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A 3-dimensional finite element method for groundwater flow and containment transport

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A 3 - DIMENSIONAL FINITE ELEMENT METHOD FOR GROUNDWATER FLOW AND CONTAMINANT TRANSPORT

by

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ABSTRACT

A code was written to model groundwater flow and to solve for contaminant transport in variably saturated porous media using the Finite element method.. The numerical code was written in FORTRAN 77. The GWGRID program was used for mesh generation. This numerical model was applied to two nuclear waste sites.

Two test cases were run. The first one was the Savannah River Site, located in Aiken, South Carolina (SRS). The SRS has been storing radioactive waste material for several decades. Numerous studies as well as field data for the properties of the surrounding soil and contaminant presence have been conducted. Results of a two dimensional case were compared with the three dimensional case for a period of fifteen years.

The second test case was the Yucca Mountain Repository Site (YMP), which is being evaluated as a future site for storing radioactive nuclear waste. Results from the 3-D simulation were compared to results from a two-dimensional model. This simulation was run for a period of ten thousand years.

The purpose for running the 3-D simulation was to get more realistic results than the 2-D calculations. The simulations were mainly run on the Convex and the Cray computer. The results seem to be fairly accurate as compared to the work done at the sites.

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The code to solve all the test cases for the research were run on the Cray YMP and the Convex Computer at the NSCEE. The author would also like to thank Cray Research Inc and the NRC for providing the Graduate support without which the research work would not have been possible.

The data set for the Savannah River Site was provided by Mr. Dale Stephenson at the Savannah River Laboratory, Aiken, South Carolina. The Yucca Mountain Repository Site data set was converted from the two-dimensional data set evaluated by former graduate student Bryan Dunlap.

CHAPTER 1: INTRODUCTION

Groundwater is an important natural source. Many agricultural, domestic, and industrial water users rely on the groundwater as a sole source of low cost, high quality water. However, in recent years it has become apparent that many human activities can have a negative impact on both quantity and quality of groundwater resource. Two examples are the depletion of the groundwater resource by excessive pumping and the contamination of groundwater resource by waste disposal and other activities. One way to objectively assess the impact of existing or the proposed activities on groundwater quantity and quality is through the use of groundwater flow and solute transport models. The simulation of contaminant transport is hence necessary in order to effectively design mitigation methods for cleanup and prevention of deterioration of groundwater.

In developing a groundwater flow or solute transport model, the analyst begins by preparing a conceptual model consisting of a list of the physical and chemical mechanisms suspected of governing the behavior of the system being studied. The next step is to translate the conceptual model into mathematical terms and the result is a mathematical model. Presently it has become common practice in many national laboratories and research centers to use numerical models to solve the governing equations describing contaminant transport in porous media.

There is a very large number of potential sources of groundwater contamination. Virtually all of these sources could require the use of a contaminated transport model. Table 1 table shows the estimated numbers of contaminated problems that need to be addressed under various statutes.

Type of Potential Groundwater Contaminant Source	Number Nationwide (unless otherwise noted)
• Superfund hazardous waste List	951
• Potential NPL sites to be assessed by 1989	27.000
• Superfund remedial investigations and	
feasibilty studies that must be commenced	
By 1989	275
By 1992	650
• Superfund remedial actions to be commenced	
By 1989	175
By 1992	375
• RCRA hazardous waste facilities	
Operating Landfils	393
Closing landfils	1.095
Other treatment and storage facilities	3.338
• Projected # of RCRA facility investigations	2.938
• RCRA nonhazardous waste facilities(municipal and identical landfils)	70.419 to 261.930
• RCRA nonhazardous waste facilities with a high likelihood of containing hazardous wastes.	70.419
• Mining waste sites	22.339
• Underground storage tanks	10.820
• Pesticide - contaminated sites	3.920
• Underground injection wells	
Class I wells (haz. waste injected below a U.S.drinking water supply)	533
Class II wells (secondary oil and gas production)	153.126
Class III wells (mining)	249
Class IV wells (haz. waste injected in or on water)	25
Class V wells (all other miscellaneous wells)	46.271
Total for Class I wells	200.204
• Abadoned and unplugged gas & oil wells	1.200.000
• Sites with releases of radioactive materials	1.502
• Environmental impact statements per year	549
• Surface impoundments	
Industrial	25.749
Municipal	36.179
Agricultural	19.167
Mining	24.451
Oil / gas brine pits	64.951
Others	5.748
Total for Surface impoundments	176.245
• Petroleum product pipelines miles	175.000
• Liquid petroleum and non-hazardous waste underground storage tanks	2.500.000

Table 1: Nationwide Potential Contaminant Sources

Groundwater modeling needs accurate data sets for prediction and calculation purposes. The study of Savannah River site model provides an excellent example for comparison and prediction, which has indicated leakage of radioactive and non - radioactive waste products from seepage basins and storage tanks first built in 1950's. Experimental data obtained from studies conducted at several site locations show a tremendous increase of contaminants appearing in groundwater within the last few years. Wells first drilled in 1962 showed very low concentrations of tritium beneath the seepage basins. In 1963, the concentration increased over a 5 month period from 74 to 18,600 pCi/ml. In 1967, tritium was discovered in Four Mile Creek, 490 m from the basins. Assuming the tritium left the basin during 1955, the time travel to reach the Four Mile Creek was 12 years, and flow rate of about 41 m/year (Killen et al, 1987).

In this study, a modified finite element method is used to solve the 3-D transport of contaminated groundwater flow. The 3-D numerical method is based on an extension of a modified 2-D FEM model. On the basis of previous measurements and corroboration's done for the SRS at Aiken, South Carolina, data for the groundwater and soil properties were provided for a two - dimensional analysis . This data set was then converted to a three - dimensional data set assuming the conductivity in the z - direction to be same as in the x - direction. The model reads in the desired head values as the boundary condition provided and calculates the contaminant transport at the nodal points with the source provided at a specific element.

The Yucca Mountain Repository Site was the second example to be simulated. The Nuclear Waste Policy Act of 1982, as amended, identified Yucca Mountain as the sole site to be characterized for the development of a high level nuclear waste repository. The Yucca Mountain Site Characterization Project (YMP) is a series of scientific studies being undertaken to determine if Yucca Mountain is suitable site for construction of a high - level nuclear waste repository (to handle about 77,000 tons of high - level radioactive waste for 10,000 years). Some of the scientific and technical issues being studied as a part of the YMP include:

- how much water is in the rock above the deep ground water table and how does it move through the rock;
- the effects volcanic activity might have on the repository in Yucca Mountain;
- how an earthquake might affect a repository and the groundwater table about 244-366 meters below the repository; and
- environmental issues.

This model is of additional importance as it discusses another nuclear waste disposal solution in vicinity to Las Vegas. The model simulates the worst scenario possible; that of a leaking container. The results from the two and the three dimensional simulation are compared.

PURPOSE

The model was developed to permit accurate transport of radionuclides in order to assess the suitability of proposed and existing waste storage areas. For existing sites the model can be used for remediation modeling and to predict the time for the spread of contaminant plume. The model can also be used to assess the suitability of a particular site. Another purpose of the model is to examine how the contaminant spreads in the x,y,z directions which is more representative of the true dispersive nature of the contaminant.

The code was used to model the hypothetical transport of the solute at the Savannah River Site and the proposed Yucca Mountain Repository Site. Both sites are of major interest; the Savannah River Site is of interest for the purpose of remediation and to analyze preventive actions in place currently under construction. The Yucca Mountain Repository is analyzed as a means to assess risk and performance characteristics of the site prior to actual construction and waste emplacement.

BACKGROUND

Finite element codes have been used effectively to simulate transport of subsurface contaminant (Bear, et al. 1993; Istok, 1989). Reviews of historical development of groundwater flow and solute transport models can be seen in Huyakorn and Pinder (1983) and Prickett (1975).

Analytical solutions to selected groundwater flow and solute transport problems are discussed in Bear(1979), Javenel at el. (1984), as Bear and Verrujit (1987). Reviews of existing computer models can be discussed in Bachmat et al. (1978) and Oster (1982). Nwaogazie (1986) developed a 2-D transient finite element code for modeling groundwater flow and transport on the PC using quadrilateral elements. Azrag, et al. (1986) developed a similar model using linear triangular elements.

While several three - dimensional models for fluid flow are described in the literature (Long et al , 1985; Shapiro and Andersson, 1985; Elseworth, 1986; Liggett and Medina, 1988; Dverstrop and Andersson, 1989), little work has been carried out in modeling solute transport. More recent work has also been done by Nordvist et al. (1992).

Huyakorn and Woodsworth (1985) developed a 3-D finite element model for fluid flow and solute transport in saturated or unsaturated porous media. Camp Dresser and Mckee (1989) used a 3-D finite element model and a random walk technique with Lagrangian particles to simulate tritium dispersion. FTWORK (GeoTrans, SRL, 1993) is a three dimensional, finite difference code for simulating the flow of groundwater and the transport of dissolved components under confined and unconfined conditions. This code is an alternative to the more comprehensive model such as SWIFT II (Reeves et al., 1986) and HST3D (Kipp, 1987). This code was also implemented at Savannah River Laboratory (SRL).

CHAPTER 2: METHODOLOGY

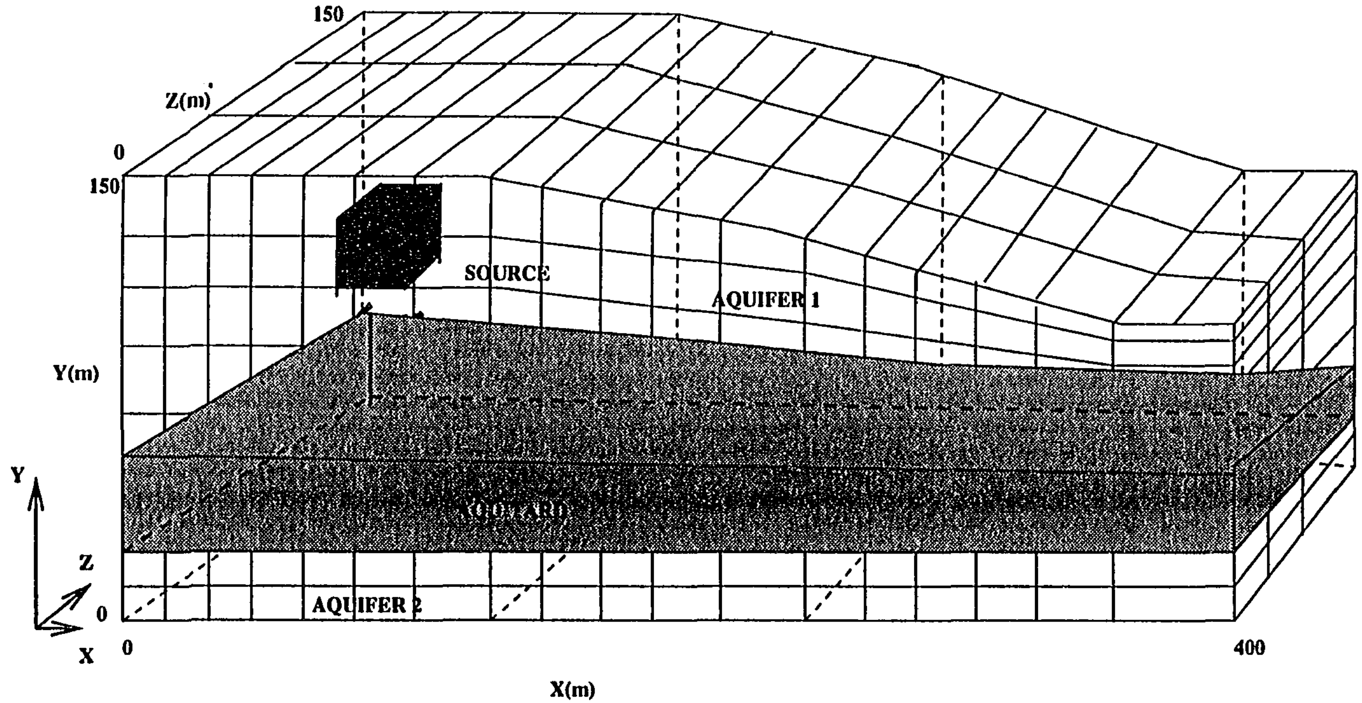
A three dimensional FEM code has been developed to calculate groundwater flow and contaminant transport in variably saturated porous media. The algorithm incorporates Petrov - Galerkin weighting for the advection term to enhance stability. Trilinear isoparametric hexahedral elements are used to discretize a problem domain. The standard weak formulation of Galerkin weighted residual technique is employed to cast the governing equations into integral form. The mesh for the test cases is generated by a code called GWGRID.

MESH GENERATION

The primary objective of the GWGRID code is to generate a consistent set of data, as required for discrete modeling and analysis for groundwater systems. Generated coordinates, and finite element data are maintained in memory (only) for the currently processed macro - element. When a macro - element generated data set is complete it is entered into the disk database. Distributed output quantities generally include coordinates and parameters of each generated node and a node connection table which forms the local finite element maps.

Program Description

GWGRID computer program is written in Fortran 77. It consists of a main program and 17 subroutines. The main program initializes the named Common arrays and affects calls to subroutines which functionally perform grid refinement and data read / write functions. Subroutine Refine is called for grid refinement which incorporates macro - element of type HEXA.

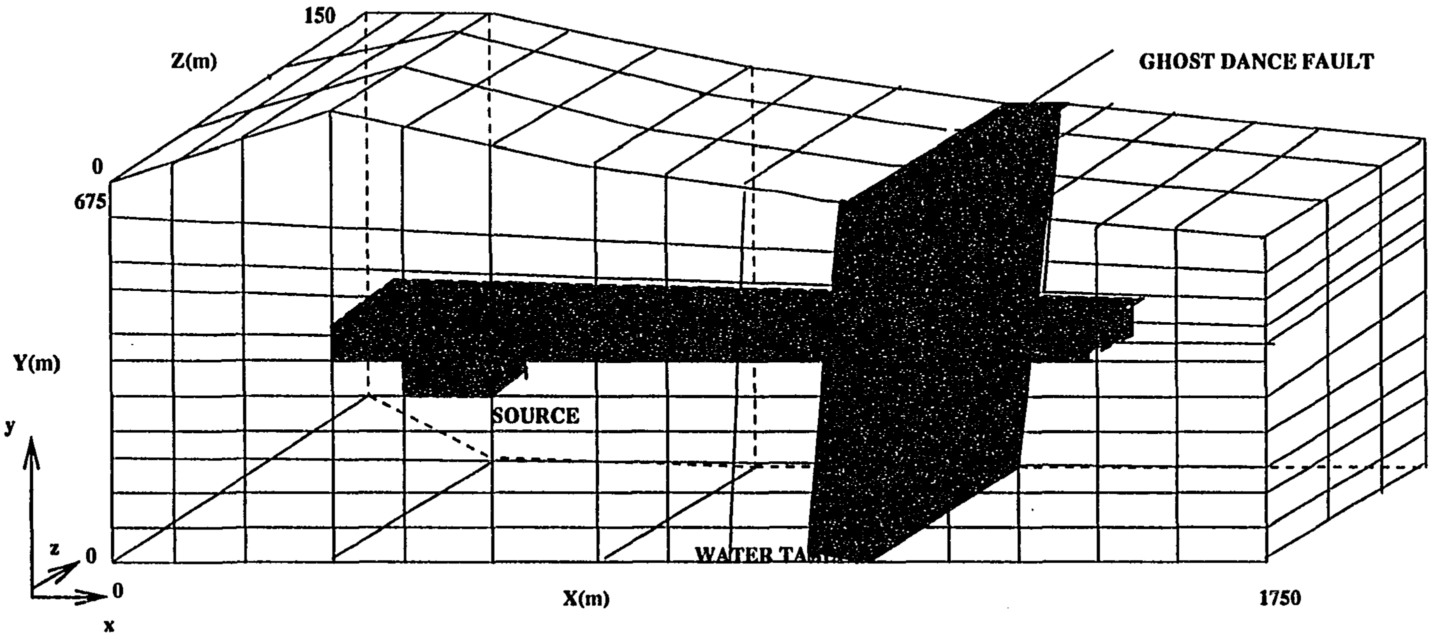


No of Elements : 513

Source Located at element 116.

No of Nodes : 800

Fig 1: INPUT MESH FOR THE TEST CASE FOR SAVANNAH RIVER SITE



No of Elements : 768

No of Nodes : 495

Source located at element 149

Fig 2: YUCCA MOUNTAIN REPOSITORY SITE MODEL

Modeling Groundwater Flow

Groundwater is constantly flowing from areas of recharge to areas of discharge. The flow is laminar, and the quantity of flow is directly proportional to the hydraulic conductivity of the aquifer material, the hydraulic gradient, and the cross - sectional area.

Heads and Gradients

Total head is the sum of elevation, pressure and velocity head. Because velocities in porous media are usually low, velocity heads are neglected without appreciable error. Therefore the potential energy equation can be reduced to

$$h = \frac{p}{\rho g} + z = \varphi + z$$

where g is the gravitational acceleration vector (m / day^2), p is the fluid pressure (N/m) and z is the standing fluid height usually measured in meters above sea - level.

Hydraulic Conductivity

Aquifers act as a porous conduit transmitting water from areas of recharge to areas of discharge. A measurement of how well an aquifer transmits water is the hydraulic conductivity. It is the measure of both the geologic material and the fluid moving through the material. Quantitatively hydraulic conductivity is directly proportional to the specific weight of the fluid and inversely proportional to dynamic viscosity. Conceptually, the hydraulic conductivity is the volume of water per unit time that moves through a unit area of aquifer with a unit decline of hydraulic gradient. Its units are the same as velocity.

Saturated hydraulic conductivity of the medium, k is related to the permeability of the medium, κ by

$$\kappa = \frac{\rho g}{\mu} + k$$

where μ is the fluid viscosity. Hydraulic conductivity decreases as water content decreases or as capillary pressure (suction) increases. Capillary pressure, P_c, is defined as a difference between the non - wetting phase (air) pressure and the wetting phase (water) pressure in the porous media, $P_c = P_a - P_w$ (Vauclin,1989). Pressure head can be defined as a function of the difference between the saturated water pressure, p, and the air pressure , p_a , by

$$\Psi = \frac{p - p_a}{\rho g}$$

where air pressure is currently taken as atmospheric pressure.

Darcy's Law

A generalized Darcy's law as proposed by Richards (1931) for a steady flow through the soil is given by

$$\vec{V} = -\kappa(\gamma).\vec{\nabla} h$$

where the hydraulic conductivity is a function of γ (Specific Weight) of either the capillary pressure or the water content, implying that the hydraulic conductance used for the saturated soils is a particular case of unsaturated parameter (De Backer, 1989).

Since the movement of the solute is governed by advection - diffusion transport equation, fluid velocity components through the anisotropic medium can also be determined from the modified Darcy's relation (Bear 1979); Verrujit, 1982).

$$
\begin{aligned}
u &= -\left(k_{xx}\tfrac{\partial h}{\partial x} + k_{xy}\tfrac{\partial h}{\partial y} + k_{xz}\tfrac{\partial h}{\partial z}\right)/\,\theta \\
v &= -\left(k_{yy}\tfrac{\partial h}{\partial y} + k_{yx}\tfrac{\partial h}{\partial x} + k_{yz}\tfrac{\partial h}{\partial z}\right)/\,\theta \\
w &= -\left(k_{zz}\tfrac{\partial h}{\partial z} + k_{zx}\tfrac{\partial h}{\partial x} + k_{zy}\tfrac{\partial h}{\partial y}\right)/\,\theta
\end{aligned}
$$

where θ is the effective porosity.

The three dimensional tensor notation of conductivity is given as:

$$
k_{ij} = \begin{bmatrix} K_{xx} & K_{xy} & K_{xz} \\ K_{yx} & K_{yy} & K_{yz} \\ K_{zx} & K_{zy} & K_{zz} \end{bmatrix}
$$

where k_{ij} is the tensor components for conductivity (m /day), u, v, and w denote the fluid velocities in the x and y and z coordinates, respectively. The initial boundary conditions can be expressed as

$$
\begin{aligned}
&h(x,y,z,t_0) = h_0(x,y,z) \\
&h(x,y,z,t) = H(\Gamma_1) \\
&un_x + vn_y + wn_z = -V_n(\Gamma_2)
\end{aligned}
$$

where h (m) is the initial head value assigned to all elements at the beginning of the transient solution. H(m) is the fixed head values assigned to the Direchlet boundary conditions that are denoted by boundary Γ_1. The unit normal component vectors n_x, n_y, and n_z point outward from the Neumann boundary conditions (flux) denoted by boundary Γ_2 and V_n is the fluid flux on Γ_2.

The conservation of mass for unsteady fluid flow in a porous medium can be expressed as

$$\frac{\partial(\rho S_w \theta)}{\partial t} + \nabla.(\rho V) = \rho Q$$

where S_w is the normalized value of the saturation of water in the porous medium, θ is porosity of the medium, Q is the source/sink terms (m/day) and t is time (day). In variably saturated media, where S_w is less than 1, it is desired to link pressure dependence to the transient term of the flow equation

$$\frac{\partial\ S_w\theta}{\partial\ t} = \frac{\partial\ S_w\theta}{\partial\ \psi} * \frac{\partial\Psi}{\partial\ t}$$

From this expression, the specific storage parameter as a function of pressure head is defined as

$$S_h = S_h(\Psi)$$

By assuming incompressible, isothermal groundwater conditions and combining the conservation of mass with the extended Darcy's law, the equation of unsteady groundwater flow finally can be written as

$$S_h \frac{\partial h}{\partial t} = \vec{\nabla}.\left(\kappa \bullet \vec{\nabla} h\right) + Q$$

Modeling Solute Transport

In porous media, solute transport occurs by three processes: advection, diffusion, and mechanical dispersion.

Advection

The process by which solute are transported by bulk motion of the flowing water is called *advection*. The rate of solute transport occurs by advection is given by the product of solute concentration C and the components of apparent groundwater velocity v_x, v_y, v_z. In terms of the three components of the solute transport in the x, y, and the z directions, the rate of solute transport by advection is

$$F_x)_{Advection} = v_x C$$
$$F_y)_{Advection} = v_y C$$
$$F_z)_{Advection} = v_z C$$

Diffusion

The process by which solutes are transported by the random thermal motion of solute molecules is called *diffusion*. The rate of solute transport that occurs by diffusion is given by Fick's law. In terms of the three components of the solute transport in the x, y, and the z direction, the rate of solute transport by diffusion is given by

$$F_x)_{Diffusion} = -D^* \partial C/\partial x$$
$$F_y)_{Diffusion} = -D^* \partial C/\partial y$$
$$F_z)_{Diffusion} = -D^* \partial C/\partial z$$

where D^* is the solute's apparent diffusion coefficient. The apparent diffusion coefficient for a solute in the porous media is much smaller than the diffusion coefficient for the same solute in the aqueous solution, D_o. An empirical relationship for D^* can be written as

$$\underset{\text{(porous media)}}{D^*} = \omega(\theta)\underset{\text{(aqueous solution)}}{D_o}$$

where $\omega(\theta)$ is an empirical correction factor that is a function of volumetric water content. The small size of apparent diffusion content means that the rate of solute transport by diffusion is usually negligibly small relative to rates of solute transport by advection and dispersion.

Mechanical Dispersion

Mechanical dispersion (or hydraulic dispersion) is a mixing or spreading process caused by small scale fluctuations in groundwater velocity along the tortuous flow paths within individual pores. The rate solute transport by mechanical dispersion is given by the generalized form of Fick's law of diffusion. In terms of three components of solute transport in the x, y, and the z direction, the rate of solute transport by mechanical dispersion is given by

$$F_x)_{\text{Mechanical Dispersion}} = -D_{xx}\frac{\partial(\theta C)}{\partial x} - D_{xy}\frac{\partial(\theta C)}{\partial y} - D_{xz}\frac{\partial(\theta C)}{\partial z}$$
$$F_y)_{\text{Mechanical Dispersion}} = -D_{yx}\frac{\partial(\theta C)}{\partial x} - D_{yy}\frac{\partial(\theta C)}{\partial y} - D_{yz}\frac{\partial(\theta C)}{\partial z}$$
$$F_z)_{\text{Mechanical Dispersion}} = -D_{zx}\frac{\partial(\theta C)}{\partial x} - D_{zy}\frac{\partial(\theta C)}{\partial y} - D_{zz}\frac{\partial(\theta C)}{\partial z}$$

where D_{xx}, D_{xy}, etc are the coefficients of mechanical dispersion. These coefficients can be computed from the expression

$$D_{ij} = a_{ijkm}\frac{\bar{v}_m \bar{v}_n}{\sqrt{v_m^2 + v_n^2}}$$

where the subscripts i and j refer to the three directions x, y, and z, $\bar{v}_m$ and $\bar{v}_n$ are the components of the pore water velocity, and the subscripts m and n refer to the directions of the principal components of pore water velocity. Components of the pore water velocity are computed from

$$\bar{v}_x = v_x / \theta$$
$$\bar{v}_y = v_y / \theta$$
$$\bar{v}_z = v_z / \theta$$

where θ is the volumetric water content of the porous media.

The terms a_{ijmn} are the components of the aquifer's dispersivity. If the aquifer is assumed to be isotropic with respect to dispersion, all components of the aquifer's dispersivity are zero except for

$$a_{iiii} = a_L$$
$$a_{iijj} = a_T$$
$$a_{ijij} = a_{ijji} = \frac{1}{2}(a_L - a_T), \quad i \neq j$$

where a_L is the longitudinal dispersivity and a_T is the transverse dispersivity of the aquifer. Coefficients of mechanical dispersion can be computed from the following expressions

$$D_{xx} = [a_T(\bar{v}_y^2 + \bar{v}_z^2) + a_L \bar{v}_x^2] / |\bar{v}|$$

$$D_{yy} = [a_T(\bar{v}_x^2 + \bar{v}_z^2) + a_L \bar{v}_y^2] / |\bar{v}|$$

$$D_{zz} = [a_T(\bar{v}_x^2 + \bar{v}_y^2) + a_L \bar{v}_z^2] / |\bar{v}|$$

$$D_{xy} = D_{yx} = [(a_L - a_T)\bar{v}_x \bar{v}_y] / |\bar{v}|$$

$$D_{xz} = D_{zx} = [(a_L - a_T)\bar{v}_x \bar{v}_z] / |\bar{v}|$$

$$D_{yz} = D_{zy} = [(a_L - a_T)\bar{v}_y \bar{v}_z] / |\bar{v}|$$

where $|\bar{v}| = (\bar{v}_x^2 + \bar{v}_y^2 + \bar{v}_z^2)^{1/2}$

The governing equation for multi - dimensional, time dependent aerial transport of a single contaminant for all the three processes combined is written in vector form as (Bear, 1979; Nwaogazie, 1986) as

$$R_d \frac{\partial C}{\partial t} + \vec{V}.\vec{\nabla}C = \vec{\nabla}\cdot(D\cdot\vec{\nabla}C) + S$$

where R_d is the retardation factor, C is the contaminant concentration (g/m^3), V is the transport medium velocity (m/day), D is the dispersion tensor (m^2 / day), and S is the summation of all the source / sink terms for both the contaminant and transport vehicle.The velocity vector of the transporting medium V, is dependent on the hydraulic head gradient from Darcy's relation

$$\vec{V} = -\kappa.\frac{\vec{\nabla}h}{\theta}$$

The boundary conditions are defined by the relations

$$-(D.\vec{\nabla}C_O).\vec{n} = F_O$$
$$\text{if } \vec{V}.\vec{n} < 0,\ (\vec{V}C_0 - D.\vec{\nabla}C_O).\vec{n} = \vec{V}C_O.\vec{n}$$
$$\text{if } \vec{V}.\vec{n} > 0,\ -(D.\vec{\nabla}C_O).\vec{n} = 0$$

where $\dot{C}_o$ is the mean concentration of the contaminant, F_o is the mass flux of the solute at the prescribed boundaries, and $\vec{n}$ is the unit vector normal to the boundary.

CHAPTER 3: FINITE ELEMENT METHOD

The finite element method is used as the basis for numerical implementation. Trilinear isoparametric hexahedral elements are used to discretize a 3-D problem domain; Mesh generation is achieved from GWGRID.

The shape functions for the hexahedron are defined as :

$$\begin{Bmatrix} N_1 \\ N_2 \\ N_3 \\ N_4 \\ N_5 \\ N_6 \\ N_7 \\ N_8 \end{Bmatrix} = \frac{1}{8} \begin{Bmatrix} (1-\xi)(1-\eta)(1-\zeta) \\ (1+\xi)(1-\eta)(1-\zeta) \\ (1+\xi)(1+\eta)(1-\zeta) \\ (1-\xi)(1+\eta)(1-\zeta) \\ (1-\xi)(1-\eta)(1+\zeta) \\ (1+\xi)(1-\eta)(1+\zeta) \\ (1+\xi)(1+\eta)(1+\zeta) \\ (1-\xi)(1+\eta)(1+\zeta) \end{Bmatrix}$$

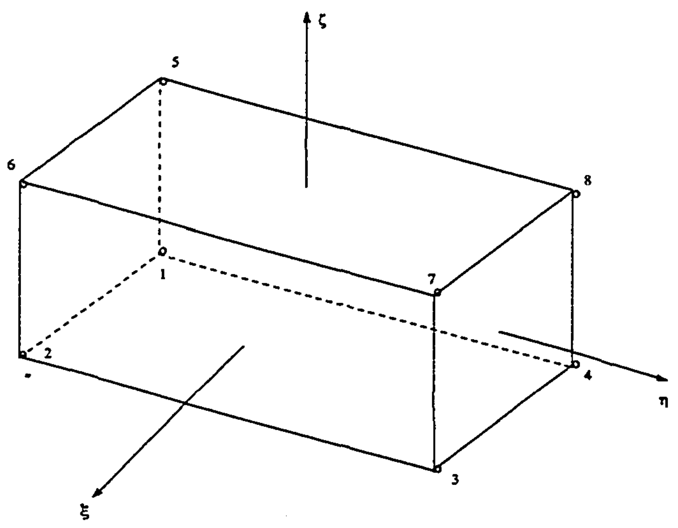


Fig 3: NATURAL COORDINATE SYSTEM FOR THE HEXAHEDRON ELEMENT

where ξ, η and ζ are the orthogonal system coordinates.

The derivatives of the above become for a isoparametric element :

$$\begin{vmatrix} \frac{\partial N_i}{\partial \xi} \\ \frac{\partial N_i}{\partial \eta} \\ \frac{\partial N_i}{\partial \zeta} \end{vmatrix} = \begin{vmatrix} \frac{\partial x}{\partial \xi} & \frac{\partial y}{\partial \xi} & \frac{\partial z}{\partial \xi} \\ \frac{\partial x}{\partial \eta} & \frac{\partial y}{\partial \eta} & \frac{\partial z}{\partial \eta} \\ \frac{\partial x}{\partial \zeta} & \frac{\partial y}{\partial \zeta} & \frac{\partial z}{\partial \zeta} \end{vmatrix} \begin{vmatrix} \frac{\partial N_i}{\partial x} \\ \frac{\partial N_i}{\partial y} \\ \frac{\partial N_i}{\partial z} \end{vmatrix} = J \begin{vmatrix} \frac{\partial N_i}{\partial x} \\ \frac{\partial N_i}{\partial y} \\ \frac{\partial N_i}{\partial z} \end{vmatrix}$$

where J is the Jacobian. Since,

$$x = x(\xi,\eta,\zeta)$$
$$y = y(\xi,\eta,\zeta)$$
$$z = z(\xi,\eta,\zeta)$$

Determinant |J| is obtained as

$$|J| = \frac{dx}{d\xi}\left(\frac{dy}{d\eta}\frac{dz}{d\zeta} - \frac{dy}{d\zeta}\frac{dz}{d\eta}\right) - \frac{dx}{d\eta}\left(\frac{dy}{d\xi}\frac{dz}{d\zeta} - \frac{dy}{d\zeta}\frac{dz}{d\xi}\right) + \frac{dx}{d\zeta}\left(\frac{dy}{d\xi}\frac{dz}{d\eta} - \frac{dy}{d\eta}\frac{dz}{d\xi}\right)$$

The inverse is given as

$$J^{-1} = \frac{\text{Adjoint } J}{|J|} = \begin{vmatrix} C_{11} & C_{21} & C_{31} \\ C_{12} & C_{22} & C_{32} \\ C_{13} & C_{23} & C_{33} \end{vmatrix}$$

where $\mathbf{C}_{ij}$ are the cofactors of the Jacobian

Finally, the discretized shape function derivatives are shown as

$$\begin{Bmatrix} \frac{\partial N_i}{\partial x} \\ \frac{\partial N_i}{\partial y} \\ \frac{\partial N_i}{\partial z} \end{Bmatrix} = J^{-1} \begin{Bmatrix} \frac{\partial N_i}{\partial \xi} \\ \frac{\partial N_i}{\partial \eta} \\ \frac{\partial N_i}{\partial \zeta} \end{Bmatrix}$$

The standard weak formulation of the Galerkin weighted residual technique is employed to cast the governing equations into their integral form. The Galerkin integral forms for the governing equations are:

$$\int_{\Omega}[W(R_d \frac{\partial C}{\partial t} + \vec{V}\cdot\vec{\nabla}C - S) + \vec{\nabla}W\cdot(D\cdot\vec{\nabla}C)]d\Omega - \int_{\Gamma} W_n(D\cdot\vec{\nabla}C)d\Gamma = 0$$

$$\int_{\Omega}[W(S_h \frac{\partial h}{\partial t} - Q) + \vec{\nabla}W\cdot(K\cdot\vec{\nabla}h)]d\Omega - \int_{\Gamma} W_n(K\cdot\vec{\nabla}h)d\Gamma = 0$$

where W is the weighting function, Ω is the computational domain with the boundary Γ, and n is the unit vector normal to Γ. The boundary integrals arise from the application of the Green's identity to the respective flux terms. The flux boundary conditions associated with both equations are readily satisfied through the natural boundary conditions of these expressions.

The concentration C and head h are represented by the trial approximations

$$\hat{C}(x,y,z,t) = \sum_{i=1}^{n} N_i(x,y,z)C_i(t)$$

$$\hat{h}(x,y,z,t) = \sum_{i=1}^{n} N_i(x,y,z)h_i(t)$$

where x denotes vector space and N_i is the linear basis function; in this instance, $W = N_i$. The velocity V is approximated similarly.

The matrix equivalent forms of the resultant weak statements can be expressed as

$$[M]\{\dot{C}\} + [K_c\{C\}] + [A(V)]\{C\} = \{F_c\}$$

$$[M]\{\dot{h}\} + [K_h\{h\}] = \{F_h\}$$

where the . refers to time differentiation, M, K and A(V) are sparse matrix coefficients, and F_h

F_c are the right hand side vector loads.

The matrix coefficients are defined as

$$[M]=m_{ij}=\int_{\Omega}N_iN_jd\Omega$$
$$[A(V^h)]=a_{ij}=\int_{\Omega}W_i(V^h.\nabla N_jd\Omega$$
$$[K_C]=k_{C_{ij}}=\int_{\Omega}\nabla N_i(D.\nabla N_jd\Omega$$
$$[K_h]=k_{h_{ij}}=\int_{\Omega}\nabla N_i(k.\nabla N_j)d\Omega$$
$$\{F_C\}=fC_i=\int_{\Omega}N_iSd\Omega+\int_{\Gamma}N_i[n.(D.\nabla C^h)]d\Omega$$
$$\{F_h\}=fh_i=\int_{\Omega}N_iQd\Omega+\int_{\Gamma}N_i[n.(k.\nabla h^h)]d\Omega$$

For steady state flow, the resulting Poisson equation for h is solved using a Cholesky skyline decomposition.

Simple modifications are used to replace the typical FEM global assembly operations with local formulations (8 * 8 in 3-D) per time step. Although the coefficient matrices are explicitly reformed with each time step, performing the operations on a local level significantly reduces storage and enhances overall solution speed. In cases where element distortion is minimal, reduced integration is used. Detailed descriptions of the matrix coefficient modifications are discussed in Pepper and Singer (1990).

Petrov - Galerkin Weighting

A Petrov - Galerkin scheme is used to stabilize the species transport equation. In this approach, the advection term is weighted by the function

$$W_i = N_i + \frac{\alpha}{2}\frac{h_e}{V}\left(u\frac{\partial N_i}{\partial x} + v\frac{\partial N_i}{\partial y} + w\frac{\partial N_i}{\partial z}\right)$$

rather than by the standard shape function N_i. The element size h_e is calculated using the mesh length vectors. For a three dimensional hexahedral element, its value is given by

$$h_e = \frac{|V.h_\xi| + |V.h_{\eta\xi}| + |V.h_\zeta|}{V}$$

where $\alpha = \coth \beta/2 - 2/\beta$ with $\beta = |V|h_e/2D_e$ (Yu and Heinrich., 1986). The diffusion coefficients D_e is an effective diffusion in the direction of the local velocity vector and is calculated using the components of D as

$$D_e = \frac{V^T.D.V}{|V|^2}$$

The coefficient (D_e) describes effective diffusion in the direction of the local velocity vector. The modified weighing function are dependent on the magnitude and the direction of the flow velocity and media diffusion parameter. The weight function introduces a scaled diffusion into the numerical scheme which adjusts its damping affect on the model according to specific trouble zones. Elements with little advection will have weighting functions equal to standard shape fuñctions; elements with high flow velocities will use augmented weighting functions in order to control the advection terms.

The weighting has the effect of introducing a form of anisotropic balancing diffusion into the numerical scheme which acts along the local streamline. The precise amount of artificial diffusion (for eliminating the shortest waves) and direction in which it must be added for optimizing accuracy is calculated over each element.

Petrov - Galerkin mesh length vectors are defined as :

UL = upper left corner (front)
UR = upper right corner (front)
BUL= upper left corner (back)
BUR= upper right corner (back)

LL = lower left corner (front)
LR = lower right corner (front)
BLL= lower left corner (back)
BLR= lower right corner (back)

$$h_{\xi x} = .333*[(x_{LR}+x_{UR})-(x_{LL}+x_{UL})+(x_{BLR}+x_{BUR})-(x_{BLL}+x_{BUL})]$$
$$h_{\xi y} = .333*[(y_{LR}+y_{UR})-(y_{LL}+y_{UL})+(y_{BLR}+y_{BUR})-(y_{BLL}+y_{BUL})]$$
$$h_{\xi z} = .333*[(z_{LR}+z_{UR})-(z_{LL}+z_{UL})+(z_{BLR}+z_{BUR})-(z_{BLL}+z_{BUL})]$$
$$h_{\eta x} = .333*[(x_{UR}+x_{UL})-(x_{LR}+x_{LL})+(x_{BUR}+x_{BUL})-(x_{BLR}+x_{BLL})]$$
$$h_{\eta y} = .333*[(y_{UR}+y_{UL})-(y_{LR}+y_{LL})+(y_{BUR}+y_{BUL})-(y_{BLR}+y_{BLL})]$$
$$h_{\eta z} = .333*[(z_{UR}+z_{UL})-(z_{LR}+z_{LL})+(z_{BUR}+z_{BUL})-(z_{BLR}+z_{BLL})]$$
$$h_{\zeta x} = .333*[(x_{LR}+x_{LL})-(x_{BLR}+x_{BLL})+(x_{UR}+x_{UL})-(x_{BUR}+x_{BUL})]$$
$$h_{\zeta y} = .333*[(y_{LR}+y_{LL})-(y_{BLR}+y_{BLL})+(y_{UR}+y_{UL})-(y_{BUR}+y_{BUL})]$$
$$h_{\zeta z} = .333*[(z_{LR}+z_{LL})-(z_{BLR}+z_{BLL})+(z_{UR}+z_{UL})-(z_{BUR}+z_{BUL})]$$

$$h_1 = \frac{(uh_{\xi x}+vh_{\xi y}+wh_{\xi z})}{|\bar{u}|}$$
$$h_2 = \frac{(uh_{\eta x}+vh_{\eta y}+wh_{\eta z})}{|\bar{u}|}$$
$$h_3 = \frac{(uh_{\zeta x}+vh_{\zeta y}+wh_{\zeta z})}{|\bar{u}|}$$

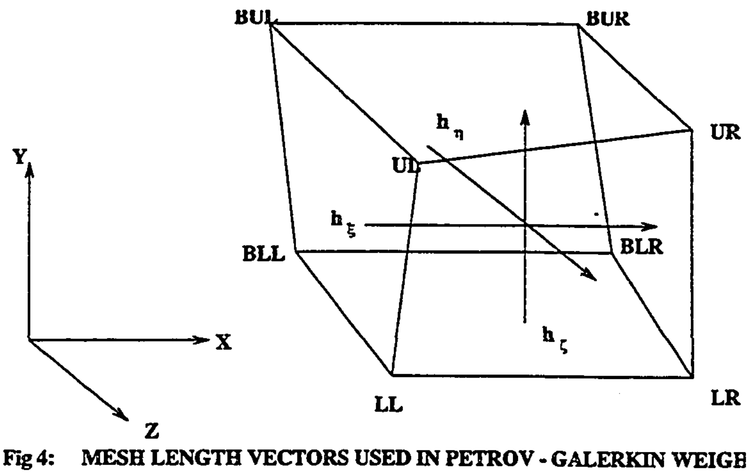


Fig 4: **MESH LENGTH VECTORS USED IN PETROV - GALERKIN WEIGH**

$h_e = |h_1| + |h_2| + |h_3|$

CHAPTER 4: PROGRAMMING BASICS

Cholesky Decomposition

One of the most efficient and popular approaches for solving banded system of equations is Cholesky decomposition which is a modified Gauss Elimination method.The algorithm relies on the fact that a symmetric matrix can be decomposed into lower and upper triangular matrices ie.,

$$M = U^T . U$$

where the subscript T denotes the transpose. The above equation can be written in recurrence form as:

$$u_{ij} = \left(m_{ij} - \sum_{k=1}^{i-1} u_{ki}^2 \right)^{1/2}, i = j$$

$$u_{ij} = \frac{m_{ij} - \sum_{k=1}^{i-1} u_{ki} u_{kj}}{u_{ii}}, i < j$$

$$u_{ij} = 0, i > j$$

which makes the matrix positive definite. This procedure significantly speeds up the LU decomposition step. Forward and backward substitution can then be performed to yield the solution vector. In this method, pivoting is not required to avoid division by zero. The positive definiteness of the matrix A guarantees that $u_{ii} > 0$ for all values of I.

The matrix formulation for the transient, saturated flow equation is set as follows:

$$[M] = [C] + \Delta t[K]$$
$$\{X\} = \{h\}_{t+\Delta t}$$
$$\{B\} = \left([C] - \Delta t[K]\right)\{h_t\} + \Delta t(\{F\}_t + \{F\}_{t+\Delta t})$$

where [C] is the global capacitance matrix, [K] is the global conductance matrix, Δt is the time step, and {F} are the specified rates of groundwater flow representing sources and sinks at the Neumann nodes. {F} is known at all time steps. $\{h\}_t$ is known from the initial conditions or from solution obtained from the previous time step.$\{h\}_{t+\Delta t}$ are the known values of hydraulic heads at time $t + \Delta t$.

[M] ,[C] and [K] are symmetric. The choice of Δt will have no effect on the symmetry of [M]. Because [M] is symmetric, the banded equations can be easily solved in vector storage.

Vector Storage: In vector storage only the entries within the band are stored; the entries outside the band (which are all zero) are discarded. The phenomenon can be explained with an example. Assume 6 equations with semi - bandwidth of 2. In full matrix storage, 36 entries are stored including the 20 entries "outside" the band that are known to be zero. If the matrix is non - symmetric, the entries within the band can be stored in vector with length IJSIZE where

$$IJSIZE = (NDOF)^2 - (NDOF - SBW)(1 + NDOF - SBW)$$

where NDOF (for Number of Degrees of Freedom) is the number of equations and SBW is the semi - bandwidth. For this case :

$$IJSIZE = (6)^2 - (6 - 2)(1 + 6 - 2) = 16$$

(a) Full Matrix Storage NDOF = 6 SBW = 2

$$[M] = \begin{vmatrix} m_{11} & m_{12} & 0 & 0 & 0 & 0 \\ m_{21} & m_{22} & m_{23} & 0 & 0 & 0 \\ 0 & m_{32} & m_{33} & m_{34} & 0 & 0 \\ 0 & 0 & m_{43} & m_{44} & m_{45} & 0 \\ 0 & 0 & 0 & m_{54} & m_{55} & m_{56} \\ 0 & 0 & 0 & 0 & m_{65} & m_{66} \end{vmatrix}$$

36 entries ; 20 entries outside the band (o' s)

(b) Vector storage
Non - Symmetric Matrix

$$\{M\} = \begin{Bmatrix} m_{11} \\ m_{12} \\ m_{21} \\ m_{22} \\ m_{23} \\ m_{32} \\ m_{33} \\ m_{34} \\ m_{43} \\ m_{44} \\ m_{45} \\ m_{54} \\ m_{55} \\ m_{56} \\ m_{65} \\ m_{66} \end{Bmatrix}$$

(c) Vector storage
Symmetric Matrix

$$\{M\} = \begin{Bmatrix} m_{11} \\ m_{12} \\ m_{22} \\ m_{23} \\ m_{33} \\ m_{34} \\ m_{44} \\ m_{45} \\ m_{55} \\ m_{56} \\ m_{66} \end{Bmatrix}$$

Minimization of the *semi - bandwidth* is desirable because the size of the system of linear equations created by the finite element method could be quite large. When the system of equations is operated on in matrix form, the storage capacity of many computers can be quickly be exceeded. The semi - bandwidth for any mesh can be computed from: SBW = R + 1, where R is the maximum difference in any two node numbers within a single element in a mesh (if the value of the field variable is specified at a node however that node is not used in the calculation of R). The minimum bandwidth for a particular mesh can be achieved by numbering nodes across the narrow dimension of the problem domain.

Mass Matrix

In the θ - method, the time derivative is replaced by the simple difference as:

$$\frac{\partial T}{\partial t} = \frac{T^{n+1} - T^{n}}{\Delta t}$$

where $T^n = T(x, t_n)$ denotes the variable's value at time $t = t_n$, Δt is the time increment, and $t_{n+1} = t_n + \Delta t$. A relaxation parameter θ is introduced now and the solution T is written in the form:

$$T = \theta T^{n+1} + (1-\theta)T^{n}, t_n \leq t \leq t_{n+1}$$

If we set $\theta = 0$, we will not obtain a fully explicit method due to the presence of mass matrix which must always be inverted.

For an equation of the type:

$$MT^{n+1} = \Delta t[F_{q2-3} + F_Q - (k + H_{2-3})T^{n}] + MT^{n}$$

To calculate T^{n+1} requires M^{-1} to be computed or some elimination method to be used to solve for T^{n+1} due to the coupling created by the mass matrix.

In order to obtain a fully explicit scheme, we diagonalize or "lump" the mass matrix M. The mass matrix is then replaced by the lumped mass matrix M^l, defined by

$$M^l = [m^l_{ij}]$$

where

$$m^l_{ij} = \begin{cases} 0 & \text{if } i \neq j \\ \sum_{j=1}^{n} m_{ij} & \text{if } i = j \end{cases}$$

which is a diagonal matrix. The above eq. is then modified to:

$$T^{n+1} = \Delta t (M^l)^{-1}[F_{q2-3} + F_Q - (k + H_{2-3})T^n] + T^n$$

which is fully explicit. $(M^l)^{-1}$ is trivial to compute sinceit is given by:

$$[m^l_{ij}]^{-1} = \begin{cases} 0 & \text{if } i \neq j \\ \dfrac{1}{m^l_{ii}} & \text{if } i = j \end{cases}$$

To produce a fully explicit algorithm, the mass matrix [M] is diagonalized by employing the following lumped mass approximation.

$$m_i^l = \int_\Gamma N_i \left(\sum_{j=1}^{n} N_j\right) d\Omega$$

where m_i^l denotes the diagonal term I of the lumped mass matrix. By construction, all off diagonal terms of the mass matrix are zero. This technique permits easy matrix inversion, allowing explicit solution steps.

Time Marching

An explicit second order Runge - Kutta method is used to advance the discretized equations in time. With the lumped mass matrix denoted by $[M^l]$, {C} is advanced in time according to the following two - step algorithm:

$$\{\hat{C}\}^{n+\frac{1}{2}} = \{\hat{C}\}^{n} + \frac{\Delta t[M^l]^{-1}}{2R_d}(\{F_c\} - [K_c]\{\hat{C}\} - [A]\{\hat{C}\})^{n}$$

$$\{\hat{C}\}^{n+1} = \{\hat{C}\}^{n} + \frac{\Delta t[M^l]^{-1}}{2R_d}(\{F_c\} - [K_c]\{\hat{C}\} - [A]\{\hat{C}\})^{n+\frac{1}{2}}$$

where $[M^l]^{-1}$ is the inverse lumped mass matrix; superscript n denotes a quantity evaluated at time $n\Delta t$, with Δt being the magnitude of the time step. The temporal integration of the nodal values for the head is carried out in an analogous fashion. The Courant limit is calculated for each element and the time step is adjusted to ensure the explicit discretization stability (Hoffman and Chiang, 1993).

By assuming the head (h) to be steady state, a Poisson equation for h is obtained

$$\nabla^2 h = f(x,y,z)$$

which can be solved using either a Cholesky skyline decomposition or a Conjugate gradient method.

CHAPTER 5: SIMULATIONS

The code is used to compare three - dimension with the two - dimension model results of two cases: namely the Savannah River Site model and the Yucca Mountain Repository model. The Savannah River site model is a purely saturated case model with variable saturated soil conditions at the surface; the Yucca Mountain model has its domain in the unsaturated zone with the water table acting as the boundary condition at the bottom of the grid.

Both models assume isothermal, steady state hydrologic conditions over the course of solution. Since there is only a single source of contaminant discharge and the solver was run until the maximum desired time limit for both the cases was surpassed.

Savannah River Repository

The two dimensional data set for the Savannah River site was easily available (SRL, S. Carolina) and has also been worked upon by former UNLV graduate student Bryan Dunlop. An accurate remediation model can be developed.

The study performed shows a general comparison of the code's results against actual conditions which exist at the F-Basin site.

Background

Process water discharge from the F Area to the F Area basin 3 began in 1957 (Fenimore and Horton, 1972). Tritium was detected in well F18 and concentrations peaked in November 1963. Fennimore and Horton (1972) assumed a travel time of 52 months over distance of 800 ft and calculated an interstitial groundwater velocity of 184.6 ft/yr. These authors also determined that the average hydraulic gradient near the basin 3 was equal to .005. Assuming an effective porosity of 0.20, the hydraulic conductivity was calculated to be 20.2 ft/day. These extremely high hydraulic conductivity estimate suggests that local zones of preferred flow control groundwater movement near the F area seepage basin 3.

Estimates of the amount of aqueous tritium released to the environment from both the F and H-Area basins are about 444,000 curies for the years from 1954 to 1988 (Murphy et al.,1991). Data about the amount and the types of pollutants are extensive yet no guidelines are set to good approximation for contaminant release.

In March 1986, a study was done on the characterization of groundwater flow and transport in the separation zones by GeoTrans for the Savannah River Laboratory(Aiken, South Carolina). FTWORK; a three dimensional groundwater flow and solute transport code, was written to trace the contour of the concentration of the solute transport. The code utilizes finite difference method and does take into account the mechanism of transport of advection, dispersion, adsorption and decay. It solves both the transient and steady state flow with source and sink terms. Results generated from the code showed the flow moving north to south in Aquifer 1 and 2 and northwesterly in Aquifer 3. Solute concentrations down gradient of the H-Area seepage basins increase with time. F-Area basin to Four Mile Branch Creek, source to sink, travel times are estimated to Five and Eight years (Killian et al., 1985; Ashley et al., 1982). Also it is important that the migration of the contaminant did not occur in the lower aquifer except in minute amounts. Historically only traces of tritium have been recorded there (GeoTrans, 1993).

Savannah River Site Model

This section explains the textural characteristics of the different sections of the river site; namely the Barnwell, McBean, Congaree and the upper Tuscaloosa aquifers, and the Tan, Green, and the Ellenton Clay confining units. The Barnwell aquifer has two distinct units with respect to textural character. The upper part of the Barnwell is mostly clayey sand with discontinuous clay and silt lenses: in the lower part, silty and poorly graded sand predominate. The Tan clay separates the Barnwell and McBean aquifers. The clay is areally discontinuous but appears to have confining effects extensively over the study area. The Tan Clay ranges from 0 to more than 10ft thick, averaging 3 to 5 ft thick. The clay layer is assumed continuous unit by the model.

The McBean aquifer also exhibits vertical textural trends. The upper part of the unit is mostly clayey sand and poorly graded sand, while the lower layer is mainly clayey and silty sand. Clay and silty layer are also distributed throughout the full thickness of the McBean. Some portions of the McBean also exhibit calcareous zones. The McBean and the Congaree aquifers are separated by a very competent, continuous confining unit, the Green clay. The clay is areally extensive through the model area. The observed thickness varies from 0 to 20 ft but averages between 3 and 6 ft.

The Congaree is composed of coarsening upward sequence of clays, silts and sands. The upper part of the unit consists of poorly sorted sand. The lower part is mainly made of finer grained particles.

For the model, the maximum head was assumed to be 100m at the top of the mesh near the basin and the lowest was 65 m at the river. There is only one source which is submerged into the saturated zone. Conductance values for the elements were derived from the soil samples typical for the site. In the aquifer above the clay confining layer $k_{xx} = 1.10$ (m/day) and $k_{yy} = .006$. kzz in

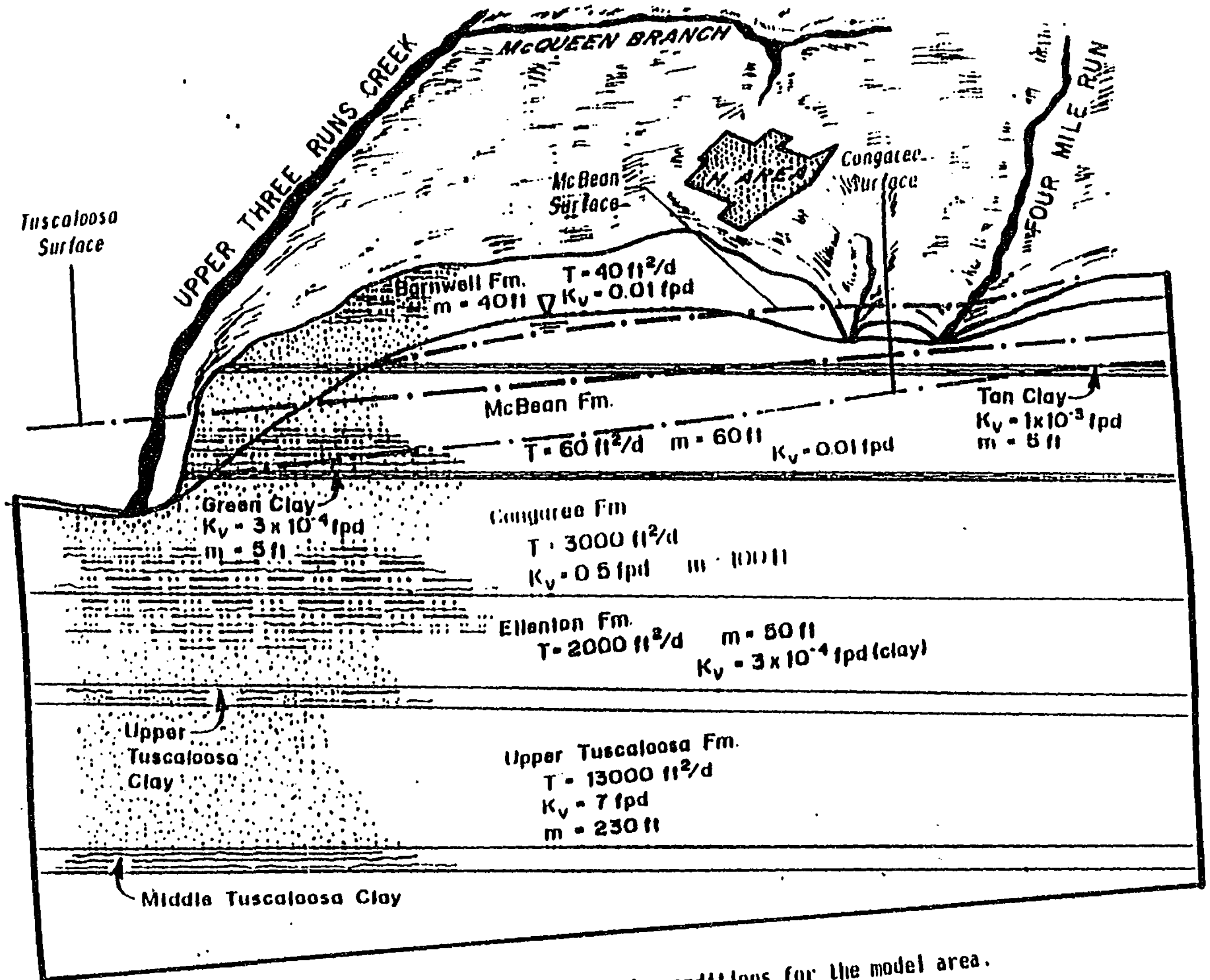


Fig 5: Summary of hydrogeologic conditions for the model area.

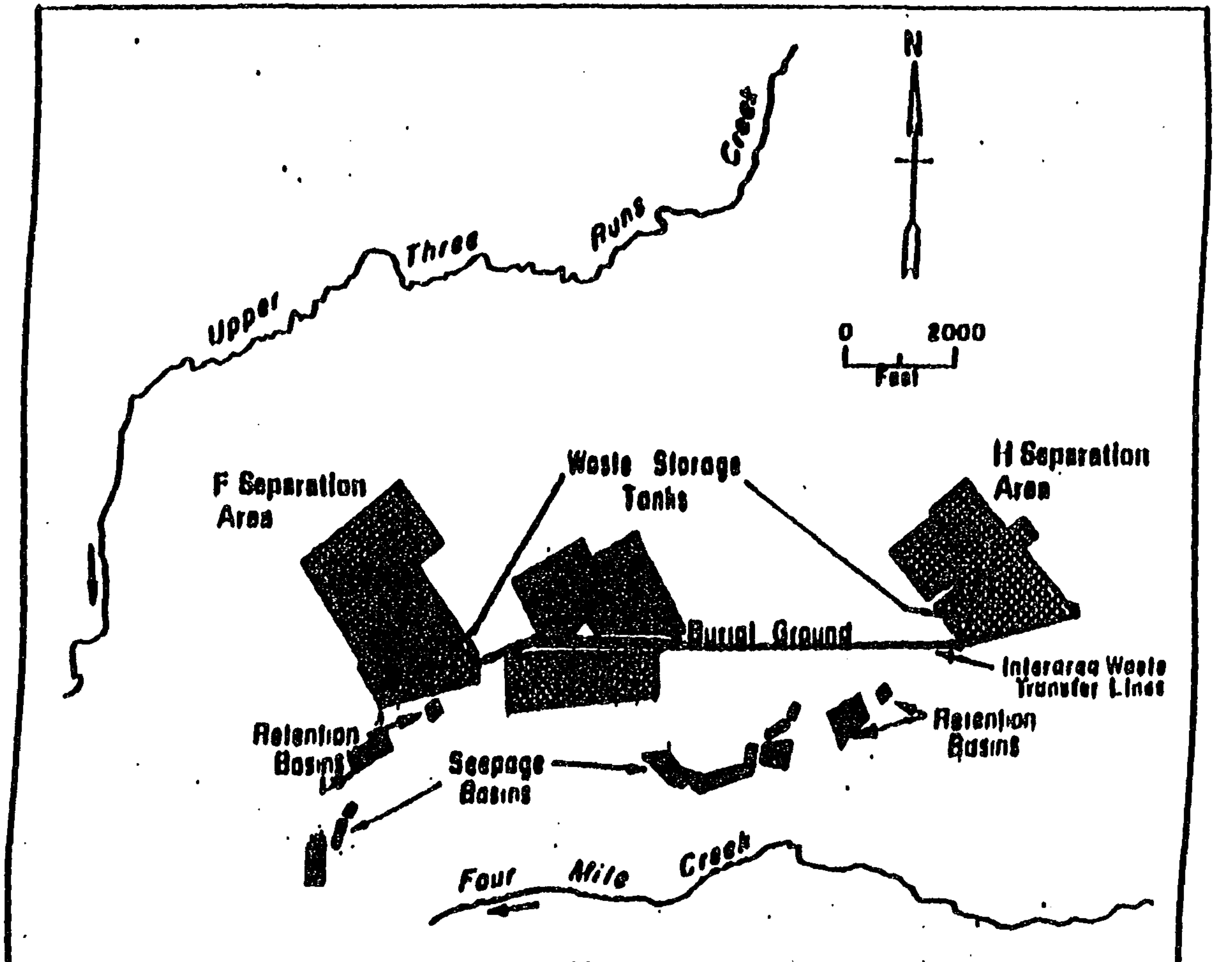


Fig 6: Relative locations of separation areas and associated waste-handling facilities.

the z direction is the same as in the x direction. The lower aquifer has conductance of $k_{xx} = 1.2$ and $k_{yy} = 6*10^{-5}$. All clay elements are assigned conductivity's of k_{xx} = and $k_{yy} = 6*10^{-5}$.

Savannah Results

The mesh used for this model is a fairly coarse mesh. The number of nodes and elements are 800 and 513 respectively. The planes in the z - direction change from 0 to 150 with intervals of 50. The source is kept at the middle plane at z = 50 and z = 100. The solute transport is observed for 15 years time frame. Source was located at element 116 of the mesh.

From the Concentration contour it is evident that the contour traces a flow extensively in the x-direction while the flow in the vertical direction (y-direction) is comparatively confined. As the conductivity in the z-direction is the same as in the x-direction, the concentration of the variable is spread centrally ie. maximum on the middle plane and equally but little less spread in the outward planes; at z = 0 and z = 150. The velocities in the x-direction are highly varied, while the velocity in y-direction is about in the same range. In the x-direction the velocity changed from a magnitude of 10^{-9} to .17 (m/day). The velocity in the z-direction also observes the same pattern as the x-direction and the magnitude changes from 10^{-11} to 10^{-3} (m/day). Velocity in the x and z direction are mainly positive. The velocity in the y-direction varies from 10^{-3} to 10^{-1} (m/day).

The results showed that the clay intrusions near the source did little to hinder the flow of the plume while the lower clay layers did control the flow of the contaminant. The contaminant hardly migrated in the lower aquifer region which is consistent with the historical data from the site. The contaminant range varies from -69 to 341 (gm/m^3).

Results of the two dimension simulation are close in magnitude and direction of flow matches to that of the three dimension simulation.

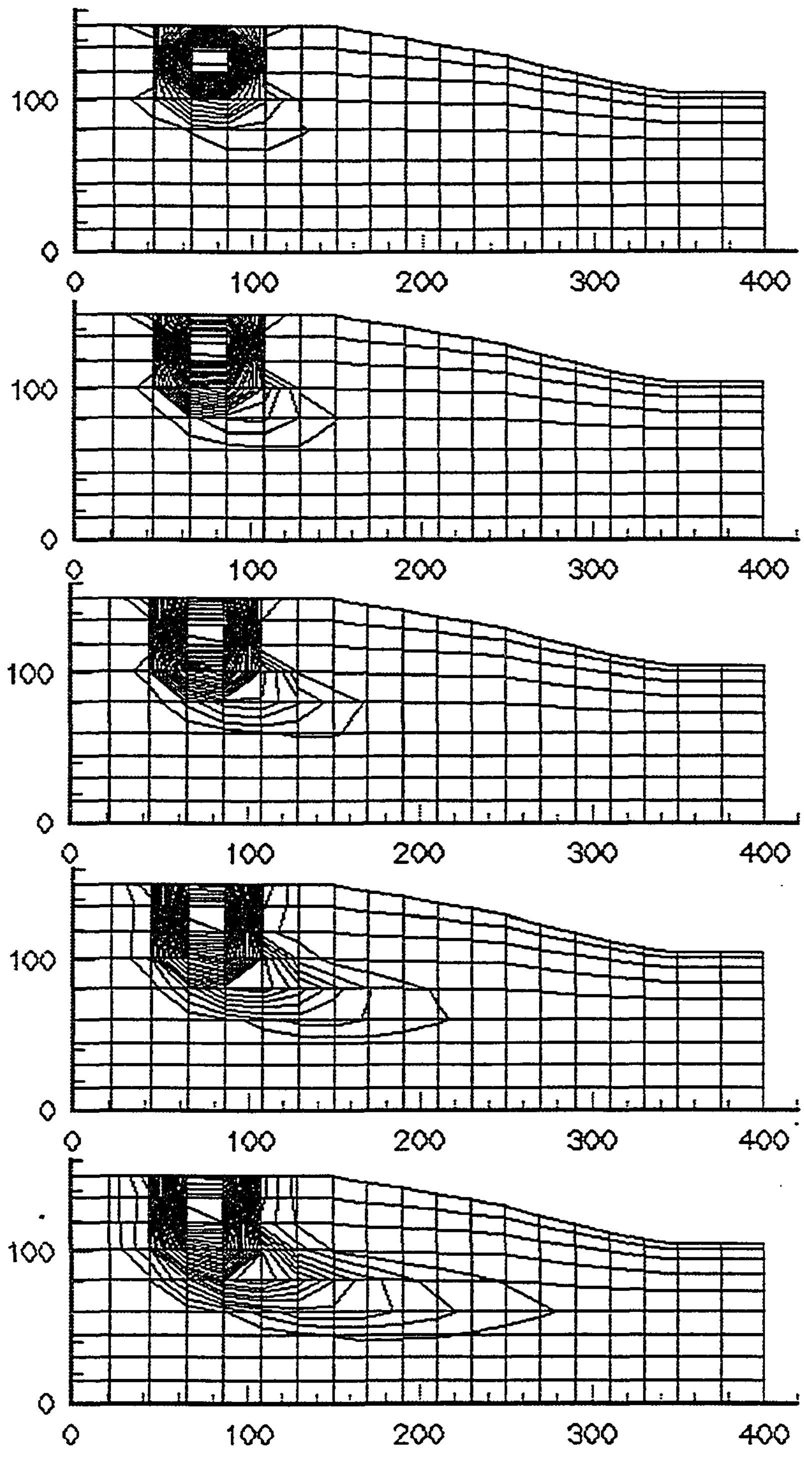


Fig 7: Concentration Contour (SRS2-D) for a) 2 yr b) 4 yr c) 6 yr d) 10 yr e) 15 yr

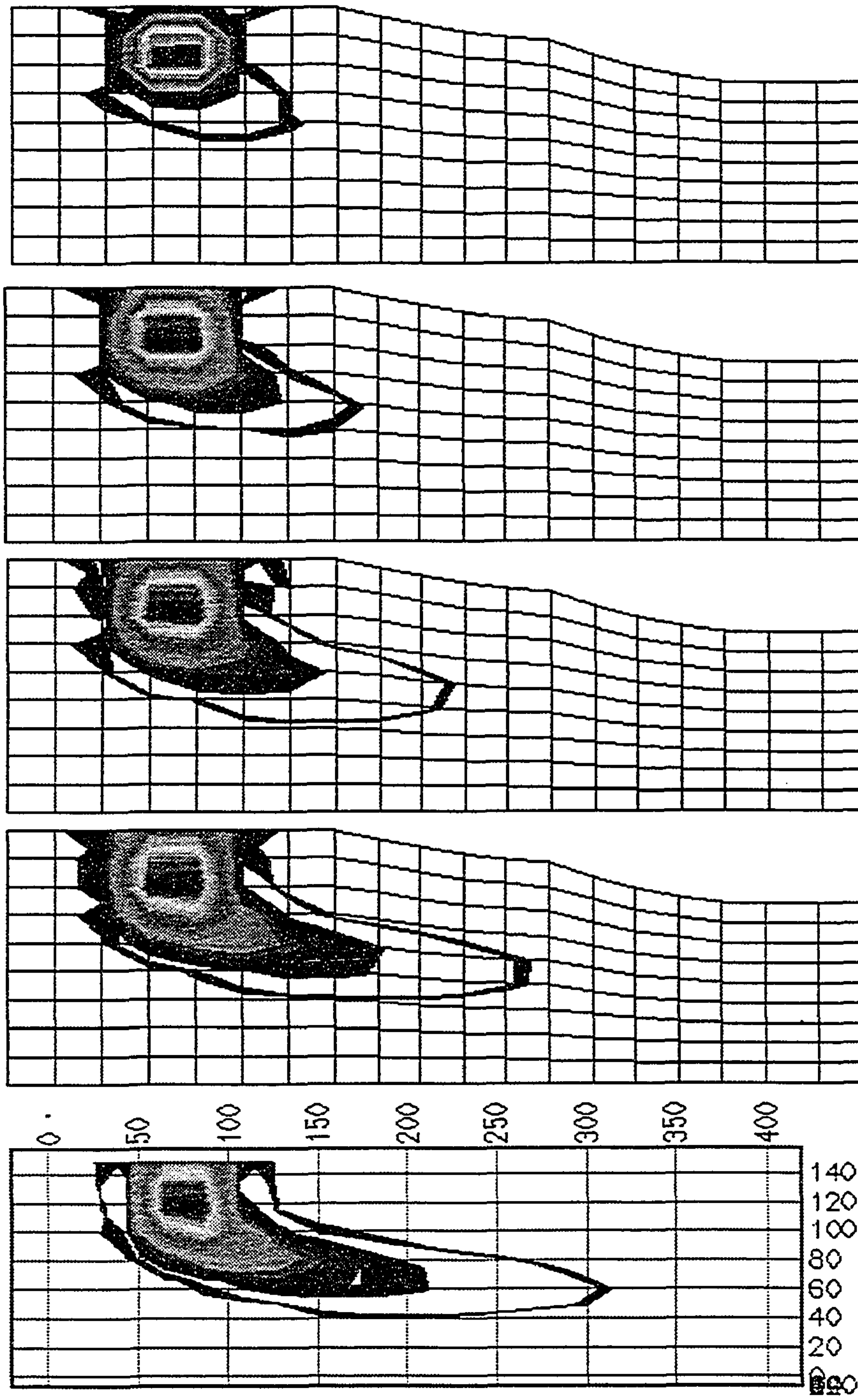


Fig 8: Concentration Contour (SRS 3-D) for a) 2yr b) 4 yr c) 6 yr d) 10 yr e) 15 yr

top view of the plot

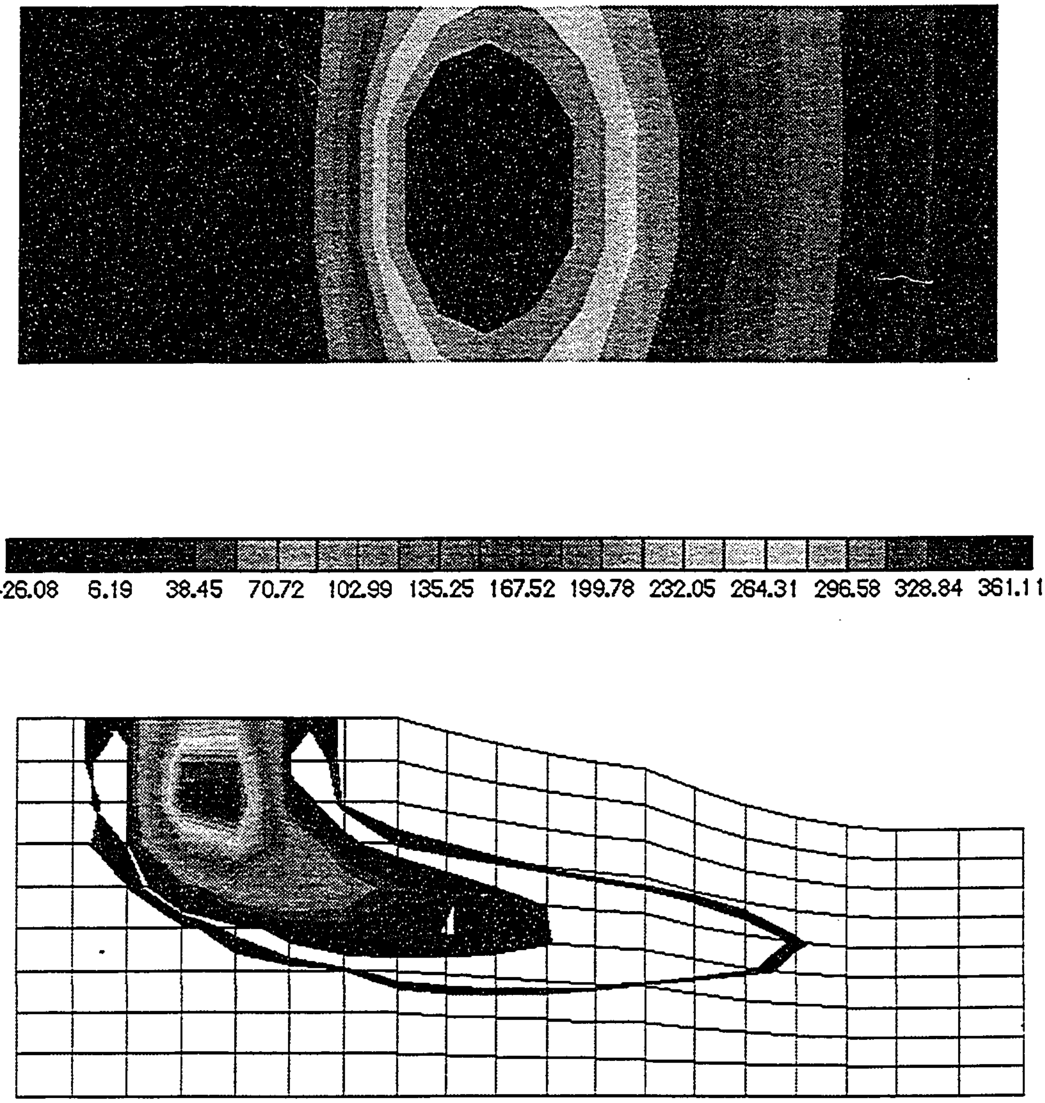
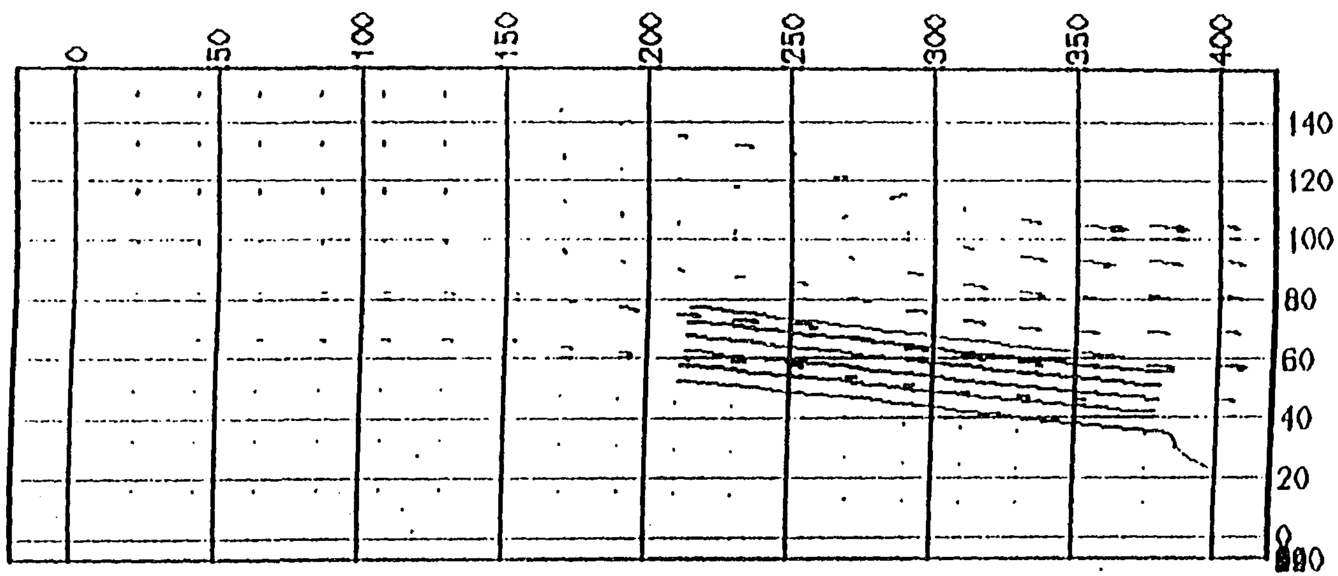


fig 9: Concentration Contour for Savannah River (3-D) 15 yrs.

Fig 9

z direction is inside the paper.



Vector plot for a period of 15 years along with streamtraces

Fig 9: Vector plot for the Savannah River Site Model (3-d).

Yucca Mountain Repository Model

This is the second of the two test cases run for this research project. The data set pertaining to the rock and the soil characteristics is still under observation and being collected, hence more assumptions regarding the parameters are taken into account. While the existence regarding the proposed site is still a big question mark; future models of thus site should contain fewer assumptions and approximations.

Background

A large amount of effort has been conducted on the proposed plan of high level nuclear repository at the Yucca Mountain. But still by the end of 1995, there was doubt over lack of emphasis being placed over the determination of the mass transport of the radio - nuclides under partially saturated conditions.

In the past few years numerical models for the site hydrology have been developed and used to determine the importance of specific parameters to the over -all hydrological system (Zimmerman and Bodvarsson, 1990; Rockhold et. al., 1990; Wittwer et al., 1993). Work has been done on the two - dimensional analysis for this particular project but not sufficiently for 'large - scale '.

Yucca Model

The Yucca Mountain Repository is approximately 300 m above the water table. The stratification of the cross section is not as detailed as the Savannah River site model but it does contain very distinct layering.

The characterization of the Yucca Mountain Repository is undergoing constant development and change and therefore the information and the data needed for the making of this model might become outdated. The Exploratory Studies Facility (ESF) will evolve into the

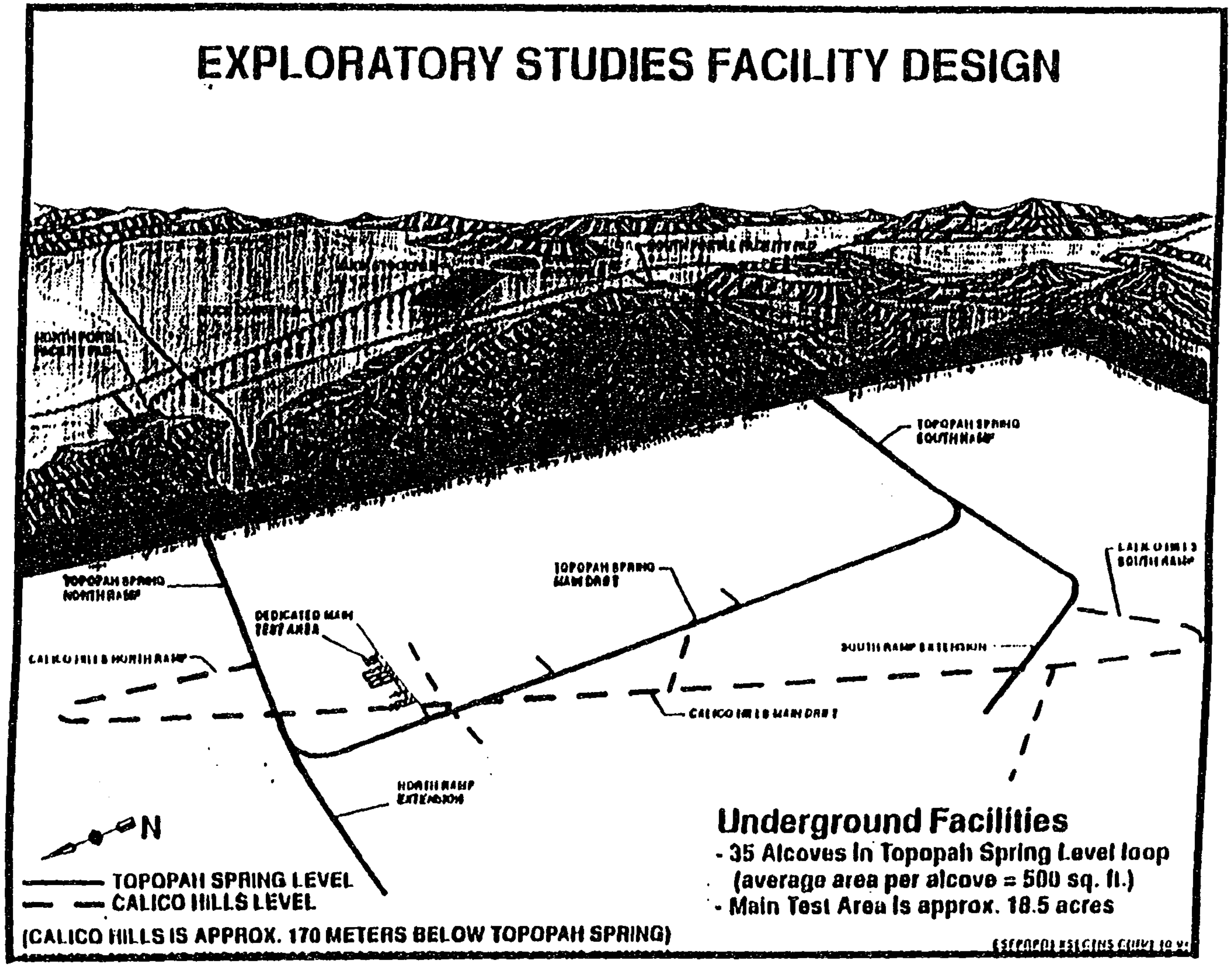
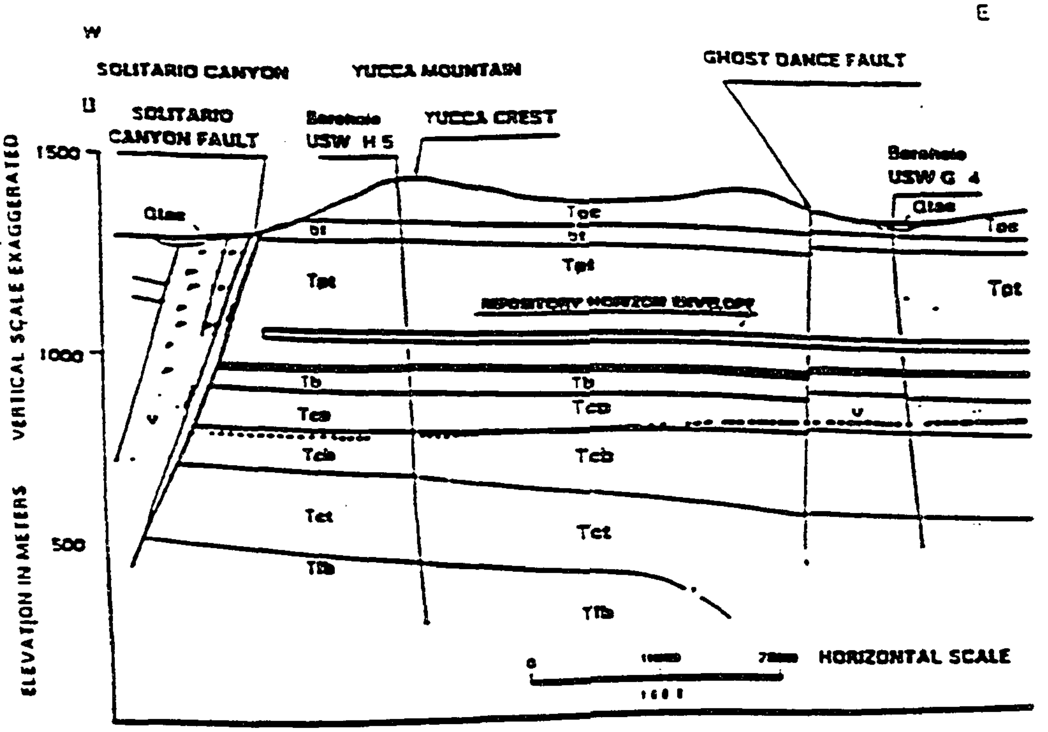


Fig 10: Conceptual Illustration of the Exploratory Studies Facility, Yucca Mountain Project. No. YMP/CM-0019, Rev. 0, ICN-2



Tcp	PROW PASS MEMBER
Tcb	BULLFROG MEMBER
Tct	TRAM MEMBER
Tfb	FLOW BRECCIA
Tpc	TIVA CANYON MEMBER
bt	BEDDED TUFF
Tpt	TOPOPAH SPRING MEMBER
Tht	TUFFACEOUS BEDS OF CALICO HILLS
	HIGHLY FAULTED AND BRECCIATED ZONE
Qtac	ALLUVIUM & COLLUVIUM
	BASAL VITROPYRE
?	STRATIGRAPHY UNCERTAIN
v	WATER TABLE
	ARROWS SHOW DIRECTION OF RELATIVE DISPLACEMENT

FAULT WITH MAJOR DIP SLIP DISPLACEMENTS POSITIONS KNOWN OR CONCEALED AT SURFACE.

Hydrogeological Unit	Abbreviation	Description	Permeability(m^2)
Tiva Canyon (welded)	TCw	[illegible]	$1.0e^{-16}$
			$2.0e^{-16}$
			$1.0e^{-16}$
Paintbrush (non - welded)	PTn	[illegible]	$1.0e^{-11}$
			$5.0e^{-12}$
			$1.0e^{-11}$
Topopah Spring (welded)	TSw		$1.0e^{-16}$
			$4.0e^{-14}$
			$4.0e^{-16}$
			$5.0e^{-16}$
			$4.0e^{-16}$
	Tsv		$1.0e^{-16}$
Calico Hills (non - welded)	CHn		$1.0e^{-11}$
	Chnv		$2.0e^{-12}$
			$5.0e^{-12}$
		[illegible]	$1.0e^{-11}$
	Chnz	[illegible]	$1.0e^{-11}$

Table 2: Lithological layers as described by the LBL/USGS Site - Scale model of the unsaturated zone at the proposed Yucca Mountain repository site.

repository block should the studies prove the site to be suitable. As observed for the Savannah river model, GWGRID was used to design the mesh for the Yucca Mountain model.
For the Ghost Dance Fault (GDP); that runs through the proposed repository block site, was modeled as an ordinary element with a high vertical conductance on the order of 100 times greater than the neighboring elements. The analysis occurs over thousand of years so the water table should not be assumed to be at its current level during the whole analysis. An average head value for the water table was calculated based on the current head and the highest predicted head values (Winograd et al., 1980; Czarnecki, 1985). The bottom of the mesh was assigned head values for 791 m. A zero hydraulic flux constraint was used along the sides of the mesh. A source hydraulic flux was used along the top of the mesh to simulate the water infiltration rate seen normally for the area, 0.10 mm/yr (Wittwer et al., 1993).

The horizontal conductivity of the various strata was approximated as being equal to the vertical conductivity except the GDF elements. The conductivity in z-direction is same as that of the x-direction again. For upper tuffs the vertical conductivity k ranged from .004 to .0055 m/day while the lower tuffs ranged from .0007 to .0032 m/day (Natl' Res. Council, 1992). A contaminant may be assumed to be leaking from a constant, continuous source during the entire simulation which is highly unlikely but still a conservative estimate.

Yucca Mountain Repository Results

The number of nodes and elements are 768 and 495 respectively. The planes in the z - direction change from 0 to 150 with intervals of 50. The source is kept at the middle plane for z = 50 and z = 100. The solute transport is simulated for 10,000 year time frame. Source was located at element 149 of the mesh.

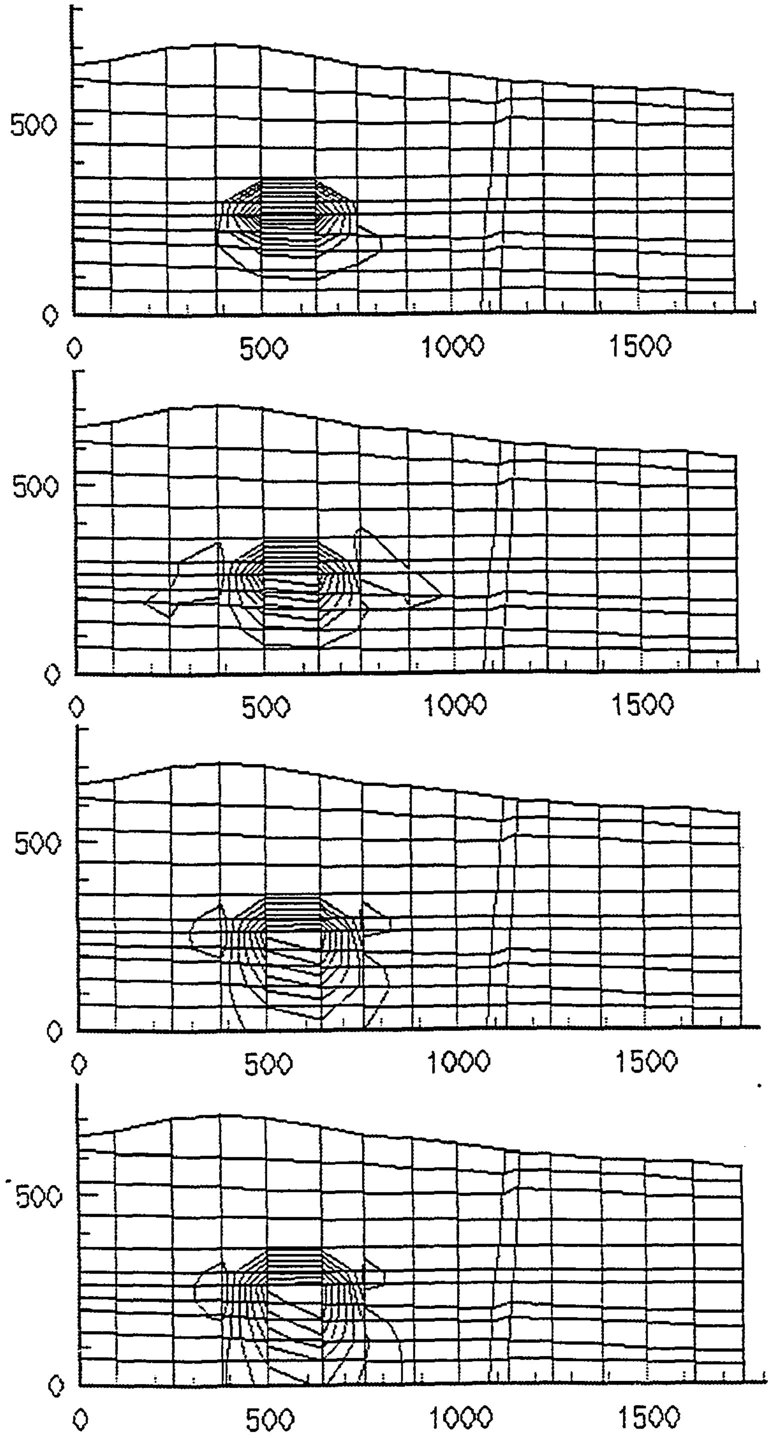


Fig 13: Concentration Contour (Yucca Mtn 2-D) for (a) 2500 b) 5000 c) 7500 d) 10000)yrs

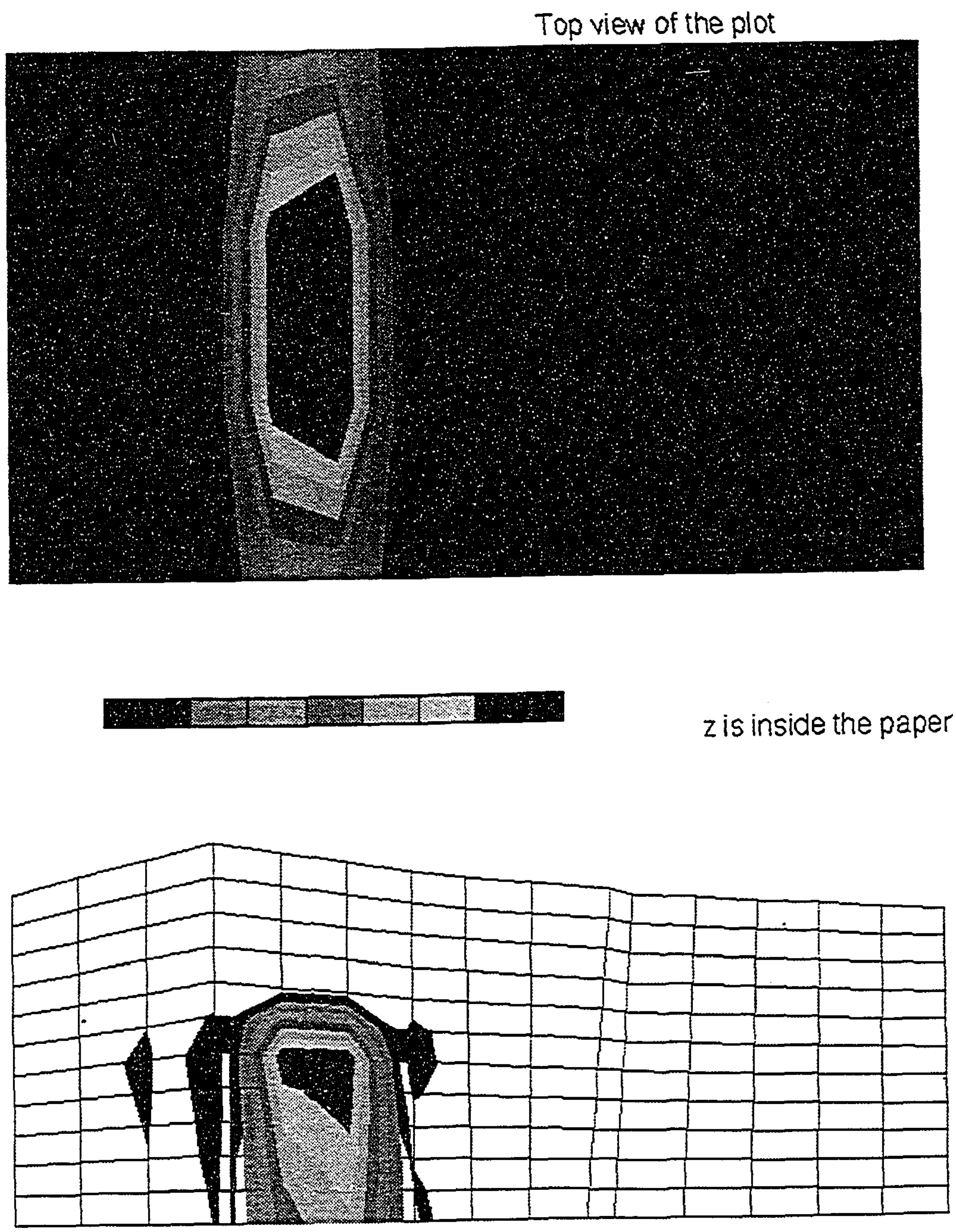


Fig 14: Concentration Contour for Yucca Mtn (3-D) 10,000 years

Fig 14

The contour plot for the solute shows that the contour spread is only confined to the y - direction (vertical) and hardly spreads in the x - direction (along the horizontal). The velocities are extremely small and hardly noticeable for the x and the z - direction (order: 10^{-7} m/day). The major flow of the velocity is in the vertical direction. Also in the Ghost dance fault, one observes fluctuating high velocities due to steep fall.

On this particular model, there was definite observance of numerical noise generation. The cause is attributed to the relatively coarse mesh. The model showed the contaminant to merge at the bottom level after 10,000 years; but as the model is based on the assumption of a continuous leaking cylinder and slightly saturated flow, the result can be taken as being on the safer side.

Even for this model; there was remarkable similarity of results for both the two - dimensional and the three - dimensional model.

	Simulation Time (Yrs) Savannah River Site	Simulation time (Yrs) Yucca Mountain	WallClock Time (sec.)
2 - Dimension	15 years	10,000 years	121 secs / 245 secs
3 - Dimension	15 years	10,000 years	258 secs / 17500 secs

Table 3: Time comparison of the two Models.

CHAPTER 6: CLOSING REMARKS

The comparison of both the models from the three dimension to the two dimension were good. The results were highly dependent on the assumption that the hydraulic conductivity in the z - direction (depth) was assumed to be the same as the conductivity in the x - direction (horizontal).

The proposed Yucca Mountain site is hydraulically suitable for storage of high - level radioactive waste as it will require over ten thousand years for the water to reach the water table. The simulation run from the three - dimensional model with the corresponding similar boundary conditions proved that the two - dimensional result is quite good. Both model suffers from numerical noise production and numerical instability, in the absence of adaption.

It was assumed that the container is undergoing a continuous leakage a ten thousand year period which is the worst scenario possible. The assumption that the model is isothermal can lead to the conclusion that air pressure varies little and therefore the governing equations used are good approximations for large saturated zones.

The Savannah River site model also predicted the results effectively. As seen from the two - dimensional simulation. the plume spreads more in the lateral direction than in the transverse direction. indicating motion towards the water bed. The three - dimensional analysis showed the plume to be a little more spread in the z - direction than extensively going in the lateral direction. The result of the plume movement could be attributed to the ease of movement of the groundwater flow in the z - direction as the hydraulic conductivity is assumed to be same in z - direction and the x - direction. Even the three dimensional model evaluated the model to be safe for a period of fifteen years which is more than the half - life of Tritium.

fifteen years which is more than the half - life of Tritium.

Comparisons to the other models was difficult since less work has been done in the three - dimensional modeling. Also the data sets for prediction of the hydraulic conductivity varies from model to model.

SUMMARY

A definite need exists for a accurate, inexpensive, and simple use of numerical models for the transport of the groundwater contaminants. The 3-D model appears capable of providing possible scenarios for new possible repository area design and remediation. The code incorporates a Petrov - Galerkin scheme weighting, mass lumping and reduced integration scheme.

The proposed Yucca Mountain site is currently under a great deal of scrutiny. The approximations for contaminant transport, if a leak were to occur, tend to occur over a period of ten thousand years to water table impact. It appears that the ten thousand year period falls well inside the safety requirements and there should be no possibility of the plume reaching the water bed. All the approximations assume a continuous release of contaminant, an unlikely scenario , suggesting that the location of the high level radioactive waste repository is hydraulically suitable. Recent developments have shown a negative attitude of the U.S. government to allocate this site for nuclear dumping.

The Savannah River site F- basin was also an example case for numerical model. An explanation of the two dimensional and three dimensional results suggests that the plume flow closely follows observed values. There plume reached the water bed within a 15 year period.

RECOMMENDATIONS

A look at the results and the study done through the thesis work suggest the following:

- A finer mesh is needed to obtain more precise results. Adaption of the mesh is another factor which will help in obtaining more accurate solutions.
- A need to obtain a more realistic three dimension data set (instead of assumption of conductivity in the x - direction to be same as in z - direction) would indeed alter results.
- Carefully adjusting the time step will help obtaining better solutions.
- Optimization of the band width would also help in reducing memory requirements.
- Having precise model parameter values for the parameter file will also be highly helpful .
- Code to run the unsaturated model will prove extremely effective getting accurate results.

NOMENCLATURE

$C =$ Concentration(g / m^3)

$\mathbf{V} =$ Vector, velocity field (m / day)

$D =$ Vector Dispersion tensor (m^2 / day)

$h =$ height of the water table (m)

$H =$ Prescribed head value (m)

$\mathbf{n} =$ unit vector normal to the boundaries

$S =$ Contaminant Source / Sink (gm / day)

$Q =$ groundwater source / sink (m / day)

$V =$ absolute fluid flow velocity, $|\mathbf{V}| = \sqrt{\mathbf{u}^2{}_x + \mathbf{v}^2{}_x + \mathbf{w}^2{}_x}$

$W =$ Galerkin Weighting Function

$R_d =$ Retardation factor, value of 1 is used

$C_0 =$ Mean Concentration (g / m^3)

$S_h =$ Specific Yield

$K_{ij} =$ Permeability (m / day)

$h_0 =$ initial head (m)

$n_x =$ outward unit normal (x - direction)

$n_y =$ outward unit normal (y - direction)

$n_z =$ outward unit normal (z - direction)

$\Gamma_i =$ boundary group of nodes

$u_i =$ Darcy's Velocity components (m / day)

$d_{ij} =$ hydrodynamic dispersion tensoral components (m)

$\mu_d =$ molecular diffusion (m^2 / day)

$\alpha_T =$ transverse dispersivity (m)

$\alpha_L =$ longitudanel dispersivity (m)

$C_i =$ nodal contaminant concentration (g / m^3)

$\Omega =$ Computational domain

$\Gamma =$ domain boundary

$N_i =$ trilinear isoparametric shape function

$W_i =$ Petrov Galerkin weighting function

$h_e =$ Element size parameter

h_ξ = Horizontal mesh length vector

h_η = Vertical mesh length vector

h_ζ = Diagonal mesh length vector (z)

β = Species transport equation Peclet number

n = number of nodes in the mesh

θ = effective porosity

κ = tensor hydraulic conductivity (m / day)

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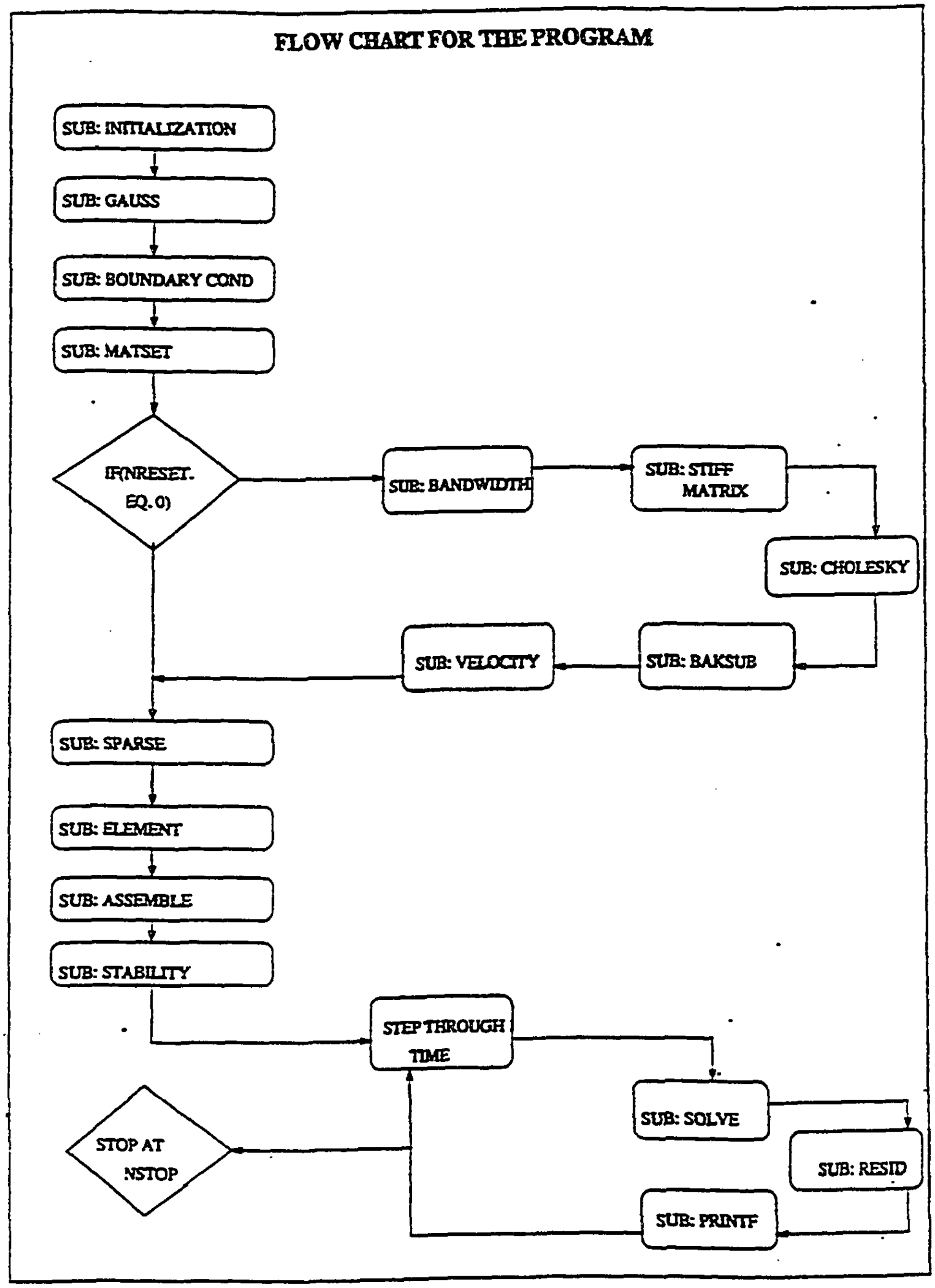
APPENDIX A: FLOWCHART OF THE CODE


FLOW CHART FOR THE PROGRAM
SUB: INITIALIZATION
SUB: GAUSS
SUB: BOUNDARY COND
SUB: MATSET
IF(NRESET.
EQ. 0)
SUB: BANDWIDTH
SUB: STIFF
MATRIX
SUB: CHOLESKY
SUB: BAKSUB
SUB: VELOCITY
SUB: SPARSE
SUB: ELEMENT
SUB: ASSEMBLE
SUB: STABILITY
STEP THROUGH
TIME
SUB: SOLVE
SUB: RESID
SUB: PRINTF
STOP AT
NSTOP

APPENDIX B: INPUT FILES FOR SAVANNAH RIVER SITE AND YUCCA MOUNTAIN REPOSITORY

3-D DATA SET FOR SAVANNAH RIVER SITE

800 513

1	0.00000	0.00000	0.00000
2	21.42860	0.00000	0.00000
3	42.85710	0.00000	0.00000
4	64.28570	0.00000	0.00000
5	85.71430	0.00000	0.00000
6	107.14300	0.00000	0.00000
7	128.57100	0.00000	0.00000
8	150.00000	0.00000	0.00000
9	0.00000	16.66670	0.00000
10	21.42860	16.66670	0.00000
11	42.85710	16.66670	0.00000
12	64.28570	16.66670	0.00000
13	85.71430	16.66670	0.00000
14	107.14300	16.66670	0.00000
15	128.57100	16.66670	0.00000
16	150.00000	16.66670	0.00000
17	0.00000	33.33330	0.00000
18	21.42860	33.33330	0.00000
19	42.85710	33.33330	0.00000
20	64.28570	33.33330	0.00000
21	85.71430	33.33330	0.00000
22	107.14300	33.33330	0.00000
23	128.57100	33.33330	0.00000
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28	64.28570	50.00000	0.00000
29	85.71430	50.00000	0.00000
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61	85.71430	116.66700	0.00000
62	107.14300	116.66700	0.00000
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64	150.00000	116.66700	0.00000
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66	21.42860	133.33299	0.00000
67	42.85710	133.33299	0.00000
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69	85.71430	133.33299	0.00000
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204	64.28570	83.33330	100.00000
205	85.71430	83.33330	100.00000
206	107.14300	83.33330	100.00000
207	128.57100	83.33330	100.00000
208	150.00000	83.33330	100.00000
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213	85.71430	100.00000	100.00000
214	107.14300	100.00000	100.00000
215	128.57100	100.00000	100.00000
216	150.00000	100.00000	100.00000
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218	21.42860	116.66700	100.00000
219	42.85710	116.66700	100.00000
220	64.28570	116.66700	100.00000
221	85.71430	116.66700	100.00000
222	107.14300	116.66700	100.00000
223	128.57100	116.66700	100.00000
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229	85.71430	133.33299	100.00000
230	107.14300	133.33299	100.00000
231	128.57100	133.33299	100.00000
232	150.00000	133.33299	100.00000
233	0.00000	150.00000	100.00000
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235	42.85710	150.00000	100.00000
236	64.28570	150.00000	100.00000
237	85.71430	150.00000	100.00000
238	107.14300	150.00000	100.00000
239	128.57100	150.00000	100.00000
240	150.00000	150.00000	100.00000
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243	42.85710	0.00000	150.00000
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280	150.00000	66.66670	150.00000

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283	42.85710	83.33330	150.00000
284	64.28570	83.33330	150.00000
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287	128.57100	83.33330	150.00000
288	150.00000	83.33330	150.00000
289	0.00000	100.00000	150.00000
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292	64.28570	100.00000	150.00000
293	85.71430	100.00000	150.00000
294	107.14300	100.00000	150.00000
295	128.57100	100.00000	150.00000
296	150.00000	100.00000	150.00000
297	0.00000	116.66700	150.00000
298	21.42860	116.66700	150.00000
299	42.85720	116.66700	150.00000
300	64.28570	116.66700	150.00000
301	85.71430	116.66700	150.00000
302	107.14300	116.66700	150.00000
303	128.57100	116.66700	150.00000
304	150.00000	116.66700	150.00000
305	0.00000	133.33299	150.00000
306	21.42860	133.33299	150.00000
307	42.85710	133.33299	150.00000
308	64.28570	133.33299	150.00000
309	85.71430	133.33299	150.00000
310	107.14300	133.33299	150.00000
311	128.57100	133.33299	150.00000
312	150.00000	133.33299	150.00000
313	0.00000	150.00000	150.00000
314	21.42860	150.00000	150.00000
315	42.85710	150.00000	150.00000
316	64.28570	150.00000	150.00000
317	85.71430	150.00000	150.00000
318	107.14300	150.00000	150.00000
319	128.57100	150.00000	150.00000
320	150.00000	150.00000	150.00000
321	170.00000	0.00000	0.00000
322	190.00000	0.00000	0.00000
323	210.00000	0.00000	0.00000
324	230.00000	0.00000	0.00000
325	250.00000	0.00000	0.00000
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15	17	18	26	25	97	98	106	105	0.0	0.0000001	0.00006	0.0000001
16	18	19	27	26	98	99	107	106	0.0	0.0000001	0.00006	0.0000001
17	19	20	28	27	99	100	108	107	0.0	0.0000001	0.00006	0.0000001
18	20	21	29	28	100	101	109	108	0.0	0.0000001	0.00006	0.0000001
19	21	22	30	29	101	102	110	109	0.0	0.0000001	0.00006	0.0000001
20	22	23	31	30	102	103	111	110	0.0	0.0000001	0.00006	0.0000001

21	23	24	32	31	103	104	112	111	0.0	0.0000001	0.00006	0.0000001
22	25	26	34	33	105	106	114	113	0.0	0.0000001	0.00006	0.0000001
23	26	27	35	34	106	107	115	114	0.0	0.0000001	0.00006	0.0000001
24	27	28	36	35	107	108	116	115	0.0	0.0000001	0.00006	0.0000001
25	28	29	37	36	108	109	117	116	0.0	0.0000001	0.00006	0.0000001
26	29	30	38	37	109	110	118	117	0.0	0.0000001	0.00006	0.0000001
27	30	31	39	38	110	111	119	118	0.0	0.0000001	0.00006	0.0000001
28	31	32	40	39	111	112	120	119	0.0	0.0000001	0.00006	0.0000001
29	33	34	42	41	113	114	122	121	0.0	1.1000000	0.00600	1.1000000
30	34	35	43	42	114	115	123	122	0.0	1.1000000	0.00600	1.1000000
31	35	36	44	43	115	116	124	123	0.0	1.1000000	0.00600	1.1000000
32	36	37	45	44	116	117	125	124	0.0	1.1000000	0.00600	1.1000000
33	37	38	46	45	117	118	126	125	0.0	1.1000000	0.00600	1.1000000
34	38	39	47	46	118	119	127	126	0.0	1.1000000	0.00600	1.1000000
35	39	40	48	47	119	120	128	127	0.0	1.1000000	0.00600	1.1000000
36	41	42	50	49	121	122	130	129	0.0	1.1000000	0.00600	1.1000000
37	42	43	51	50	122	123	131	130	0.0	1.1000000	0.00600	1.1000000
38	43	44	52	51	123	124	132	131	0.0	1.1000000	0.00600	1.1000000
39	44	45	53	52	124	125	133	132	0.0	1.1000000	0.00600	1.1000000
40	45	46	54	53	125	126	134	133	0.0	1.1000000	0.00600	1.1000000
41	46	47	55	54	126	127	135	134	0.0	1.1000000	0.00600	1.1000000
42	47	48	56	55	127	128	136	135	0.0	1.1000000	0.00600	1.1000000
43	49	50	58	57	129	130	138	137	0.0	1.1000000	0.00600	1.1000000
44	50	51	59	58	130	131	139	138	0.0	1.1000000	0.00600	1.1000000
45	51	52	60	59	131	132	140	139	0.0	1.1000000	0.00600	1.1000000
46	52	53	61	60	132	133	141	140	0.0	1.1000000	0.00600	1.1000000
47	53	54	62	61	133	134	142	141	0.0	1.1000000	0.00600	1.1000000
48	54	55	63	62	134	135	143	142	0.0	1.1000000	0.00600	1.1000000
49	55	56	64	63	135	136	144	143	0.0	1.1000000	0.00600	1.1000000
50	57	58	66	65	137	138	146	145	0.0	1.1000000	0.00600	1.1000000
51	58	59	67	66	138	139	147	146	0.0	1.1000000	0.00600	1.1000000
52	59	60	68	67	139	140	148	147	0.0	1.1000000	0.00600	1.1000000
53	60	61	69	68	140	141	149	148	0.0	1.1000000	0.00600	1.1000000
54	61	62	70	69	141	142	150	149	0.0	1.1000000	0.00600	1.1000000
55	62	63	71	70	142	143	151	150	0.0	1.1000000	0.00600	1.1000000
56	63	64	72	71	143	144	152	151	0.0	1.1000000	0.00600	1.1000000
57	65	66	74	73	145	146	154	153	0.0	1.1000000	0.00600	1.1000000
58	66	67	75	74	146	147	155	154	0.0	1.1000000	0.00600	1.1000000
59	67	68	76	75	147	148	156	155	0.0	1.1000000	0.00600	1.1000000
60	68	69	77	76	148	149	157	156	0.0	1.1000000	0.00600	1.1000000
61	69	70	78	77	149	150	158	157	0.0	1.1000000	0.00600	1.1000000
62	70	71	79	78	150	151	159	158	0.0	1.1000000	0.00600	1.1000000
63	71	72	80	79	151	152	160	159	0.0	1.1000000	0.00600	1.1000000
64	81	82	90	89	161	162	170	169	0.0	1.2000000	0.00006	1.2000000
65	82	83	91	90	162	163	171	170	0.0	1.2000000	0.00006	1.2000000
66	83	84	92	91	163	164	172	171	0.0	1.2000000	0.00006	1.2000000
67	84	85	93	92	164	165	173	172	0.0	1.2000000	0.00006	1.2000000
68	85	86	94	93	165	166	174	173	0.0	1.2000000	0.00006	1.2000000
69	86	87	95	94	166	167	175	174	0.0	1.2000000	0.00006	1.2000000
70	87	88	96	95	167	168	176	175	0.0	1.2000000	0.00006	1.2000000
71	89	90	98	97	169	170	178	177	0.0	1.2000000	0.00006	1.2000000
72	90	91	99	98	170	171	179	178	0.0	1.2000000	0.00006	1.2000000
73	91	92	100	99	171	172	180	179	0.0	1.2000000	0.00006	1.2000000
74	92	93	101	100	172	173	181	180	0.0	1.2000000	0.00006	1.2000000

75	93	94	102	101	173	174	182	181	0.0	1.2000000	0.00006	1.2000000
76	94	95	103	102	174	175	183	182	0.0	1.2000000	0.00006	1.2000000
77	95	96	104	103	175	176	184	183	0.0	1.2000000	0.00006	1.2000000
78	97	98	106	105	177	178	186	185	0.0	0.0000001	0.00006	0.0000001
79	98	99	107	106	178	179	187	186	0.0	0.0000001	0.00006	0.0000001
80	99	100	108	107	179	180	188	187	0.0	0.0000001	0.00006	0.0000001
81	100	101	109	108	180	181	189	188	0.0	0.0000001	0.00006	0.0000001
82	101	102	110	109	181	182	190	189	0.0	0.0000001	0.00006	0.0000001
83	102	103	111	110	182	183	191	190	0.0	0.0000001	0.00006	0.0000001
84	103	104	112	111	183	184	192	191	0.0	0.0000001	0.00006	0.0000001
85	105	106	114	113	185	186	194	193	0.0	0.0000001	0.00006	0.0000001
86	106	107	115	114	186	187	195	194	0.0	0.0000001	0.00006	0.0000001
87	107	108	116	115	187	188	196	195	0.0	0.0000001	0.00006	0.0000001
88	108	109	117	116	188	189	197	196	0.0	0.0000001	0.00006	0.0000001
89	109	110	118	117	189	190	198	197	0.0	0.0000001	0.00006	0.0000001
90	110	111	119	118	190	191	199	198	0.0	0.0000001	0.00006	0.0000001
91	111	112	120	119	191	192	200	199	0.0	0.0000001	0.00006	0.0000001
92	113	114	122	121	193	194	202	201	0.0	1.1000000	0.00600	1.1000000
93	114	115	123	122	194	195	203	202	0.0	1.1000000	0.00600	1.1000000
94	115	116	124	123	195	196	204	203	0.0	1.1000000	0.00600	1.1000000
95	116	117	125	124	196	197	205	204	0.0	1.1000000	0.00600	1.1000000
96	117	118	126	125	197	198	206	205	0.0	1.1000000	0.00600	1.1000000
97	118	119	127	126	198	199	207	206	0.0	1.1000000	0.00600	1.1000000
98	119	120	128	127	199	200	208	207	0.0	1.1000000	0.00600	1.1000000
99	121	122	130	129	201	202	210	209	0.0	1.1000000	0.00600	1.1000000
100	122	123	131	130	202	203	211	210	0.0	1.1000000	0.00600	1.1000000
101	123	124	132	131	203	204	212	211	0.0	1.1000000	0.00600	1.1000000
102	124	125	133	132	204	205	213	212	0.0	1.1000000	0.00600	1.1000000
103	125	126	134	133	205	206	214	213	0.0	1.1000000	0.00600	1.1000000
104	126	127	135	134	206	207	215	214	0.0	1.1000000	0.00600	1.1000000
105	127	128	136	135	207	208	216	215	0.0	1.1000000	0.00600	1.1000000
106	129	130	138	137	209	210	218	217	0.0	1.1000000	0.00600	1.1000000
107	130	131	139	138	210	211	219	218	0.0	1.1000000	0.00600	1.1000000
108	131	132	140	139	211	212	220	219	0.0	1.1000000	0.00600	1.1000000
109	132	133	141	140	212	213	221	220	0.0	1.1000000	0.00600	1.1000000
110	133	134	142	141	213	214	222	221	0.0	1.1000000	0.00600	1.1000000
111	134	135	143	142	214	215	223	222	0.0	1.1000000	0.00600	1.1000000
112	135	136	144	143	215	216	224	223	0.0	1.1000000	0.00600	1.1000000
113	137	138	146	145	217	218	226	225	0.0	1.1000000	0.00600	1.1000000
114	138	139	147	146	218	219	227	226	0.0	1.1000000	0.00600	1.1000000
115	139	140	148	147	219	220	228	227	0.0	1.1000000	0.00600	1.1000000
116	140	141	149	148	220	221	229	228	1.0	1.1000000	0.00600	1.1000000
117	141	142	150	149	221	222	230	229	0.0	1.1000000	0.00600	1.1000000
118	142	143	151	150	222	223	231	230	0.0	1.1000000	0.00600	1.1000000
119	143	144	152	151	223	224	232	231	0.0	1.1000000	0.00600	1.1000000
120	145	146	154	153	225	226	234	233	0.0	1.1000000	0.00600	1.1000000
121	146	147	155	154	226	227	235	234	0.0	1.1000000	0.00600	1.1000000
122	147	148	156	155	227	228	236	235	0.0	1.1000000	0.00600	1.1000000
123	148	149	157	156	228	229	237	236	0.0	1.1000000	0.00600	1.1000000
124	149	150	158	157	229	230	238	237	0.0	1.1000000	0.00600	1.1000000
125	150	151	159	158	230	231	239	238	0.0	1.1000000	0.00600	1.1000000
126	151	152	160	159	231	232	240	239	0.0	1.1000000	0.00600	1.1000000
127	161	162	170	169	241	242	250	249	0.0	1.2000000	0.00006	1.2000000
128	162	163	171	170	242	243	251	250	0.0	1.2000000	0.00006	1.2000000

129	163	164	172	171	243	244	252	251	0.0	1.2000000	0.00006	1.2000000
130	164	165	173	172	244	245	253	252	0.0	1.2000000	0.00006	1.2000000
131	165	166	174	173	245	246	254	253	0.0	1.2000000	0.00006	1.2000000
132	166	167	175	174	246	247	255	254	0.0	1.2000000	0.00006	1.2000000
133	167	168	176	175	247	248	256	255	0.0	1.2000000	0.00006	1.2000000
134	169	170	178	177	249	250	258	257	0.0	1.2000000	0.00006	1.2000000
135	170	171	179	178	250	251	259	258	0.0	1.2000000	0.00006	1.2000000
136	171	172	180	179	251	252	260	259	0.0	1.2000000	0.00006	1.2000000
137	172	173	181	180	252	253	261	260	0.0	1.2000000	0.00006	1.2000000
138	173	174	182	181	253	254	262	261	0.0	1.2000000	0.00006	1.2000000
139	174	175	183	182	254	255	263	262	0.0	1.2000000	0.00006	1.2000000
140	175	176	184	183	255	256	264	263	0.0	1.2000000	0.00006	1.2000000
141	177	178	186	185	257	258	266	265	0.0	0.0000001	0.00006	0.0000001
142	178	179	187	186	258	259	267	266	0.0	0.0000001	0.00006	0.0000001
143	179	180	188	187	259	260	268	267	0.0	0.0000001	0.00006	0.0000001
144	180	181	189	188	260	261	269	268	0.0	0.0000001	0.00006	0.0000001
145	181	182	190	189	261	262	270	269	0.0	0.0000001	0.00006	0.0000001
146	182	183	191	190	262	263	271	270	0.0	0.0000001	0.00006	0.0000001
147	183	184	192	191	263	264	272	271	0.0	0.0000001	0.00006	0.0000001
148	185	186	194	193	265	266	274	273	0.0	0.0000001	0.00006	0.0000001
149	186	187	195	194	266	267	275	274	0.0	0.0000001	0.00006	0.0000001
150	187	188	196	195	267	268	276	275	0.0	0.0000001	0.00006	0.0000001
151	188	189	197	196	268	269	277	276	0.0	0.0000001	0.00006	0.0000001
152	189	190	198	197	269	270	278	277	0.0	0.0000001	0.00006	0.0000001
153	190	191	199	198	270	271	279	278	0.0	0.0000001	0.00006	0.0000001
154	191	192	200	199	271	272	280	279	0.0	0.0000001	0.00006	0.0000001
155	193	194	202	201	273	274	282	281	0.0	1.1000000	0.00600	1.1000000
156	194	195	203	202	274	275	283	282	0.0	1.1000000	0.00600	1.1000000
157	195	196	204	203	275	276	284	283	0.0	1.1000000	0.00600	1.1000000
158	196	197	205	204	276	277	285	284	0.0	1.1000000	0.00600	1.1000000
159	197	198	206	205	277	278	286	285	0.0	1.1000000	0.00600	1.1000000
160	198	199	207	206	278	279	287	286	0.0	1.1000000	0.00600	1.1000000
161	199	200	208	207	279	280	288	287	0.0	1.1000000	0.00600	1.1000000
162	201	202	210	209	281	282	290	289	0.0	1.1000000	0.00600	1.1000000
163	202	203	211	210	282	283	291	290	0.0	1.1000000	0.00600	1.1000000
164	203	204	212	211	283	284	292	291	0.0	1.1000000	0.00600	1.1000000
165	204	205	213	212	284	285	293	292	0.0	1.1000000	0.00600	1.1000000
166	205	206	214	213	285	286	294	293	0.0	1.1000000	0.00600	1.1000000
167	206	207	215	214	286	287	295	294	0.0	1.1000000	0.00600	1.1000000
168	207	208	216	215	287	288	296	295	0.0	1.1000000	0.00600	1.1000000
169	209	210	218	217	289	290	298	297	0.0	1.1000000	0.00600	1.1000000
170	210	211	219	218	290	291	299	298	0.0	1.1000000	0.00600	1.1000000
171	211	212	220	219	291	292	300	299	0.0	1.1000000	0.00600	1.1000000
172	212	213	221	220	292	293	301	300	0.0	1.1000000	0.00600	1.1000000
173	213	214	222	221	293	294	302	301	0.0	1.1000000	0.00600	1.1000000
174	214	215	223	222	294	295	303	302	0.0	1.1000000	0.00600	1.1000000
175	215	216	224	223	295	296	304	303	0.0	1.1000000	0.00600	1.1000000
176	217	218	226	225	297	298	306	305	0.0	1.1000000	0.00600	1.1000000
177	218	219	227	226	298	299	307	306	0.0	1.1000000	0.00600	1.1000000
178	219	220	228	227	299	300	308	307	0.0	1.1000000	0.00600	1.1000000
179	220	221	229	228	300	301	309	308	0.0	1.1000000	0.00600	1.1000000
180	221	222	230	229	301	302	310	309	0.0	1.1000000	0.00600	1.1000000
181	222	223	231	230	302	303	311	310	0.0	1.1000000	0.00600	1.1000000
182	223	224	232	231	303	304	312	311	0.0	1.1000000	0.00600	1.1000000

183	225	226	234	233	305	306	314	313	0.0	1.1000000	0.00600	1.1000000
184	226	227	235	234	306	307	315	314	0.0	1.1000000	0.00600	1.1000000
185	227	228	236	235	307	308	316	315	0.0	1.1000000	0.00600	1.1000000
186	228	229	237	236	308	309	317	316	0.0	1.1000000	0.00600	1.1000000
187	229	230	238	237	309	310	318	317	0.0	1.1000000	0.00600	1.1000000
188	230	231	239	238	310	311	319	318	0.0	1.1000000	0.00600	1.1000000
189	231	232	240	239	311	312	320	319	0.0	1.1000000	0.00600	1.1000000
190	8	321	326	16	88	371	376	96	0.0	1.2000000	0.00006	1.2000000
191	321	322	327	326	371	372	377	376	0.0	1.2000000	0.00006	1.2000000
192	322	323	328	327	372	373	378	377	0.0	1.2000000	0.00006	1.2000000
193	323	324	329	328	373	374	379	378	0.0	1.2000000	0.00006	1.2000000
194	324	325	330	329	374	375	380	379	0.0	1.2000000	0.00006	1.2000000
195	16	326	331	24	96	376	381	104	0.0	1.2000000	0.00006	1.2000000
196	326	327	332	331	376	377	382	381	0.0	1.2000000	0.00006	1.2000000
197	327	328	333	332	377	378	383	382	0.0	1.2000000	0.00006	1.2000000
198	328	329	334	333	378	379	384	383	0.0	1.2000000	0.00006	1.2000000
199	329	330	335	334	379	380	385	384	0.0	1.2000000	0.00006	1.2000000
200	24	331	336	32	104	381	386	112	0.0	0.0000001	0.00006	0.0000001
201	331	332	337	336	381	382	387	386	0.0	0.0000001	0.00006	0.0000001
202	332	333	338	337	382	383	388	387	0.0	0.0000001	0.00006	0.0000001
203	333	334	339	338	383	384	389	388	0.0	0.0000001	0.00006	0.0000001
204	334	335	340	339	384	385	390	389	0.0	0.0000001	0.00006	0.0000001
205	32	336	341	40	112	386	391	120	0.0	0.0000001	0.00006	0.0000001
206	336	337	342	341	386	387	392	391	0.0	0.0000001	0.00006	0.0000001
207	337	338	343	342	387	388	393	392	0.0	0.0000001	0.00006	0.0000001
208	338	339	344	343	388	389	394	393	0.0	0.0000001	0.00006	0.0000001
209	339	340	345	344	389	390	395	394	0.0	0.0000001	0.00006	0.0000001
210	40	341	346	48	120	391	396	128	0.0	1.1000000	0.00600	1.1000000
211	341	342	347	346	391	392	397	396	0.0	1.1000000	0.00600	1.1000000
212	342	343	348	347	392	393	398	397	0.0	1.1000000	0.00600	1.1000000
213	343	344	349	348	393	394	399	398	0.0	1.1000000	0.00600	1.1000000
214	344	345	350	349	394	395	400	399	0.0	1.1000000	0.00600	1.1000000
215	48	346	351	56	128	396	401	136	0.0	1.1000000	0.00600	1.1000000
216	346	347	352	351	396	397	402	401	0.0	1.1000000	0.00600	1.1000000
217	347	348	353	352	397	398	403	402	0.0	1.1000000	0.00600	1.1000000
218	348	349	354	353	398	399	404	403	0.0	1.1000000	0.00600	1.1000000
219	349	350	355	354	399	400	405	404	0.0	1.1000000	0.00600	1.1000000
220	56	351	356	64	136	401	406	144	0.0	1.1000000	0.00600	1.1000000
221	351	352	357	356	401	402	407	406	0.0	1.1000000	0.00600	1.1000000
222	352	353	358	357	402	403	408	407	0.0	1.1000000	0.00600	1.1000000
223	353	354	359	358	403	404	409	408	0.0	1.1000000	0.00600	1.1000000
224	354	355	360	359	404	405	410	409	0.0	1.1000000	0.00600	1.1000000
225	64	356	361	72	144	406	411	152	0.0	1.1000000	0.00600	1.1000000
226	356	357	362	361	406	407	412	411	0.0	1.1000000	0.00600	1.1000000
227	357	358	363	362	407	408	413	412	0.0	1.1000000	0.00600	1.1000000
228	358	359	364	363	408	409	414	413	0.0	1.1000000	0.00600	1.1000000
229	359	360	365	364	409	410	415	414	0.0	1.1000000	0.00600	1.1000000
230	72	361	366	80	152	411	416	160	0.0	1.1000000	0.00600	1.1000000
231	361	362	367	366	411	412	417	416	0.0	1.1000000	0.00600	1.1000000
232	362	363	368	367	412	413	418	417	0.0	1.1000000	0.00600	1.1000000
233	363	364	369	368	413	414	419	418	0.0	1.1000000	0.00600	1.1000000
234	364	365	370	369	414	415	420	419	0.0	1.1000000	0.00600	1.1000000
235	88	371	376	96	168	421	426	176	0.0	1.2000000	0.00006	1.2000000
236	371	372	377	376	421	422	427	426	0.0	1.2000000	0.00006	1.2000000

237	372	373	378	377	422	423	428	427	0.0	1.2000000	0.00006	1.2000000
238	373	374	379	378	423	424	429	428	0.0	1.2000000	0.00006	1.2000000
239	374	375	380	379	424	425	430	429	0.0	1.2000000	0.00006	1.2000000
240	96	376	381	104	176	426	431	184	0.0	1.2000000	0.00006	1.2000000
241	376	377	382	381	426	427	432	431	0.0	1.2000000	0.00006	1.2000000
242	377	378	383	382	427	428	433	432	0.0	1.2000000	0.00006	1.2000000
243	378	379	384	383	428	429	434	433	0.0	1.2000000	0.00006	1.2000000
244	379	380	385	384	429	430	435	434	0.0	1.2000000	0.00006	1.2000000
245	104	381	386	112	184	431	436	192	0.0	0.0000001	0.00006	0.0000001
246	381	382	387	386	431	432	437	436	0.0	0.0000001	0.00006	0.0000001
247	382	383	388	387	432	433	438	437	0.0	0.0000001	0.00006	0.0000001
248	383	384	389	388	433	434	439	438	0.0	0.0000001	0.00006	0.0000001
249	384	385	390	389	434	435	440	439	0.0	0.0000001	0.00006	0.0000001
250	112	386	391	120	192	436	441	200	0.0	0.0000001	0.00006	0.0000001
251	386	387	392	391	436	437	442	441	0.0	0.0000001	0.00006	0.0000001
252	387	388	393	392	437	438	443	442	0.0	0.0000001	0.00006	0.0000001
253	388	389	394	393	438	439	444	443	0.0	0.0000001	0.00006	0.0000001
254	389	390	395	394	439	440	445	444	0.0	0.0000001	0.00006	0.0000001
255	120	391	396	128	200	441	446	208	0.0	1.1000000	0.00600	1.1000000
256	391	392	397	396	441	442	447	446	0.0	1.1000000	0.00600	1.1000000
257	392	393	398	397	442	443	448	447	0.0	1.1000000	0.00600	1.1000000
258	393	394	399	398	443	444	449	448	0.0	1.1000000	0.00600	1.1000000
259	394	395	400	399	444	445	450	449	0.0	1.1000000	0.00600	1.1000000
260	128	396	401	136	208	446	451	216	0.0	1.1000000	0.00600	1.1000000
261	396	397	402	401	446	447	452	451	0.0	1.1000000	0.00600	1.1000000
262	397	398	403	402	447	448	453	452	0.0	1.1000000	0.00600	1.1000000
263	398	399	404	403	448	449	454	453	0.0	1.1000000	0.00600	1.1000000
264	399	400	405	404	449	450	455	454	0.0	1.1000000	0.00600	1.1000000
265	136	401	406	144	216	451	456	224	0.0	1.1000000	0.00600	1.1000000
266	401	402	407	406	451	452	457	456	0.0	1.1000000	0.00600	1.1000000
267	402	403	408	407	452	453	458	457	0.0	1.1000000	0.00600	1.1000000
268	403	404	409	408	453	454	459	458	0.0	1.1000000	0.00600	1.1000000
269	404	405	410	409	454	455	460	459	0.0	1.1000000	0.00600	1.1000000
270	144	406	411	152	224	456	461	232	0.0	1.1000000	0.00600	1.1000000
271	406	407	412	411	456	457	462	461	0.0	1.1000000	0.00600	1.1000000
272	407	408	413	412	457	458	463	462	0.0	1.1000000	0.00600	1.1000000
273	408	409	414	413	458	459	464	463	0.0	1.1000000	0.00600	1.1000000
274	409	410	415	414	459	460	465	464	0.0	1.1000000	0.00600	1.1000000
275	152	411	416	160	232	461	466	240	0.0	1.1000000	0.00600	1.1000000
276	411	412	417	416	461	462	467	466	0.0	1.1000000	0.00600	1.1000000
277	412	413	418	417	462	463	468	467	0.0	1.1000000	0.00600	1.1000000
278	413	414	419	418	463	464	469	468	0.0	1.1000000	0.00600	1.1000000
279	414	415	420	419	464	465	470	469	0.0	1.1000000	0.00600	1.1000000
280	168	421	426	176	248	471	476	256	0.0	1.2000000	0.00006	1.2000000
281	421	422	427	426	471	472	477	476	0.0	1.2000000	0.00006	1.2000000
282	422	423	428	427	472	473	478	477	0.0	1.2000000	0.00006	1.2000000
283	423	424	429	428	473	474	479	478	0.0	1.2000000	0.00006	1.2000000
284	424	425	430	429	474	475	480	479	0.0	1.2000000	0.00006	1.2000000
285	176	426	431	184	256	476	481	264	0.0	1.2000000	0.00006	1.2000000
286	426	427	432	431	476	477	482	481	0.0	1.2000000	0.00006	1.2000000
287	427	428	433	432	477	478	483	482	0.0	1.2000000	0.00006	1.2000000
288	428	429	434	433	478	479	484	483	0.0	1.2000000	0.00006	1.2000000
289	429	430	435	434	479	480	485	484	0.0	1.2000000	0.00006	1.2000000
290	184	431	436	192	264	481	486	272	0.0	0.0000001	0.00006	0.0000001

291	431	432	437	436	481	482	487	486	0.0	0.0000001	0.00006	0.0000001
292	432	433	438	437	482	483	488	487	0.0	0.0000001	0.00006	0.0000001
293	433	434	439	438	483	484	489	488	0.0	0.0000001	0.00006	0.0000001
294	434	435	440	439	484	485	490	489	0.0	0.0000001	0.00006	0.0000001
295	192	436	441	200	272	486	491	280	0.0	0.0000001	0.00006	0.0000001
296	436	437	442	441	486	487	492	491	0.0	0.0000001	0.00006	0.0000001
297	437	438	443	442	487	488	493	492	0.0	0.0000001	0.00006	0.0000001
298	438	439	444	443	488	489	494	493	0.0	0.0000001	0.00006	0.0000001
299	439	440	445	444	489	490	495	494	0.0	0.0000001	0.00006	0.0000001
300	200	441	446	208	280	491	496	288	0.0	1.1000000	0.00600	1.1000000
301	441	442	447	446	491	492	497	496	0.0	1.1000000	0.00600	1.1000000
302	442	443	448	447	492	493	498	497	0.0	1.1000000	0.00600	1.1000000
303	443	444	449	448	493	494	499	498	0.0	1.1000000	0.00600	1.1000000
304	444	445	450	449	494	495	500	499	0.0	1.1000000	0.00600	1.1000000
305	208	446	451	216	288	496	501	296	0.0	1.1000000	0.00600	1.1000000
306	446	447	452	451	496	497	502	501	0.0	1.1000000	0.00600	1.1000000
307	447	448	453	452	497	498	503	502	0.0	1.1000000	0.00600	1.1000000
308	448	449	454	453	498	499	504	503	0.0	1.1000000	0.00600	1.1000000
309	449	450	455	454	499	500	505	504	0.0	1.1000000	0.00600	1.1000000
310	216	451	456	224	296	501	506	304	0.0	1.1000000	0.00600	1.1000000
311	451	452	457	456	501	502	507	506	0.0	1.1000000	0.00600	1.1000000
312	452	453	458	457	502	503	508	507	0.0	1.1000000	0.00600	1.1000000
313	453	454	459	458	503	504	509	508	0.0	1.1000000	0.00600	1.1000000
314	454	455	460	459	504	505	510	509	0.0	1.1000000	0.00600	1.1000000
315	224	456	461	232	304	506	511	312	0.0	1.1000000	0.00600	1.1000000
316	456	457	462	461	506	507	512	511	0.0	1.1000000	0.00600	1.1000000
317	457	458	463	462	507	508	513	512	0.0	1.1000000	0.00600	1.1000000
318	458	459	464	463	508	509	514	513	0.0	1.1000000	0.00600	1.1000000
319	459	460	465	464	509	510	515	514	0.0	1.1000000	0.00600	1.1000000
320	232	461	466	240	312	511	516	320	0.0	1.1000000	0.00600	1.1000000
321	461	462	467	466	511	512	517	516	0.0	1.1000000	0.00600	1.1000000
322	462	463	468	467	512	513	518	517	0.0	1.1000000	0.00600	1.1000000
323	463	464	469	468	513	514	519	518	0.0	1.1000000	0.00600	1.1000000
324	464	465	470	469	514	515	520	519	0.0	1.1000000	0.00600	1.1000000
325	325	521	526	330	375	571	576	380	0.0	1.2000000	0.00006	1.2000000
326	521	522	527	526	571	572	577	576	0.0	1.2000000	0.00006	1.2000000
327	522	523	528	527	572	573	578	577	0.0	1.2000000	0.00006	1.2000000
328	523	524	529	528	573	574	579	578	0.0	1.2000000	0.00006	1.2000000
329	524	525	530	529	574	575	580	579	0.0	1.2000000	0.00006	1.2000000
330	330	526	531	335	380	576	581	385	0.0	1.2000000	0.00006	1.2000000
331	526	527	532	531	576	577	582	581	0.0	1.2000000	0.00006	1.2000000
332	527	528	533	532	577	578	583	582	0.0	1.2000000	0.00006	1.2000000
333	528	529	534	533	578	579	584	583	0.0	1.2000000	0.00006	1.2000000
334	529	530	535	534	579	580	585	584	0.0	1.2000000	0.00006	1.2000000
335	335	531	536	340	385	581	586	390	0.0	0.0000001	0.00006	0.0000001
336	531	532	537	536	581	582	587	586	0.0	0.0000001	0.00006	0.0000001
337	532	533	538	537	582	583	588	587	0.0	0.0000001	0.00006	0.0000001
338	533	534	539	538	583	584	589	588	0.0	0.0000001	0.00006	0.0000001
339	534	535	540	539	584	585	590	589	0.0	0.0000001	0.00006	0.0000001
340	340	536	541	345	390	586	591	395	0.0	0.0000001	0.00006	0.0000001
341	536	537	542	541	586	587	592	591	0.0	0.0000001	0.00006	0.0000001
342	537	538	543	542	587	588	593	592	0.0	0.0000001	0.00006	0.0000001
343	538	539	544	543	588	589	594	593	0.0	0.0000001	0.00006	0.0000001
344	539	540	545	544	589	590	595	594	0.0	0.0000001	0.00006	0.0000001

345	345	541	546	350	395	591	596	400	0.0	1.1000000	0.00600	1.1000000
346	541	542	547	546	591	592	597	596	0.0	1.1000000	0.00600	1.1000000
347	542	543	548	547	592	593	598	597	0.0	1.1000000	0.00600	1.1000000
348	543	544	549	548	593	594	599	598	0.0	1.1000000	0.00600	1.1000000
349	544	545	550	549	594	595	600	599	0.0	1.1000000	0.00600	1.1000000
350	350	546	551	355	400	596	601	405	0.0	1.1000000	0.00600	1.1000000
351	546	547	552	551	596	597	602	601	0.0	1.1000000	0.00600	1.1000000
352	547	548	553	552	597	598	603	602	0.0	1.1000000	0.00600	1.1000000
353	548	549	554	553	598	599	604	603	0.0	1.1000000	0.00600	1.1000000
354	549	550	555	554	599	600	605	604	0.0	1.1000000	0.00600	1.1000000
355	355	551	556	360	405	601	606	410	0.0	1.1000000	0.00600	1.1000000
356	551	552	557	556	601	602	607	606	0.0	1.1000000	0.00600	1.1000000
357	552	553	558	557	602	603	608	607	0.0	1.1000000	0.00600	1.1000000
358	553	554	559	558	603	604	609	608	0.0	1.1000000	0.00600	1.1000000
359	554	555	560	559	604	605	610	609	0.0	1.1000000	0.00600	1.1000000
360	360	556	561	365	410	606	611	415	0.0	1.1000000	0.00600	1.1000000
361	556	557	562	561	606	607	612	611	0.0	1.1000000	0.00600	1.1000000
362	557	558	563	562	607	608	613	612	0.0	1.1000000	0.00600	1.1000000
363	558	559	564	563	608	609	614	613	0.0	1.1000000	0.00600	1.1000000
364	559	560	565	564	609	610	615	614	0.0	1.1000000	0.00600	1.1000000
365	365	561	566	370	415	611	616	420	0.0	1.1000000	0.00600	1.1000000
366	561	562	567	566	611	612	617	616	0.0	1.1000000	0.00600	1.1000000
367	562	563	568	567	612	613	618	617	0.0	1.1000000	0.00600	1.1000000
368	563	564	569	568	613	614	619	618	0.0	1.1000000	0.00600	1.1000000
369	564	565	570	569	614	615	620	619	0.0	1.1000000	0.00600	1.1000000
370	375	571	576	380	425	621	626	430	0.0	1.2000000	0.00006	1.2000000
371	571	572	577	576	621	622	627	626	0.0	1.2000000	0.00006	1.2000000
372	572	573	578	577	622	623	628	627	0.0	1.2000000	0.00006	1.2000000
373	573	574	579	578	623	624	629	628	0.0	1.2000000	0.00006	1.2000000
374	574	575	580	579	624	625	630	629	0.0	1.2000000	0.00006	1.2000000
375	380	576	581	385	430	626	631	435	0.0	1.2000000	0.00006	1.2000000
376	576	577	582	581	626	627	632	631	0.0	1.2000000	0.00006	1.2000000
377	577	578	583	582	627	628	633	632	0.0	1.2000000	0.00006	1.2000000
378	578	579	584	583	628	629	634	633	0.0	1.2000000	0.00006	1.2000000
379	579	580	585	584	629	630	635	634	0.0	1.2000000	0.00006	1.2000000
380	385	581	586	390	435	631	636	440	0.0	0.0000001	0.00006	0.0000001
381	581	582	587	586	631	632	637	636	0.0	0.0000001	0.00006	0.0000001
382	582	583	588	587	632	633	638	637	0.0	0.0000001	0.00006	0.0000001
383	583	584	589	588	633	634	639	638	0.0	0.0000001	0.00006	0.0000001
384	584	585	590	589	634	635	640	639	0.0	0.0000001	0.00006	0.0000001
385	390	586	591	395	440	636	641	445	0.0	0.0000001	0.00006	0.0000001
386	586	587	592	591	636	637	642	641	0.0	0.0000001	0.00006	0.0000001
387	587	588	593	592	637	638	643	642	0.0	0.0000001	0.00006	0.0000001
388	588	589	594	593	638	639	644	643	0.0	0.0000001	0.00006	0.0000001
389	589	590	595	594	639	640	645	644	0.0	0.0000001	0.00006	0.0000001
390	395	591	596	400	445	641	646	450	0.0	1.1000000	0.00600	1.1000000
391	591	592	597	596	641	642	647	646	0.0	1.1000000	0.00600	1.1000000
392	592	593	598	597	642	643	648	647	0.0	1.1000000	0.00600	1.1000000
393	593	594	599	598	643	644	649	648	0.0	1.1000000	0.00600	1.1000000
394	594	595	600	599	644	645	650	649	0.0	1.1000000	0.00600	1.1000000
395	400	596	601	405	450	646	651	455	0.0	1.1000000	0.00600	1.1000000
396	596	597	602	601	646	647	652	651	0.0	1.1000000	0.00600	1.1000000
397	597	598	603	602	647	648	653	652	0.0	1.1000000	0.00600	1.1000000
398	598	599	604	603	648	649	654	653	0.0	1.1000000	0.00600	1.1000000

399	599	600	605	604	649	650	655	654	0.0	1.1000000	0.00600	1.1000000
400	405	601	606	410	455	651	656	460	0.0	1.1000000	0.00600	1.1000000
401	601	602	607	606	651	652	657	656	0.0	1.1000000	0.00600	1.1000000
402	602	603	608	607	652	653	658	657	0.0	1.1000000	0.00600	1.1000000
403	603	604	609	608	653	654	659	658	0.0	1.1000000	0.00600	1.1000000
404	604	605	610	609	654	655	660	659	0.0	1.1000000	0.00600	1.1000000
405	410	606	611	415	460	656	661	465	0.0	1.1000000	0.00600	1.1000000
406	606	607	612	611	656	657	662	661	0.0	1.1000000	0.00600	1.1000000
407	607	608	613	612	657	658	663	662	0.0	1.1000000	0.00600	1.1000000
408	608	609	614	613	658	659	664	663	0.0	1.1000000	0.00600	1.1000000
409	609	610	615	614	659	660	665	664	0.0	1.1000000	0.00600	1.1000000
410	415	611	616	420	465	661	666	470	0.0	1.1000000	0.00600	1.1000000
411	611	612	617	616	661	662	667	666	0.0	1.1000000	0.00600	1.1000000
412	612	613	618	617	662	663	668	667	0.0	1.1000000	0.00600	1.1000000
413	613	614	619	618	663	664	669	668	0.0	1.1000000	0.00600	1.1000000
414	614	615	620	619	664	665	670	669	0.0	1.1000000	0.00600	1.1000000
415	425	621	626	430	475	671	676	480	0.0	1.2000000	0.00006	1.2000000
416	621	622	627	626	671	672	677	676	0.0	1.2000000	0.00006	1.2000000
417	622	623	628	627	672	673	678	677	0.0	1.2000000	0.00006	1.2000000
418	623	624	629	628	673	674	679	678	0.0	1.2000000	0.00006	1.2000000
419	624	625	630	629	674	675	680	679	0.0	1.2000000	0.00006	1.2000000
420	430	626	631	435	480	676	681	485	0.0	1.2000000	0.00006	1.2000000
421	626	627	632	631	676	677	682	681	0.0	1.2000000	0.00006	1.2000000
422	627	628	633	632	677	678	683	682	0.0	1.2000000	0.00006	1.2000000
423	628	629	634	633	678	679	684	683	0.0	1.2000000	0.00006	1.2000000
424	629	630	635	634	679	680	685	684	0.0	1.2000000	0.00006	1.2000000
425	435	631	636	440	485	681	686	490	0.0	0.0000001	0.00006	0.0000001
426	631	632	637	636	681	682	687	686	0.0	0.0000001	0.00006	0.0000001
427	632	633	638	637	682	683	688	687	0.0	0.0000001	0.00006	0.0000001
428	633	634	639	638	683	684	689	688	0.0	0.0000001	0.00006	0.0000001
429	634	635	640	639	684	685	690	689	0.0	0.0000001	0.00006	0.0000001
430	440	636	641	445	490	686	691	495	0.0	0.0000001	0.00006	0.0000001
431	636	637	642	641	686	687	692	691	0.0	0.0000001	0.00006	0.0000001
432	637	638	643	642	687	688	693	692	0.0	0.0000001	0.00006	0.0000001
433	638	639	644	643	688	689	694	693	0.0	0.0000001	0.00006	0.0000001
434	639	640	645	644	689	690	695	694	0.0	0.0000001	0.00006	0.0000001
435	445	641	646	450	495	691	696	500	0.0	1.1000000	0.00600	1.1000000
436	641	642	647	646	691	692	697	696	0.0	1.1000000	0.00600	1.1000000
437	642	643	648	647	692	693	698	697	0.0	1.1000000	0.00600	1.1000000
438	643	644	649	648	693	694	699	698	0.0	1.1000000	0.00600	1.1000000
439	644	645	650	649	694	695	700	699	0.0	1.1000000	0.00600	1.1000000
440	450	646	651	455	500	696	701	505	0.0	1.1000000	0.00600	1.1000000
441	646	647	652	651	696	697	702	701	0.0	1.1000000	0.00600	1.1000000
442	647	648	653	652	697	698	703	702	0.0	1.1000000	0.00600	1.1000000
443	648	649	654	653	698	699	704	703	0.0	1.1000000	0.00600	1.1000000
444	649	650	655	654	699	700	705	704	0.0	1.1000000	0.00600	1.1000000
445	455	651	656	460	505	701	706	510	0.0	1.1000000	0.00600	1.1000000
446	651	652	657	656	701	702	707	706	0.0	1.1000000	0.00600	1.1000000
447	652	653	658	657	702	703	708	707	0.0	1.1000000	0.00600	1.1000000
448	653	654	659	658	703	704	709	708	0.0	1.1000000	0.00600	1.1000000
449	654	655	660	659	704	705	710	709	0.0	1.1000000	0.00600	1.1000000
450	460	656	661	465	510	706	711	515	0.0	1.1000000	0.00600	1.1000000
451	656	657	662	661	706	707	712	711	0.0	1.1000000	0.00600	1.1000000
452	657	658	663	662	707	708	713	712	0.0	1.1000000	0.00600	1.1000000

453	658	659	664	663	708	709	714	713	0.0	1.1000000	0.00600	1.1000000
454	659	660	665	664	709	710	715	714	0.0	1.1000000	0.00600	1.1000000
455	465	661	666	470	515	711	716	520	0.0	1.1000000	0.00600	1.1000000
456	661	662	667	666	711	712	717	716	0.0	1.1000000	0.00600	1.1000000
457	662	663	668	667	712	713	718	717	0.0	1.1000000	0.00600	1.1000000
458	663	664	669	668	713	714	719	718	0.0	1.1000000	0.00600	1.1000000
459	664	665	670	669	714	715	720	719	0.0	1.1000000	0.00600	1.1000000
460	525	721	723	530	575	741	743	580	0.0	1.2000000	0.00006	1.2000000
461	721	722	724	723	741	742	744	743	0.0	1.2000000	0.00006	1.2000000
462	530	723	725	535	580	743	745	585	0.0	1.2000000	0.00006	1.2000000
463	723	724	726	725	743	744	746	745	0.0	1.2000000	0.00006	1.2000000
464	535	725	727	540	585	745	747	590	0.0	0.0000001	0.00006	0.0000001
465	725	726	728	727	745	746	748	747	0.0	0.0000001	0.00006	0.0000001
466	540	727	729	545	590	747	749	595	0.0	0.0000001	0.00006	0.0000001
467	727	728	730	729	747	748	750	749	0.0	0.0000001	0.00006	0.0000001
468	545	729	731	550	595	749	751	600	0.0	1.1000000	0.00600	1.1000000
469	729	730	732	731	749	750	752	751	0.0	1.1000000	0.00600	1.1000000
470	550	731	733	555	600	751	753	605	0.0	1.1000000	0.00600	1.1000000
471	731	732	734	733	751	752	754	753	0.0	1.1000000	0.00600	1.1000000
472	555	733	735	560	605	753	755	610	0.0	1.1000000	0.00600	1.1000000
473	733	734	736	735	753	754	756	755	0.0	1.1000000	0.00600	1.1000000
474	560	735	737	565	610	755	757	615	0.0	1.1000000	0.00600	1.1000000
475	735	736	738	737	755	756	758	757	0.0	1.1000000	0.00600	1.1000000
476	565	737	739	570	615	757	759	620	0.0	1.1000000	0.00600	1.1000000
477	737	738	740	739	757	758	760	759	0.0	1.1000000	0.00600	1.1000000
478	575	741	743	580	625	761	763	630	0.0	1.2000000	0.00006	1.2000000
479	741	742	744	743	761	762	764	763	0.0	1.2000000	0.00006	1.2000000
480	580	743	745	585	630	763	765	635	0.0	1.2000000	0.00006	1.2000000
481	743	744	746	745	763	764	766	765	0.0	1.2000000	0.00006	1.2000000
482	585	745	747	590	635	765	767	640	0.0	0.0000001	0.00006	0.0000001
483	745	746	748	747	765	766	768	767	0.0	0.0000001	0.00006	0.0000001
484	590	747	749	595	640	767	769	645	0.0	0.0000001	0.00006	0.0000001
485	747	748	750	749	767	768	770	769	0.0	0.0000001	0.00006	0.0000001
486	595	749	751	600	645	769	771	650	0.0	1.1000000	0.00600	1.1000000
487	749	750	752	751	769	770	772	771	0.0	1.1000000	0.00600	1.1000000
488	600	751	753	605	650	771	773	655	0.0	1.1000000	0.00600	1.1000000
489	751	752	754	753	771	772	774	773	0.0	1.1000000	0.00600	1.1000000
490	605	753	755	610	655	773	775	660	0.0	1.1000000	0.00600	1.1000000
491	753	754	756	755	773	774	776	775	0.0	1.1000000	0.00600	1.1000000
492	610	755	757	615	660	775	777	665	0.0	1.1000000	0.00600	1.1000000
493	755	756	758	757	775	776	778	777	0.0	1.1000000	0.00600	1.1000000
494	615	757	759	620	665	777	779	670	0.0	1.1000000	0.00600	1.1000000
495	757	758	760	759	777	778	780	779	0.0	1.1000000	0.00600	1.1000000
496	625	761	763	630	675	781	783	680	0.0	1.2000000	0.00006	1.2000000
497	761	762	764	763	781	782	784	783	0.0	1.2000000	0.00006	1.2000000
498	630	763	765	635	680	783	785	685	0.0	1.2000000	0.00006	1.2000000
499	763	764	766	765	783	784	786	785	0.0	1.2000000	0.00006	1.2000000
500	635	765	767	640	685	785	787	690	0.0	0.0000001	0.00006	0.0000001
501	765	766	768	767	785	786	788	787	0.0	0.0000001	0.00006	0.0000001
502	640	767	769	645	690	787	789	695	0.0	0.0000001	0.00006	0.0000001
503	767	768	770	769	787	788	790	789	0.0	0.0000001	0.00006	0.0000001
504	645	769	771	650	695	789	791	700	0.0	1.1000000	0.00600	1.1000000
505	769	770	772	771	789	790	792	791	0.0	1.1000000	0.00600	1.1000000
506	650	771	773	655	700	791	793	705	0.0	1.1000000	0.00600	1.1000000

507	771	772	774	773	791	792	794	793	0.0	1.1000000	0.00600	1.1000000
508	655	773	775	660	705	793	795	710	0.0	1.1000000	0.00600	1.1000000
509	773	774	776	775	793	794	796	795	0.0	1.1000000	0.00600	1.1000000
510	660	775	777	665	710	795	797	715	0.0	1.1000000	0.00600	1.1000000
511	775	776	778	777	795	796	798	797	0.0	1.1000000	0.00600	1.1000000
512	665	777	779	670	715	797	799	720	0.0	1.1000000	0.00600	1.1000000
513	777	778	780	779	797	798	800	799	0.0	1.1000000	0.00600	1.1000000

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78	100.00000
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80	100.00000
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320	100.00000
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367	93.64000
368	90.46000
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416	96.82000
417	93.64000
418	90.46000
419	87.28000
420	84.10000
466	96.82000
467	93.64000
468	90.46000
469	87.28000
470	84.10000

516	96.82000
517	93.64000
518	90.46000
519	87.28000
520	84.10000
566	80.92000
567	77.74000
568	74.56000
569	71.38000
570	68.20000
616	80.92000
617	77.74000
618	74.56000
619	71.38000
620	68.20000
666	80.92000
667	77.74000
668	74.56000
669	71.38000
670	68.20000
716	80.92000
717	77.74000
718	74.56000
719	71.38000
720	68.20000
722	0.00000
724	7.20000
726	14.40000
728	21.60000
730	28.80000
732	36.00000
734	42.20000
736	49.40000
738	56.60000
739	65.00000
740	65.00000
742	0.00000
744	7.20000
746	14.40000
748	21.60000
750	28.80000
752	36.00000
754	42.20000
756	49.40000
758	56.60000
759	65.00000
760	65.00000
762	0.00000
764	7.20000
766	14.40000
768	21.60000
770	28.80000
772	36.00000
774	42.20000

776	49.40000
778	56.60000
779	65.00000
780	65.00000
782	0.00000
784	7.20000
786	14.40000
788	21.60000
790	28.80000
792	36.00000
794	42.20000
796	49.40000
798	56.60000
799	65.00000
800	65.00000

HEAD
CONC
HFLX
CFLX

3- D DATA SET FOR YUCCA MOUNTAIN

768 495

1	0.00000	0.00000	0.00000
2	126.66700	0.00000	0.00000
3	253.33299	0.00000	0.00000
4	380.00000	0.00000	0.00000
5	0.00001	56.36370	0.00000
6	126.66700	59.27270	0.00000
7	253.33299	62.18180	0.00000
8	380.00000	65.09090	0.00000
9	0.00000	112.72700	0.00000
10	126.66700	118.54500	0.00000
11	253.33299	124.36400	0.00000
12	380.00000	130.18201	0.00000
13	0.00000	169.09100	0.00000
14	126.66700	177.81799	0.00000
15	253.33299	186.54500	0.00000
16	380.00000	195.27299	0.00000
17	0.00000	225.45500	0.00000
18	126.66700	237.09100	0.00000
19	253.33299	248.72701	0.00000
20	380.00000	260.36401	0.00000
21	0.00001	281.81799	0.00000
22	126.66700	296.36401	0.00001
23	253.33299	310.90900	0.00000
24	380.00000	325.45499	0.00000
25	0.00000	338.18201	0.00000
26	126.66700	355.63599	0.00001
27	253.33299	373.09100	0.00000
28	380.00000	390.54501	0.00000
29	0.00000	394.54501	0.00000
30	126.66700	414.90900	0.00000
31	253.33299	435.27301	0.00000
32	380.00000	455.63599	0.00000
33	0.00000	450.90900	0.00000
34	126.66700	474.18201	0.00000
35	253.33299	497.45499	0.00000
36	380.00000	520.72699	0.00000
37	-0.00002	507.27301	-0.00001
38	126.66700	533.45502	0.00000
39	253.33299	559.63599	0.00000
40	380.00000	585.81799	0.00000
41	0.00000	563.63599	0.00000
42	126.66700	592.72699	0.00000
43	253.33299	621.81799	0.00000
44	380.00000	650.90900	0.00000
45	0.00000	620.00000	0.00000
46	126.66700	652.00000	0.00000
47	253.33299	684.00000	0.00000
48	380.00000	716.00000	0.00000
49	0.00001	0.00002	50.00000
50	126.66700	0.00004	50.00000
51	253.33299	0.00000	50.00000
52	380.00000	0.00002	50.00000
53	0.00003	56.36370	50.00000

54	126.66700	59.27270	50.00000
55	253.33299	62.18180	50.00000
56	380.00000	65.09090	50.00000
57	0.00001	112.72700	50.00000
58	126.66700	118.54600	50.00000
59	253.33299	124.36400	50.00000
60	380.00000	130.18201	50.00000
61	0.00000	169.09100	50.00000
62	126.66700	177.81799	50.00000
63	253.33299	186.54601	50.00000
64	380.00000	195.27299	50.00000
65	0.00000	225.45500	50.00000
66	126.66700	237.09100	50.00000
67	253.33299	248.72701	50.00000
68	380.00000	260.36401	50.00000
69	0.00003	281.81799	50.00000
70	126.66700	296.36401	50.00000
71	253.33299	310.90900	50.00000
72	380.00000	325.45401	50.00000
73	0.00002	338.18201	50.00000
74	126.66700	355.63599	50.00000
75	253.33299	373.09100	50.00000
76	380.00000	390.54501	50.00000
77	0.00001	394.54599	50.00000
78	126.66700	414.90900	50.00000
79	253.33299	435.27301	50.00000
80	380.00000	455.63599	50.00000
81	0.00001	450.90900	50.00000
82	126.66700	474.18201	50.00000
83	253.33299	497.45499	50.00000
84	380.00000	520.72699	50.00000
85	0.00000	507.27301	50.00000
86	126.66700	533.45502	50.00000
87	253.33299	559.63599	50.00000
88	380.00000	585.81799	50.00000
89	0.00001	563.63599	50.00000
90	126.66700	592.72699	50.00000
91	253.33299	621.81799	50.00000
92	380.00000	650.90900	50.00000
93	0.00001	620.00000	50.00000
94	126.66700	652.00000	50.00000
95	253.33299	684.00000	50.00000
96	380.00000	716.00000	50.00000
97	0.00000	0.00000	100.00000
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99	253.33299	0.00000	100.00000
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101	0.00001	56.36370	100.00000
102	126.66700	59.27270	100.00000
103	253.33299	62.18180	100.00000
104	380.00000	65.09090	100.00000
105	0.00000	112.72700	100.00000
106	126.66700	118.54500	100.00000
107	253.33299	124.36400	100.00000

108	380.00000	130.18201	100.00000
109	-0.00002	169.09100	100.00000
110	126.66700	177.81799	100.00000
111	253.33299	186.54500	100.00000
112	380.00000	195.27299	100.00000
113	0.00000	225.45500	100.00000
114	126.66700	237.09100	100.00000
115	253.33299	248.72701	100.00000
116	380.00000	260.36401	100.00000
117	0.00002	281.81799	100.00000
118	126.66700	296.36401	100.00000
119	253.33299	310.90900	100.00000
120	380.00000	325.45499	100.00000
121	0.00002	338.18201	100.00000
122	126.66700	355.63599	100.00000
123	253.33299	373.09100	100.00000
124	380.00000	390.54501	100.00000
125	0.00000	394.54501	100.00000
126	126.66700	414.90900	100.00000
127	253.33299	435.27301	100.00000
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129	0.00001	450.90900	100.00000
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131	253.33299	497.45499	100.00000
132	380.00000	520.72699	100.00000
133	0.00000	507.27301	100.00000
134	126.66700	533.45502	100.00000
135	253.33299	559.63599	100.00000
136	380.00000	585.81799	100.00000
137	0.00000	563.63599	100.00000
138	126.66700	592.72699	100.00000
139	253.33299	621.81799	100.00000
140	380.00000	650.90900	100.00000
141	0.00000	620.00000	100.00000
142	126.66700	652.00000	100.00000
143	253.33299	684.00000	100.00000
144	380.00000	716.00000	100.00000
145	0.00000	0.00000	150.00000
146	126.66700	0.00002	150.00000
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152	380.00000	65.09090	150.00000
153	0.00002	112.72700	150.00000
154	126.66700	118.54500	150.00000
155	253.33299	124.36400	150.00000
156	380.00000	130.18201	150.00000
157	0.00000	169.09100	150.00000
158	126.66700	177.81799	150.00000
159	253.33299	186.54500	150.00000
160	380.00000	195.27299	150.00000
161	0.00000	225.45500	150.00000

162	126.66700	237.09100	150.00000
163	253.33299	248.72701	150.00000
164	380.00000	260.36401	150.00000
165	0.00001	281.81799	150.00000
166	126.66700	296.36401	150.00000
167	253.33299	310.90900	150.00000
168	380.00000	325.45499	150.00000
169	0.00000	338.18201	150.00000
170	126.66700	355.63599	150.00000
171	253.33299	373.09100	150.00000
172	380.00000	390.54501	150.00000
173	0.00000	394.54501	150.00000
174	126.66700	414.90900	150.00000
175	253.33299	435.27301	150.00000
176	380.00000	455.63599	150.00000
177	0.00000	450.90900	150.00000
178	126.66700	474.18201	150.00000
179	253.33299	497.45499	150.00000
180	380.00000	520.72699	150.00000
181	0.00000	507.27301	150.00000
182	126.66700	533.45502	150.00000
183	253.33299	559.63599	150.00000
184	380.00000	585.81799	150.00000
185	0.00000	563.63599	150.00000
186	126.66700	592.72699	150.00000
187	253.33299	621.81799	150.00000
188	380.00000	650.90900	150.00000
189	0.00000	620.00000	150.00000
190	126.66700	652.00000	150.00000
191	253.33299	684.00000	150.00000
192	380.00000	716.00000	150.00000
193	503.33301	0.00000	0.00000
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195	750.00000	0.00000	0.00000
196	503.33301	63.27270	0.00000
197	626.66699	61.45460	0.00000
198	750.00000	59.63630	0.00000
199	503.33301	126.54500	0.00000
200	626.66699	122.90900	0.00000
201	750.00000	119.27300	0.00000
202	503.33301	189.81799	0.00000
203	626.66699	184.36400	0.00000
204	750.00000	178.90900	0.00000
205	503.33301	253.09100	0.00000
206	626.66699	245.81799	0.00000
207	750.00000	238.54500	0.00000
208	503.33301	316.36401	0.00001
209	626.66699	307.27301	0.00000
210	750.00000	298.18201	0.00000
211	503.33301	379.63599	0.00001
212	626.66699	368.72699	0.00000
213	750.00000	357.81799	0.00000
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215	626.66699	430.18201	0.00000

216	750.00000	417.45499	0.00000
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218	626.66699	491.63599	0.00000
219	750.00000	477.09100	0.00000
220	503.33301	569.45502	0.00000
221	626.66699	553.09100	0.00000
222	750.00000	536.72699	0.00000
223	503.33301	632.72699	0.00000
224	626.66699	614.54602	0.00000
225	750.00000	596.36401	0.00000
226	503.33301	696.00000	0.00000
227	626.66699	676.00000	0.00000
228	750.00000	656.00000	0.00000
229	503.33301	0.00004	50.00000
230	626.66699	0.00000	50.00000
231	750.00000	0.00002	50.00000
232	503.33301	63.27270	50.00000
233	626.66699	61.45460	50.00000
234	750.00000	59.63640	50.00000
235	503.33301	126.54600	50.00000
236	626.66602	122.90900	50.00000
237	750.00000	119.27300	50.00000
238	503.33301	189.81799	50.00000
239	626.66699	184.36400	50.00000
240	750.00000	178.90900	50.00000
241	503.33301	253.09100	50.00000
242	626.66699	245.81799	50.00000
243	750.00000	238.54601	50.00000
244	503.33301	316.36401	50.00000
245	626.66699	307.27301	50.00000
246	750.00000	298.18201	50.00000
247	503.33301	379.63599	50.00000
248	626.66699	368.72699	50.00000
249	750.00000	357.81799	50.00000
250	503.33301	442.90900	50.00000
251	626.66602	430.18201	50.00000
252	750.00000	417.45499	50.00000
253	503.33301	506.18201	50.00000
254	626.66699	491.63599	50.00000
255	750.00000	477.09100	50.00000
256	503.33301	569.45502	50.00000
257	626.66699	553.09100	50.00000
258	750.00000	536.72699	50.00000
259	503.33301	632.72699	50.00000
260	626.66699	614.54498	50.00000
261	750.00000	596.36401	50.00000
262	503.33301	696.00000	50.00000
263	626.66699	676.00000	50.00000
264	750.00000	656.00000	50.00000
265	503.33301	0.00000	100.00000
266	626.66699	0.00000	100.00000
267	750.00000	0.00000	100.00000
268	503.33301	63.27270	100.00000
269	626.66699	61.45450	100.00000

270	750.00000	59.63630	100.00000
271	503.33301	126.54500	100.00000
272	626.66699	122.90900	100.00000
273	750.00000	119.27300	100.00000
274	503.33301	189.81799	100.00000
275	626.66699	184.36400	100.00000
276	750.00000	178.90900	100.00000
277	503.33301	253.09100	100.00000
278	626.66699	245.81799	100.00000
279	750.00000	238.54500	100.00000
280	503.33301	316.36401	100.00000
281	626.66699	307.27301	100.00000
282	750.00000	298.18201	100.00000
283	503.33301	379.63599	100.00000
284	626.66699	368.72699	100.00000
285	750.00000	357.81799	100.00000
286	503.33301	442.90900	100.00000
287	626.66699	430.18201	100.00000
288	750.00000	417.45499	100.00000
289	503.33301	506.18201	100.00000
290	626.66699	491.63599	100.00000
291	750.00000	477.09100	100.00000
292	503.33301	569.45502	100.00000
293	626.66699	553.09100	100.00000
294	750.00000	536.72699	100.00000
295	503.33301	632.72699	100.00000
296	626.66699	614.54602	100.00000
297	750.00000	596.36401	100.00000
298	503.33301	696.00000	100.00000
299	626.66699	676.00000	100.00000
300	750.00000	656.00000	100.00000
301	503.33301	0.00002	150.00000
302	626.66699	0.00000	150.00000
303	750.00000	0.00000	150.00000
304	503.33301	63.27270	150.00000
305	626.66699	61.45460	150.00000
306	750.00000	59.63640	150.00000
307	503.33301	126.54500	150.00000
308	626.66699	122.90900	150.00000
309	750.00000	119.27300	150.00000
310	503.33301	189.81799	150.00000
311	626.66699	184.36400	150.00000
312	750.00000	178.90900	150.00000
313	503.33301	253.09100	150.00000
314	626.66699	245.81799	150.00000
315	750.00000	238.54500	150.00000
316	503.33301	316.36401	150.00000
317	626.66699	307.27301	150.00000
318	750.00000	298.18201	150.00000
319	503.33301	379.63599	150.00000
320	626.66699	368.72699	150.00000
321	750.00000	357.81799	150.00000
322	503.33301	442.90900	150.00000
323	626.66699	430.18201	150.00000

324	750.00000	417.45499	150.00000
325	503.33301	506.18201	150.00000
326	626.66699	491.63599	150.00000
327	750.00000	477.09100	150.00000
328	503.33301	569.45502	150.00000
329	626.66699	553.09100	150.00000
330	750.00000	536.72699	150.00000
331	503.33301	632.72699	150.00000
332	626.66699	614.54602	150.00000
333	750.00000	596.36401	150.00000
334	503.33301	696.00000	150.00000
335	626.66699	676.00000	150.00000
336	750.00000	656.00000	150.00000
337	856.66699	0.00000	0.00000
338	963.33301	0.00000	0.00000
339	1070.00000	0.00000	0.00000
340	856.14099	58.42420	0.00000
341	964.38397	57.21220	0.00000
342	1074.72998	56.00000	0.00000
343	855.61603	116.84800	0.00000
344	965.43402	114.42400	0.00000
345	1079.44995	112.00000	0.00000
346	855.09100	175.27299	0.00000
347	966.48499	171.63600	0.00000
348	1084.18005	168.00000	0.00000
349	854.56598	233.69701	0.00000
350	967.53497	228.84801	0.00000
351	1088.91003	224.00000	0.00000
352	854.03998	292.12100	0.00001
353	968.58600	286.06100	0.00000
354	1093.64001	280.00000	0.00000
355	853.51501	350.54501	0.00001
356	969.63599	343.27301	0.00000
357	1098.35999	336.00000	0.00000
358	852.98999	408.97000	0.00000
359	970.68701	400.48499	0.00000
360	1103.08997	392.00000	0.00000
361	852.46503	467.39401	0.00000
362	971.73700	457.69699	0.00000
363	1107.81995	448.00000	0.00000
364	851.93903	525.81799	0.00000
365	972.78802	514.90900	0.00000
366	1112.55005	504.00000	0.00000
367	851.41400	584.24200	0.00000
368	973.83801	572.12097	0.00000
369	1117.27002	560.00000	0.00000
370	850.88898	642.66699	0.00000
371	974.88898	629.33301	0.00000
372	1122.00000	616.00000	0.00000
373	856.66699	0.00004	50.00000
374	963.33301	0.00000	50.00000
375	1070.00000	0.00002	50.00000
376	856.14099	58.42420	50.00000
377	964.38397	57.21210	50.00000

378	1074.72998	56.00000	50.00000
379	855.61603	116.84900	50.00000
380	965.43402	114.42400	50.00000
381	1079.44995	112.00000	50.00000
382	855.09100	175.27299	50.00000
383	966.48499	171.63600	50.00000
384	1084.18005	168.00000	50.00000
385	854.56598	233.69701	50.00000
386	967.53601	228.84900	50.00000
387	1088.91003	224.00000	50.00000
388	854.03998	292.12100	50.00000
389	968.58600	286.06100	50.00000
390	1093.64001	280.00000	50.00000
391	853.51501	350.54501	50.00000
392	969.63599	343.27301	50.00000
393	1098.35999	336.00000	50.00000
394	852.98999	408.97000	50.00000
395	970.68701	400.48499	50.00000
396	1103.08997	392.00000	50.00000
397	852.46503	467.39401	50.00000
398	971.73700	457.69699	50.00000
399	1107.81995	448.00000	50.00000
400	851.94000	525.81799	50.00000
401	972.78802	514.90900	50.00000
402	1112.55005	504.00000	50.00000
403	851.41400	584.24200	50.00000
404	973.83801	572.12097	50.00000
405	1117.27002	560.00000	50.00000
406	850.88898	642.66699	50.00000
407	974.88898	629.33301	50.00000
408	1122.00000	616.00000	50.00000
409	856.66699	0.00000	100.00000
410	963.33301	0.00000	100.00000
411	1070.00000	0.00000	100.00000
412	856.14099	58.42420	100.00000
413	964.38397	57.21210	100.00000
414	1074.72998	56.00000	100.00000
415	855.61603	116.84900	100.00000
416	965.43402	114.42400	100.00000
417	1079.44995	112.00000	100.00000
418	855.09100	175.27299	100.00000
419	966.48499	171.63600	100.00000
420	1084.18005	168.00000	100.00000
421	854.56598	233.69701	100.00000
422	967.53497	228.84801	100.00000
423	1088.91003	224.00000	100.00000
424	854.03998	292.12100	100.00000
425	968.58600	286.06100	100.00000
426	1093.64001	280.00000	100.00000
427	853.51501	350.54501	100.00000
428	969.63599	343.27301	100.00000
429	1098.35999	336.00000	100.00000
430	852.98999	408.97000	100.00000
431	970.68701	400.48499	100.00000

432	1103.08997	392.00000	100.00000
433	852.46503	467.39401	100.00000
434	971.73700	457.69699	100.00000
435	1107.81995	448.00000	100.00000
436	851.93903	525.81799	100.00000
437	972.78802	514.90900	100.00000
438	1112.55005	504.00000	100.00000
439	851.41400	584.24200	100.00000
440	973.83801	572.12097	100.00000
441	1117.27002	560.00000	100.00000
442	850.88898	642.66699	100.00000
443	974.88898	629.33301	100.00000
444	1122.00000	616.00000	100.00000
445	856.66699	0.00002	150.00000
446	963.33301	0.00000	150.00000
447	1070.00000	0.00000	150.00000
448	856.14099	58.42420	150.00000
449	964.38397	57.21210	150.00000
450	1074.72998	56.00000	150.00000
451	855.61603	116.84800	150.00000
452	965.43402	114.42400	150.00000
453	1079.44995	112.00000	150.00000
454	855.09100	175.27299	150.00000
455	966.48499	171.63600	150.00000
456	1084.18005	168.00000	150.00000
457	854.56598	233.69701	150.00000
458	967.53497	228.84801	150.00000
459	1088.91003	224.00000	150.00000
460	854.03998	292.12100	150.00000
461	968.58600	286.06100	150.00000
462	1093.64001	280.00000	150.00000
463	853.51501	350.54501	150.00000
464	969.63599	343.27301	150.00000
465	1098.35999	336.00000	150.00000
466	852.98999	408.97000	150.00000
467	970.68701	400.48499	150.00000
468	1103.08997	392.00000	150.00000
469	852.46503	467.39401	150.00000
470	971.73700	457.69699	150.00000
471	1107.81995	448.00000	150.00000
472	851.93903	525.81799	150.00000
473	972.78802	514.90900	150.00000
474	1112.55005	504.00000	150.00000
475	851.41400	584.24200	150.00000
476	973.83801	572.12097	150.00000
477	1117.27002	560.00000	150.00000
478	850.88898	642.66699	150.00000
479	974.88898	629.33301	150.00000
480	1122.00000	616.00000	150.00000
481	1122.00000	0.00000	0.00000
482	1125.81995	55.09090	0.00000
483	1129.64001	110.18200	0.00000
484	1133.44995	165.27299	0.00000
485	1137.27002	220.36400	0.00000

486	1141.08997	275.45499	0.00000
487	1144.91003	330.54501	0.00000
488	1148.72998	385.63599	0.00000
489	1152.55005	440.72699	0.00000
490	1156.35999	495.81799	-0.00001
491	1160.18005	550.90900	0.00000
492	1164.00000	606.00000	0.00000
493	1122.00000	0.00002	50.00000
494	1125.81995	55.09100	50.00000
495	1129.64001	110.18200	50.00000
496	1133.44995	165.27299	50.00000
497	1137.27002	220.36400	50.00000
498	1141.08997	275.45499	50.00000
499	1144.91003	330.54501	50.00000
500	1148.72998	385.63599	50.00000
501	1152.55005	440.72699	50.00000
502	1156.35999	495.81799	50.00000
503	1160.18005	550.90900	50.00000
504	1164.00000	606.00000	50.00000
505	1122.00000	0.00000	100.00000
506	1125.81995	55.09090	100.00000
507	1129.64001	110.18200	100.00000
508	1133.44995	165.27299	100.00000
509	1137.27002	220.36400	100.00000
510	1141.08997	275.45499	100.00000
511	1144.91003	330.54501	100.00000
512	1148.72998	385.63599	100.00000
513	1152.55005	440.72699	100.00000
514	1156.35999	495.81799	100.00000
515	1160.18005	550.90900	100.00000
516	1164.00000	606.00000	100.00000
517	1122.00000	0.00000	150.00000
518	1125.81995	55.09090	150.00000
519	1129.64001	110.18200	150.00000
520	1133.44995	165.27299	150.00000
521	1137.27002	220.36400	150.00000
522	1141.08997	275.45499	150.00000
523	1144.91003	330.54501	150.00000
524	1148.72998	385.63599	150.00000
525	1152.55005	440.72699	150.00000
526	1156.35999	495.81799	150.00000
527	1160.18005	550.90900	150.00000
528	1164.00000	606.00000	150.00000
529	1250.80005	0.00000	0.00000
530	1378.00000	0.00000	0.00000
531	1503.59998	0.00000	0.00000
532	1627.59998	0.00000	0.00000
533	1750.00000	0.00000	0.00000
534	1253.56006	54.43630	0.00000
535	1379.84998	53.78180	0.00001
536	1504.68994	53.12730	0.00001
537	1628.06995	52.47270	0.00000
538	1750.00000	51.81820	0.00000
539	1256.32996	108.87300	0.00000

540	1381.70996	107.56400	0.00000
541	1505.78003	106.25500	0.00000
542	1628.55005	104.94500	0.00000
543	1750.00000	103.63600	0.00000
544	1259.08997	163.30901	0.00000
545	1383.56006	161.34500	0.00000
546	1506.87000	159.38200	0.00000
547	1629.02002	157.41800	0.00000
548	1750.00000	155.45500	0.00000
549	1261.84998	217.74500	0.00000
550	1385.42004	215.12700	0.00000
551	1507.95996	212.50900	0.00000
552	1629.48999	209.89101	0.00000
553	1750.00000	207.27299	0.00000
554	1264.62000	272.18201	0.00000
555	1387.27002	268.90900	0.00000
556	1509.05005	265.63599	0.00001
557	1629.95996	262.36401	0.00000
558	1750.00000	259.09100	0.00000
559	1267.38000	326.61801	0.00000
560	1389.13000	322.69101	0.00000
561	1510.15002	318.76401	0.00000
562	1630.43994	314.83600	0.00000
563	1750.00000	310.90900	0.00000
564	1270.15002	381.05499	0.00000
565	1390.97998	376.47299	0.00000
566	1511.23999	371.89099	0.00000
567	1630.91003	367.30899	0.00000
568	1750.00000	362.72699	0.00000
569	1272.91003	435.49100	0.00000
570	1392.83997	430.25500	0.00000
571	1512.32996	425.01801	0.00000
572	1631.38000	419.78201	0.00000
573	1750.00000	414.54501	0.00000
574	1275.67004	489.92700	0.00000
575	1394.68994	484.03601	0.00000
576	1513.42004	478.14600	0.00000
577	1631.84998	472.25500	0.00000
578	1750.00000	466.36401	-0.00001
579	1278.43994	544.36401	0.00000
580	1396.55005	537.81799	0.00000
581	1514.51001	531.27301	0.00000
582	1632.32996	524.72699	0.00000
583	1750.00000	518.18201	0.00000
584	1281.19995	598.79999	0.00000
585	1398.40002	591.59998	0.00000
586	1515.59998	584.40002	0.00000
587	1632.80005	577.20001	0.00000
588	1750.00000	570.00000	0.00000
589	1250.80005	0.00000	50.00000
590	1378.00000	0.00004	50.00000
591	1503.59998	0.00003	50.00000
592	1627.59998	0.00002	50.00000
593	1750.00000	0.00002	50.00000

594	1253.56006	54.43640	50.00000
595	1379.84998	53.78190	50.00000
596	1504.68994	53.12730	50.00000
597	1628.06995	52.47280	50.00000
598	1750.00000	51.81820	50.00000
599	1256.32996	108.87300	50.00000
600	1381.70996	107.56400	50.00000
601	1505.78003	106.25500	50.00000
602	1628.55005	104.94600	50.00000
603	1750.00000	103.63600	50.00000
604	1259.08997	163.30901	50.00000
605	1383.56006	161.34500	50.00000
606	1506.87000	159.38200	50.00000
607	1629.02002	157.41800	50.00000
608	1750.00000	155.45500	50.00000
609	1261.84998	217.74500	50.00000
610	1385.42004	215.12700	50.00000
611	1507.95996	212.50900	50.00000
612	1629.48999	209.89101	50.00000
613	1750.00000	207.27299	50.00000
614	1264.62000	272.18201	50.00000
615	1387.27002	268.90900	50.00000
616	1509.05005	265.63599	50.00000
617	1629.95996	262.36401	50.00000
618	1750.00000	259.09100	50.00000
619	1267.38000	326.61801	50.00000
620	1389.13000	322.69101	50.00000
621	1510.15002	318.76401	50.00000
622	1630.43994	314.83600	50.00000
623	1750.00000	310.90900	50.00000
624	1270.15002	381.05499	50.00000
625	1390.97998	376.47299	50.00000
626	1511.23999	371.89099	50.00000
627	1630.91003	367.30899	50.00000
628	1750.00000	362.72699	50.00000
629	1272.91003	435.49100	50.00000
630	1392.83997	430.25500	50.00000
631	1512.32996	425.01801	50.00000
632	1631.38000	419.78201	50.00000
633	1750.00000	414.54599	50.00000
634	1275.67004	489.92700	50.00000
635	1394.68994	484.03601	50.00000
636	1513.42004	478.14499	50.00000
637	1631.84998	472.25400	50.00000
638	1750.00000	466.36401	50.00000
639	1278.43994	544.36401	50.00000
640	1396.55005	537.81799	50.00000
641	1514.51001	531.27301	50.00000
642	1632.32996	524.72699	50.00000
643	1750.00000	518.18201	50.00000
644	1281.19995	598.79999	50.00000
645	1398.40002	591.59998	50.00000
646	1515.59998	584.40002	50.00000
647	1632.80005	577.20001	50.00000

648	1750.00000	570.00000	50.00000
649	1250.80005	-0.00004	100.00000
650	1378.00000	0.00000	100.00000
651	1503.59998	0.00000	100.00000
652	1627.59998	0.00000	100.00000
653	1750.00000	0.00000	100.00000
654	1253.56006	54.43640	100.00000
655	1379.84998	53.78190	100.00000
656	1504.68994	53.12730	100.00000
657	1628.06995	52.47270	100.00000
658	1750.00000	51.81820	100.00000
659	1256.32996	108.87300	100.00000
660	1381.70996	107.56400	100.00000
661	1505.78003	106.25500	100.00000
662	1628.55005	104.94500	100.00000
663	1750.00000	103.63600	100.00000
664	1259.08997	163.30901	100.00000
665	1383.56006	161.34500	100.00000
666	1506.87000	159.38200	100.00000
667	1629.02002	157.41800	100.00000
668	1750.00000	155.45399	100.00000
669	1261.84998	217.74600	100.00000
670	1385.42004	215.12700	100.00000
671	1507.95996	212.50900	100.00000
672	1629.48999	209.89101	100.00000
673	1750.00000	207.27299	100.00000
674	1264.62000	272.18201	100.00000
675	1387.27002	268.90900	100.00000
676	1509.05005	265.63599	100.00000
677	1629.95996	262.36401	100.00000
678	1750.00000	259.09100	100.00000
679	1267.38000	326.61801	100.00000
680	1389.13000	322.69101	100.00000
681	1510.15002	318.76401	100.00000
682	1630.43994	314.83600	100.00000
683	1750.00000	310.90900	100.00000
684	1270.15002	381.05499	100.00000
685	1390.97998	376.47299	100.00000
686	1511.23999	371.89099	100.00000
687	1630.91003	367.30899	100.00000
688	1750.00000	362.72699	100.00000
689	1272.91003	435.49100	100.00000
690	1392.83997	430.25500	100.00000
691	1512.32996	425.01801	100.00000
692	1631.38000	419.78201	100.00000
693	1750.00000	414.54599	100.00000
694	1275.67004	489.92700	100.00000
695	1394.68994	484.03601	100.00000
696	1513.42004	478.14499	100.00000
697	1631.84998	472.25400	100.00000
698	1750.00000	466.36401	100.00000
699	1278.43994	544.36401	100.00000
700	1396.55005	537.81799	100.00000
701	1514.51001	531.27301	100.00000

702	1632.32996	524.72699	100.00000
703	1750.00000	518.18201	100.00000
704	1281.19995	598.79999	100.00000
705	1398.40002	591.59998	100.00000
706	1515.59998	584.40002	100.00000
707	1632.80005	577.20001	100.00000
708	1750.00000	570.00000	100.00000
709	1250.80005	0.00000	150.00000
710	1378.00000	0.00000	150.00000
711	1503.59998	0.00000	150.00000
712	1627.59998	0.00000	150.00000
713	1750.00000	0.00000	150.00000
714	1253.56006	54.43640	150.00000
715	1379.84998	53.78180	150.00000
716	1504.68994	53.12730	150.00000
717	1628.06995	52.47270	150.00000
718	1750.00000	51.81820	150.00000
719	1256.32996	108.87300	150.00000
720	1381.70996	107.56400	150.00000
721	1505.78003	106.25500	150.00000
722	1628.55005	104.94500	150.00000
723	1750.00000	103.63600	150.00000
724	1259.08997	163.30901	150.00000
725	1383.56006	161.34500	150.00000
726	1506.87000	159.38200	150.00000
727	1629.02002	157.41800	150.00000
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730	1385.42004	215.12700	150.00000
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735	1387.27002	268.90900	150.00000
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737	1629.95996	262.36401	150.00000
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742	1630.43994	314.83600	150.00000
743	1750.00000	310.90900	150.00000
744	1270.15002	381.05499	150.00000
745	1390.97998	376.47299	150.00000
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747	1630.91003	367.30899	150.00000
748	1750.00000	362.72699	150.00000
749	1272.91003	435.49100	150.00000
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751	1512.32996	425.01801	150.00000
752	1631.38000	419.78201	150.00000
753	1750.00000	414.54501	150.00000
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755	1394.68994	484.03601	150.00000

756	1513.42004	478.14499	150.00000
757	1631.84998	472.25500	150.00000
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762	1632.32996	524.72699	150.00000
763	1750.00000	518.18201	150.00000
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766	1515.59998	584.40002	150.00000
767	1632.80005	577.20001	150.00000
768	1750.00000	570.00000	150.00000

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3	3	4	8	7	51	52	56	55	0.0	0.0050000	0.0020000	0.0050000
4	5	6	10	9	53	54	58	57	0.0	0.0050000	0.0020000	0.0050000
5	6	7	11	10	54	55	59	58	0.0	0.0050000	0.0020000	0.0050000
6	7	8	12	11	55	56	60	59	0.0	0.0050000	0.0020000	0.0050000
7	9	10	14	13	57	58	62	61	0.0	0.0050000	0.0030000	0.0050000
8	10	11	15	14	58	59	63	62	0.0	0.0050000	0.0030000	0.0050000
9	11	12	16	15	59	60	64	63	0.0	0.0050000	0.0030000	0.0050000
10	13	14	18	17	61	62	66	65	0.0	0.0050000	0.0030000	0.0050000
11	14	15	19	18	62	63	67	66	0.0	0.0050000	0.0030000	0.0050000
12	15	16	20	19	63	64	68	67	0.0	0.0050000	0.0030000	0.0050000
13	17	18	22	21	65	66	70	69	0.0	0.0050000	0.0050000	0.0050000
14	18	19	23	22	66	67	71	70	0.0	0.0050000	0.0050000	0.0050000
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16	21	22	26	25	69	70	74	73	0.0	0.0050000	0.0050000	0.0050000
17	22	23	27	26	70	71	75	74	0.0	0.0059000	0.0059000	0.0059000
18	23	24	28	27	71	72	76	75	0.0	0.0059000	0.0059000	0.0059000
19	25	26	30	29	73	74	78	77	0.0	0.0050000	0.0050000	0.0050000
20	26	27	31	30	74	75	79	78	0.0	0.0050000	0.0050000	0.0050000
21	27	28	32	31	75	76	80	79	0.0	0.0050000	0.0050000	0.0050000
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23	30	31	35	34	78	79	83	82	0.0	0.0050000	0.0050000	0.0050000
24	31	32	36	35	79	80	84	83	0.0	0.0050000	0.0050000	0.0050000
25	33	34	38	37	81	82	86	85	0.0	0.0050000	0.0050000	0.0050000
26	34	35	39	38	82	83	87	86	0.0	0.0050000	0.0050000	0.0050000
27	35	36	40	39	83	84	88	87	0.0	0.0050000	0.0050000	0.0050000
28	37	38	42	41	85	86	90	89	0.0	0.0050000	0.0055000	0.0050000
29	38	39	43	42	86	87	91	90	0.0	0.0050000	0.0055000	0.0050000
30	39	40	44	43	87	88	92	91	0.0	0.0050000	0.0055000	0.0050000
31	41	42	46	45	89	90	94	93	0.0	0.0075000	0.0063000	0.0075000
32	42	43	47	46	90	91	95	94	0.0	0.0075000	0.0063000	0.0075000
33	43	44	48	47	91	92	96	95	0.0	0.0075000	0.0063000	0.0075000
34	49	50	54	53	97	98	102	101	0.0	0.0050000	0.0020000	0.0050000
35	50	51	55	54	98	99	103	102	0.0	0.0050000	0.0020000	0.0050000
36	51	52	56	55	99	100	104	103	0.0	0.0050000	0.0020000	0.0050000
37	53	54	58	57	101	102	106	105	0.0	0.0050000	0.0020000	0.0050000
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40	57	58	62	61	105	106	110	109	0.0	0.0050000	0.0030000	0.0050000
41	58	59	63	62	106	107	111	110	0.0	0.0050000	0.0030000	0.0050000

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43	61	62	66	65	109	110	114	113	0.0	0.0050000	0.0030000	0.0050000
44	62	63	67	66	110	111	115	114	0.0	0.0050000	0.0030000	0.0050000
45	63	64	68	67	111	112	116	115	0.0	0.0050000	0.0030000	0.0050000
46	65	66	70	69	113	114	118	117	0.0	0.0050000	0.0050000	0.0050000
47	66	67	71	70	114	115	119	118	0.0	0.0050000	0.0050000	0.0050000
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50	70	71	75	74	118	119	123	122	0.0	0.0059000	0.0059000	0.0059000
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56	78	79	83	82	126	127	131	130	0.0	0.0050000	0.0050000	0.0050000
57	79	80	84	83	127	128	132	131	0.0	0.0050000	0.0050000	0.0050000
58	81	82	86	85	129	130	134	133	0.0	0.0050000	0.0050000	0.0050000
59	82	83	87	86	130	131	135	134	0.0	0.0050000	0.0050000	0.0050000
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61	85	86	90	89	133	134	138	137	0.0	0.0050000	0.0055000	0.0050000
62	86	87	91	90	134	135	139	138	0.0	0.0050000	0.0055000	0.0050000
63	87	88	92	91	135	136	140	139	0.0	0.0050000	0.0055000	0.0050000
64	89	90	94	93	137	138	142	141	0.0	0.0075000	0.0063000	0.0075000
65	90	91	95	94	138	139	143	142	0.0	0.0075000	0.0063000	0.0075000
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67	97	98	102	101	145	146	150	149	0.0	0.0050000	0.0020000	0.0050000
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69	99	100	104	103	147	148	152	151	0.0	0.0050000	0.0020000	0.0050000
70	101	102	106	105	149	150	154	153	0.0	0.0050000	0.0020000	0.0050000
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72	103	104	108	107	151	152	156	155	0.0	0.0050000	0.0020000	0.0050000
73	105	106	110	109	153	154	158	157	0.0	0.0050000	0.0030000	0.0050000
74	106	107	111	110	154	155	159	158	0.0	0.0050000	0.0030000	0.0050000
75	107	108	112	111	155	156	160	159	0.0	0.0050000	0.0030000	0.0050000
76	109	110	114	113	157	158	162	161	0.0	0.0050000	0.0030000	0.0050000
77	110	111	115	114	158	159	163	162	0.0	0.0050000	0.0030000	0.0050000
78	111	112	116	115	159	160	164	163	0.0	0.0050000	0.0030000	0.0050000
79	113	114	118	117	161	162	166	165	0.0	0.0050000	0.0050000	0.0050000
80	114	115	119	118	162	163	167	166	0.0	0.0050000	0.0050000	0.0050000
81	115	116	120	119	163	164	168	167	0.0	0.0050000	0.0050000	0.0050000
82	117	118	122	121	165	166	170	169	0.0	0.0059000	0.0059000	0.0059000
83	118	119	123	122	166	167	171	170	0.0	0.0059000	0.0059000	0.0059000
84	119	120	124	123	167	168	172	171	0.0	0.0059000	0.0059000	0.0059000
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86	122	123	127	126	170	171	175	174	0.0	0.0050000	0.0050000	0.0050000
87	123	124	128	127	171	172	176	175	0.0	0.0050000	0.0050000	0.0050000
88	125	126	130	129	173	174	178	177	0.0	0.0050000	0.0050000	0.0050000
89	126	127	131	130	174	175	179	178	0.0	0.0050000	0.0050000	0.0050000
90	127	128	132	131	175	176	180	179	0.0	0.0050000	0.0050000	0.0050000
91	129	130	134	133	177	178	182	181	0.0	0.0050000	0.0050000	0.0050000
92	130	131	135	134	178	179	183	182	0.0	0.0050000	0.0050000	0.0050000
93	131	132	136	135	179	180	184	183	0.0	0.0050000	0.0050000	0.0050000
94	133	134	138	137	181	182	186	185	0.0	0.0050000	0.0055000	0.0050000
95	134	135	139	138	182	183	187	186	0.0	0.0050000	0.0055000	0.0050000

96	135	136	140	139	183	184	188	187	0.0	0.0050000	0.0055000	0.0050000
97	137	138	142	141	185	186	190	189	0.0	0.0075000	0.0063000	0.0075000
98	138	139	143	142	186	187	191	190	0.0	0.0075000	0.0063000	0.0075000
99	139	140	144	143	187	188	192	191	0.0	0.0075000	0.0063000	0.0075000
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101	193	194	197	196	229	230	233	232	0.0	0.0050000	0.0020000	0.0050000
102	194	195	198	197	230	231	234	233	0.0	0.0050000	0.0020000	0.0050000
103	8	196	199	12	56	232	235	60	0.0	0.0050000	0.0020000	0.0050000
104	196	197	200	199	232	233	236	235	0.0	0.0050000	0.0020000	0.0050000
105	197	198	201	200	233	234	237	236	0.0	0.0050000	0.0020000	0.0050000
106	12	199	202	16	60	235	238	64	0.0	0.0050000	0.0030000	0.0050000
107	199	200	203	202	235	236	239	238	0.0	0.0050000	0.0030000	0.0050000
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109	16	202	205	20	64	238	241	68	0.0	0.0050000	0.0030000	0.0050000
110	202	203	206	205	238	239	242	241	0.0	0.0050000	0.0030000	0.0050000
111	203	204	207	206	239	240	243	242	0.0	0.0050000	0.0030000	0.0050000
112	20	205	208	24	68	241	244	72	0.0	0.0050000	0.0050000	0.0050000
113	205	206	209	208	241	242	245	244	0.0	0.0050000	0.0050000	0.0050000
114	206	207	210	209	242	243	246	245	0.0	0.0050000	0.0050000	0.0050000
115	24	208	211	28	72	244	247	76	0.0	0.0059000	0.0059000	0.0059000
116	208	209	212	211	244	245	248	247	0.0	0.0059000	0.0059000	0.0059000
117	209	210	213	212	245	246	249	248	0.0	0.0059000	0.0059000	0.0059000
118	28	211	214	32	76	247	250	80	0.0	0.0050000	0.0050000	0.0050000
119	211	212	215	214	247	248	251	250	0.0	0.0050000	0.0050000	0.0050000
120	212	213	216	215	248	249	252	251	0.0	0.0050000	0.0050000	0.0050000
121	32	214	217	36	80	250	253	84	0.0	0.0050000	0.0050000	0.0050000
122	214	215	218	217	250	251	254	253	0.0	0.0050000	0.0050000	0.0050000
123	215	216	219	218	251	252	255	254	0.0	0.0050000	0.0050000	0.0050000
124	36	217	220	40	84	253	256	88	0.0	0.0050000	0.0050000	0.0050000
125	217	218	221	220	253	254	257	256	0.0	0.0050000	0.0050000	0.0050000
126	218	219	222	221	254	255	258	257	0.0	0.0050000	0.0050000	0.0050000
127	40	220	223	44	88	256	259	92	0.0	0.0050000	0.0055000	0.0050000
128	220	221	224	223	256	257	260	259	0.0	0.0050000	0.0055000	0.0050000
129	221	222	225	224	257	258	261	260	0.0	0.0050000	0.0055000	0.0050000
130	44	223	226	48	92	259	262	96	0.0	0.0075000	0.0063000	0.0075000
131	223	224	227	226	259	260	263	262	0.0	0.0075000	0.0063000	0.0075000
132	224	225	228	227	260	261	264	263	0.0	0.0075000	0.0063000	0.0075000
133	52	229	232	56	100	265	268	104	0.0	0.0050000	0.0020000	0.0050000
134	229	230	233	232	265	266	269	268	0.0	0.0050000	0.0020000	0.0050000
135	230	231	234	233	266	267	270	269	0.0	0.0050000	0.0020000	0.0050000
136	56	232	235	60	104	268	271	108	0.0	0.0050000	0.0020000	0.0050000
137	232	233	236	235	268	269	272	271	0.0	0.0050000	0.0020000	0.0050000
138	233	234	237	236	269	270	273	272	0.0	0.0050000	0.0020000	0.0050000
139	60	235	238	64	108	271	274	112	0.0	0.0050000	0.0030000	0.0050000
140	235	236	239	238	271	272	275	274	0.0	0.0050000	0.0030000	0.0050000
141	236	237	240	239	272	273	276	275	0.0	0.0050000	0.0030000	0.0050000
142	64	238	241	68	112	274	277	116	0.0	0.0050000	0.0030000	0.0050000
143	238	239	242	241	274	275	278	277	0.0	0.0050000	0.0030000	0.0050000
144	239	240	243	242	275	276	279	278	0.0	0.0050000	0.0030000	0.0050000
145	68	241	244	72	116	277	280	120	0.0	0.0050000	0.0050000	0.0050000
146	241	242	245	244	277	278	281	280	0.0	0.0050000	0.0050000	0.0050000
147	242	243	246	245	278	279	282	281	0.0	0.0050000	0.0050000	0.0050000
148	72	244	247	76	120	280	283	124	0.0	0.0059000	0.0059000	0.0059000
149	244	245	248	247	280	281	284	283	0.1	0.0059000	0.0059000	0.0059000

150	245	246	249	248	281	282	285	284	0.0	0.0059000	0.0059000	0.0059000
151	76	247	250	80	124	283	286	128	0.0	0.0050000	0.0050000	0.0050000
152	247	248	251	250	283	284	287	286	0.0	0.0050000	0.0050000	0.0050000
153	248	249	252	251	284	285	288	287	0.0	0.0050000	0.0050000	0.0050000
154	80	250	253	84	128	286	289	132	0.0	0.0050000	0.0050000	0.0050000
155	250	251	254	253	286	287	290	289	0.0	0.0050000	0.0050000	0.0050000
156	251	252	255	254	287	288	291	290	0.0	0.0050000	0.0050000	0.0050000
157	84	253	256	88	132	289	292	136	0.0	0.0050000	0.0050000	0.0050000
158	253	254	257	256	289	290	293	292	0.0	0.0050000	0.0050000	0.0050000
159	254	255	258	257	290	291	294	293	0.0	0.0050000	0.0050000	0.0050000
160	88	256	259	92	136	292	295	140	0.0	0.0050000	0.0055000	0.0050000
161	256	257	260	259	292	293	296	295	0.0	0.0050000	0.0055000	0.0050000
162	257	258	261	260	293	294	297	296	0.0	0.0050000	0.0055000	0.0050000
163	92	259	262	96	140	295	298	144	0.0	0.0075000	0.0063000	0.0075000
164	259	260	263	262	295	296	299	298	0.0	0.0075000	0.0063000	0.0075000
165	260	261	264	263	296	297	300	299	0.0	0.0075000	0.0063000	0.0075000
166	100	265	268	104	148	301	304	152	0.0	0.0050000	0.0020000	0.0050000
167	265	266	269	268	301	302	305	304	0.0	0.0050000	0.0020000	0.0050000
168	266	267	270	269	302	303	306	305	0.0	0.0050000	0.0020000	0.0050000
169	104	268	271	108	152	304	307	156	0.0	0.0050000	0.0020000	0.0050000
170	268	269	272	271	304	305	308	307	0.0	0.0050000	0.0020000	0.0050000
171	269	270	273	272	305	306	309	308	0.0	0.0050000	0.0020000	0.0050000
172	108	271	274	112	156	307	310	160	0.0	0.0050000	0.0030000	0.0050000
173	271	272	275	274	307	308	311	310	0.0	0.0050000	0.0030000	0.0050000
174	272	273	276	275	308	309	312	311	0.0	0.0050000	0.0030000	0.0050000
175	112	274	277	116	160	310	313	164	0.0	0.0050000	0.0030000	0.0050000
176	274	275	278	277	310	311	314	313	0.0	0.0050000	0.0030000	0.0050000
177	275	276	279	278	311	312	315	314	0.0	0.0050000	0.0030000	0.0050000
178	116	277	280	120	164	313	316	168	0.0	0.0050000	0.0050000	0.0050000
179	277	278	281	280	313	314	317	316	0.0	0.0050000	0.0050000	0.0050000
180	278	279	282	281	314	315	318	317	0.0	0.0050000	0.0050000	0.0050000
181	120	280	283	124	168	316	319	172	0.0	0.0059000	0.0059000	0.0059000
182	280	281	284	283	316	317	320	319	0.0	0.0059000	0.0059000	0.0059000
183	281	282	285	284	317	318	321	320	0.0	0.0059000	0.0059000	0.0059000
184	124	283	286	128	172	319	322	176	0.0	0.0050000	0.0050000	0.0050000
185	283	284	287	286	319	320	323	322	0.0	0.0050000	0.0050000	0.0050000
186	284	285	288	287	320	321	324	323	0.0	0.0050000	0.0050000	0.0050000
187	128	286	289	132	176	322	325	180	0.0	0.0050000	0.0050000	0.0050000
188	286	287	290	289	322	323	326	325	0.0	0.0050000	0.0050000	0.0050000
189	287	288	291	290	323	324	327	326	0.0	0.0050000	0.0050000	0.0050000
190	132	289	292	136	180	325	328	184	0.0	0.0050000	0.0050000	0.0050000
191	289	290	293	292	325	326	329	328	0.0	0.0050000	0.0050000	0.0050000
192	290	291	294	293	326	327	330	329	0.0	0.0050000	0.0050000	0.0050000
193	136	292	295	140	184	328	331	188	0.0	0.0050000	0.0055000	0.0050000
194	292	293	296	295	328	329	332	331	0.0	0.0050000	0.0055000	0.0050000
195	293	294	297	296	329	330	333	332	0.0	0.0050000	0.0055000	0.0050000
196	140	295	298	144	188	331	334	192	0.0	0.0075000	0.0063000	0.0075000
197	295	296	299	298	331	332	335	334	0.0	0.0075000	0.0063000	0.0075000
198	296	297	300	299	332	333	336	335	0.0	0.0075000	0.0063000	0.0075000
199	195	337	340	198	231	373	376	234	0.0	0.0050000	0.0020000	0.0050000
200	337	338	341	340	373	374	377	376	0.0	0.0050000	0.0020000	0.0050000
201	338	339	342	341	374	375	378	377	0.0	0.0050000	0.0020000	0.0050000
202	198	340	343	201	234	376	379	237	0.0	0.0050000	0.0020000	0.0050000
203	340	341	344	343	376	377	380	379	0.0	0.0050000	0.0020000	0.0050000

204	341	342	345	344	377	378	381	380	0.0	0.0050000	0.0020000	0.0050000
205	201	343	346	204	237	379	382	240	0.0	0.0050000	0.0030000	0.0050000
206	343	344	347	346	379	380	383	382	0.0	0.0050000	0.0030000	0.0050000
207	344	345	348	347	380	381	384	383	0.0	0.0050000	0.0030000	0.0050000
208	204	346	349	207	240	382	385	243	0.0	0.0050000	0.0030000	0.0050000
209	346	347	350	349	382	383	386	385	0.0	0.0050000	0.0030000	0.0050000
210	347	348	351	350	383	384	387	386	0.0	0.0050000	0.0030000	0.0050000
211	207	349	352	210	243	385	388	246	0.0	0.0050000	0.0050000	0.0050000
212	349	350	353	352	385	386	389	388	0.0	0.0050000	0.0050000	0.0050000
213	350	351	354	353	386	387	390	389	0.0	0.0050000	0.0050000	0.0050000
214	210	352	355	213	246	388	391	249	0.0	0.0059000	0.0059000	0.0059000
215	352	353	356	355	388	389	392	391	0.0	0.0059000	0.0059000	0.0059000
216	353	354	357	356	389	390	393	392	0.0	0.0059000	0.0059000	0.0059000
217	213	355	358	216	249	391	394	252	0.0	0.0050000	0.0050000	0.0050000
218	355	356	359	358	391	392	395	394	0.0	0.0050000	0.0050000	0.0050000
219	356	357	360	359	392	393	396	395	0.0	0.0050000	0.0050000	0.0050000
220	216	358	361	219	252	394	397	255	0.0	0.0050000	0.0050000	0.0050000
221	358	359	362	361	394	395	398	397	0.0	0.0050000	0.0050000	0.0050000
222	359	360	363	362	395	396	399	398	0.0	0.0050000	0.0050000	0.0050000
223	219	361	364	222	255	397	400	258	0.0	0.0050000	0.0050000	0.0050000
224	361	362	365	364	397	398	401	400	0.0	0.0050000	0.0050000	0.0050000
225	362	363	366	365	398	399	402	401	0.0	0.0050000	0.0050000	0.0050000
226	222	364	367	225	258	400	403	261	0.0	0.0050000	0.0055000	0.0050000
227	364	365	368	367	400	401	404	403	0.0	0.0050000	0.0055000	0.0050000
228	365	366	369	368	401	402	405	404	0.0	0.0050000	0.0055000	0.0050000
229	225	367	370	228	261	403	406	264	0.0	0.0075000	0.0063000	0.0075000
230	367	368	371	370	403	404	407	406	0.0	0.0075000	0.0063000	0.0075000
231	368	369	372	371	404	405	408	407	0.0	0.0075000	0.0063000	0.0075000
232	231	373	376	234	267	409	412	270	0.0	0.0050000	0.0020000	0.0050000
233	373	374	377	376	409	410	413	412	0.0	0.0050000	0.0020000	0.0050000
234	374	375	378	377	410	411	414	413	0.0	0.0050000	0.0020000	0.0050000
235	234	376	379	237	270	412	415	273	0.0	0.0050000	0.0020000	0.0050000
236	376	377	380	379	412	413	416	415	0.0	0.0050000	0.0020000	0.0050000
237	377	378	381	380	413	414	417	416	0.0	0.0050000	0.0020000	0.0050000
238	237	379	382	240	273	415	418	276	0.0	0.0050000	0.0030000	0.0050000
239	379	380	383	382	415	416	419	418	0.0	0.0050000	0.0030000	0.0050000
240	380	381	384	383	416	417	420	419	0.0	0.0050000	0.0030000	0.0050000
241	240	382	385	243	276	418	421	279	0.0	0.0050000	0.0030000	0.0050000
242	382	383	386	385	418	419	422	421	0.0	0.0050000	0.0030000	0.0050000
243	383	384	387	386	419	420	423	422	0.0	0.0050000	0.0030000	0.0050000
244	243	385	388	246	279	421	424	282	0.0	0.0050000	0.0050000	0.0050000
245	385	386	389	388	421	422	425	424	0.0	0.0050000	0.0050000	0.0050000
246	386	387	390	389	422	423	426	425	0.0	0.0050000	0.0050000	0.0050000
247	246	388	391	249	282	424	427	285	0.0	0.0059000	0.0059000	0.0059000
248	388	389	392	391	424	425	428	427	0.0	0.0059000	0.0059000	0.0059000
249	389	390	393	392	425	426	429	428	0.0	0.0059000	0.0059000	0.0059000
250	249	391	394	252	285	427	430	288	0.0	0.0050000	0.0050000	0.0050000
251	391	392	395	394	427	428	431	430	0.0	0.0050000	0.0050000	0.0050000
252	392	393	396	395	428	429	432	431	0.0	0.0050000	0.0050000	0.0050000
253	252	394	397	255	288	430	433	291	0.0	0.0050000	0.0050000	0.0050000
254	394	395	398	397	430	431	434	433	0.0	0.0050000	0.0050000	0.0050000
255	395	396	399	398	431	432	435	434	0.0	0.0050000	0.0050000	0.0050000
256	255	397	400	258	291	433	436	294	0.0	0.0050000	0.0050000	0.0050000
257	397	398	401	400	433	434	437	436	0.0	0.0050000	0.0050000	0.0050000

258	398	399	402	401	434	435	438	437	0.0	0.0050000	0.0050000	0.0050000
259	258	400	403	261	294	436	439	297	0.0	0.0050000	0.0055000	0.0050000
260	400	401	404	403	436	437	440	439	0.0	0.0050000	0.0055000	0.0050000
261	401	402	405	404	437	438	441	440	0.0	0.0050000	0.0055000	0.0050000
262	261	403	406	264	297	439	442	300	0.0	0.0075000	0.0063000	0.0075000
263	403	404	407	406	439	440	443	442	0.0	0.0075000	0.0063000	0.0075000
264	404	405	408	407	440	441	444	443	0.0	0.0075000	0.0063000	0.0075000
265	267	409	412	270	303	445	448	306	0.0	0.0050000	0.0020000	0.0050000
266	409	410	413	412	445	446	449	448	0.0	0.0050000	0.0020000	0.0050000
267	410	411	414	413	446	447	450	449	0.0	0.0050000	0.0020000	0.0050000
268	270	412	415	273	306	448	451	309	0.0	0.0050000	0.0020000	0.0050000
269	412	413	416	415	448	449	452	451	0.0	0.0050000	0.0020000	0.0050000
270	413	414	417	416	449	450	453	452	0.0	0.0050000	0.0020000	0.0050000
271	273	415	418	276	309	451	454	312	0.0	0.0050000	0.0030000	0.0050000
272	415	416	419	418	451	452	455	454	0.0	0.0050000	0.0030000	0.0050000
273	416	417	420	419	452	453	456	455	0.0	0.0050000	0.0030000	0.0050000
274	276	418	421	279	312	454	457	315	0.0	0.0050000	0.0030000	0.0050000
275	418	419	422	421	454	455	458	457	0.0	0.0050000	0.0030000	0.0050000
276	419	420	423	422	455	456	459	458	0.0	0.0050000	0.0030000	0.0050000
277	279	421	424	282	315	457	460	318	0.0	0.0050000	0.0050000	0.0050000
278	421	422	425	424	457	458	461	460	0.0	0.0050000	0.0050000	0.0050000
279	422	423	426	425	458	459	462	461	0.0	0.0050000	0.0050000	0.0050000
280	282	424	427	285	318	460	463	321	0.0	0.0059000	0.0059000	0.0059000
281	424	425	428	427	460	461	464	463	0.0	0.0059000	0.0059000	0.0059000
282	425	426	429	428	461	462	465	464	0.0	0.0059000	0.0059000	0.0059000
283	285	427	430	288	321	463	466	324	0.0	0.0050000	0.0050000	0.0050000
284	427	428	431	430	463	464	467	466	0.0	0.0050000	0.0050000	0.0050000
285	428	429	432	431	464	465	468	467	0.0	0.0050000	0.0050000	0.0050000
286	288	430	433	291	324	466	469	327	0.0	0.0050000	0.0050000	0.0050000
287	430	431	434	433	466	467	470	469	0.0	0.0050000	0.0050000	0.0050000
288	431	432	435	434	467	468	471	470	0.0	0.0050000	0.0050000	0.0050000
289	291	433	436	294	327	469	472	330	0.0	0.0050000	0.0050000	0.0050000
290	433	434	437	436	469	470	473	472	0.0	0.0050000	0.0050000	0.0050000
291	434	435	438	437	470	471	474	473	0.0	0.0050000	0.0050000	0.0050000
292	294	436	439	297	330	472	475	333	0.0	0.0050000	0.0055000	0.0050000
293	436	437	440	439	472	473	476	475	0.0	0.0050000	0.0055000	0.0050000
294	437	438	441	440	473	474	477	476	0.0	0.0050000	0.0055000	0.0050000
295	297	439	442	300	333	475	478	336	0.0	0.0075000	0.0063000	0.0075000
296	439	440	443	442	475	476	479	478	0.0	0.0075000	0.0063000	0.0075000
297	440	441	444	443	476	477	480	479	0.0	0.0075000	0.0063000	0.0075000
298	339	481	482	342	375	493	494	378	0.0	0.0050000	0.0500000	0.0050000
299	342	482	483	345	378	494	495	381	0.0	0.0050000	0.0500000	0.0050000
300	345	483	484	348	381	495	496	384	0.0	0.0050000	0.0500000	0.0050000
301	348	484	485	351	384	496	497	387	0.0	0.0050000	0.0500000	0.0050000
302	351	485	486	354	387	497	498	390	0.0	0.0050000	0.0500000	0.0050000
303	354	486	487	357	390	498	499	393	0.0	0.0059000	0.0059000	0.0059000
304	357	487	488	360	393	499	500	396	0.0	0.0050000	0.0500000	0.0050000
305	360	488	489	363	396	500	501	399	0.0	0.0050000	0.0050000	0.0050000
306	363	489	490	366	399	501	502	402	0.0	0.0050000	0.0500000	0.0050000
307	366	490	491	369	402	502	503	405	0.0	0.0050000	0.0500000	0.0050000
308	369	491	492	372	405	503	504	408	0.0	0.0050000	0.0500000	0.0050000
309	375	493	494	378	411	505	506	414	0.0	0.0050000	0.0500000	0.0050000
310	378	494	495	381	414	506	507	417	0.0	0.0050000	0.0500000	0.0050000
311	381	495	496	384	417	507	508	420	0.0	0.0050000	0.0500000	0.0050000

312	384	496	497	387	420	508	509	423	0.0	0.0050000	0.0500000	0.0050000
313	387	497	498	390	423	509	510	426	0.0	0.0050000	0.0500000	0.0050000
314	390	498	499	393	426	510	511	429	0.0	0.0059000	0.0059000	0.0059000
315	393	499	500	396	429	511	512	432	0.0	0.0050000	0.0500000	0.0050000
316	396	500	501	399	432	512	513	435	0.0	0.0050000	0.0050000	0.0050000
317	399	501	502	402	435	513	514	438	0.0	0.0050000	0.0500000	0.0050000
318	402	502	503	405	438	514	515	441	0.0	0.0050000	0.0500000	0.0050000
319	405	503	504	408	441	515	516	444	0.0	0.0050000	0.0500000	0.0050000
320	411	505	506	414	447	517	518	450	0.0	0.0050000	0.0500000	0.0050000
321	414	506	507	417	450	518	519	453	0.0	0.0050000	0.0500000	0.0050000
322	417	507	508	420	453	519	520	456	0.0	0.0050000	0.0500000	0.0050000
323	420	508	509	423	456	520	521	459	0.0	0.0050000	0.0500000	0.0050000
324	423	509	510	426	459	521	522	462	0.0	0.0050000	0.0500000	0.0050000
325	426	510	511	429	462	522	523	465	0.0	0.0059000	0.0059000	0.0059000
326	429	511	512	432	465	523	524	468	0.0	0.0050000	0.0500000	0.0050000
327	432	512	513	435	468	524	525	471	0.0	0.0050000	0.0050000	0.0050000
328	435	513	514	438	471	525	526	474	0.0	0.0050000	0.0500000	0.0050000
329	438	514	515	441	474	526	527	477	0.0	0.0050000	0.0500000	0.0050000
330	441	515	516	444	477	527	528	480	0.0	0.0050000	0.0500000	0.0050000
331	481	529	534	482	493	589	594	494	0.0	0.0050000	0.0020000	0.0050000
332	529	530	535	534	589	590	595	594	0.0	0.0050000	0.0020000	0.0050000
333	530	531	536	535	590	591	596	595	0.0	0.0050000	0.0020000	0.0050000
334	531	532	537	536	591	592	597	596	0.0	0.0050000	0.0020000	0.0050000
335	532	533	538	537	592	593	598	597	0.0	0.0050000	0.0020000	0.0050000
336	482	534	539	483	494	594	599	495	0.0	0.0050000	0.0020000	0.0050000
337	534	535	540	539	594	595	600	599	0.0	0.0050000	0.0020000	0.0050000
338	535	536	541	540	595	596	601	600	0.0	0.0050000	0.0020000	0.0050000
339	536	537	542	541	596	597	602	601	0.0	0.0050000	0.0020000	0.0050000
340	537	538	543	542	597	598	603	602	0.0	0.0050000	0.0020000	0.0050000
341	483	539	544	484	495	599	604	496	0.0	0.0050000	0.0030000	0.0050000
342	539	540	545	544	599	600	605	604	0.0	0.0050000	0.0030000	0.0050000
343	540	541	546	545	600	601	606	605	0.0	0.0050000	0.0030000	0.0050000
344	541	542	547	546	601	602	607	606	0.0	0.0050000	0.0030000	0.0050000
345	542	543	548	547	602	603	608	607	0.0	0.0050000	0.0030000	0.0050000
346	484	544	549	485	496	604	609	497	0.0	0.0050000	0.0030000	0.0050000
347	544	545	550	549	604	605	610	609	0.0	0.0050000	0.0030000	0.0050000
348	545	546	551	550	605	606	611	610	0.0	0.0050000	0.0030000	0.0050000
349	546	547	552	551	606	607	612	611	0.0	0.0050000	0.0030000	0.0050000
350	547	548	553	552	607	608	613	612	0.0	0.0050000	0.0030000	0.0050000
351	485	549	554	486	497	609	614	498	0.0	0.0050000	0.0050000	0.0050000
352	549	550	555	554	609	610	615	614	0.0	0.0050000	0.0050000	0.0050000
353	550	551	556	555	610	611	616	615	0.0	0.0050000	0.0050000	0.0050000
354	551	552	557	556	611	612	617	616	0.0	0.0050000	0.0050000	0.0050000
355	552	553	558	557	612	613	618	617	0.0	0.0050000	0.0050000	0.0050000
356	486	554	559	487	498	614	619	499	0.0	0.0059000	0.0059000	0.0059000
357	554	555	560	559	614	615	620	619	0.0	0.0059000	0.0059000	0.0059000
358	555	556	561	560	615	616	621	620	0.0	0.0059000	0.0059000	0.0059000
359	556	557	562	561	616	617	622	621	0.0	0.0059000	0.0059000	0.0059000
360	557	558	563	562	617	618	623	622	0.0	0.0059000	0.0050000	0.0059000
361	487	559	564	488	499	619	624	500	0.0	0.0050000	0.0050000	0.0050000
362	559	560	565	564	619	620	625	624	0.0	0.0050000	0.0050000	0.0050000
363	560	561	566	565	620	621	626	625	0.0	0.0050000	0.0050000	0.0050000
364	561	562	567	566	621	622	627	626	0.0	0.0050000	0.0050000	0.0050000
365	562	563	568	567	622	623	628	627	0.0	0.0050000	0.0050000	0.0050000

366	488	564	569	489	500	624	629	501	0.0	0.0050000	0.0050000	0.0050000
367	564	565	570	569	624	625	630	629	0.0	0.0050000	0.0050000	0.0050000
368	565	566	571	570	625	626	631	630	0.0	0.0050000	0.0050000	0.0050000
369	566	567	572	571	626	627	632	631	0.0	0.0050000	0.0050000	0.0050000
370	567	568	573	572	627	628	633	632	0.0	0.0050000	0.0050000	0.0050000
371	489	569	574	490	501	629	634	502	0.0	0.0050000	0.0050000	0.0050000
372	569	570	575	574	629	630	635	634	0.0	0.0050000	0.0050000	0.0050000
373	570	571	576	575	630	631	636	635	0.0	0.0050000	0.0050000	0.0050000
374	571	572	577	576	631	632	637	636	0.0	0.0050000	0.0050000	0.0050000
375	572	573	578	577	632	633	638	637	0.0	0.0050000	0.0050000	0.0050000
376	490	574	579	491	502	634	639	503	0.0	0.0050000	0.0055000	0.0050000
377	574	575	580	579	634	635	640	639	0.0	0.0050000	0.0055000	0.0050000
378	575	576	581	580	635	636	641	640	0.0	0.0050000	0.0055000	0.0050000
379	576	577	582	581	636	637	642	641	0.0	0.0050000	0.0055000	0.0050000
380	577	578	583	582	637	638	643	642	0.0	0.0050000	0.0055000	0.0050000
381	491	579	584	492	503	639	644	504	0.0	0.0075000	0.0063000	0.0075000
382	579	580	585	584	639	640	645	644	0.0	0.0075000	0.0063000	0.0075000
383	580	581	586	585	640	641	646	645	0.0	0.0075000	0.0063000	0.0075000
384	581	582	587	586	641	642	647	646	0.0	0.0075000	0.0063000	0.0075000
385	582	583	588	587	642	643	648	647	0.0	0.0075000	0.0063000	0.0075000
386	493	589	594	494	505	649	654	506	0.0	0.0050000	0.0020000	0.0050000
387	589	590	595	594	649	650	655	654	0.0	0.0050000	0.0020000	0.0050000
388	590	591	596	595	650	651	656	655	0.0	0.0050000	0.0020000	0.0050000
389	591	592	597	596	651	652	657	656	0.0	0.0050000	0.0020000	0.0050000
390	592	593	598	597	652	653	658	657	0.0	0.0050000	0.0020000	0.0050000
391	494	594	599	495	506	654	659	507	0.0	0.0050000	0.0020000	0.0050000
392	594	595	600	599	654	655	660	659	0.0	0.0050000	0.0020000	0.0050000
393	595	596	601	600	655	656	661	660	0.0	0.0050000	0.0020000	0.0050000
394	596	597	602	601	656	657	662	661	0.0	0.0050000	0.0020000	0.0050000
395	597	598	603	602	657	658	663	662	0.0	0.0050000	0.0020000	0.0050000
396	495	599	604	496	507	659	664	508	0.0	0.0050000	0.0030000	0.0050000
397	599	600	605	604	659	660	665	664	0.0	0.0050000	0.0030000	0.0050000
398	600	601	606	605	660	661	666	665	0.0	0.0050000	0.0030000	0.0050000
399	601	602	607	606	661	662	667	666	0.0	0.0050000	0.0030000	0.0050000
400	602	603	608	607	662	663	668	667	0.0	0.0050000	0.0030000	0.0050000
401	496	604	609	497	508	664	669	509	0.0	0.0050000	0.0030000	0.0050000
402	604	605	610	609	664	665	670	669	0.0	0.0050000	0.0030000	0.0050000
403	605	606	611	610	665	666	671	670	0.0	0.0050000	0.0030000	0.0050000
404	606	607	612	611	666	667	672	671	0.0	0.0050000	0.0030000	0.0050000
405	607	608	613	612	667	668	673	672	0.0	0.0050000	0.0030000	0.0050000
406	497	609	614	498	509	669	674	510	0.0	0.0050000	0.0050000	0.0050000
407	609	610	615	614	669	670	675	674	0.0	0.0050000	0.0050000	0.0050000
408	610	611	616	615	670	671	676	675	0.0	0.0050000	0.0050000	0.0050000
409	611	612	617	616	671	672	677	676	0.0	0.0050000	0.0050000	0.0050000
410	612	613	618	617	672	673	678	677	0.0	0.0050000	0.0050000	0.0050000
411	498	614	619	499	510	674	679	511	0.0	0.0059000	0.0059000	0.0059000
412	614	615	620	619	674	675	680	679	0.0	0.0059000	0.0059000	0.0059000
413	615	616	621	620	675	676	681	680	0.0	0.0059000	0.0059000	0.0059000
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415	617	618	623	622	677	678	683	682	0.0	0.0059000	0.0059000	0.0059000
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419	621	622	627	626	681	682	687	686	0.0	0.0050000	0.0050000	0.0050000

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421	500	624	629	501	512	684	689	513	0.0	0.0050000	0.0050000	0.0050000
422	624	625	630	629	684	685	690	689	0.0	0.0050000	0.0050000	0.0050000
423	625	626	631	630	685	686	691	690	0.0	0.0050000	0.0050000	0.0050000
424	626	627	632	631	686	687	692	691	0.0	0.0050000	0.0050000	0.0050000
425	627	628	633	632	687	688	693	692	0.0	0.0050000	0.0050000	0.0050000
426	501	629	634	502	513	689	694	514	0.0	0.0050000	0.0050000	0.0050000
427	629	630	635	634	689	690	695	694	0.0	0.0050000	0.0050000	0.0050000
428	630	631	636	635	690	691	696	695	0.0	0.0050000	0.0050000	0.0050000
429	631	632	637	636	691	692	697	696	0.0	0.0050000	0.0050000	0.0050000
430	632	633	638	637	692	693	698	697	0.0	0.0050000	0.0050000	0.0050000
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449	656	657	662	661	716	717	722	721	0.0	0.0050000	0.0020000	0.0050000
450	657	658	663	662	717	718	723	722	0.0	0.0050000	0.0020000	0.0050000
451	507	659	664	508	519	719	724	520	0.0	0.0050000	0.0030000	0.0050000
452	659	660	665	664	719	720	725	724	0.0	0.0050000	0.0030000	0.0050000
453	660	661	666	665	720	721	726	725	0.0	0.0050000	0.0030000	0.0050000
454	661	662	667	666	721	722	727	726	0.0	0.0050000	0.0030000	0.0050000
455	662	663	668	667	722	723	728	727	0.0	0.0050000	0.0030000	0.0050000
456	508	664	669	509	520	724	729	521	0.0	0.0050000	0.0030000	0.0050000
457	664	665	670	669	724	725	730	729	0.0	0.0050000	0.0030000	0.0050000
458	665	666	671	670	725	726	731	730	0.0	0.0050000	0.0030000	0.0050000
459	666	667	672	671	726	727	732	731	0.0	0.0050000	0.0030000	0.0050000
460	667	668	673	672	727	728	733	732	0.0	0.0050000	0.0030000	0.0050000
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465	672	673	678	677	732	733	738	737	0.0	0.0050000	0.0050000	0.0050000
466	510	674	679	511	522	734	739	523	0.0	0.0059000	0.0059000	0.0059000
467	674	675	680	679	734	735	740	739	0.0	0.0059000	0.0059000	0.0059000
468	675	676	681	680	735	736	741	740	0.0	0.0059000	0.0059000	0.0059000
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