Energy Fuels Resources

November 4, 2010

Mr. Steve Tarlton, Program Manager
Radiation Management Program
Hazardous Materials & Waste Management Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South HMWMD-B2
Denver, CO 80246-1530

Transmittal: Replacement Attachment D for the Tailings Cell Closure Design Report in Response No. 2 to Request for Additional Information No. 2
Piñon Ridge Mill License Application, Montrose County, Colorado

Dear Steve:

Per a verbal conversation with Larry Bruskin, Energy Fuels is providing the attached revised pages to the Tailings Cell Closure Design Report, Attachment D submitted to your office on September 22, 2010 as Response No. 2 to RFI #2. Mr. Bruskin noted that some of the data presented in Attachment D were difficult to read due to small font and black and white graphs. The replacement pages provided with this submittal are identical in content to the September 22 submittal, the text and graphs have simply been revised to facilitate reading of the document. Four copies of the Attachment D replacement pages are attached to update the September 22nd submittal. In addition, an electronic copy of this letter and the replacement pages has been emailed to you for ease is posting to your website.

Please contact me should you have any questions or require additional information.

Sincerely,

Zach Rogers, EIT
Environmental Engineer

Attachments

Cc: S. White, Montrose County
A. Kuhn, Kleinfelder
M. Bloomstran, Edge
K. Morrison, Golder
B. Monok, F. Filas, S. Antony – Energy Fuels

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ATTACHMENT D

UNSAT-H Flow Modeling and Analysis

This summary presents the results of a one-dimensional bounding unsaturated flow analysis for the cover design for the three proposed tailings cells for Energy Fuels Resource Corporation at its Piñon Ridge Uranium Mill site in Montrose County, Colorado. The program UNSAT-H Version 3.01 (Kleinfelder, 2009, Ref. 3.7) hereinafter referred to as UNSAT-H was used in the analysis to simulate a range of infiltration rates over a five-year period. Based upon the cover design that provides thicknesses of each cover layer, and an estimation of each layer's unsaturated flow properties, an unsaturated flow model was developed subject to an upper bound hydraulic boundary condition that induces a range of infiltration rates. The lower flow- boundary condition consists of a unit gradient boundary condition.

The calculation develops estimation for the infiltration from previous analysis, and well known correlations between infiltration and rainfall. The meteorological records from the Uravan station represent the most recent and complete data available, but these data lack some parametric values needed to estimate the surface infiltrations rate based upon a field water balance. Therefore, a conservatively high estimate of surface infiltration from 8mm to 20 mm/year over a several year period was used. These infiltration rates exceed those used for similar modeling at other sites at Monticello Utah, the Rocky Mountain Arsenal (RMA) Colorado, and at Ft. Carson, Colorado.

The UNSAT-H model geometry is based upon the design section that includes, from bottom to top:

- the interim cover, 2 ft (61 cm) and is the first layer above the tailings. It is native soil compacted to 90% Standard Proctor with the gravimetric moisture content within +- 2% of the optimum moisture content.
- the pond liner, 0.03 ft. (1 cm) thick with an equivalent hydraulic conductivity of 1×10^{-9} cm/s.
- the radon barrier consisting of native soil compacted to 85% Standard Proctor with gravimetric moisture content within +- 2% of the optimum moisture content. The radon barrier thickness of 5.7 ft. is determined to limit radon flux to 20 piC/m^2/sec.
- the bio-intrusion barrier, 0.5 ft. (15 cm of cobbles up to six inches in diameter spread to achieve a uniform cover without gaps.
- the capillary break layer, 0.5 ft. (15 cm) of granular soil
- the vegetative cover layer, 4.0 ft of native soil compacted to not more than 85% Standard Proctor density

The tailings layers are not modeled in the UNSAT-H analysis because the objective of the model is to estimate infiltration through the cover layers that might reach the tailings.

The UNSAT H model was run With moisture values at -15 bar, per the SWCC testing, to represent initial conditions. The model predicts a period of decreasing "Infiltrability" followed by a period of steady "infiltrability" after 1200 days. The analysis is conservative because the field water balance that was used in the previous Itasca calculations resulted in an approximate 50 year Infiltration rate of about 4 mm per year in the upper layer after accounting for precipitation, evapotranspiration, and bare soil evaporation. If after 10 years there was a wet period that would have resulted in such a high infiltration rate, there would be a subsequent "dry" period in which evapotranspiration exceeded precipitation, and there would be a drying out of the layers.

The results with this model show that the Bio-intrusion/ capillary break zone performs as a capillary barrier under these infiltration rates over this period, and there is no indication that saturated levels build up in the vegetative cover to cause the head to exceed the air-entry pressure for this layer as might be expected if saturated conditions in the vegetative cover were to occur. The analysis shows that the percolation rate below the pond liner into the interim cover is quite small.

The UNSAT-H modeling is documented in the calculation # 83088.4.4-ALB10CA003, Rev. 0.

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CALCULATION COVER SHEET

Date:

Project No.: 83088 Project Title: Pinon Ridge Tailings Closure Plan

Calculation No.: 83088.4.4-ALB10CA003
Calculation Title: Unsaturated Flow Modeling and Analysis

Design Review and analysis Required: X Yes ☐ No

Calculation Type: ☐ Scoping ☐ Preliminary X Final ☐ Voided
☐ Superseded by Calculation No.:

ORIGINAL AND REVISED CALCULATIONS/ANALYSIS APPROVAL

	Rev. 0 Printed Name/Signature/Date	Rev. 0 Printed Name/Signature/Date	Rev. ___ Printed Name/Signature/Date
Originator:	John Case	[signature] 11/01/10	
Checked By:	Courtney Vallejo	[signature] 11/03/10	
Approved By:	Alan Kuhn	[signature] 11/03/10	
Other:			

AFFECTED DOCUMENTS

Document Number	Document Title	Rev. No.	Responsible Project Manager Initials
N/A	N/A	N/A	N/A

RECORD OF REVISION

Rev.	Reason for Revision
0	Original Issue

CALCULATION COVER SHEET
CONTINUATION PAGE

ATTACHMENTS

Attachment No.	Title	Total Pages
A	Estimation of UNSATH Infiltration Boundary Condition	7
B	Pinon Ridge Infiltration Results	12
C	Pinon Ridge Percolation Results	6
D	CD ROM of Files	1

1.0 INTRODUCTION

1.1 Objective

The purpose of this calculation is to perform a bounding unsaturated flow analysis for the cover design for the three proposed tailings cells for Energy Fuels Resource Corporation at its Piñion Ridge Uranium Mill site in Montrose County, Colorado. The calculation develops an estimation for the infiltration from previous analysis, and well known corelations between infiltration and rainfall. The program UNSAT-H Version 3.01 (Kleinfelder, 2009, Ref. 3.7) hereinafter referred to as UNSAT-H is used in the analysis. Based upon the cover design that provides thicknesses of each cover layer, and an estimation of each layer's unsaturated flow properties, an unsaturated flow model is developed subject to a upper bound hydraulic boundary condition that induces a range of infiltration rates.The lower flow boundary condition consists of a unit gradient boundary condition.

1.2 Scope

The scope of this calculation is limited to the Pinion Ridge Tailings Closure Design. The UNSAT-H flow model is used to perform
the transient flow analysis for estimating the moisture potential, the moisture content, and percolation through the system.

2.0 BASIS

2.1 Design Inputs

2.1.1 Model Geometry

The UNSAT-H model geometry is obtained from Kleinfelder (2010, Ref. 3.1) in which the radon barrier thickness is determined to limit radon flux to 20 "piC/m^2/sec. The thickness of the radon barrier is 5.7 ft (173.7 cm). The tailings layer is not modeled in the UNSAT-H analysis. Table 2-1 summarizes the model geometry. The interim cover thickness is 2 ft (61 cm) and is the first layer above the tailings. It is native soil compacted to 85% Standard Proctor with the gravimetric moisture content within +- 2% of the optimum moisture content. The next layer is a geosynthetic Liner .03 ft (1 cm) thick with an equivalent hydraulic conductivity of 1*e-09 cm/s. The next layer is the radon barrier layer compacted to 95% Standard Proctor with a gravimetric moisture content within +- 2% of the optimum moisture content. The next layer is the biointrusion layer 0.5 ft (15 cm) thick. It consists of cobbles up to six inches in diameter spread to achieve a uniform cover without gaps. The next layer is the capillary break layer 0.5 ft (15 cm) thick. The vegetative layer is the top most layer and has a thickness of 4 ft.

2.1.2 Soil Retention Characteristics

The UNSAT-H model uses the Van Genuchten soil retention properties as determined by Kleinfelder (2010, Ref. 3.2). The soil retention properties are presented in Table 2-1. The soil retention relationships are presented in Figure 2-1.

2.1.3 Saturated and Unsaturated Hydraulic Conductivity

The UNSAT-H model uses unsaturated hydraulic conductivity as determined by Kleinfelder (2010, Ref. 3.2). The saturated hydraulic conductivity properties for each of the layers is presented in Table 2-2. The unsaturated hydraulic conductivity relationships are presented in Figure 2-2.

The vegetative cover, and the biointrusion layer use the properties of the native soil while the pond liner consists of a high plasticity clay.

Table 2-1 Model Geometry and Unsaturated Flow Water Storage Parameters (Ref. 3.1 and 3.2)

Cover Design		Unsaturated Flow Properties				
		Water Storage Parameters				
Cover Element	Thickness ft.	Van Genuchten Parameters				Change In Storage
		α (cm^-1)	n	Residual	Porosity	
Rock Mulch	0.5	0.0216	1.24	0.02	0.39	0.37
Vegetative Cover	3.5	0.0216	1.24	0.02	0.39	0.37
Capillary Break	0.5	2.8	2.5	0.03	0.33	0.3
Bio-intrusion Barrier	0.5 min.	0.0216	1.24	0.02	0.39	0.37
Radon barrier	5.7	0.0216	1.24	0.02	0.32	0.3
Geosynthetic Liner	0.02	0.008	1.09	0.068	0.47	0.402
Interim Cover	2	0.0216	1.24	0.02	0.39	0.37

Table 2-2 Geotechnical Parameters and Saturated Hydraulic Conductivity (Ref. 3.2)

Cover Design		Saturated Hydraulic Conductivity					Initial Conditions		
Cover Element	Thickness ft.	Min	Average	Max	Average	Average			
		(cm/sec)			mm/yr	cm/hr	Initial	Initial	Initial
Rock Mulch	0.5	2.70E-05	1.00E-04	1.80E-04	3.16E+04	3.60E-01	200	0.27	68%
Vegetative Cover	3.5	2.70E-05	1.00E-04	1.80E-04	3.16E+04	3.60E-01	200	0.27	68%
Capillary Break	0.5	6.20E-03	6.20E-02	1.00E+02	1.96E+07	223.2	15300	0.03	0%
Bio-intrusion Barrier	0.5 min.	2.70E-05	1.00E-04	1.80E-04	3.16E+04	0.36	15300	0.11	24%
Radon barrier	5.7	2.70E-05	1.00E-04	1.80E-04	3.16E+04	0.36	15300	0.09	23%
Geosynthetic Liner	0.02	1.00E-09	1.00E-09	1.00E-05	3.16E-01	3.60E-06	15300	0.33	65%
Interim Cover	2	2.70E-05	1.00E-04	1.80E-04	3.16E+04	0.36	15300	0.11	25%

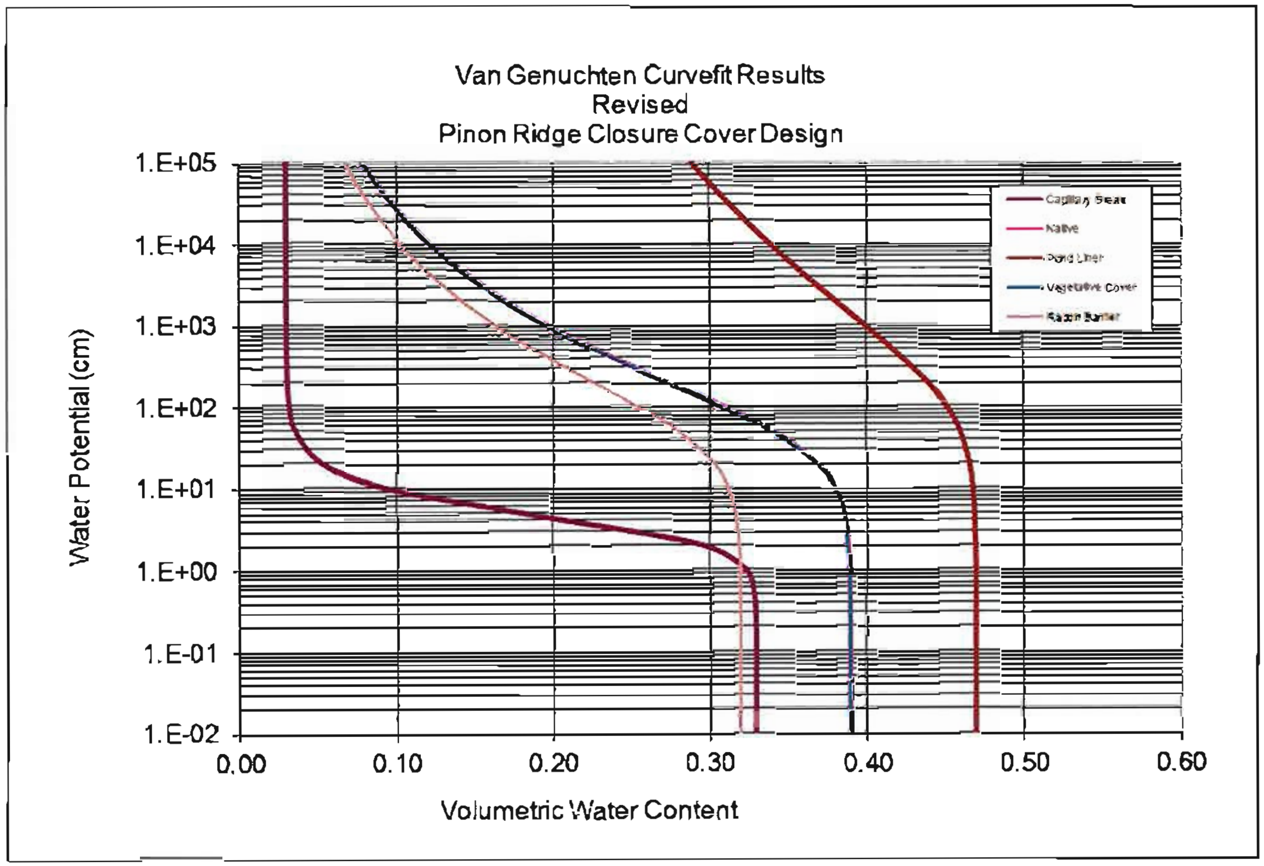


Figure 2-1 Soil Water Retention Relationships

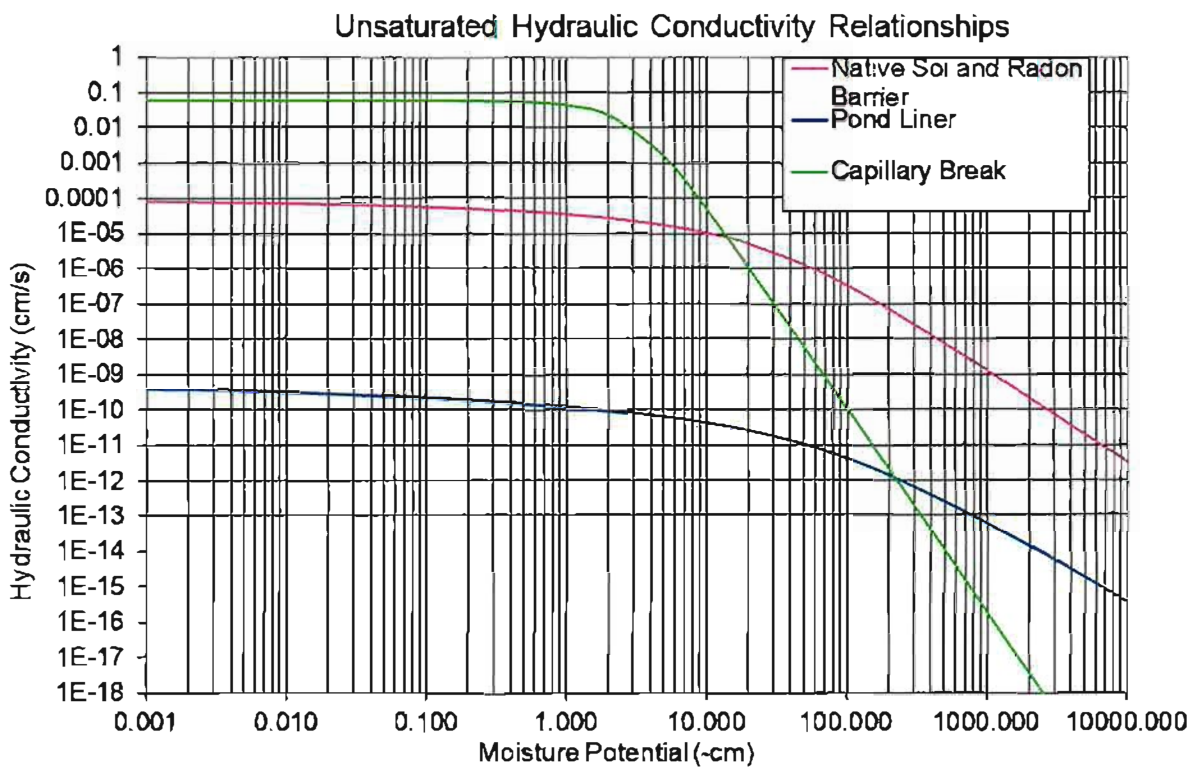


Figure 2-2 Unsaturated Hydraulic Conductivity Relationships

2.2 DESIGN CRITERIA

Published textbooks and documents in the field of vadose zone hydrogeology (Ref. 3.9) , along with data identified in Section 2.1 above, were used to develop the fundamental geotechnical and hydrologic properties.

2.3 ASSUMPTIONS

2.3.1 The lateral dimensions relative to the depths of the layered system are large such that unsaturated flow in one dimension can be modeled.The model neglects the diversion of flow at the capillary barrier. This is a reasonable assumption near the center of the closure system since the vertical dimension downward is small relative to the lateral horizontal dimension.

2.3.2 The water balance which is takes into account precipitation, runoff, bare soil evaporation, and plant transpiration is bounded by the selection of an upper hydraulic moisture potential condition. The analysis is bounding when compared to the previous cover analysis for soil infiltration by Itasca (Shchipansky A, and Sterrett R, 2008 Ref. 3.3)

2.3.3 The initial moisture potential for the analysis is set to -200 cm and reflects a long term soil moisture condition in which the soil has resaturated from the emplaced moisture content, and then has dried out due to a drought period. The analysis is bounding in that infiltration rates will be higher due to capillary pressure driven flow.

2.3.4 The analysis is performed under isothermal conditions. The analysis is bounding in that a more detailed analysis of the field water balance would show that infiltration would be smaller.

3.0 REFERENCES

3.1 Kleinfelder, 2010, "Pinon Ridge Radon Barrier Cover Design," Calculation Brief, Calculation Brief No. 83088.4.4-ALB10CA001, Kleinfelder , Albuquerque New Mexico.

3.2 Kleinfelder, 2010, "Pinon Ridge Closure Cover Geotechnical and Hydrologic Properties", Calculation Brief, Calculation Brief No. 83088.4.4-ALB10CA001, Kleinfelder , Albuquerque New Mexico.

3.3 Shchipansky A, and Sterrett R., 2008, Numerical Analysis of Water Percolation through the Cover Cap of "Pinon Ridge" Uranium Mill Tailings (Colorado), Technical Memorandum, HCITasca, Denver Colorado.

3.4 SNL, 2007, Simulation of Net Infiltration for Present-Day and Potential Future Climates, MDL-NBS-HS-000023 Rev01, Sandia National Laboratories, Albuquerque New Mexico.

3.5 URAVAN Weather Data Climate Summary, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co8560.

3.6 Fayer, M. 2000, UNSAT-H Version 3.0: Unsaturated Soil Water and Heat Flow Model Theory, User Manual, and Examples PNNL-13249, PACIFIC NORTHWEST NATIONAL LABORATORY operated by BATTELLE for the UNITED STATES DEPARTMENT OF ENERGY under Contract DE-AC06- 76RLO 1830.

3.7 Kleinfelder, 2009, UNSAT-H Verification and Validation Report, ARES Report, Verification No. CMRR -09-10-001, ARES Albuquerque New Mexico.

3.8 Kleinfelder West, Inc. , 2009, Software Verification and Validation Work Plan for UNSAT-H, DCN: 1 01492.4.1ALB09QA001, dated April 27, 2009.

3.9 Fetter, C., 1993, Contaminant Hydrogeology, 1993, Macmillan Co., New York.

3.10 Fayer, M. 2000, UNSAT-H Version 3.0: Unsaturated Soil Water and Heat Flow Model Theory, User Manual, and Examples PNNL-13249, PACIFIC NORTHWEST NATIONAL LABORATORY operated by BATTELLE for the UNITED STATES DEPARTMENT OF ENERGY under Contract DE-AC06- 76RLO 1830.

3.11 Hillel D., 1998 Environmental Soil Physics, Academic Press, San Diego.

3.12 Filas, F., 2010, "Request for Work Scope and Budget, Response to Radiation Control Program Request for Information #2, Tailings Cell Closure Design Report Pinon Ridge Mill Project, Montrose County, Colorado.

4.0 METHODS OF ANALYSIS

The modeling and analysis of unsaturated flow was performed with UNSAT-H Version 3.01. UNSAT-H Version 3.01 (Kleinfelder Software Tracking Number (STN): ALB-006), referred to as UNSAT-H, is a one dimensional nonlinear unsaturated soil water and heat flow model developed by the Pacific Northwest National Laboratory (PNNL). UNSAT-H can be used to solve one dimensional unsaturated flow problems for multiple layers defined by different soil-water characteristic relations for different flow and moisture potential boundary conditions.

The one-dimensional flow of water under gravity was assumed to be the dominating driving mechanism (heat and chemical potentials were not considered). The source of water is assumed to be precipitation but the volume of precipitation is reduced significantly by the processes of evaporation, vapor transport, transpiration, and storage of water within the soils. The model used 196 nodes over the depth of interest. The hydraulic properties of the soil layers used in the model
are listed in Tables 2-1 and 2-2.

Kleinfelder prepared Verification and Validation (V&V Report) according to a V and V Work Plan (Kleinfelder, 2009, Ref 3.8) for UNSAT-H Version 3.01. UNSAT-H Version 3.01 was used within the range of validation for Unsaturated Flow Modeling and Analysis.

The initial condition for the unsaturated flow analysis is determined from the Van Genuchten Soil Retention characteristic relationship (Fetter, 1993, p. 172, Ref. 3.9):

$$\theta_c = \frac{1}{\left[1 + (\alpha \cdot |\psi|)^n\right]^m} \qquad \theta = \frac{\theta - \theta_r}{\left[1 + (\alpha \cdot |\psi|)^n\right]^m} + \theta_r$$

where

α Van Genuchten Air Entry Parameter (cm^{-1}),
n Van Genuchten Parameter (-),
m Van Genuchten Parameter (1-1/n), and
ψ Moisture potential

5.0 CONCLUSIONS

The UNSAT H model was run for the revised design section (Table 2.1). Unsaturated flow properties were selected for each of the layers (Tables 2.2). Initial moisture contents were selected based upon the estimated soil infiltration for vegetatative cover, and the moisture content at -15 bar per the SWCC testing, were used to represent initial conditions below the capillary break. Because even the Uravan data lack some parametric values used to estimate the surface infiltrations rate, we simplified the model by estimating conservatively high surface infiltration from 8mm to 20 mm/year, values that exceed those used for Monticello, RMA, or Ft. Carson (Filas, 2010, Ref 3.12). The model predicts a period of decreasing "infiltrability" followed by a period steady "infiltrability" after 1200 days (Hillel, 1998, Ref. 3.11). The analysis is conservative because the field water balance that was used in the previous Itasca calculations (Shchipansky, A. and Sterrett, 2008, Ref. 3.3) resulted in an approximate 50 year infiltration rate of about 4 mm per year in the upper layer after accounting for precipitation, evapotranspiration, and bare soil evaporation. If after 10 years there was a wet period that would have resulted in such a high infiltration rate; there would be a subsequent "dry" period in which evapotranspiration exceeded precipitation, and there would be a drying out of the layers.

The results with this model show that the Bio-intrusion/ capillary break zone performs as a capillary barrier under these infiltration rates over this period, and there is no indication that saturated levels build up in the vegetative cover to cause the head to exceed the air-entry pressure for this layer as might be expected if saturated conditions in the vegetative cover were to occur. The analysis shows that the percolation rate below the Pond LIner is quite small and much less than 0.1 mm per year.

6.0 CALCULATED DATA

6.1 Upper Boundary Condition

The upper boundary condition at the top of the model is a constant moisture potential condition of 180 cm. The peak infiltration that can be used as a constant flux boundary condition for unsaturated flow modeling is approximated by considering the water content profile with the highest hydraulic conductivity and the change in moisture content over a period of 30 years from Figures 5 and 6 of Shcipansky, and Sterret, 2008. The approximate thickness of the zone of increased saturation is 100cm. The analysis also utilized a variety of correlations relating soil infiltration to precipitation (SNL 2007, Ref 3.4)

Based upon the previous analysis (Shchipansky, A. and Sterrett, 2008, Ref. 3.3), the peak infiltration rate into the soil was about 8 mm per year. The average infiltration rate is about 4 mm per year. The peak rate from the Uranvan precipitation data and various correlations is about 18 mm per year (Attachment A).

6.2 Lower Boundary Condition

The lower boundary of the model is the top of tailings layer. This boundary was simulated using a unit hydraulic gradient so that water would readily leave the model at this boundary.

6.3 Initial Moisture Condition

Calculate the initial moisture condition for the vegetative cover under a moisture potential of 200 cm.

$\alpha := .0216$ $\quad n := 1.24$ $\quad m := 1 - \frac{1}{n}$ $\quad m = 0.193548$ $\quad \psi := -200$ $\quad \theta_s := 0.39$ $\quad \theta_r := 0.02$

$$\theta := \frac{\theta_s - \theta_r}{\left[1 + (\alpha \cdot |\psi|)^n\right]^m} + \theta_r \qquad \theta = 0.273$$

The result agrees with the post processing file Pinon12.lis for the upper vegetative cover.

Table 6-1 presents the initial conditions used in the analysis.

Table 6-1 UNSATH Initial Conditions

Cover Design		Model Geometry			Initial Conditions		
Cover Element	Thickness ft.		Depth (cm)		Initial	Initial	Initial
		Thickness	Top (cm)	Bottom (cm)			
Rock Mulch	0.5	15.2	0	15.2	200	0.27	68%
Vegetative Cover	3.5	106.7	15.2	121.9	200	0.27	68%
Capillary Break	0.5	15.2	121.9	137.2	15300	0.03	0%
Bio-intrusion Barrier	0.5 min.	15.2	137.2	152.4	15300	0.11	24%
Radon barrier	5.7	173.7	153.4	327.1	15300	0.09	23%
Geosynthetic Liner	0.02	1.0	327.1	328.1	15300	0.33	65%
Interim Cover	2	61.0	328.1	389.1	15300	0.11	25%

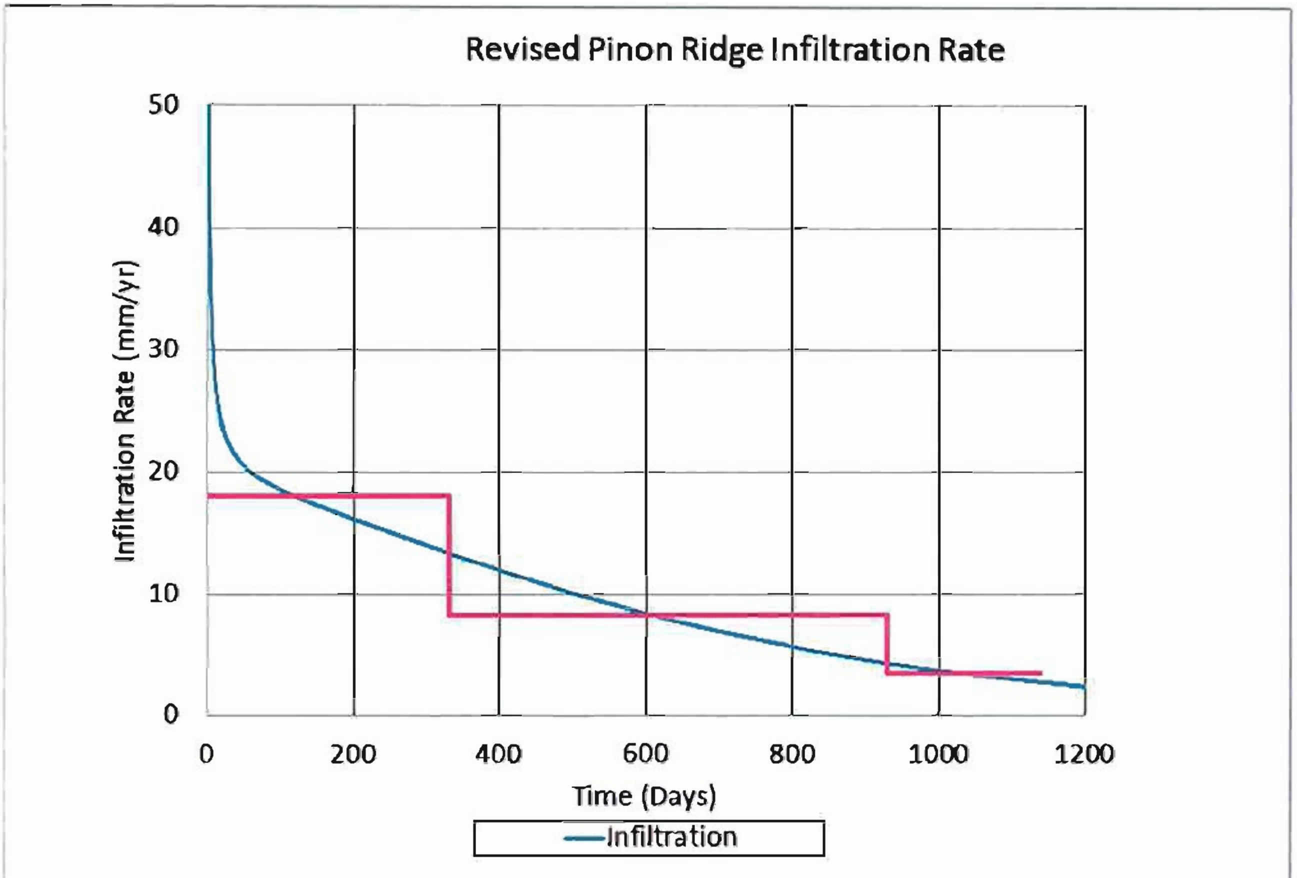
6.4 Modeling Results

Table 6-2 presents a listing of the files presented on the CD-ROM of Attachment D. The UNSAT-H file pinon12.inp was prepared according to the Users' Manual instruction (Fayer, 2000, Ref. 3.10). The preprocessing program din30.exe which produced the file pinon12.lis which performs checks on the input file. The file terminated normally. The main program uns301.exe wasexecuted and produced a series of pinon12*.res for each of the five years simulated in the analysis. The post processing program dout301.exe was executed, and generated individual output files. The files include plotting water content, or moisture content with depth. They also include plotting infiltration or percolation rates as a function of time.

Table 6-2 Summary of UNSAT-H Input and Output Files on the CD ROM

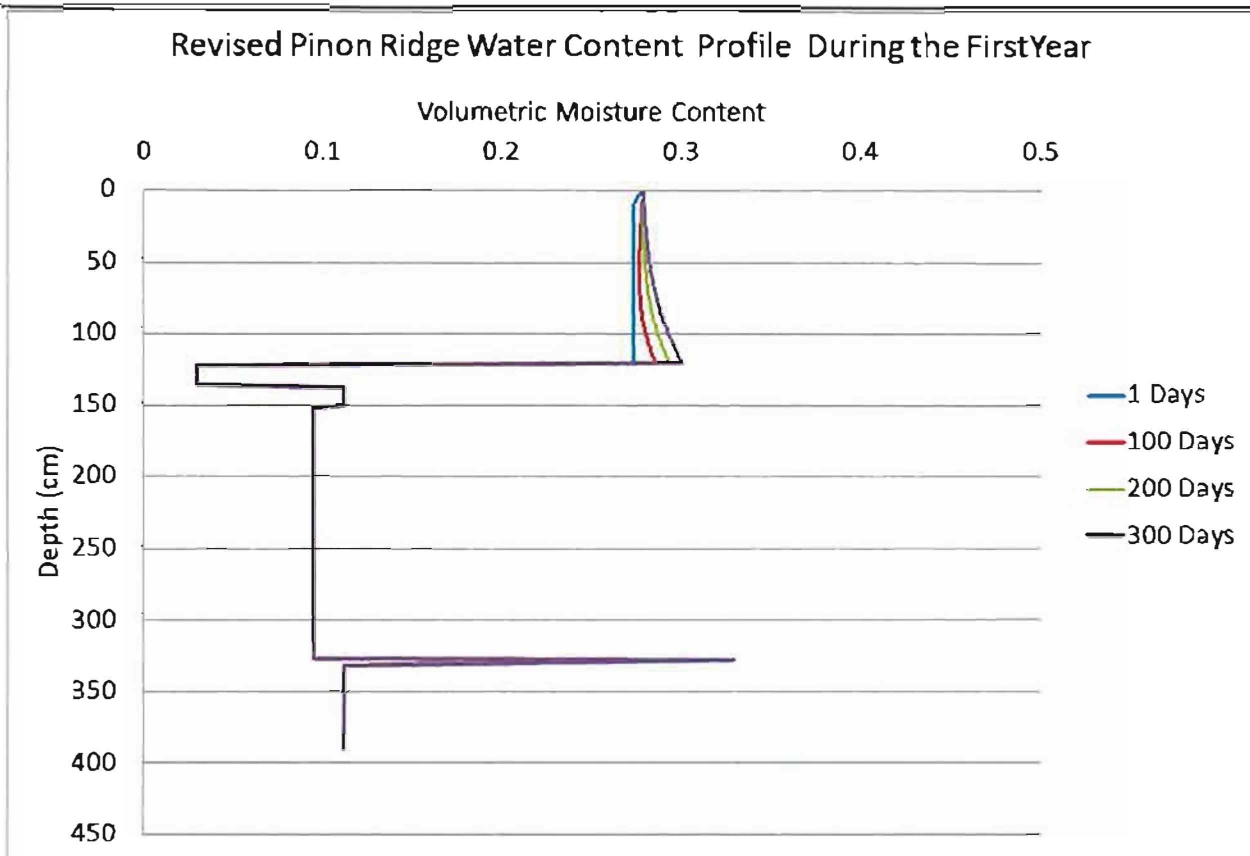
Date	Time	Size (bytes)	Title	Description
8/24/2010	9:21 AM	808,106	Pinon Ridge Percolation Into Cover.xlsm	Percolation at Various Levels in the Cover System
8/25/2010	8:41 AM	1,066,496	Pinon Ridge Results Rev03.xls	Infiltration, Water Content and Moisture Potential Results
8/14/2010	6:06 AM	3,668	Pinon12.inp	UNSAT-H Input File
8/14/2010	6:07 AM	20,501	pinon12.lis	UNSAT-H Preprocessing Output File
8/14/2010	6:09 AM	3,017,600	pinon122010.res	UNSAT-H Binary File 2010
8/14/2010	6:17 AM	30,489	pinon122010ba	UNSAT-H Water Balance 2010
8/14/2010	6:33 AM	12,334	pinon122010he	UNSAT-H Moisture Potential 2010
8/24/2010	6:52 AM	30,530	pinon122010ql	UNSAT-H Water Liquid Flows 2010
8/14/2010	6:33 AM	12,349	pinon122010wc	UNSAT-H Water Content 2010
8/14/2010	6:10 AM	3,017,600	pinon122011.res	UNSAT-H Binary File 2011
8/14/2010	6:18 AM	30,489	pinon122011ba	UNSAT-H Water Balance 2011
8/24/2010	6:52 AM	30,530	pinon122011ql	UNSAT-H Water Liquid Flows 2011
8/14/2010	6:10 AM	3,017,600	pinon122012.res	UNSAT-H Binary File 2012
8/14/2010	6:18 AM	30,489	pinon122012ba	UNSAT-H Water Balance 2012
8/24/2010	6:54 AM	30,530	pinon122012ql	UNSAT-H Water Liquid Flows 2012
8/14/2010	6:11 AM	3,017,600	pinon122013.res	UNSAT-H Binary File 2013
8/14/2010	6:19 AM	30,489	pinon122013ba	UNSAT-H Water Balance 2013
8/24/2010	6:54 AM	30,530	pinon122013ql	UNSAT-H Water Liquid Flows 2013
8/14/2010	6:12 AM	3,025,800	pinon122014.res	UNSAT-H Binary File 2014
8/14/2010	6:19 AM	30,571	pinon122014ba	UNSAT-H Water Balance 2014
8/14/2010	6:36 AM	12,334	pinon122014he	UNSAT-H Moisture Potential 2014
8/24/2010	6:55 AM	30,612	pinon122014ql	UNSAT-H Water Liquid Flows 2014
8/14/2010	6:36 AM	12,349	pinon122014wc	UNSAT-H Water Content 2014
8/25/2010	7:22 AM	42,496	UNSAT Cover Design Layers Rev02.xls	Closure Flow Modeling Analysis and Parameters
8/25/2010	8:41 AM	1,092,501	Unsaturated Flow Modeling and Analysis.xmcd	Calculation Brief

The results of the modeling and analysis are presented in Figures 6-1 through 6-4. Figure 6-1 shows infiltration into the vegetative cover for the first five years. The soil infiltration decreases over a range from over 20 mm per year to several 3 mm per year in response to the the hydraulic moisture potential condition at the top of the model. In response to the infiltration pulse, the water content in the vegetative cover is increased (Figure 6.2) in the first year. The analysis shows the performance of the capillary break in that there is little change in moisture content below the capillary break. After five years, moisture redistribution is completed with small changes in all layers. Figure 6.4 shows the percolation near the base of the vegetative cover. Average percolation fluxes range from 0.5 mm per year for the first year to 0.1 mm per year after five years.



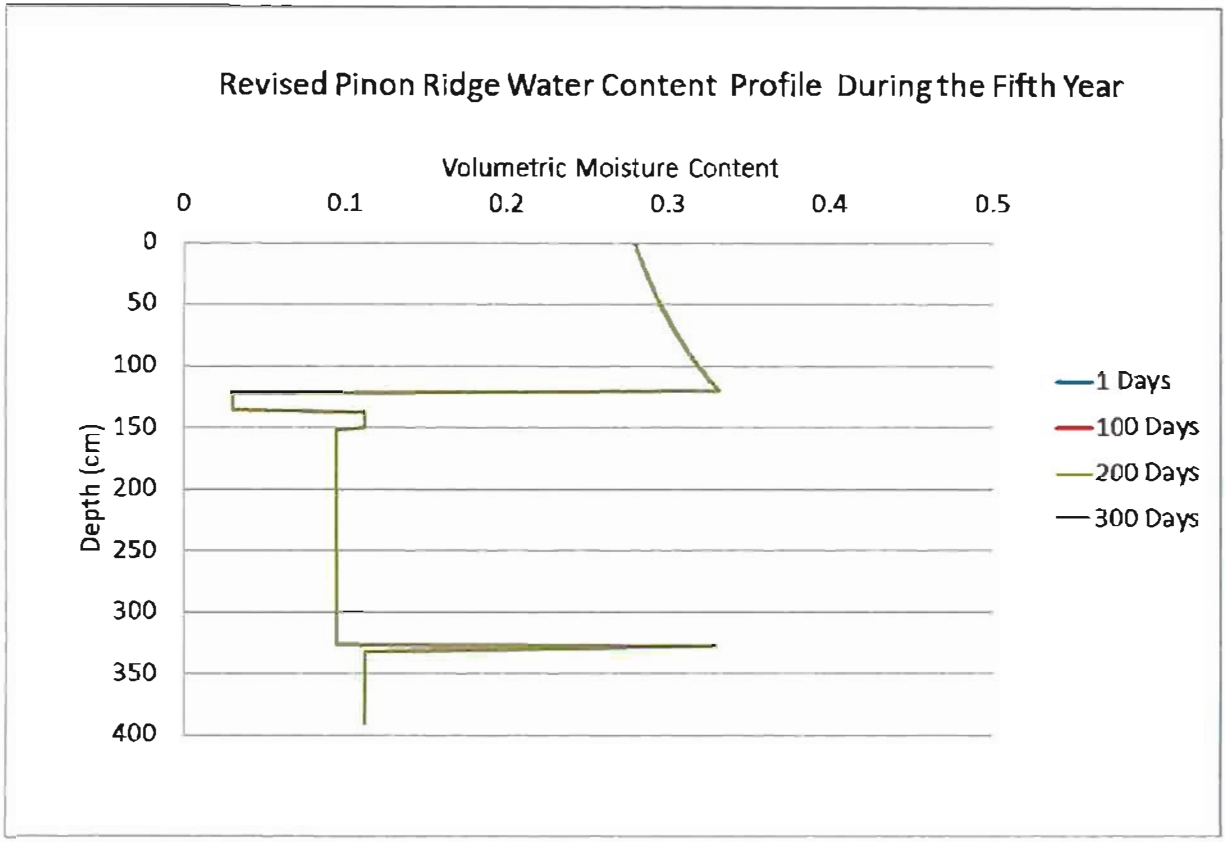
Source: Attachment B Pinon Ridge Results Rev03.xls

Figure 6-1 Infiltration Versus Time for the Pinon Ridge Tailings Closure Design



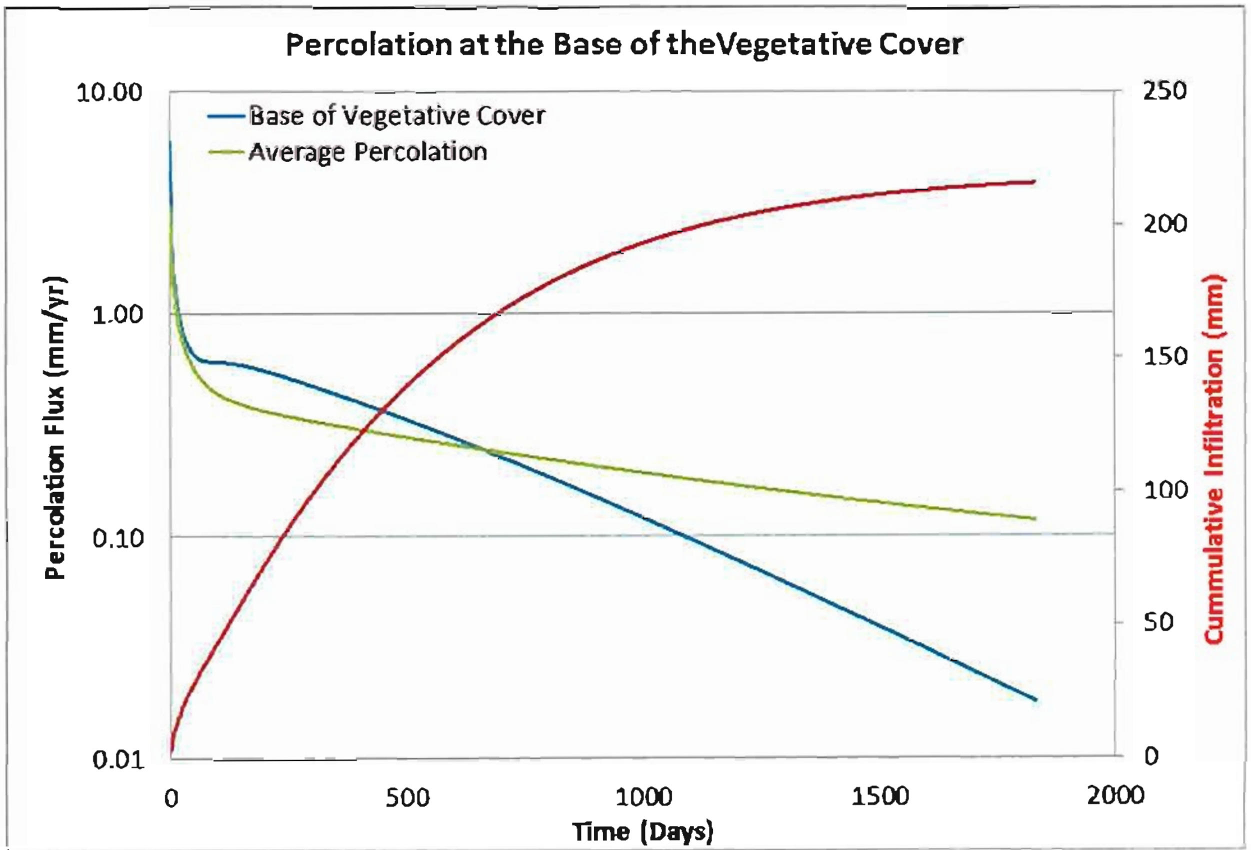
Source: Attachment B Pinon Ridge Results Rev03.xls

Figure 6.2 Volumetric Pinon Ridge Water Content Profile During the First Year



Source: Attachment B Pinon Ridge Results Rev03.xls

Figure 6.3 Volumetric Pinon Ridge Water Content Profile During the First Year



Source: Pinon Ridge Percolation Into Cover.xls

Figure 6-4 Percolation at the Base of the Vegetative Cover

ATTACHMENT A Estimation of UNSAT-H Infiltration Boundary Condition

PROBLEM STATEMENT:

Develop a bounding range of infiltration for the updated analysis of the Pinon Ridge Cover Based Upon (1) Evaluation of the (1) Peak Infiltration Rate from the Previous Analysis, and the (2) Maxey Eagen Relationship for semiarid environments

REFERENCES :

1. Shchipansky A, and Sterrett R., 2008, Numerical Analysis of Water Percolation through the Cover Cap of "Pinon Ridge" Uranium Mill Tailings (Colorado), Technical Memorandum, HCITasca, Denver Colorado.

2. SNL, 2007, Simulation of Net Infiltration for Present-Day and Potential Future Climates, MDL-NBS-HS-000023 Rev01, Sandia National Laboratories, Albuquerque New Mexico.

3. URAVAN Weather Data Climate Summary, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co8560

4. Kleinfelder, 2008, Pinon Ridge Closure Cover Geotechnical and Hydrological Properties, Kleinfelder Calculation Brief 89241.7-ALB08CA003, Kleinfelder, Albuquerque New Mexico

5. Kleinfelder, 2008, Radon Barrier Cover Thickness Design, Kleinfelder Calculation Brief 89241.7-ALB08CA001, Kleinfelder, Albuquerque, New Mexico.

The peak infiltration that can be used as a constant flux boundary condition for unsaturated flow modeling is approximated by considering the water content profile with the highest hydraulic conductivity and the change in moisture content over a period of 30 years from Figures 5 and 6 of Shcipansky, and Sterret, 2008. The approximate thickness of the zone of increased saturation is 100cm.

The change in moisture content is from .05 to 0.275. This is equivalent to approximately 23 cm of water over a period of 30 years for the upper approximate layer thickness of 100 cm. Calculate a peak infiltration rate for Scenario 3 which represents the maximum hydraulic concuctivity:

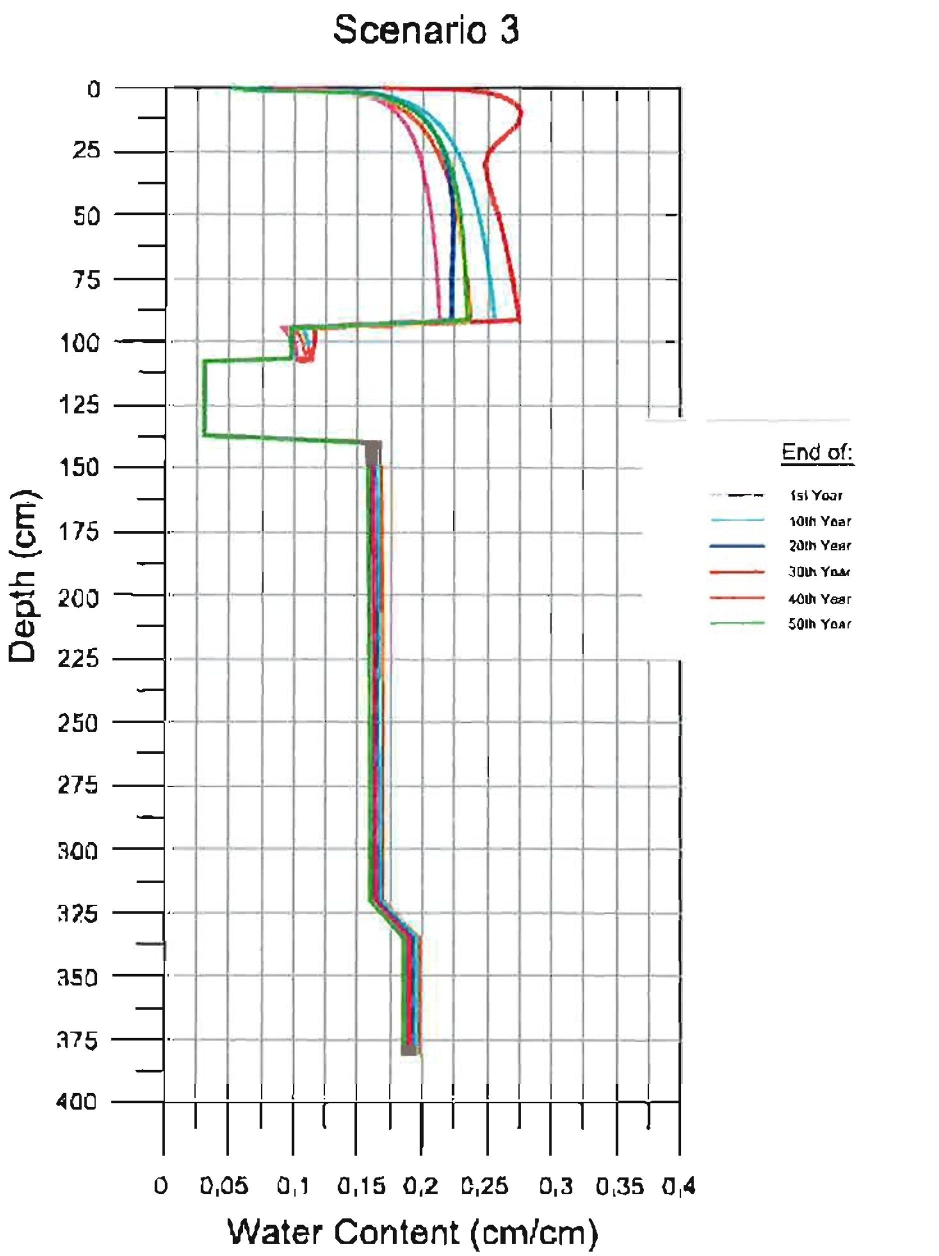


Figure 1 Water Content vs Depth for Scenario 3 (After Shchipansky and Sterrett, 2008).

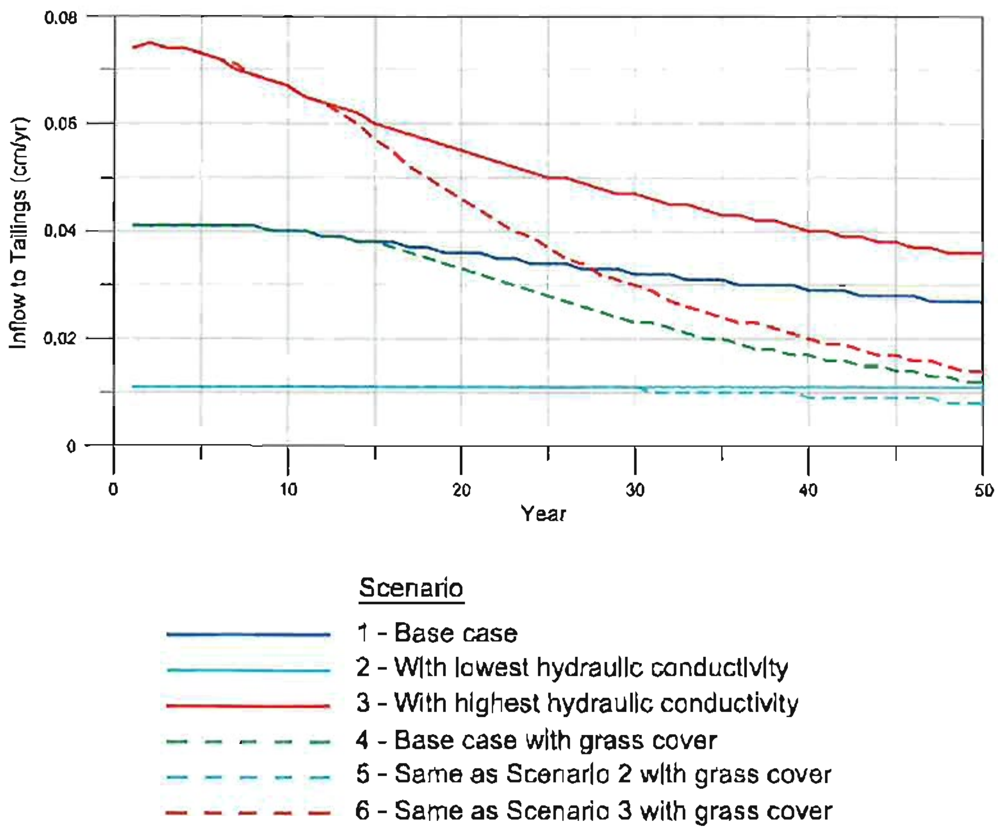


Figure 2 Predicted Inflows to Tailings through Landfill Cap (After Shchipansky and Sterrett, 2008)

To the change of water content in the upper 100 cm, add the pecolation flux into tl underlying tailings. The approximate average percolation flux into the tailings is about 0.6 mm per year.

$$J := \frac{23 \cdot cm + .06 \cdot \frac{cm}{yr} \cdot 30 \cdot yr}{30 \cdot yr}$$

$$J = 8.267 \cdot \frac{mm}{yr}$$

The estimated peak infiltration rate over thirty years is approximately 8 mm per year. Now calculate the average infiltration rate over 50 years. The approximat change in water content is from 0.05 to 0.23. This represents about 18 cm of water in upper layer thickness of 100 cm:

$$I := \frac{15 \cdot cm + .05 \cdot \frac{cm}{yr} \cdot 50 \cdot yr}{50 \cdot yr}$$

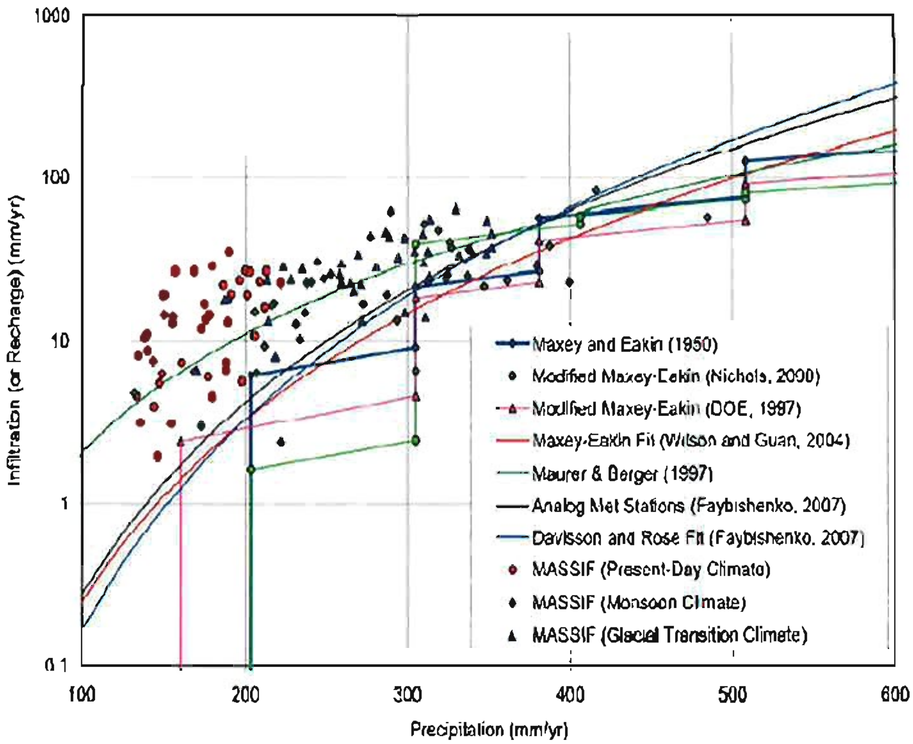
$$I = 3.5 \cdot \frac{mm}{yr}$$

The average infiltration rate is approximately 4 mm per year.

Compare this calculated value to the SNL relationship developed below. From the Uravan Web Site, the maximum percolation is 12.57 inches per year. Calculate the precipitation rate in mm/yr.

$$P := 12.57 \cdot \frac{in}{yr} \qquad P = 319.278 \cdot \frac{mm}{yr}$$

Use 320 mm per year, and use Figure 7.2.1.2-1 to estimate the infiltration from SNL 2007:



Source: Output DTNs: SN0701T0502206.034, SN0701T0502206.036, and SN0701T0502206.035; Validation Output DTN: SN0704T0502206.047

NOTE: Vertical lines that extend to the horizontal axis associated with the Maxey-Eakin and Modified Maxey-Eakin models represent the precipitation amounts below which the models predict zero recharge.

Figure 7.2.1.2-1. Comparison of MASSIF Net Infiltration Results for Three Climates with Several Models

For 320 mm per year, the estimated infiltration rate is

$$10^{1.25} \cdot \frac{mm}{yr} = 17.783 \cdot \frac{mm}{yr}$$

CONCLUSION:

Based upon the previous analysis, the peak infiltration rate into the soil was abou 8 mm per year. The average infiltration rate is about 4 mm per year. The peak rate from the Uranvan precipitation data and various correlations is about 18 mm per year.

ATTACHMENT B Pinon Ridge Infiltration Results

Program	DATAINH
Version	3.01

Input Filename: C:\New Energy Fuels Project\pinon12.inp
Date Processed: 14 Aug 2010
Time Processed: 07:13.6
Title:
Pinon Ridge

General options:

IPLANT	=	0	NGRAV	=	1					
IFDEND	=	366	IDTBEG	=	1	IDTEND	=	366		
IYS	=	2010	NYEARS	=	5	ISTEAD	=	1		
IFLIST	=	0	NFLIST	=	1					
NPRINT	=	0	STOPHR	=	2.40E+01					
ISMETH	=	1	INMAX	=	2	ISWDIF	=	1	DMAXBA	= 1.00E-02
DELMAX	=	1.50E-01	DELMIN	=	1.00E-15	OUTTIM	=	1.50E-01		
RFACT	=	2.00E+00	RAINIF	=	1.00E-05	DHTOL	=	0.00E+00		
DHMAX	=	0.00E+00	DHFACT	=	0.00E+00					
KOPT	=	4	KEST	=	3	WTF	=	0.00E+00		
ITOPBC	=	1	IEVOPT	=	0	NFHOUR	=	2	LOWER	= 1
HIRRI	=	0.00E+00	HDRY	=	2.00E+04	HTOP	=	1.80E+02	RHA	= 0.00E+00
IETOPT	=	0	ICLOUD	=	0	ISHOPT	=	0		
IRAIN	=	0	HPR	=	1.00E+00					

Hysteresis options:

IHYS	=	0	AIRTOL	=	0.00E+00	HYSTOL	=	0.00E+00	HYSMXH	= 0.00E+00

Heat flow options:

IHEAT	=	0	ICONVH	=	0	DMAXHE	=	0.00E+00		
UPPERH	=	0	TSMEAN	=	0.00E+00	TSAMP	=	0.00E+00	QHCTOP	= 0.00E+00
LOWERH	=	0	QHLEAK	=	0.00E+00	TGRAD	=	0.00E+00		

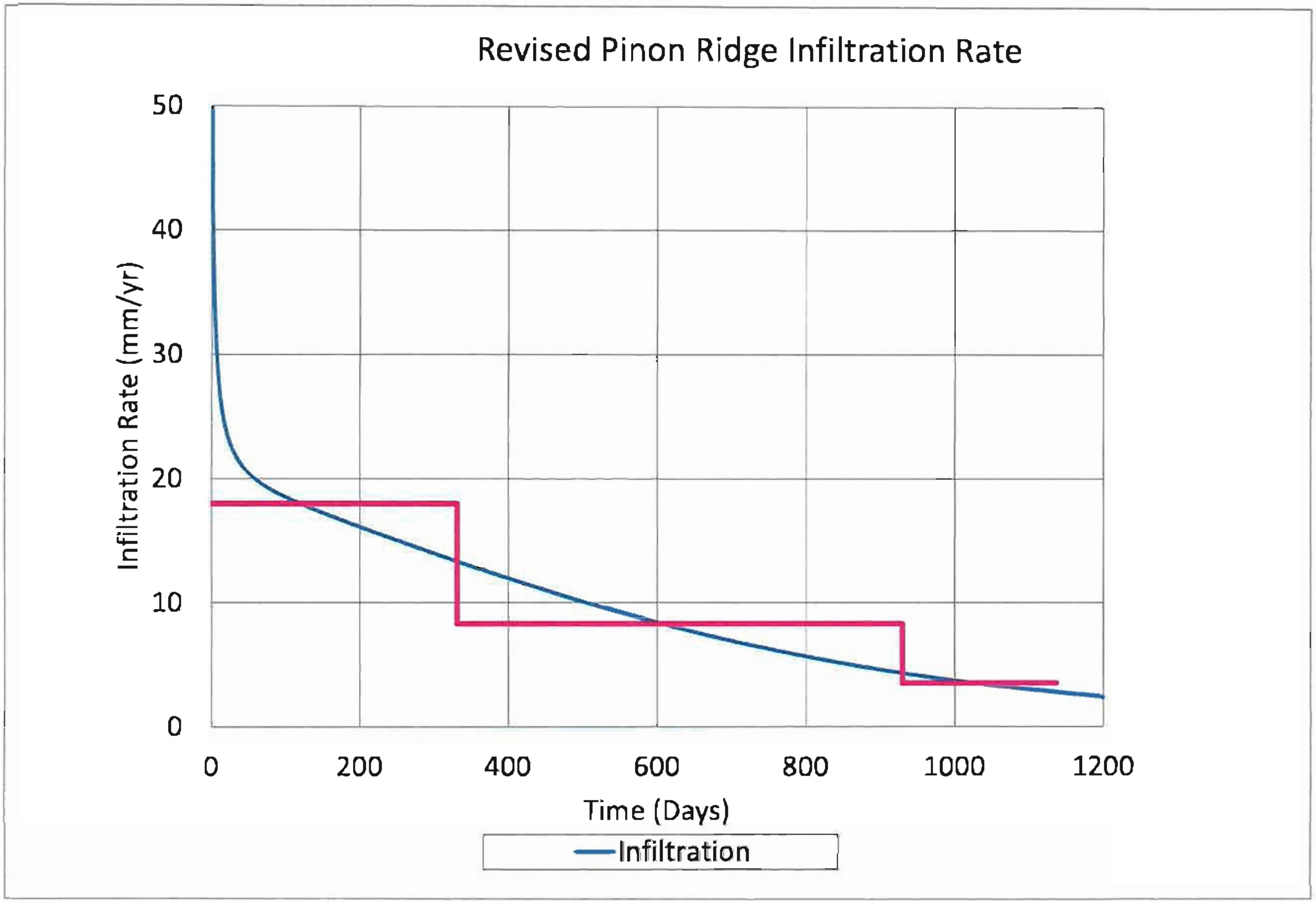
Vapor flow options:

IVAPOR	=	0	TORT	=	6.60E-01	TSOIL	=	1.70E+02	VAPDIF	= 2.40E-01

Grid options:

MATN	=	4	NPT	=	196

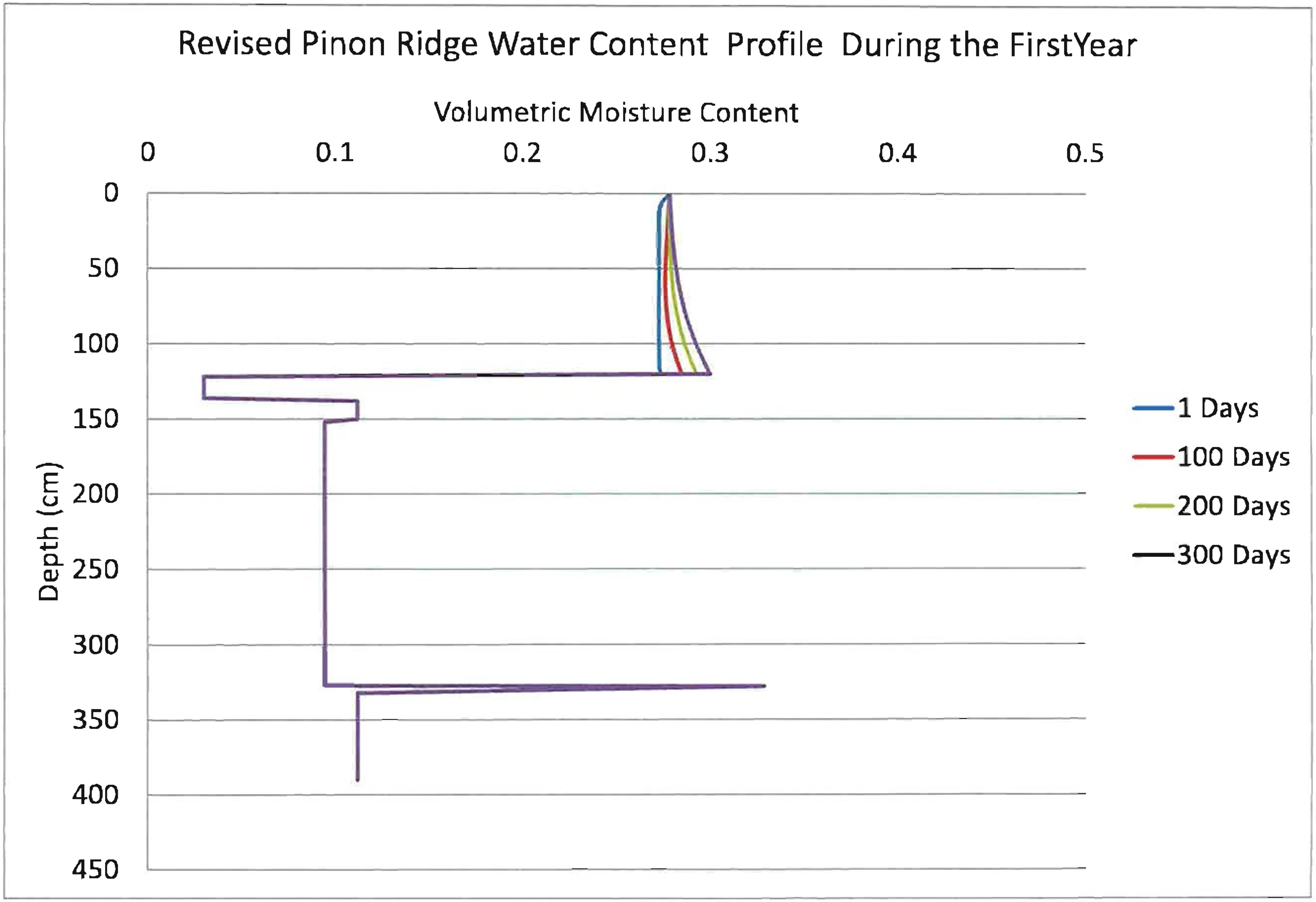
Time (Days	DAYINF (cm/hr)	Cumulative (cm)	DAYINF (mm/yr)	Average Infiltration (mm/yr)
0	1.16E-03	0.00	102	
1	5.65E-04	0.00	50	151.44
2	4.73E-04	0.00	42	96.44
3	4.25E-04	0.00	37	76.70
4	3.94E-04	0.00	35	66.15
5	3.72E-04	0.00	33	59.44
6	3.55E-04	0.00	31	54.72
7	3.42E-04	0.00	30	51.18
8	3.31E-04	0.00	29	48.41
9	3.22E-04	0.00	28	46.17
10	3.14E-04	0.01	28	44.30
11	3.08E-04	0.01	27	42.73
12	3.02E-04	0.01	26	41.37
13	2.96E-04	0.01	26	40.19
14	2.92E-04	0.01	26	39.14
15	2.88E-04	0.01	25	38.22
16	2.84E-04	0.01	25	37.38
17	2.80E-04	0.01	25	36.63
18	2.77E-04	0.01	24	35.94
19	2.74E-04	0.01	24	35.32
20	2.72E-04	0.01	24	34.74
21	2.69E-04	0.01	24	34.21
22	2.67E-04	0.01	23	33.72
23	2.65E-04	0.01	23	33.26
24	2.62E-04	0.01	23	32.83
25	2.61E-04	0.01	23	32.43
26	2.59E-04	0.01	23	32.06
27	2.57E-04	0.01	23	31.71
28	2.55E-04	0.01	22	31.37
29	2.54E-04	0.01	22	31.06
30	2.52E-04	0.01	22	30.76
31	2.51E-04	0.01	22	30.48
32	2.50E-04	0.01	22	30.21
33	2.48E-04	0.01	22	29.95
34	2.47E-04	0.01	22	29.71
35	2.46E-04	0.01	22	29.48
36	2.45E-04	0.01	22	29.25
37	2.44E-04	0.01	21	29.04
38	2.43E-04	0.01	21	28.84
39	2.42E-04	0.01	21	28.64
40	2.41E-04	0.01	21	28.45
41	2.40E-04	0.01	21	28.27
42	2.39E-04	0.01	21	28.10
43	2.38E-04	0.01	21	27.93
44	2.37E-04	0.01	21	27.77


Revised Pinon Ridge Infiltration Rate
50
40
30
20
10
0
Infiltration Rate (mm/yr)
0
200
400
600
800
1000
1200
Time (Days)
Infiltration

UNSA	T-H Vers	ion 3.01	
Inpu	t File:	C:\New Energy Fuels P roject\pinon12.inp	
Resu	lts File	: C:\New Energy Fuels P roject\pinon122010.res	
Date	of Run:	14-Aug	2010
Time	of Run:	6:08	7.68

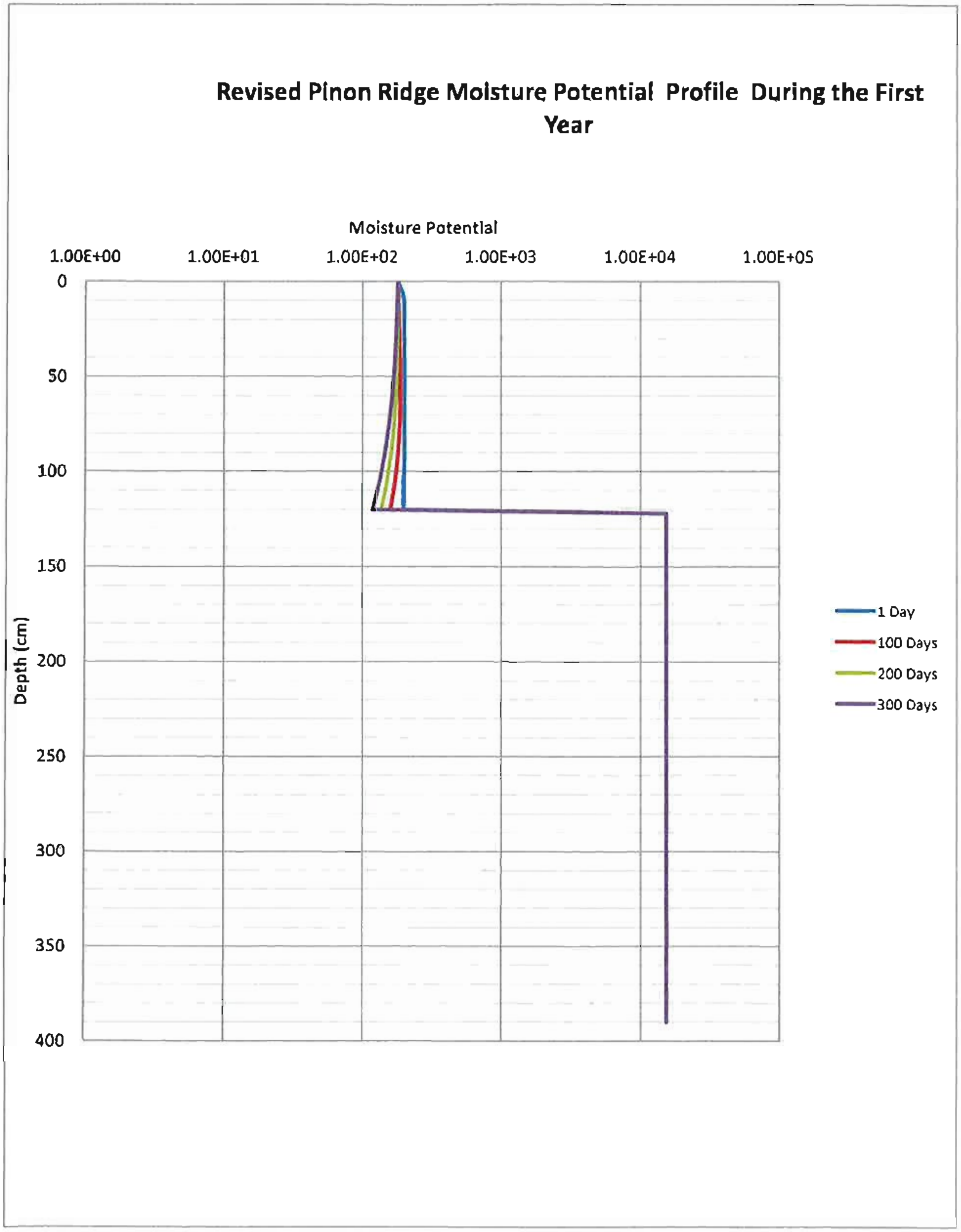
WATE R CONTENT(cm3/cm3)

Node No.	Depth (cm)	Simulation Day 1	100	200	300
1	0	0.278435	0.278435	0.278435	0.278435
2	2	0.276928	0.278351	0.278438	0.278516
3	4	0.275526	0.278264	0.278442	0.278599
4	6	0.274419	0.278175	0.278445	0.278685
5	8	0.273678	0.278083	0.27845	0.278773
6	10	0.273255	0.27799	0.278456	0.278865
7	12	0.273046	0.277895	0.278462	0.27896
8	14	0.272956	0.277799	0.278471	0.27906
9	16	0.27292	0.277702	0.278481	0.279163
10	18	0.272908	0.277605	0.278494	0.279271
11	20	0.272904	0.277507	0.278509	0.279383
12	22	0.272903	0.277409	0.278527	0.279501
13	24	0.272903	0.277312	0.278548	0.279624
14	26	0.272902	0.277216	0.278573	0.279754
15	28	0.272902	0.27712	0.278601	0.279889
16	30	0.272902	0.277027	0.278634	0.280032
17	32	0.272902	0.276936	0.278672	0.280181
18	34	0.272902	0.276847	0.278715	0.280338
19	36	0.272902	0.276762	0.278764	0.280502
20	38	0.272902	0.276681	0.278819	0.280675
21	40	0.272902	0.276604	0.278881	0.280857
22	42	0.272902	0.276532	0.27895	0.281048
23	44	0.272902	0.276465	0.279027	0.281249
24	46	0.272902	0.276405	0.279112	0.281459
25	48	0.272902	0.276352	0.279205	0.281681
26	50	0.272902	0.276306	0.279308	0.281913
27	52	0.272902	0.276268	0.279421	0.282156
28	54	0.272902	0.27624	0.279545	0.282412
29	56	0.272902	0.276221	0.279679	0.28268
30	58	0.272902	0.276212	0.279825	0.28296
31	60	0.272902	0.276215	0.279984	0.283254
32	62	0.272902	0.276229	0.280155	0.283562
33	64	0.272902	0.276256	0.280339	0.283883
34	66	0.272902	0.276297	0.280538	0.28422
35	68	0.272902	0.276351	0.280751	0.284571
36	70	0.272902	0.276421	0.280979	0.284937


Revised Pinon Ridge Water Content Profile During the FirstYear
Volumetric Moisture Content
0
0.1
0.2
0.3
0.4
0.5
Depth (cm)
0
50
100
150
200
250
300
350
400
450
1 Days
100 Days
200 Days
300 Days

UNSA	T-H Vers	ion 3.01		
Inpu	t File:	C:\New Enrgy Fuels P	roject\pino	n12.inp
Resu	lts File	: C:\New Ergy Fuels P	roject\pino	n122010.res
Date	of Run:	14-Aug	2010	
Time	of Run:	6:08	7.68	

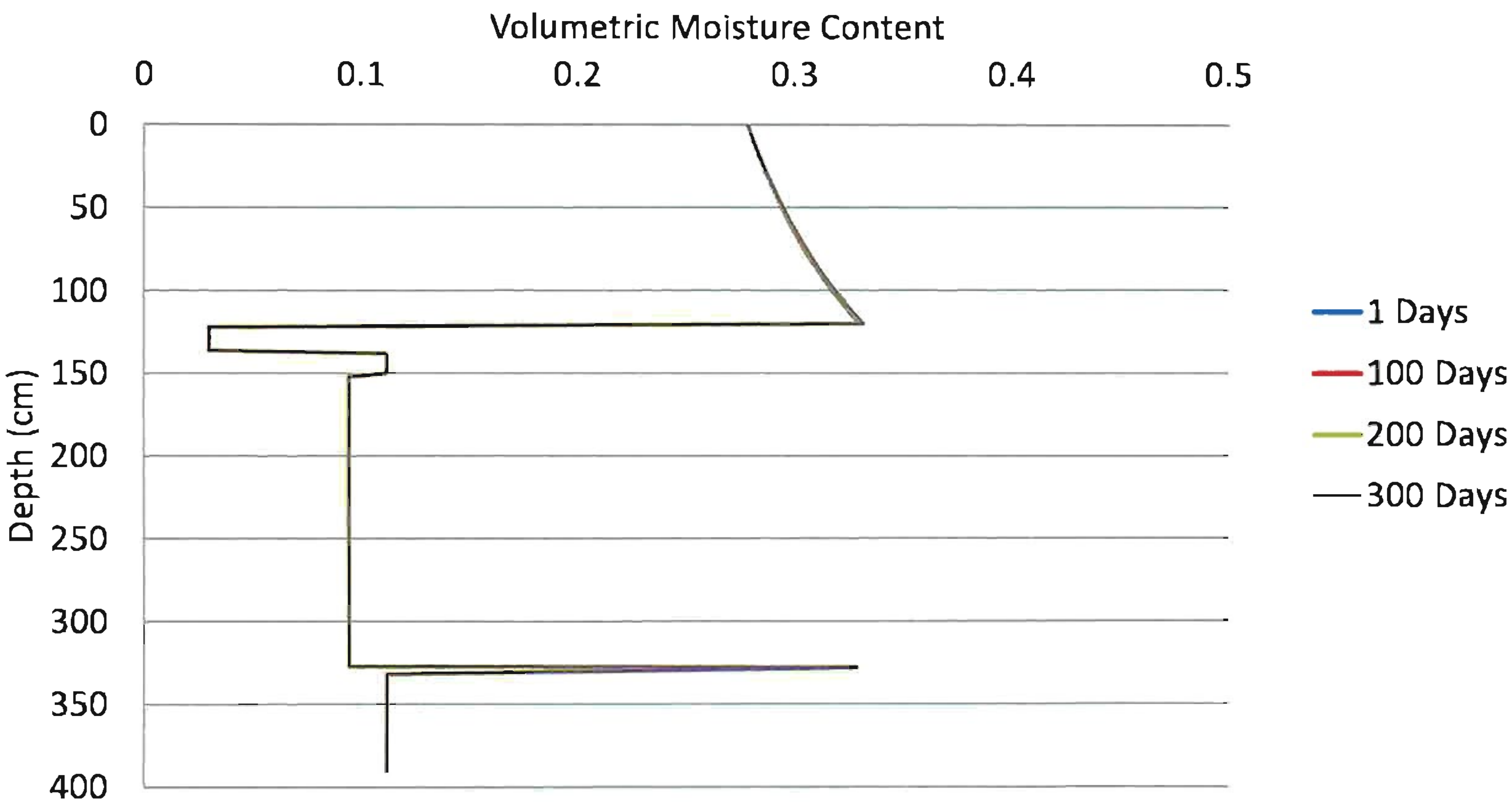
				HEAD	(cm)	
Node No.	Depth (cm)	Elevation			Simulation Day	
			1	100	200	300
-----	----		-------	-------	-------	-------
1	0	0	1.80E+02	1.80E+02	1.80E+02	1.80E+02
2	2	-2	1.85E+02	1.80E+02	1.80E+02	1.80E+02
3	4	-4	1.90E+02	1.81E+02	1.80E+02	1.79E+02
4	6	-6	1.94E+02	1.81E+02	1.80E+02	1.79E+02
5	8	-8	1.97E+02	1.81E+02	1.80E+02	1.79E+02
6	10	-10	1.99E+02	1.82E+02	1.80E+02	1.79E+02
7	12	-12	2.00E+02	1.82E+02	1.80E+02	1.78E+02
8	14	-14	2.00E+02	1.82E+02	1.80E+02	1.78E+02
9	16	-16	2.00E+02	1.83E+02	1.80E+02	1.78E+02
10	18	-18	2.00E+02	1.83E+02	1.80E+02	1.77E+02
11	20	-20	2.00E+02	1.83E+02	1.80E+02	1.77E+02
12	22	-22	2.00E+02	1.84E+02	1.80E+02	1.76E+02
13	24	-24	2.00E+02	1.84E+02	1.80E+02	1.76E+02
14	26	-26	2.00E+02	1.84E+02	1.80E+02	1.76E+02
15	28	-28	2.00E+02	1.85E+02	1.79E+02	1.75E+02
16	30	-30	2.00E+02	1.85E+02	1.79E+02	1.75E+02
17	32	-32	2.00E+02	1.85E+02	1.79E+02	1.74E+02
18	34	-34	2.00E+02	1.86E+02	1.79E+02	1.74E+02
19	36	-36	2.00E+02	1.86E+02	1.79E+02	1.73E+02
20	38	-38	2.00E+02	1.86E+02	1.79E+02	1.72E+02
21	40	-40	2.00E+02	1.86E+02	1.78E+02	1.72E+02
22	42	-42	2.00E+02	1.87E+02	1.78E+02	1.71E+02
23	44	-44	2.00E+02	1.87E+02	1.78E+02	1.71E+02
24	46	-46	2.00E+02	1.87E+02	1.78E+02	1.70E+02
25	48	-48	2.00E+02	1.87E+02	1.77E+02	1.69E+02
26	50	-50	2.00E+02	1.87E+02	1.77E+02	1.68E+02
27	52	-52	2.00E+02	1.88E+02	1.77E+02	1.68E+02
28	54	-54	2.00E+02	1.88E+02	1.76E+02	1.67E+02
29	56	-56	2.00E+02	1.88E+02	1.76E+02	1.66E+02
30	58	-58	2.00E+02	1.88E+02	1.75E+02	1.65E+02


Revised Pinon Ridge Moisture Potential Profile During the First Year
Moisture Potential
1.00E+00
1.00E+01
1.00E+02
1.00E+03
1.00E+04
1.00E+05
0
50
100
150
200
250
300
350
400
Depth (cm)
1 Day
100 Days
200 Days
300 Days

UNSA T-H Vers ion 3.01
Inpu t File: C:\New En(rgy Fuels P roject\pinon12.inp
Resu lts File : C:\New E(rgy Fuels P roject\pinon122014.res
Date of Run: 14-Aug 2010
Time of Run: 6:08 7.68

		WATE R CONTENT(cm3/cm3)			
Node	Depth			Simulation Day	
No.	(cm)	1	100	200	300
-----	-----				
1	0	0.278435	0.278435	0.278435	0.278435
2	2	0.278973	0.278983	0.278991	0.278997
3	4	0.279518	0.279537	0.279553	0.279565
4	6	0.28007	0.280099	0.280122	0.28014
5	8	0.280629	0.280668	0.280698	0.280723
6	10	0.281196	0.281244	0.281282	0.281312
7	12	0.28177	0.281827	0.281873	0.281909
8	14	0.282352	0.282418	0.282471	0.282513
9	16	0.282942	0.283017	0.283077	0.283125
10	18	0.283539	0.283624	0.283692	0.283745
11	20	0.284145	0.284239	0.284314	0.284373
12	22	0.28476	0.284862	0.284944	0.285009
13	24	0.285382	0.285494	0.285583	0.285654
14	26	0.286014	0.286134	0.286231	0.286307
15	28	0.286654	0.286783	0.286887	0.286969
16	30	0.287304	0.287441	0.287552	0.28764
17	32	0.287963	0.288109	0.288226	0.288319
18	34	0.288631	0.288786	0.28891	0.289008
19	36	0.289309	0.289472	0.289603	0.289707
20	38	0.289997	0.290168	0.290306	0.290415
21	40	0.290695	0.290875	0.291019	0.291134
22	42	0.291403	0.291591	0.291742	0.291862
23	44	0.292122	0.292318	0.292476	0.292601
24	46	0.292851	0.293056	0.29322	0.29335
25	48	0.293592	0.293805	0.293975	0.29411
26	50	0.294344	0.294565	0.294742	0.294882
27	52	0.295107	0.295336	0.295519	0.295665
28	54	0.295882	0.296119	0.296309	0.296459
29	56	0.296669	0.296914	0.29711	0.297265
30	58	0.297469	0.297721	0.297924	0.298084
31	60	0.298281	0.298541	0.29875	0.298915
32	62	0.299106	0.299374	0.299589	0.299758
33	64	0.299944	0.30022	0.300441	0.300615
34	66	0.300795	0.301079	0.301306	0.301486
35	68	0.301661	0.301952	0.302185	0.30237
36	70	0.30254	0.302839	0.303079	0.303268

Revised Pinon Ridge Water Content Profile During the Fifth Year



UNSA	T-H Vers	ion 3.01		
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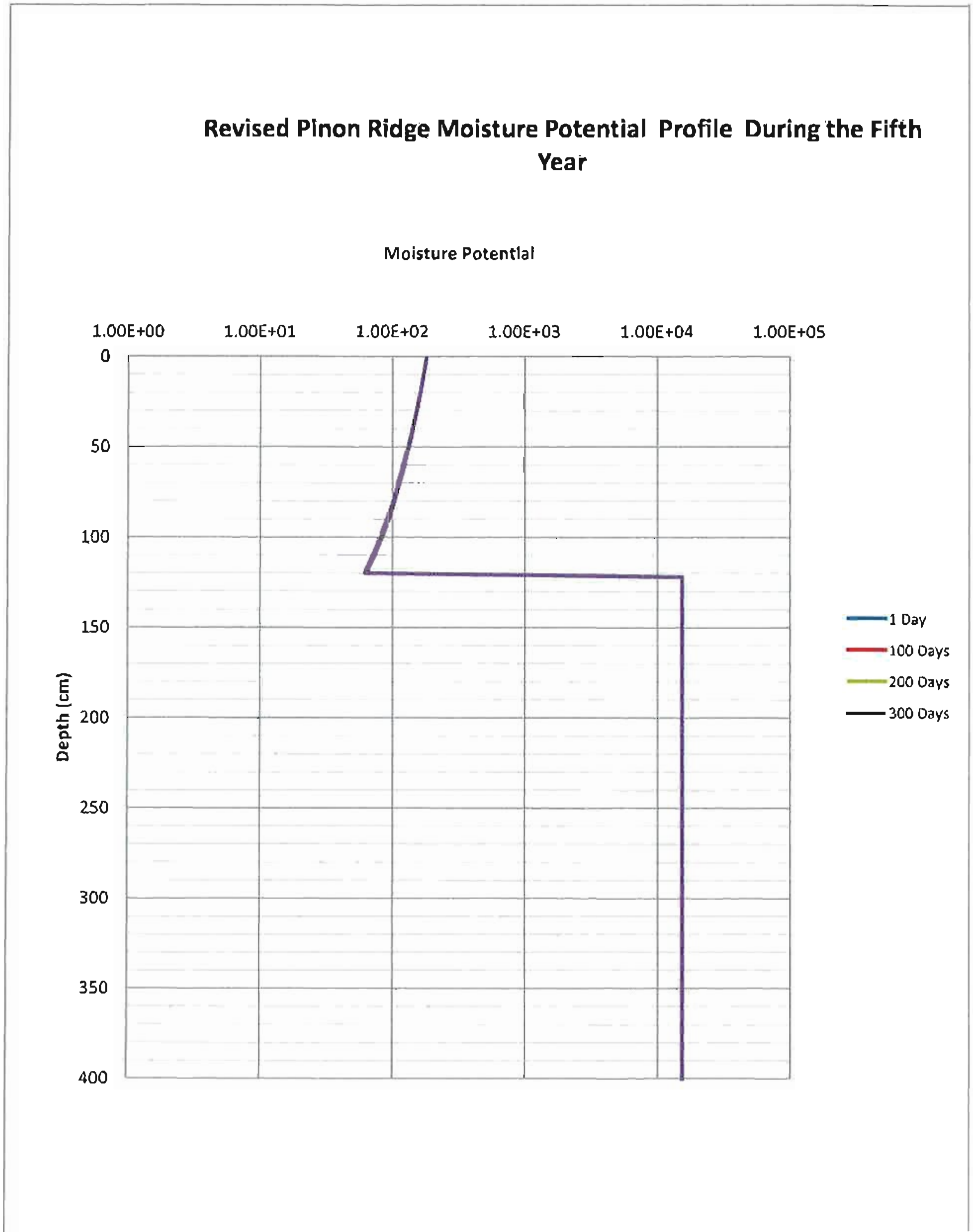
Resu	lts File	: C:\New Ergy Fuels P	roject\pino	n112014.res
Date	of Run:	6-Aug	2010	
Time	of Run:	13:34	51.7	

				HEAD	(cm)	
Node	Depth	Elevation			Simulatio	n Day
No.	(cm)		1	100	200	300
1	0	0	1.80E+02	1.80E+02	1.80E+02	1.80E+02
2	2	-2	1.78E+02	1.78E+02	1.78E+02	1.78E+02
3	4	-4	1.76E+02	1.76E+02	1.76E+02	1.76E+02
4	6	-6	1.74E+02	1.74E+02	1.74E+02	1.74E+02
5	8	-8	1.73E+02	1.72E+02	1.72E+02	1.72E+02
6	10	-10	1.71E+02	1.71E+02	1.70E+02	1.70E+02
7	12	-12	1.69E+02	1.69E+02	1.69E+02	1.68E+02
8	14	-14	1.67E+02	1.67E+02	1.67E+02	1.67E+02
9	16	-16	1.65E+02	1.65E+02	1.65E+02	1.65E+02
10	18	-18	1.63E+02	1.63E+02	1.63E+02	1.63E+02
11	20	-20	1.61E+02	1.61E+02	1.61E+02	1.61E+02
12	22	-22	1.60E+02	1.59E+02	1.59E+02	1.59E+02
13	24	-24	1.58E+02	1.57E+02	1.57E+02	1.57E+02
14	26	-26	1.56E+02	1.55E+02	1.55E+02	1.55E+02
15	28	-28	1.54E+02	1.53E+02	1.53E+02	1.53E+02
16	30	-30	1.52E+02	1.52E+02	1.51E+02	1.51E+02
17	32	-32	1.50E+02	1.50E+02	1.49E+02	1.49E+02
18	34	-34	1.48E+02	1.48E+02	1.47E+02	1.47E+02
19	36	-36	1.46E+02	1.46E+02	1.45E+02	1.45E+02
20	38	-38	1.44E+02	1.44E+02	1.43E+02	1.43E+02
21	40	-40	1.42E+02	1.42E+02	1.41E+02	1.41E+02
22	42	-42	1.40E+02	1.40E+02	1.40E+02	1.39E+02
23	44	-44	1.39E+02	1.38E+02	1.38E+02	1.37E+02
24	46	-46	1.37E+02	1.36E+02	1.36E+02	1.35E+02
25	48	-48	1.35E+02	1.34E+02	1.34E+02	1.33E+02
26	50	-50	1.33E+02	1.32E+02	1.32E+02	1.31E+02
27	52	-52	1.31E+02	1.30E+02	1.30E+02	1.29E+02
28	54	-54	1.29E+02	1.28E+02	1.28E+02	1.27E+02
29	56	-56	1.27E+02	1.26E+02	1.26E+02	1.25E+02
30	58	-58	1.25E+02	1.24E+02	1.24E+02	1.23E+02
31	60	-60	1.23E+02	1.22E+02	1.22E+02	1.21E+02


Revised Pinon Ridge Moisture Potential Profile During the Fifth Year
Moisture Potential
1.00E+00
1.00E+01
1.00E+02
1.00E+03
1.00E+04
1.00E+05
0
50
100
150
200
250
300
350
400
Depth (cm)
1 Day
100 Days
200 Days
300 Days

ATTACHMENT C Pinon Ridge Percolation Results

Program	DATAINH
Version	3.01

Input Filename: C:\New Energy Fuels Project\pinon12.inp
Date Processed: 14 Aug 2010
Time Processed: 07:13.6
Title:
Pinon Ridge

General options:

IPLANT	=	0	NGRAV	=	1					
IFDEND	=	366	IDTBEG	=	1	IDTEND	=	366		
IYS	=	2010	NYEARS	=	5	ISTEAD	=	1		
IFLIST	=	0	NFLIST	=	1					
NPRINT	=	0	STOPHR	=	2.40E+01					
ISMETH	=	1	INMAX	=	2	ISWDIF	=	1	DMAXBA =	1.00E-02
DELMAX	=	1.50E-01	DELMIN	=	1.00E-15	OUTTIM	=	1.50E-01		
RFACT	=	2.00E+00	RAINIF	=	1.00E-05	DHTOL	=	0.00E+00		
DHMAX	=	0.00E+00	DHFACT	=	0.00E+00					
KOPT	=	4	KEST	=	3	WTF	=	0.00E+00		
ITOPBC	=	1	IEVOPT	=	0	NFHOUR	=	2	LOWER =	1
HIRRI	=	0.00E+00	HDRY	=	2.00E+04	HTOP	=	1.80E+02	RHA =	0.00E+00
IETOPT	=	0	ICLOUD	=	0	ISHOPT	=	0		
IRAIN	=	0	HPR	=	1.00E+00					

Hysteresis options:

IHYS	=	0	AIRTOL	=	0.00E+00	HYSTOL	=	0.00E+00	HYSMXH =	0.00E+00

Heat flow options:

IHEAT	=	0	ICONVH	=	0	DMAXHE	=	0.00E+00		
UPPERH	=	0	TSMEAN	=	0.00E+00	TSAMP	=	0.00E+00	QHCTOP =	0.00E+00
LOWERH	=	0	QHLEAK	=	0.00E+00	TGRAD	=	0.00E+00		

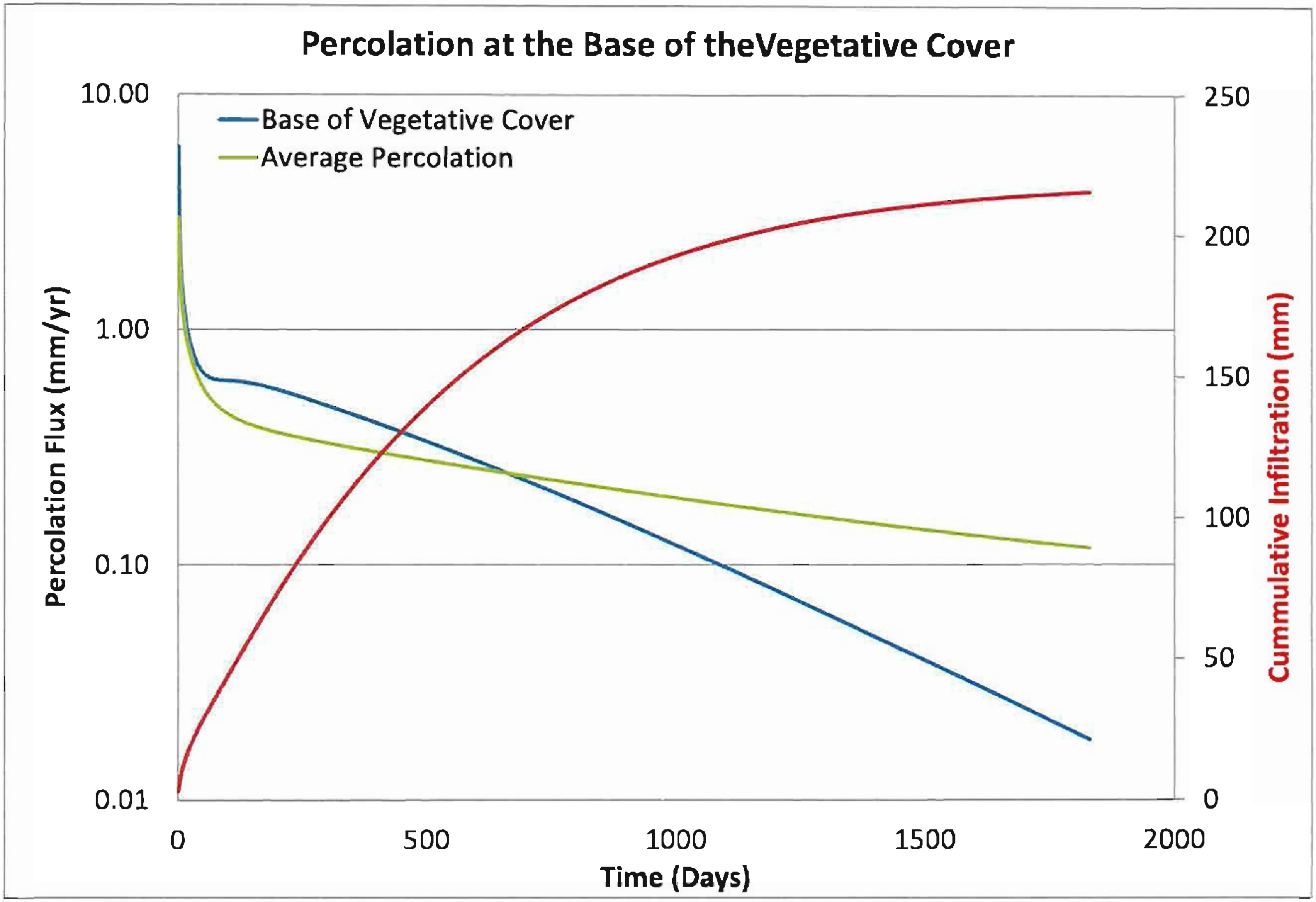
Vapor flow options:

IVAPOR	=	0	TORT	=	6.60E-01	TSOIL	=	1.70E+02	VAPDIF =	2.40E-01

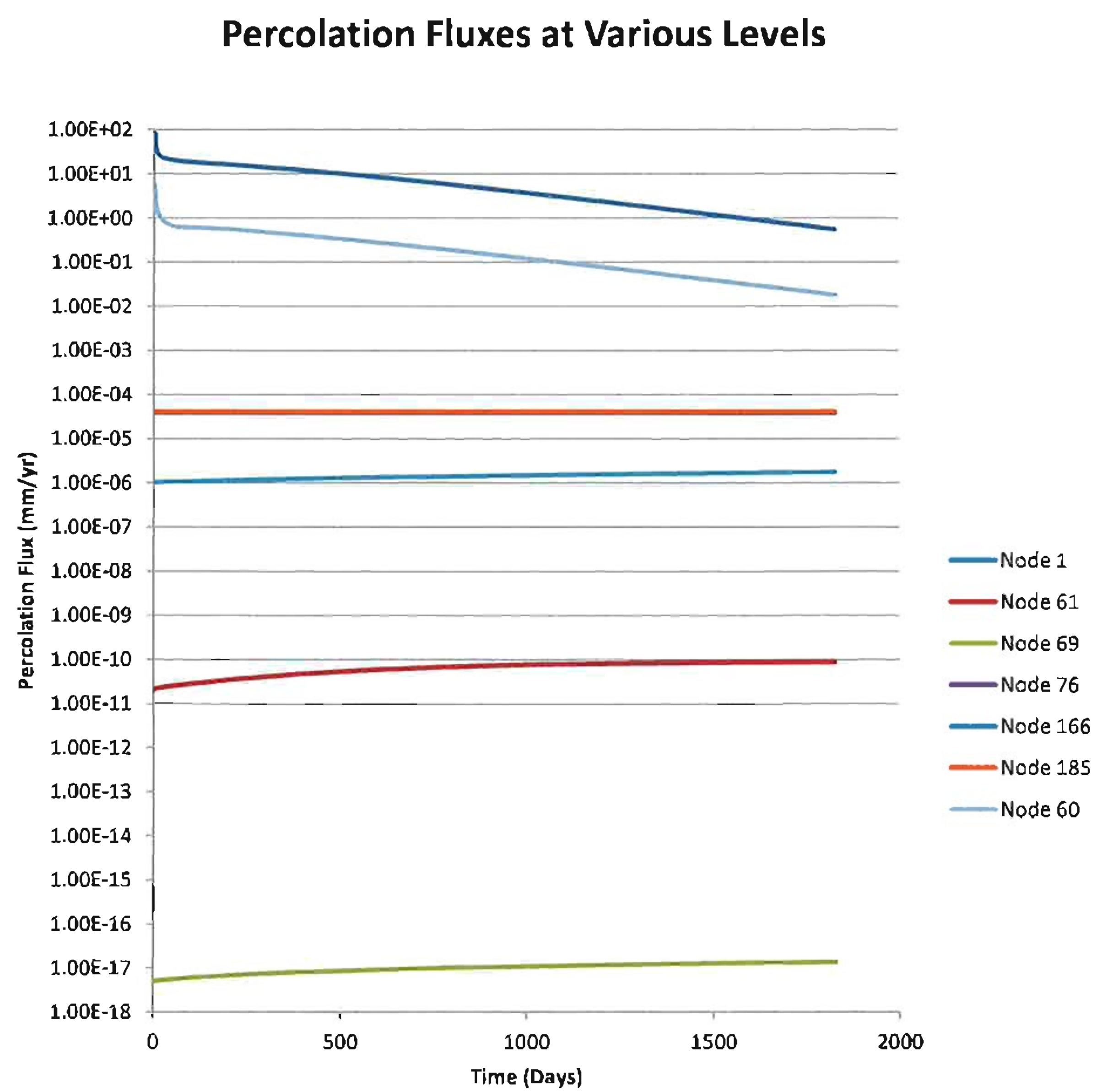
Grid options:

MATN	=	4	NPT	=	196

	Percolatior	Cumulative	Average
0	0	0	
1	6.00	3.00	3.00
2	3.21	4.61	2.30
3	2.50	5.86	1.95
4	2.13	6.92	1.73
5	1.89	7.86	1.57
6	1.72	8.72	1.45
7	1.59	9.52	1.36
8	1.48	10.26	1.28
9	1.40	10.96	1.22
10	1.33	11.62	1.16
11	1.27	12.26	1.11
12	1.22	12.86	1.07
13	1.17	13.45	1.03
14	1.13	14.02	1.00
15	1.09	14.56	0.97
16	1.06	15.09	0.94
17	1.03	15.61	0.92
18	1.00	16.11	0.90
19	0.98	16.60	0.87
20	0.96	17.08	0.85
21	0.94	17.55	0.84
22	0.92	18.01	0.82
23	0.90	18.46	0.80
24	0.88	18.90	0.79
25	0.86	19.33	0.77
26	0.85	19.75	0.76
27	0.84	20.17	0.75
28	0.82	20.58	0.74
29	0.81	20.99	0.72
30	0.80	21.39	0.71
31	0.79	21.78	0.70
32	0.78	22.17	0.69
33	0.77	22.55	0.68
34	0.76	22.93	0.67
35	0.75	23.30	0.67
36	0.74	23.67	0.66
37	0.73	24.04	0.65
38	0.72	24.40	0.64
39	0.72	24.76	0.63
40	0.71	25.11	0.63
41	0.70	25.46	0.62
42	0.70	25.81	0.61
43	0.69	26.15	0.61
44	0.69	26.50	0.60
45	0.68	26.84	0.60


Percolation at the Base of theVegetative Cover
Base of Vegetative Cover
Average Percolation
Percolation Flux (mm/yr)
10.00
1.00
0.10
0.01
Cummulative Infiltration (mm)
250
200
150
100
50
0
0
500
1000
1500
2000
Time (Days)

NODE OVER Z		1	61	69	76	166	185
DEPTH (cm)=		1.00E+00	1.21E+02	1.37E+02	1.51E+02	3.30E+02	3.69E+02
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	8.17E+01	2.10E-11	5.06E-18	3.89E-05	1.02E-06	4.13E-05
	3	4.95E+01	2.14E-11	5.07E-18	3.89E-05	1.02E-06	4.13E-05
	4	4.14E+01	2.16E-11	5.08E-18	3.89E-05	1.02E-06	4.13E-05
	5	3.72E+01	2.17E-11	5.09E-18	3.89E-05	1.02E-06	4.13E-05
	6	3.45E+01	2.19E-11	5.10E-18	3.89E-05	1.02E-06	4.13E-05
	7	3.26E+01	2.20E-11	5.11E-18	3.89E-05	1.02E-06	4.13E-05
	8	3.11E+01	2.22E-11	5.12E-18	3.89E-05	1.03E-06	4.13E-05
	9	3.00E+01	2.23E-11	5.13E-18	3.89E-05	1.03E-06	4.13E-05
	10	2.90E+01	2.24E-11	5.14E-18	3.89E-05	1.03E-06	4.13E-05
	11	2.82E+01	2.25E-11	5.15E-18	3.89E-05	1.03E-06	4.13E-05
	12	2.75E+01	2.26E-11	5.16E-18	3.89E-05	1.03E-06	4.13E-05
	13	2.70E+01	2.27E-11	5.17E-18	3.89E-05	1.03E-06	4.13E-05
	14	2.64E+01	2.28E-11	5.18E-18	3.89E-05	1.03E-06	4.13E-05
	15	2.60E+01	2.29E-11	5.19E-18	3.89E-05	1.03E-06	4.13E-05
	16	2.56E+01	2.30E-11	5.20E-18	3.89E-05	1.03E-06	4.13E-05
	17	2.52E+01	2.31E-11	5.21E-18	3.89E-05	1.03E-06	4.13E-05
	18	2.49E+01	2.32E-11	5.22E-18	3.89E-05	1.03E-06	4.13E-05
	19	2.46E+01	2.32E-11	5.23E-18	3.89E-05	1.03E-06	4.13E-05
	20	2.43E+01	2.33E-11	5.24E-18	3.89E-05	1.03E-06	4.13E-05
	21	2.40E+01	2.34E-11	5.25E-18	3.89E-05	1.03E-06	4.13E-05
	22	2.38E+01	2.35E-11	5.26E-18	3.89E-05	1.03E-06	4.13E-05
	23	2.36E+01	2.36E-11	5.27E-18	3.89E-05	1.03E-06	4.13E-05
	24	2.34E+01	2.36E-11	5.28E-18	3.89E-05	1.04E-06	4.13E-05
	25	2.32E+01	2.37E-11	5.29E-18	3.89E-05	1.04E-06	4.13E-05
	26	2.30E+01	2.38E-11	5.30E-18	3.89E-05	1.04E-06	4.13E-05
	27	2.28E+01	2.38E-11	5.31E-18	3.89E-05	1.04E-06	4.13E-05
	28	2.27E+01	2.39E-11	5.31E-18	3.89E-05	1.04E-06	4.13E-05
	29	2.25E+01	2.40E-11	5.32E-18	3.89E-05	1.04E-06	4.13E-05
	30	2.24E+01	2.41E-11	5.33E-18	3.89E-05	1.04E-06	4.13E-05
	31	2.22E+01	2.41E-11	5.34E-18	3.89E-05	1.04E-06	4.13E-05
	32	2.21E+01	2.42E-11	5.35E-18	3.89E-05	1.04E-06	4.13E-05
	33	2.20E+01	2.43E-11	5.36E-18	3.89E-05	1.04E-06	4.13E-05
	34	2.19E+01	2.43E-11	5.37E-18	3.89E-05	1.04E-06	4.13E-05
	35	2.18E+01	2.44E-11	5.38E-18	3.89E-05	1.04E-06	4.13E-05
	36	2.17E+01	2.45E-11	5.39E-18	3.89E-05	1.04E-06	4.13E-05
	37	2.16E+01	2.45E-11	5.40E-18	3.89E-05	1.04E-06	4.13E-05
	38	2.15E+01	2.46E-11	5.41E-18	3.89E-05	1.04E-06	4.13E-05
	39	2.14E+01	2.46E-11	5.42E-18	3.89E-05	1.05E-06	4.13E-05
	40	2.13E+01	2.47E-11	5.43E-18	3.89E-05	1.05E-06	4.13E-05


Percolation Fluxes at Various Levels
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
1.00E-13
1.00E-14
1.00E-15
1.00E-16
1.00E-17
1.00E-18
Percolation Flux (mm/yr)
0
500
1000
1500
2000
Time (Days)
Node 1
Node 61
Node 69
Node 76
Node 166
Node 185
Node 60