1.99	4.38	2.21	4.14	2.73
	5.32	4.79	5.44	3.60	2.36	3.98
STD. DEVIATIONS	2.28	1.14	2.58	1.21	2.31	1.09
	5.09	3.03	2.32	3.18	0.62	0.26
RUNOFF						
TOTALS	3.321	1.089	2.738	1.315	2.576	1.537
	3.978	3.414	4.337	2.792	1.535	2.906
STD. DEVIATIONS	2.004	0.776	2.255	1.069	1.561	0.786
	4.180	2.606	1.978	2.705	0.348	0.336
EVAPOTRANSPIRATION						
TOTALS	1.209	0.924	1.581	0.934	1.554	1.270
	1.320	1.354	1.109	0.815	0.708	1.078
STD. DEVIATIONS	0.272	0.412	0.401	0.267	0.881	0.395
	0.966	0.403	0.571	0.538	0.182	0.192

PERCOLATION FROM LAYER 3

TOTALS	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003
STD. DEVIATIONS	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	45.37	(10.898)	938751.	100.00
RUNOFF	31.538	(9.235)	652552.	69.51
EVAPOTRANSPIRATION	13.855	(2.297)	286674.	30.54
PERCOLATION FROM LAYER 3	0.0023	(0.0023)	48.	0.01
CHANGE IN WATER STORAGE	-0.025	(0.179)	-524.	-0.06

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	4.73	97868.4
RUNOFF	4.595	95066.6
PERCOLATION FROM LAYER 3	0.0000	0.5
SNOW WATER	0.92	19035.7

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2111

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1800

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.49	0.1869
2	172.88	0.2881
3	37.11	0.3092

SNOW WATER 0.00

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****
****

RJRRUN1
RJ REYNOLDS PHASE III - SUBAREA B, SECTION 1
AUGUST 1993

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

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FIELD CAPACITY	=	0.3210 VOL/VOL
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INITIAL SOIL WATER CONTENT	=	0.1800 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000001000000 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	600.00 INCHES
POROSITY	=	0.4530 VOL/VOL
FIELD CAPACITY	=	0.1900 VOL/VOL

WILTING POINT = 0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.3000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000010000000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER
THICKNESS = 120.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3210 VOL/VOL
WILTING POINT = 0.2210 VOL/VOL
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GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 0.00
TOTAL AREA OF COVER = 418000. SQ FT
EVAPORATIVE ZONE DEPTH = 21.00 INCHES
UPPER LIMIT VEG. STORAGE = 9.0300 INCHES
INITIAL VEG. STORAGE = 4.0639 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 214.3200 INCHES

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SOLAR RADIATION FOR GREENSBORO NORTH CAROLINA

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END OF GROWING SEASON (JULIAN DATE) = 302

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.50	39.90	48.00	58.30	66.50	73.50
77.20	76.30	69.90	58.40	48.50	40.20

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.43	1.99	4.38	2.21	4.14	2.73
	5.32	4.79	5.44	3.60	2.36	3.98
STD. DEVIATIONS	2.28	1.14	2.58	1.21	2.31	1.09
	5.09	3.03	2.32	3.18	0.62	0.26
RUNOFF						
TOTALS	3.321	1.089	2.738	1.315	2.576	1.537
	3.978	3.414	4.337	2.792	1.535	2.906
STD. DEVIATIONS	2.004	0.776	2.255	1.069	1.561	0.786
	4.180	2.606	1.978	2.705	0.348	0.336
EVAPOTRANSPIRATION						
TOTALS	1.209	0.924	1.581	0.934	1.554	1.270
	1.320	1.354	1.109	0.815	0.708	1.078
STD. DEVIATIONS	0.272	0.412	0.401	0.267	0.881	0.395
	0.966	0.403	0.571	0.538	0.182	0.192

PERCOLATION FROM LAYER 3

TOTALS	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003
STD. DEVIATIONS	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	45.37	(10.898)	1580388.	100.00
RUNOFF	31.538	(9.235)	1098573.	69.51
EVAPOTRANSPIRATION	13.855	(2.297)	482617.	30.54
PERCOLATION FROM LAYER 3	0.0023	(0.0023)	80.	0.01
CHANGE IN WATER STORAGE	-0.025	(0.179)	-881.	-0.06

****

****

PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	4.73	164761.7
RUNOFF	4.595	160044.7
PERCOLATION FROM LAYER 3	0.0000	0.8
SNOW WATER	0.92	32046.7

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2111

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1800

****

****

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.49	0.1869
2	172.88	0.2881
3	37.11	0.3092

SNOW WATER 0.00

****
****

APPENDIX IX
MULTIMED Computer Analysis

SUMMARY OF LABORATORY TESTING

R. J. REYNOLDS ASH MANAGEMENT AREA

GCI JOB NO: 93011

CONSTANT HEAD PERMEABILITY TEST

ASTM D 5084

I. Date of Test: June 7 - 11, 1993

II. Test Locations: B-12 (0.0' - 2.0')

III. Material Description: Reddish Brown Clayey SILT

IV. Material Condition: Undisturbed Sample

V. Proctor Data:
Maximum Dry Density (pcf): ND
Optimum Moisture Content (%): ND

VI. Test Data:

Dry Density (pcf):	101.0
Initial Moisture Content (%):	18.3
Final Moisture Content (%):	21.7
Sample Length (cm):	5.08
Sample Area (cm^2):	42.08
Head (cm):	140.68
Quantity of Water Passing Through Sample (cm^3):	21.9
Elapsed Time (sec):	1200
Temperature (°F):	73
Viscosity Correction Factor:	0.931
Coefficient of Permeability -k (cm/sec):	1.5×10^{-5}

VII. Comments: Consolidated and tested at 2 psi head difference.

SUMMARY OF LABORATORY TESTING

R. J. REYNOLDS ASH MANAGEMENT AREA

GCI JOB NO: 93011

CONSTANT HEAD PERMEABILITY TEST

ASTM D 5084

I. Date of Test: June 7 - 11, 1993

II. Test Locations: B-9 (2.3' - 4.3')

III. Material Description: Reddish Brown Clayey SILT

IV. Material Condition: Undisturbed Sample

V. Proctor Data:
Maximum Dry Density (pcf): ND
Optimum Moisture Content (%): ND

VI. Test Data:

Dry Density (pcf):	103.9
Initial Moisture Content (%):	18.7
Final Moisture Content (%):	23.4
Sample Length (cm):	5.16
Sample Area (cm^2):	42.08
Head (cm):	140.68
Quantity of Water Passing Through Sample (cm^3):	20.6
Elapsed Time (sec):	5340
Temperature (°F):	73
Viscosity Correction Factor:	0.931
Coefficient of Permeability -k (cm/sec):	3.1×10^{-6}

VII. Comments: Consolidated and tested at 2 psi head difference.

SUMMARY OF LABORATORY TESTING

R. J. REYNOLDS ASH MANAGEMENT AREA

GCI JOB NO: 93011
CONSTANT HEAD PERMEABILITY TEST
ASTM D 5084

I. Date of Test: June 7 - 11, 1993

II. Test Locations: B-11 (20.0' - 22.0')

III. Material Description: Tan Sandy SILT

IV. Material Condition: Undisturbed Tube Sample

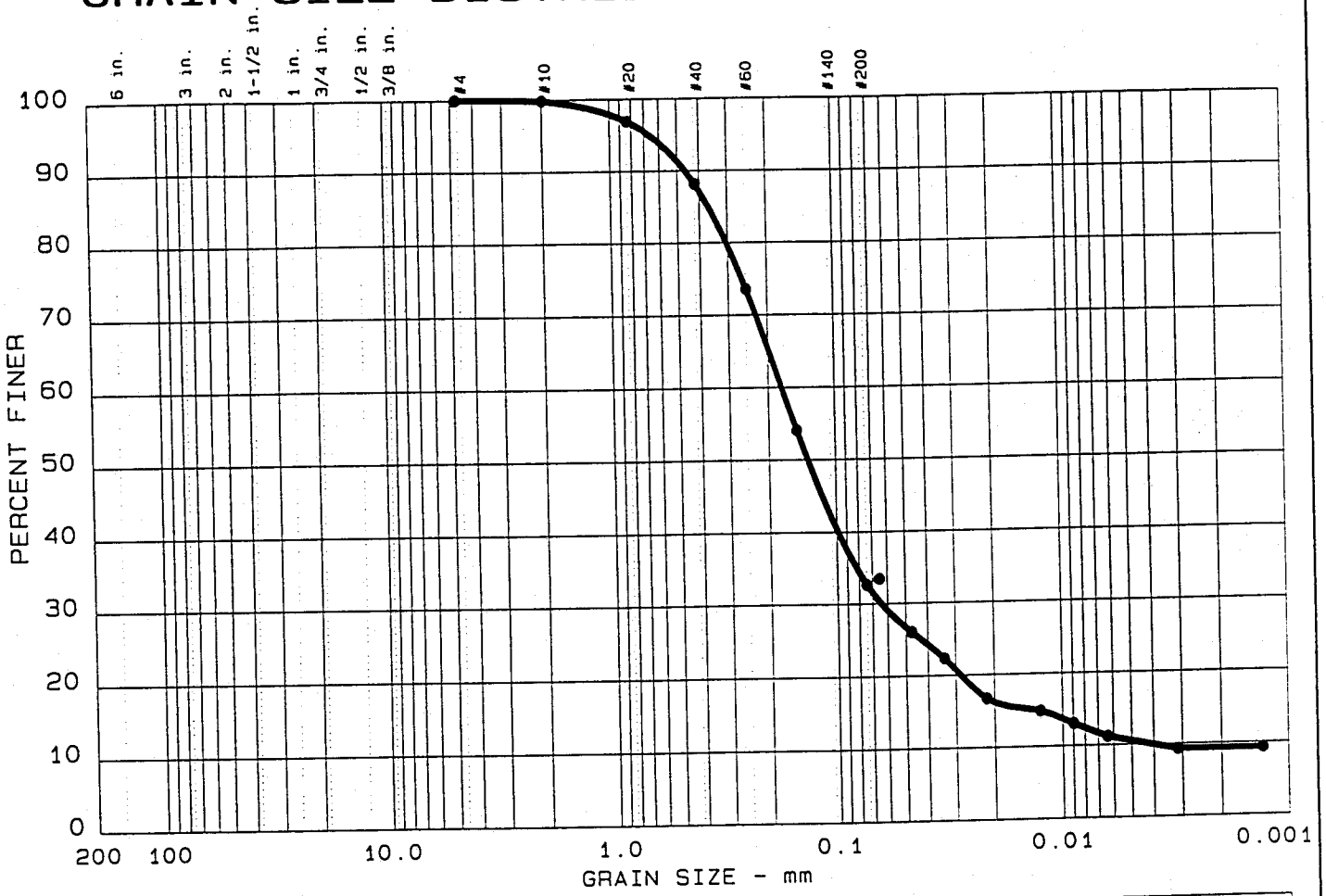
V. Proctor Data:
Maximum Dry Density (pcf): ND
Optimum Moisture Content (%): ND

VI. Test Data:

Dry Density (pcf):	77.2
Initial Moisture Content (%):	12.9
Final Moisture Content (%):	34.8
Sample Length (cm):	5.08
Sample Area (cm^2):	42.08
Head (cm):	140.68
Quantity of Water Passing Through Sample (cm^3):	108.9
Elapsed Time (sec):	240
Temperature (°F):	73
Viscosity Correction Factor:	0.931
Coefficient of Permeability -k (cm/sec):	3.6×10^{-4}

VII. Comments: Consolidated and tested at 2 psi head difference.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	67.4	22.1	10.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	0.36	0.17	0.13	0.064	0.0130	0.0040	5.82	43.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Reddish Brown Clayey SILT	ND	ND

Project No.: 93011
Project: R. J. Reynolds Ash Management
● Location: B-9/2.3-4.3'

Date: 6-14-93

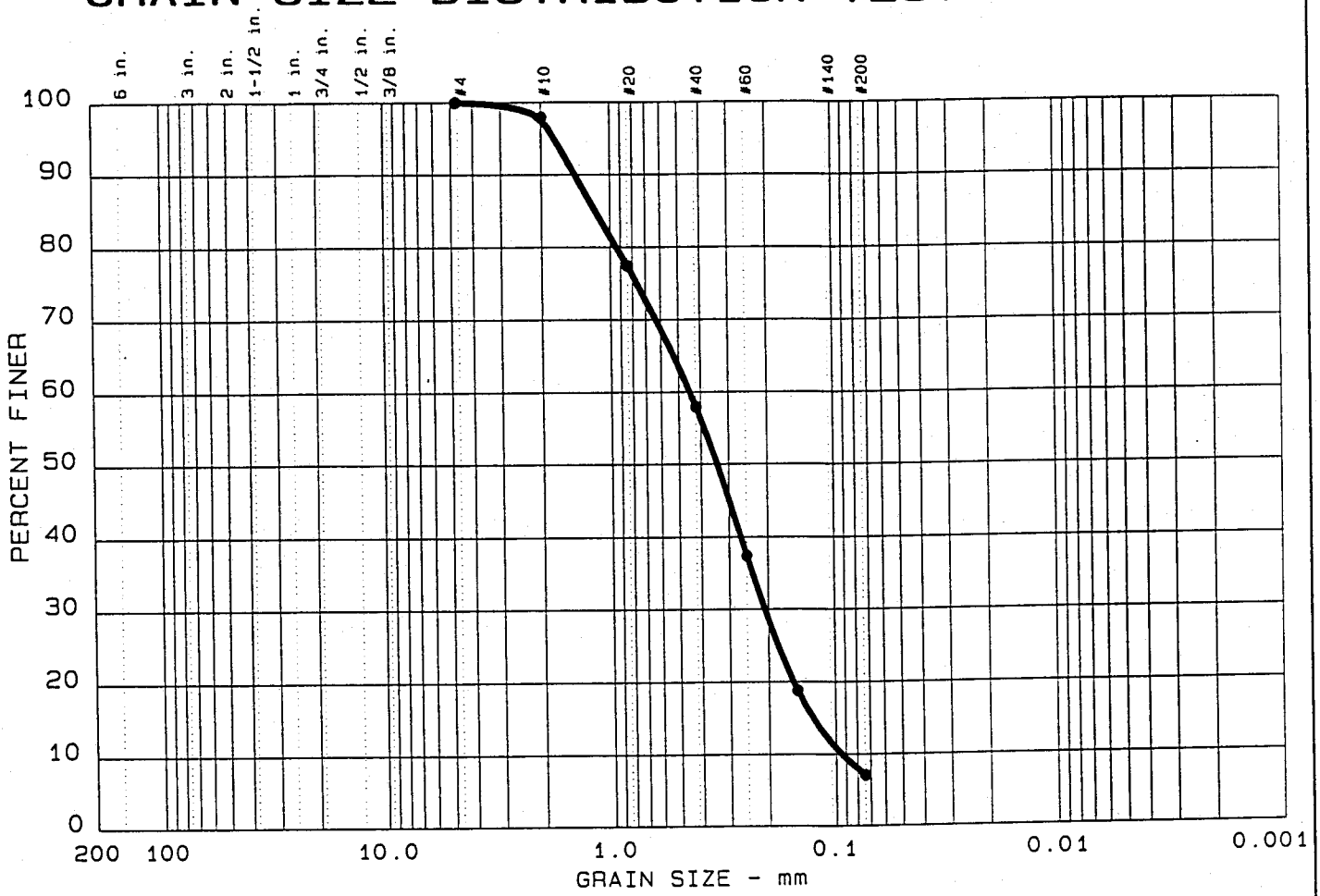
GRAIN SIZE DISTRIBUTION TEST REPORT

Remarks:

SPECIFIC GRAVITY=2.77

GEO-ENVIRONMENTAL CONSULTANTS, INC.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	92.9	7.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	1.16	0.45	0.34	0.208	0.1266	0.0939	1.03	4.8

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Micaceous Silty SAND	ND	ND

Project No.: 93011
Project: R.J. Reynolds Ash Management Area
● Location: B-9/15.0-15.7'

Date: 6-14-93

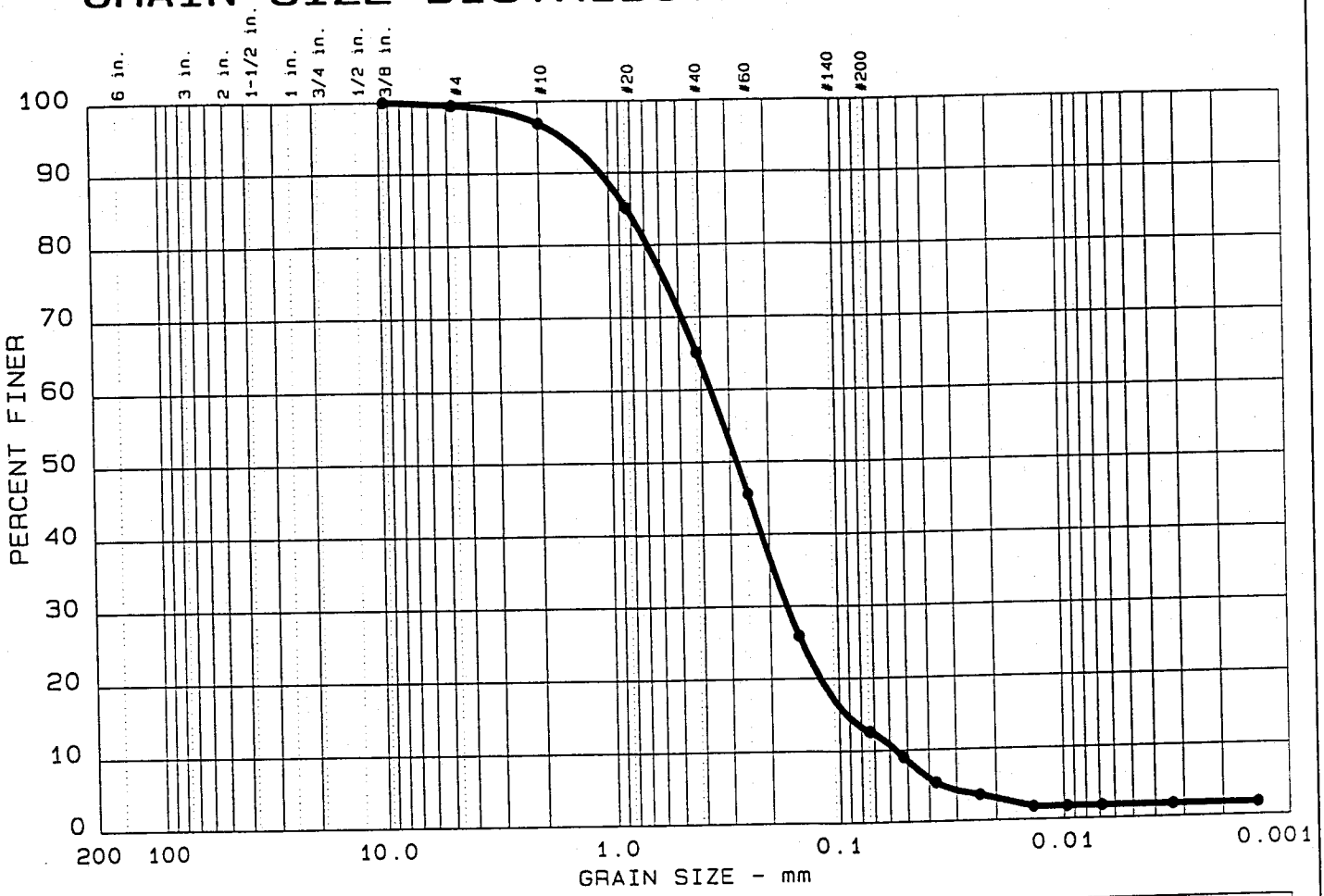
GRAIN SIZE DISTRIBUTION TEST REPORT

Remarks:

SPECIFIC GRAVITY=2.94

GEO-ENVIRONMENTAL CONSULTANTS, INC.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.5	86.8	10.9	1.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	0.83	0.36	0.28	0.168	0.0933	0.0562	1.38	6.5

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown SILT with Little Mica	ND	ND

Project No.: 93011
Project: R. J. Reynolds Ash Management Area
● Location: B-11

Date: 6-14-93

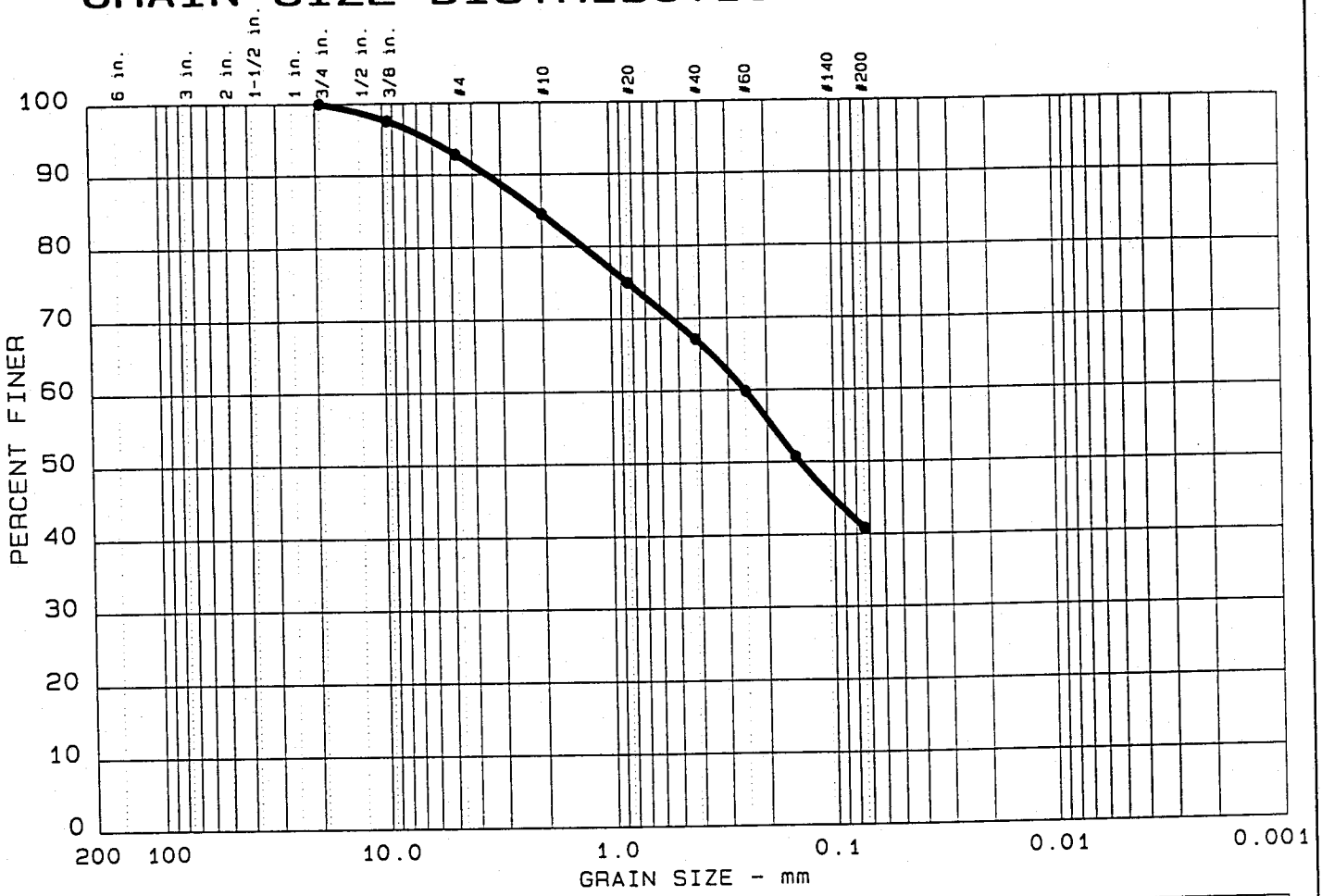
GRAIN SIZE DISTRIBUTION TEST REPORT

Remarks:

SPECIFIC GRAVITY=2.61

GEO-ENVIRONMENTAL CONSULTANTS, INC.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	7.1	52.1	40.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	38	15	2.07	0.25	0.14					

MATERIAL DESCRIPTION	USCS	AASHTO
● Reddish Brown Clayey SILT	ND	ND

Project No.: 93011

Project: R. J. Reynolds Ash Management Area

● Location: B-12/0.0-2.0'

Date: 6-14-93

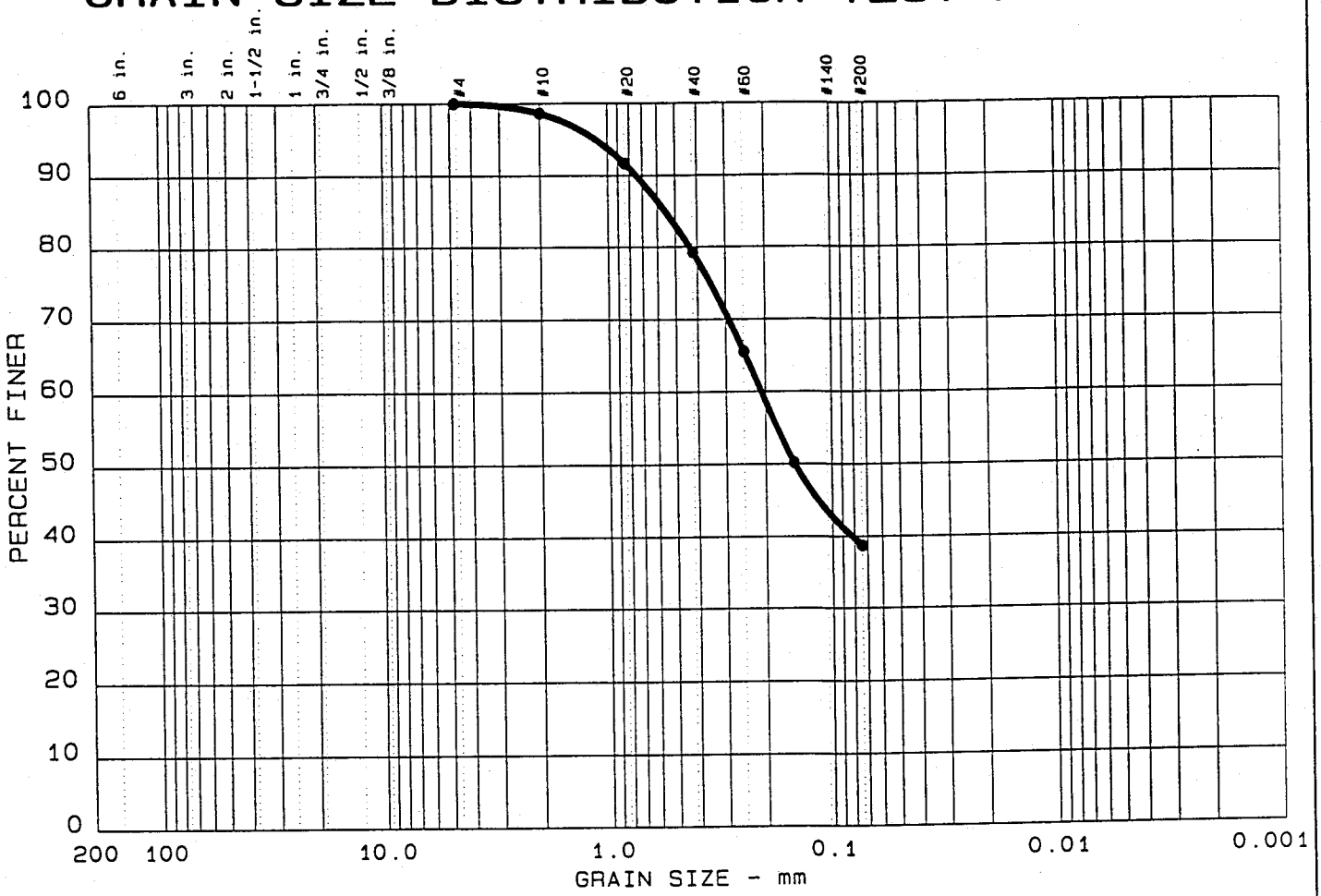
GRAIN SIZE DISTRIBUTION TEST REPORT

Remarks:

SPECIFIC GRAVITY=2.69

GEO-ENVIRONMENTAL CONSULTANTS, INC.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	61.3	38.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	39	13	0.55	0.21	0.15					

MATERIAL DESCRIPTION	USCS	AASHTO
● Reddish Brown Clayey SILT	ND	ND

Project No.: 93011
Project: R. J. Reynolds Ash Management Area
● Location: B-13/1.0-2.0'

Date: 6-14-93

GRAIN SIZE DISTRIBUTION TEST REPORT

Remarks:

SPECIFIC GRAVITY=2.60

GEO-ENVIRONMENTAL CONSULTANTS, INC.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

SELENIUM - TRIAL NO. 1A

DISTANCE FROM WELL: 1200 (FT)

DEFAULT

CASE
Chemical simulated is SELENIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.500E-01	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	365.	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.2590E-11 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

SELENIUM - TRIAL NO. 2A

DISTANCE FROM WELL: 500 (FT)

DEFAULT

CASE
Chemical simulated is SELENIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.500E-01	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	152.	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.6093E-05 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

SELENIUM - TRIAL NO. 3A

DISTANCE FROM WELL: 100 (FT)

DEFAULT

CASE
Chemical simulated is SELENIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.500E-01	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.5	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.2363E-02 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

CHROMIUM - TRIAL NO. 1B

DISTANCE FROM WELL: 1200 (FT)

DEFAULT

CASE
Chemical simulated is CHROMIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.840E-01	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	365.	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.4352E-11 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

CHROMIUM - TRIAL NO. 2B

DISTANCE FROM WELL: 500 (FT)

DEFAULT

CASE
Chemical simulated is CHROMIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.840E-01	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	152.	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.1024E-04 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

CHROMIUM - TRIAL NO. 3B

DISTANCE FROM WELL: 100 (FT)

DEFAULT

CASE
Chemical simulated is CHROMIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.840E-01	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.5	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3970E-02 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

BARIUM - TRIAL NO. 1C

DISTANCE FROM WELL: 1200 (FT)

DEFAULT

CASE
Chemical simulated is BARIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.660	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	365.	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3419E-10 mg/l.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

BARIUM - TRIAL NO. 2C

DISTANCE FROM WELL: 500 (FT)

DEFAULT

CASE
Chemical simulated is BARIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN

Infiltration input by user
Run was steady-state
Reject runs if Y coordinate outside plume
Do not reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 3

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.000E+00	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.000E+00	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.000E+00	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.660	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	152.	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.8043E-04 mg/l.

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

BARIUM - TRIAL NO. 3C

DISTANCE FROM WELL: 100 (FT)

DEFAULT

CASE
Chemical simulated is BARIUM

Option Chosen	Saturated and unsaturated zone models
Run was	DETERMIN
Infiltration input by user	
Run was steady-state	
Reject runs if Y coordinate outside plume	
Do not reject runs if Z coordinate outside plume	
Gaussian source used in saturated zone model	

UNSATURATED ZONE FLOW MODEL PARAMETERS
(input parameter description and value)

NP	-	Total number of nodal points	240
NMAT	-	Number of different porous materials	3
KPROP	-	Van Genuchten or Brooks and Corey	1
IMSHGN	-	Spatial discretization option	1
NVFLAYR	-	Number of layers in flow model	3

OPTIONS CHOSEN

Van Genuchten functional coefficients
User defined coordinate system

Layer information

LAYER NO.	LAYER THICKNESS	MATERIAL PROPERTY
1	3.10	1
2	1.20	2
3	3.10	3

DATA FOR MATERIAL 1

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.220E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.420	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 1

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.100E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.23	-999.	1.00	5.00

DATA FOR MATERIAL 2

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.460	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 2

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.670E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

DATA FOR MATERIAL 3

VADOSE ZONE MATERIAL VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Saturated hydraulic conductivity	cm/hr	CONSTANT	0.540E-01	-999.	0.100E-10	0.100E+05
Unsaturated zone porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Air entry pressure head	m	CONSTANT	0.100E-03	-999.	0.000E+00	-999.
Depth of the unsaturated zone	m	CONSTANT	7.40	-999.	0.100E-08	-999.

DATA FOR MATERIAL 3

VADOSE ZONE FUNCTION VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Residual water content	--	CONSTANT	0.890E-01	-999.	0.100E-08	1.00
Brook and Corey exponent,EN	--	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
ALFA coefficient	1/cm	CONSTANT	0.200E-01	-999.	0.000E+00	1.00
Van Genuchten exponent, ENN	--	CONSTANT	1.41	-999.	1.00	5.00

UNSATURATED ZONE TRANSPORT MODEL PARAMETERS

NLAY	-	Number of different layers used	3
NTSTPS	-	Number of time values concentration calc	40
DUMMY	-	Not presently used	1
ISOL	-	Type of scheme used in unsaturated zone	1
N	-	Stehfest terms or number of increments	18
NTEL	-	Points in Lagrangian interpolation	3
NGPTS	-	Number of Gauss points	104
NIT	-	Convolution integral segments	2
IBOUND	-	Type of boundary condition	1
ITSGEN	-	Time values generated or input	1
TMAX	-	Max simulation time --	0.0
WTFUN	-	Weighing factor --	1.2

OPTIONS CHOSEN

Stehfest numerical inversion algorithm
Nondecaying continuous source
Computer generated times for computing concentrations

DATA FOR LAYER 1

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	3.10	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer		DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.49	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

DATA FOR LAYER 2

VADOSE TRANSPORT VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Thickness of layer	m	CONSTANT	1.20	-999.	0.100E-08	-999.
Longitudinal dispersivity of layer	m	DERIVED	-999.	-999.	0.100E-02	0.100E+05
Percent organic matter	--	CONSTANT	0.530	-999.	0.000E+00	100.
Bulk density of soil for layer	g/cc	CONSTANT	1.38	-999.	0.100E-01	5.00
Biological decay coefficient	1/yr	CONSTANT	0.100E-04	-999.	0.000E+00	-999.

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.100E-03	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.388E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	-999.	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.100E-03	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	0.660	-999.	0.000E+00	-999.
Length scale of facility	m	DERIVED	210.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	DERIVED	185.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	0.100E-01	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.260	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.76	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	100.	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.540E-01	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.500E-01	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	-999.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	CONSTANT	10.0	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Transverse dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Vertical dispersivity	m	FUNCTION of X	-999.	-999.	-999.	-999.
Temperature of aquifer	C	CONSTANT	13.0	-999.	0.000E+00	100.
pH	--	CONSTANT	7.50	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.310E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	30.5	-999.	1.00	-999.
Angle off center	degree	CONSTANT	5.00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.100E-01	-999.	0.000E+00	1.00

CONCENTRATION AFTER SATURATED ZONE MODEL 0.3120E-01 mg/l.