January 1977

A Model of Environmental Transport of Heavy Metals Originating From Stack Derived Particulate Emission in Semi-Arid Regions

J. J. Jurinak

William J. Grenney

Gene L. Wooldridge

J. Paul Riley

R. J. Wagenet

99995

A MODEL OF ENVIRONMENTAL TRANSPORT OF HEAVY METALS ORIGINATING FROM STACK DERIVED PARTICULATE EMISSION IN SEMI-ARID REGIONS

UTAH STATE UNIVERSITY LOGAN, UTAH 84322 • JANUARY 1977

A MODEL OF ENVIRONMENTAL TRANSPORT OF HEAVY METALS ORIGINATING FROM STACK DERIVED PARTICULATE EMISSION IN SEMI-ARID REGIONS

PREPARED FOR

SOUTHERN CALIFORNIA EDISON COMPANY

CONTRACT NO. U0966901

BY

J. J. JURINAK
WM. J. GRENNEY
GENE L. WOOLDRIDGE
J. PAUL RILEY
R. J. WAGENET

UTAH STATE UNIVERSITY

LOGAN, UTAH 84322

JANUARY, 1977

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

LIST OF TABLES

EXECUTIVE SUMMARY

Purpose

The general model TOHM was developed to predict the transport of heavy metals originating from stack emmission of a coal-fired electric generating facility into the final environmental sink. The metals studied were Zn, Cr, Pb, Cd and Hg. TOHM is the result of interfacing four submodels: SPEDTEC, an atmospheric diffusion model; EROS, a soil erosion submodel; RAIN3, a precipitation predicting submodel; and CHEM, a soil chemistry submodel. TOHM integrates and describes the continuum of atmosphere-water-soil.

TOHM was developed to predict heavy metal transport in the semi-arid and arid regions of the intermountain west. Except for the climatic constraint, TOHM is not site specific.

Method

The input data for TOHM was taken from the Kaiparowits Plateau region of southern Utah. A hypothetical coal-fired electric generating facility was situated on Four Mile Bench and the stack emission was considered as the source of heavy metal pollution. The proximity of Lake Powell to the hypothetical generating facility made it the logical choice for the final environmental sink.

The aerosol fallout impact area was defined and divided into a grid of land sections measuring 10 km x 10 km (100 km^2). A 100 km^2 unit is referred to as an element. The fallout area contained about 288 elements. Each element was defined with respect to soil type, topography and vegetation. The element represented the finest resolution in terms of terrestrial description.

The principle underlying the prediction of heavy metal transport to the environmental sink is that the major vector for transport is the eroded soil carrying both indigenous and aerosol deposited heavy metals in the adsorbed or particulate form. Model TOHM incorporates

(1) the prediction of the amount of heavy metal deposited from stack effluent on each element;

(2) the prediction of both rainfall amounts and intensities for each element;

(3) prediction of the amount of eroded soil in each element;

(4) the interaction between adjacent elements in terms of loss or accumulation of eroded material;

(5) quantitative consideration of the chemical transformations of heavy metals that occur in the surface soil; and

(6) quantification of the amount of heavy metals stored in the subsoil and transported with the eroded soil to Lake Powell.

Summary of Results

Because of the importance of erosion to the overall prediction capability of TOHM, EROS was run to simulate sediment production in the study area over a 50 year period. The data showed

(1) Soil erosion rates as predicted by EROS are insensitive to the seed number used for the random number generator in the precipitation submodel (RAIN3).

(2) Soil erosion rates are relatively sensitive to the coefficients (C_i) of the Universal Soil Loss Equation, which is the basic equation of EROS.

(3) The rate of heavy metals transported to the environmental sink, using only the erosion option of TOHM, suggested that the transport of heavy metals to the sink by erosion will not reach 50 percent of the maximum rate until about 20 to 50 years after the initiation of aerosol deposition.

Submodel CHEM was run on a single test element to show the affect of soil chemistry on the transport of Zn, Cr, Pb, Cd and Hg to the environmental sink over a simulated 50 year period. The data showed that

(1) Heavy metal transport is insensitive to the chemistry submodel. CHEM predicts all aerosol deposited heavy metals accumulate in the surface soil and are subject to erosion.

(2) In the test element run, the Zn, Cr, Pb and Cd loading of the sink was attributed to the natural (indigenous) level of these metals in the soil. Fallout was insignificant with regard to the total amount of these metals eroded to the lake.

(3) In the test element run, the loading of the sink was materially affected by Hg fallout. About 65 percent of the Hg loading of the sink was contributed by fallout. This result is ascribed to the low level of indigenous Hg in the soil relative to the amount of the Hg in the fallout.

(4) The test runs with various option of the CHEM submodel showed that refined chemistry is not necessary to predict heavy metal transportation in arid climatic zones. The transport of the metals studied showed that an erosion model coupled with an aerosol deposition model can predict the movement of deposited aerosol to the environmental sink.

The general model TOHM was applied to the total impact study site to simulate Zn, Cr, Pb, Cd and Hg loading of the environment sink over a 25 year period. The conclusion essentially corroborated the findings of the CHEM submodel study. The results showed that

(1) The loading of Zn, Cr and Pb into the lake (sink) could be accounted for by indigenous metal eroded to the lake. Fallout of these heavy metals had no impact on the loading.

(2) The Hg loading of the lake was dramatically affected by aerosol deposition. After 25 years, 83 percent of the Hg loading resulted from fallout. About 6 percent of Cd loading was attributed to fallout in the study area.

(3) Aerosol fallout increased Hg loading of the sink by 600 percent over the level contributed by indigenous Hg in the system. Fallout increased Cd loading by about 11 percent above the natural baseline level.

(4) After 25 years, 15 percent of the heavy metals in the fallout have eroded to the sink leaving 85 percent stored in the surface soil of the study area.

The data simulated by TOHM are considered to give a realistic approximation of the impact of a coal-fired electric generating facility on the heavy metal loading of an environmental sink. TOHM has provided the necessary first step in an integrated approach to solve the complex problem of interacting natural systems.

CHAPTER 1

INTRODUCTION

The impact of a coal-fired electric generating plant on its surrounding environment is a subject of controversy. Pollutants which are normally associated with coal-fired generating plants are residual ash and the oxides of sulfur and nitrogen which are emitted by the stack into the atmosphere. There is also a potentially more dangerous pollutant which is released into the atmosphere during burning of coal, that is, the heavy metals which are constituents of the fuel. This group includes such toxic metals as mercury (Hg), lead (Pb), cadmium (Cd), chromium (Cr), zinc (Zn), beryllium (Be), etc.

The fate of the heavy metals entering the environment via stack emission is open to question. However, the documented toxicity of many of the heavy metals coupled with their tendency to accumulate in biological systems makes the assessment of the interaction of air-borne heavy metal contaminants with the environment of major importance.

The broad objective of this study was to predict the ultimate fate of heavy metal pollutants which enter the environment from the stack emmission of a coal-fired electric generating station situated in a semi-arid climatic region. This objective was accomplished by the development of a general model designated as TOHM which estimates the mass flow transport of heavy metals in an environmental continuum of soil, water and atmosphere.

The development of TOHM consisted of essentially interfacing an atmospheric model (SPEDTEC), a rainfall generating model (RAIN3), a terrestrial erosion model (EROS) and a soil chemistry model (CHEM) to effect a realistic prediction of the interaction of heavy metal containing aerosols with semi-arid or arid environments in the intermountain west. Except for the climatic constraint, TOHM is a model of general applicability and is not site specific.

Study Area of Project

The model TOHM was developed with input data from the Kaiparowits Plateau region of south-central Utah. A hypothetical coal-fired electric generating plant was situated on Four Mile Bench and the stack emission was considered as the source of heavy metal pollution. The location of Four Mile Bench on the Kaiparowits Plateau and its proximity to the Colorado River and Lake Powell allowed prediction by TOHM of the heavy metal loading of Lake Powell as effected by stack effluent. Lake Powell can be considered the primary regional sink for both natural and man-induced pollution. The fallout impact (deposition) area for the hypothetical generating station was defined to fall within the Colorado River drainage basin, north of Glen Canyon Dam and within a 150 km radius of the generating station. The base map of the study area is shown in Figure 1.1.

Baseline data used in this study were obtained from several sample collecting trips to Lake Powell and the surrounding area as well as from published information (U. S. Dept. of Interior, Bur. of Land Mngt., 1976; Murdock et al., 1975; Waltham, 1976).

The General Model TOHM

TOHM integrates four submodels and predicts the mass transport of Hg, Pb, Cd, Zn and Cr into Lake Powell. TOHM is a first generation model which unifies a series of complex natural phenomena. Although baseline data were used when available, considerable input data were necessarily

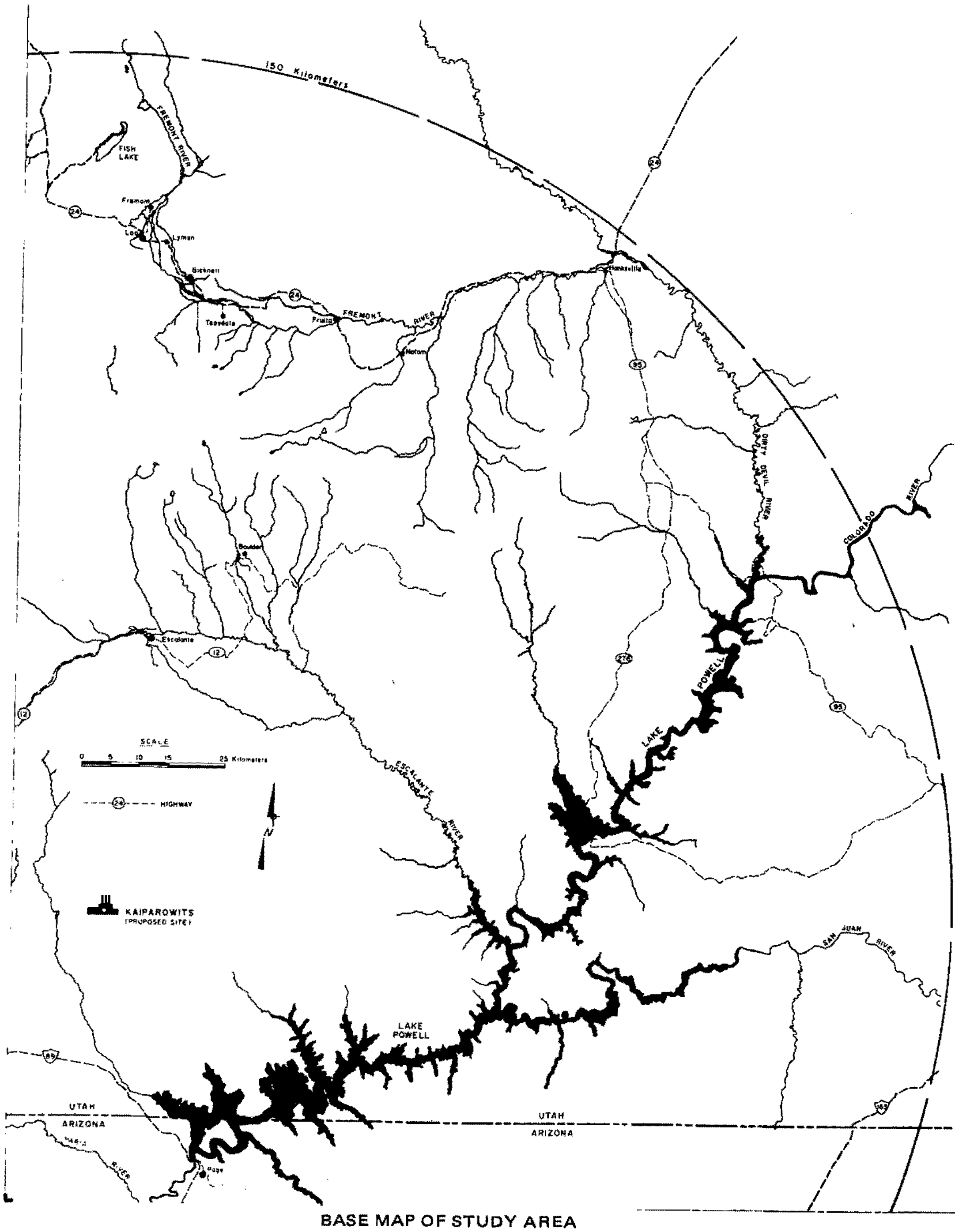

Figure 1.1. Base map of fallout impact area for the general model TOHM.

based on "best" estimates.

A description of the general approach used in TOHM is given. The fallout impact area (Figure 1.1) was divided into a grid of land sections measuring 10 km x 10 km or 100 km^2. A 100 km^2 unit is referred to as an element. The fallout area contained about 288 elements. Each element was described in terms of its predominant soil type, vegetation and topography. The element represented the finest resolution in terms of the terrestrial system.

The fallout deposition, for any given season, was distributed over the impact area as determined by the submodel SPEDTEC. For any given element the aerosol deposition was uniformly distributed over the 100 km^2 area. The total amount deposited, however, varied from element to element depending upon various factors to be discussed in Chapter 2. No chemical reactions involving heavy metals were considered to have occurred in the aerosol form and no attempt was made to partition the various heavy metals between the size fractions of the aerosols. The escape fractions for the metals in question were obtained from the estimates of Walther (1976). In any element, total aerosol deposition multiplied by the escape fraction for a given heavy metal gave the amount of a given heavy metal (kg/km^2) deposited. The choice of a 150 km radius aerosol deposition zone was based on a reasonable compromise between the diverse concepts of (1) total deposition within a short distance (ca. 50 km) from the generating site; and (2) negligible deposition within the Colorado River Basin. Submodel SPEDTEC further assumed that approximately 75 percent of the total stack particulate emission (assumed to be 955 kg/hr) was deposited in the area enclosed by the 150 km radius.

When a rainfall event occurs, as generated by submodel RAIN3, the deposited aerosol is mixed with the upper 1 cm of surface soil (crust) by raindrop action and the heavy metal of the deposited aerosol is added to the indigenous heavy metal content of the soil. The indigenous heavy metal concentration is assumed to be constant with depth. The submodel CHEM then either precipitates the heavy metal into its carbonate, hydrous oxide or other chemical form or adsorbs it on the exchange complex of the soil depending on the chemical activity of the ion in question. If the rainfall moves moisture below the 1 cm soil crust, heavy metal is transported into the subsoil in an amount controlled by its solubility product or exchange function. The heavy metal is assumed stored in the subsoil. If rainfall exceeds the infiltration rate of the soil, runoff and subsequent erosion occurs. The amount of soil eroded within each element is predicted by submodel EROS. As the eroded surface soil is transported from one element to another, a certain fraction of the deposited plus indigenous heavy metal in the surface soil is also transported. Depending on the predominate topography and soil type of each element, EROS allows only a certain fraction of eroded soil to move to adjacent elements. The interaction between adjacent elements wherein the eroded material from one element will be deposited in a neighboring element is accounted for by TOHM. This predicts that certain elements will accumulate heavy metals at the expense of neighboring elements. The accounting procedure which keeps track of eroded material transported from or deposited in the 288 elements is one of the primary functions of TOHM. If a element contains a non-intermittent mapped perennial stream channel it is assumed that all eroded soil in the element will enter the channel and enter Lake Powell within a 12 month period.

RAIN3 generates random rainfall on given elements for each month.

This submodel predicts the maximum 30 minute intensity during a month and also the amount of rainfall that will infiltrate the soil. These data are read into TOHM as if all rainfall occurred as one event per month. This result is reflected in the fact that the submodels CHEM and EROS are also activated on a one time per month per element basis. It was considered that the existing data do not justify a smaller time increment than a one month period.

The principle underlying the prediction of heavy metal transport to an environmental sink is that the major vector for transport is the eroded soil carrying both indigenous and aerosol deposited heavy metals in adsorbed or particulate form. Model TOHM therefore incorporates (1) the prediction of the amount of heavy metal deposited from stack effluent on each element, (2) the prediction of both rainfall amounts and intensities for each element, (3) prediction of the amount of eroded soil in each element, (4) the interaction between adjacent elements in terms of loss or accumulation of eroded material, (5) quantitative consideration of the chemical transformations of heavy metals that occur in the surface soils, and (6) quantification of the amount of heavy metals stored in the subsoil and transported with the eroded soil to Lake Powell. Figure 1.2 shows a simplified version of the flowchart for TOHM indicating the interfacing of the various submodels.

The chapters which follow in the report explain in detail the submodels SPEDTEC, EROS, RAIN3, and CHEM and the general model TOHM.

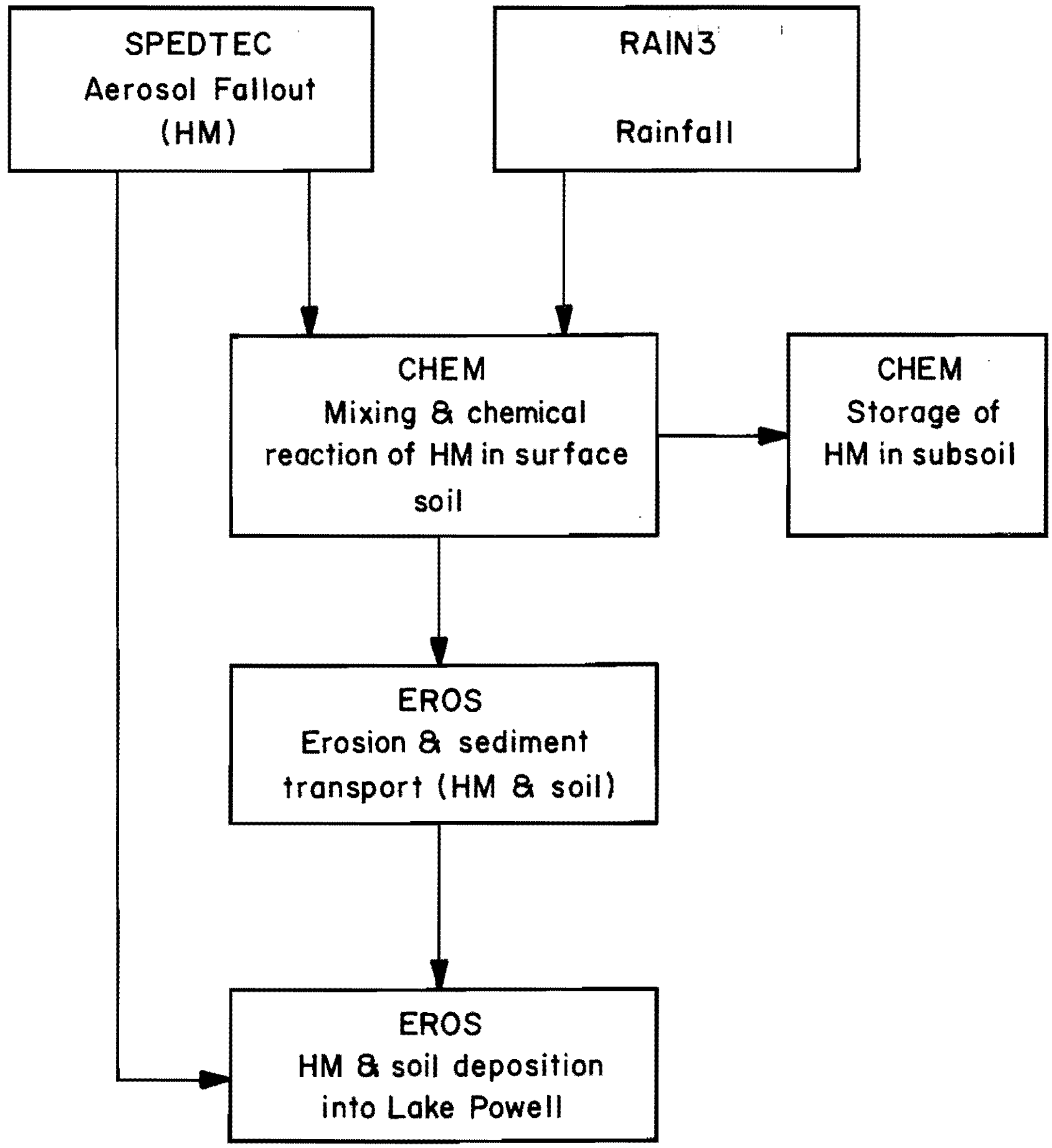

Figure 1.2. A simplified flow sheet for TOHM, a first generation model for heavy metal (HM) transport in semi-arid and arid environments.

CHAPTER 2

AN ATMOSPHERIC DISPERSION MODEL OF PARTICULATE DEPOSITION

Gene L. Wooldridge

The model described in this chapter predicts the fallout concentration of heavy metals, on soil and vegetative surfaces, that originates from the stack effluent of a hypothetical coal fired electric generating plant. The fallout deposition values for Pb, Zn, Cd, Hg and Cr are reported as kg of heavy metal for km^2 of element in the predicted impact area. The fallout concentration of a given heavy metal is assumed to be uniformly distributed over the surface of each element. The deposition data are predicted on a seasonal (monthly) basis. The model is designated as SPEDTEC.

Model Description

The dispersion of particulate stack effluent in the atmosphere depends on the effective stack height attained by the effluent plume, the vertical profile of the turbulent intensity of the atmosphere, the presence and location of atmospheric stable layers, the wind field, and the particle size distribution of the aerosols.

Effective stack height, or the final height of the horizontal plume center after emerging from the stack, is a function of exit gas temperature and velocity, stack height and diameter, wind speed, and atmospheric temperature structure. The equations for effective stack height have been verified extensively and present little difficulty for plume modeling.

Turbulent intensities, however, are not well known and are seldom measured directly over the proposed plant site. Tracer studies over mountainous terrain indicate an increase in turbulent intensity when compared to level terrain, due to mechanically-produced turbulence. Differential heating of mountain slopes also produces small circulation features which can be interpreted as turbulence. The author has measured turbulent intensities over mountainous terrain and found relationships which allow a treatment of diffusivity coefficients as a function of height, depending upon the roughness of the site terrain and the static stability of the atmosphere.

Particle size distributions can be measured in the stack or in the plume, and depend on the fuel burned, the combustion processes, and the pollution control devices fitted to the burners and the stack. The smallest particles, up to ten micrometers or so, have low settling velocities and can be modeled much like gaseous aerosols. The larger particles can be divided into size groups, each of which can be approximated by a mean radius.

The dispersion model applied here to predict the surface deposition of particulate effluent from a single steady-state elevated source utilizes site-characteristic diffusivity coefficient profiles. It adjusts the effective stack height and diffusivity profile according to atmospheric conditions and the terrain features. The model is said to be specific diffusivity terrain corrected. Climatological data on wind direction and speed at projected plume levels, the depth of the boundary mixed layer, and atmospheric stabilities are applied to model calculations.

The removal of particulates from an effluent plume results from the gravitational settling of particles and from attachment, or sorption, to soil and vegetation. Vegetation can be particularly active in sorption due to the large surface area of leaves and stems, the presence of dew, and inhalation through stomates. Gaseous effluents also undergo significant sorption under turbulent atmospheric conditions, and have been observed to become rapidly depleted in a plume over certain types of vegetative cover.

Estimations of long-term average concentrations of aerosols due to emmissions from an elevated pollutant source follow from the expression:

$$\chi(x,\theta) = \sum_{L}\sum_{S}\sum_{N}\left\{\left[\frac{2Qf(\theta,L,S,N)}{\sqrt{2\pi}\sigma_{z,S}U_N\left(\frac{2\pi x}{16}\right)}\right]\left(\exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_{z,S}}\right)^2\right] + (1-\alpha)\cdot \exp\left[-\frac{1}{2}\left(\frac{H}{\sigma_{z,S}}\right)^2\right]\right)\right\} \quad (2\text{-}1)$$

Summation can be taken over distributions of upper level stable layers at height L, stabilities S, and wind speed classes N. The expression has been adapted from Turner (1969, p. 38), with the addition of the L summation and the final term, which accounts for reflection from the Earth's soil or vegetative surface. Q represents the emission source strength; f (θ, L, S, N) is the fraction of total time for given sector θ, upper reflective surface height L, stability class S, and wind speed class N; H is the effective stack height; $\sigma_{z,S}$ is the standard deviation vertical separation distance for stability class S; U_N is the mean wind speed for class N; x is the downwind distance of the effluent from its source; and α is the attachment coefficient for the reflected material. $\chi(x,\theta)$ is computed as the surface effluent concentration within θ, one of the sixteen sectors centered on the compass points of the wind rose.

For application at a site located in mountainous terrain, specific values of $\sigma_{z,S}$ are required. Since the most satisfactory method of accomplishing this requires direct measurement of the vertical diffusivity component, (2-1) was modified through the relationships

$$\sigma_{z,S} = \sqrt{2K_{z,S}t}; \; x = U_N t \tag{2-2}$$

where t is the time-of-flight for stack effluent. It is particularly significant to determine the shape of the profile of vertical diffusivity, $K_{z,S}(z)$, as well as the values at key points in the profile (Lewis and Wooldridge, 1976).

The diffusion model accomodates changes in terrain by allowing the height of the effective stack (representing the undisturbed centerline of an effluent plume) to rise one-half as much as terrain height increases, and to fall one-half as far as height decreases. This procedure yields a degree of compromise between the concepts of centerline impingement and of laminar fluid flow as a plume meets or follows terrain features (Intera, 1976). As the centerline moves vertically with terrain changes, surface $K_{z,S}(z)$ values also change according to the prescribed shape of the vertical profile of $K_{z,S}(z)$.

Calculations of initial plume rise in the model use equations recommended by Briggs (1969), and Pasquill (1974) for three atmospheric situations: (1) neutral stability, with wind speed at effective stack height greater than 2 ms^{-1}; (2) stable atmosphere, with wind speed greater than 2 ms^{-1}; and (3) stable atmosphere, wind speed equal to or less than 2 ms^{-1}. The stability and wind speed criteria used for diffusivity calculations also served for the calculations for effluent rise to effective stack height, H.

Deposition of aerosols at the soil and vegetative surfaces was computed using the deposition velocity concept, expressed as

$$\omega = V_d \chi_o \tag{2-3}$$

where ω is the mass deposited per unit time, V_d is the deposition velocity, and χ_o the surface concentration predicted from the final diffusion equation.

For aerosols of very small diameters, deposition velocities have been estimated on the order of 10^{-1} to 10^{-2} ms^{-1}. This follows from high 'sorption capabilities of foliage in addition to soils, and has been shown to be dependent on wind speed, types of soil and foliage, moisture, and low-level turbulent intensities. The stability and wind speed criteria adopted for diffusivity coefficient profiles served to establish the estimated values of deposition velocities for small particulates. The deposition velocities reported by Gifford (1962) indicated a decrease with increasing distance downwind from the emission source point. This may be due to the selective 'sorption of certain particle sizes, with enhanced 'sorption of some of the size distribution, and slower 'sorption of the remaining particles. The ratio of deposition velocity, $V_{d,x}$ at a distance x, to deposition velocity, V_{d,x_r} at a reference distance x_r, was fitted to a power function

$$V_{d,x} = V_{d,x_r} \left(\frac{x}{x_r} \right)^p , \tag{2-3}$$

using the measurements of V_d. While agreement of p for the various experiments was not as good as desired, p = 0.6 was estimated and used for the calculations reported here.

Particulate emissions large enough to have Stokes' terminal fall velocities greater than the V_d's computed from (2-3) were gravitationally deposited in the model using the "tilted plume" method. In this category, a mean particle size was assigned for three size bands in the estimated particle size distribution. In the tilted plume, the initial effective stack height H_o is adjusted according to the terminal fall velocity V_g:

$$H_x = H_{o,x} - \frac{xV_g}{U_N} \quad (2\text{-}5)$$

in the dispersion equation. Deposition by this method is assumed if $V_g \geq V_{d,x}$; total deposition was summed over all size classes, including smaller particles which were assigned deposition velocities anticipated for small aerosols.

The effects of atmospheric chemical changes in emissions were not included in the deposition calculations, since the time constants are strongly a function of ambient relative humidity, and are poorly known. However, these changes may be incorporated in the model when the rate constants become available for each particulate or gaseous emission compound.

Application of the Model at Four-Mile Bench

The incompleteness of the existing atmospheric stability climatology, including the location, strength, and frequency of upper level inversions did not encourage excessive iteration of the final dispersion equation. Therefore, a joint distribution of wind speed class (U_N), stability (S), and depth of mixed layer (L) was assumed for each of the sixteen points of the wind roses, for each season of the year, for day and night. An example of this follows:

Table 2-1. Winter wind speeds, stabilities, and mixing depths.

Season: Winter

Daytime	$U_N(ms^{-1})$	$\Delta\theta/\Delta z(deg\ m^{-1})$	L(m)
	3	3×10^{-3}	1.5×10^3
	7	2×10^{-3}	2.0×10^3
	12	1×10^{-3}	2.5×10^3
	18	0	2.5×10^3

Night-time	3	2×10^{-3}	1.5×10^{3}
	7	1×10^{-1}	1.5×10^{3}
	12	0	1.8×10^{3}
	17	0	2.0×10^{3}

These joint distributions changed from one season to the next, with generally decreased stabilities and increased mixing depths into the spring, summer, and fall seasons (see Holzworth, 1972). The calculations were thus reduced to a summation over wind speed classes and particulate size bands.

Wind speeds and directions utilized here were those estimated for the Final Environmental Impact Statement by researchers for the U. S. Dept. of Interior (1976) for 2225 M msl at the hypothetical Four-Mile Bench site, from the Winslow, and Page, Arizona wind data.

The surface inversions observed at Four-Mile Bench generally extended less than 200 meters above the surface; plumes rising from the stacks of the proposed power-plant here were assumed to penetrate into the air above these inversions.

Terrain features in each of the sixteen sectors were derived from Geological Survey topographic maps at the 1:250,000 scale at five kilometer intervals along a radius originating at the proposed Four-Mile Bench site. The terrain was averaged across the 22.5 degree arc of each sector, resulting in some diminishment of isolated peak heights and increases in the lowest elevation features. For daytime calculations, the smoothed sector terrain was applied directly to modify the effective stack height and to determine the diffusivity coefficient. For night terrain, the lower basin and river valley elevations were increased to allow for surface inversions at those locations. These inversions were assumed total reflectors of lofted plumes, two hundred meters thick at lowest smoothed terrain regions. $\alpha = 0$ applied to the lower reflecting and upper limiting inversion levels; $\alpha = 1$ applied to the lower levels everywhere else, day and night. The day terrain features were assumed applicable half the hours of the day; the "night" terrain, with surface inversions, the other half.

Plume rise computations made use of the following atmospheric and stack parameters:

U_N, mean wind speed for each speed class N;

$\Delta\theta/\Delta z$, atmospheric stability, according to joint distribution as shown in Table 1;

R_o, stack radius of 5.0 meters;

T_g, stack gas temperature of 355^oK;

T_a, mean ambient air temperature of 284^oK;

W_o, stack gas exit velocity of 21 ms^{-1} at full load; and

g, gravitational constant of 9.8 ms^{-2}.

Multi-stack enhancement of plume rise was not considered, but would result in greater rise for some wind directions and lower deposition rates near the stacks.

The total particulate emission rate used here was placed at 1.05 tons per hour, predicated on an average abatement efficiency at the electrostatic precipitator of 99.1 percent for the proposed four-unit 3000 megawatt facility, fired with average coal such as from the Kaiparowits fields. The reduced efficiency is suggested because of occasional start-ups and shut-downs as load demand fluctuates during the day and over the seasons (U. S. Department of Interior, Bureau of Land Management, 1976).

The reference deposition velocities for small particulates varied according to three stabiiity classes: (1) for moderately to strongly stable air, .03 ms^{-1}; (2) for slightly stable air, 0.075 ms^{-1}; and (3) for neutral or unstable air, 0.10 ms^{-1}. These values agree with those offered by Gifford (1962) and serve to attain an approximate 75 percent mass deposition over an area outlined by a 150 kilometer radius from the source.

Measurements of the particulate size distribution from the stack at the Navajo power plant when under operation revealed very few particles of size large enough to have terminal fall velocities larger than the deposition velocities listed above. However, size distributions sampled by Lee et al. (1975) showed a significant fraction over 1 μm in diameter. Further, Lee determined a particle size distribution which varied according to each metal examined.

To accomodate large particles in the plant emission inventory, the "tilting plume" method was applied for three size fractions in this dispersion model. These particle size bands were: 3 percent of total particulates with a mean radius of 25 μm; 5 percent with radius 12.5 μ; and 10 percent with radius 7.5 μm. The model can accomodate a distribution for each metal when the appropriate numbers become available.

Vertical diffusivity coefficients selected for the application of the dispersion model were drawn from field measurements over and in mountainous terrain (Wooldridge and Ellis, 1974; Wooldridge and Orgill, 1975; Wooldridge, 1976). These were in turn fitted to three profiles as suggested by Agee et al. (1973) in the form

$$K_{z,S}(z) = a\left[\exp\left(-\frac{bz}{Z_T}\right) - \exp\left(-\frac{bcz}{Z_T}\right)\right] \qquad (2\text{-}6)$$

in which a, b, and c are specific data-fitting constants, z is the height for which the coefficient $K_{z,S}(z)$ is calculated, and Z_T is the height of the top of the planetary boundary layer.

The profiles resulting from application of (2-6) to field dispersion data are shown in Figure 2.1. The near-surface diffusivity coefficients used in the calculations were those computed for the 10-meter height from the appropriate profile when terrain equaled or was lower than the height of the source. When the effective stack height was increased or decreased to follow terrain at higher elevations, the vertical diffusivity coefficient at that height on the coefficient profile derived from (2-6).

The effects of changing the effective stack height and applying the appropriate vertical diffusivity coefficient for that height can be seen in Figure 2.2. The terrain in Fig. 2.2 is sector-averaged for locations north of Four-Mile Bench; surface deposition was calculated at 5 kilometer intervals up to 150 km distant with terrain and diffusivity corrections and, for comparison, with no terrain variations. Upon reaching the Kaiparowits Plateau deposition increased approximately by a factor of two or more due to rising terrain. Higher ground at 60 km distance caused slight increases, but highest levels showed slight decreases. This highest terrain decrease resulted from a decrease in diffusivity coefficient above the top of the boundary layer and from the presence of subsidence inversions. Small changes due to terrain features at large distances from the source are expected, since vertical mixing in this time-average dispersion model becomes so thorough 40 km and further downwind that little vertical variation exists in the plume.

Results of Time-Averaged Deposition Calculations

Computations of surface deposition of total particulates from the proposed power generating plant on Four-Mile Bench, using 16-point wind rose data, resulted in four (one for each season) charts of deposition within the area of interest, up to distances of 150 kilometers. Analyses

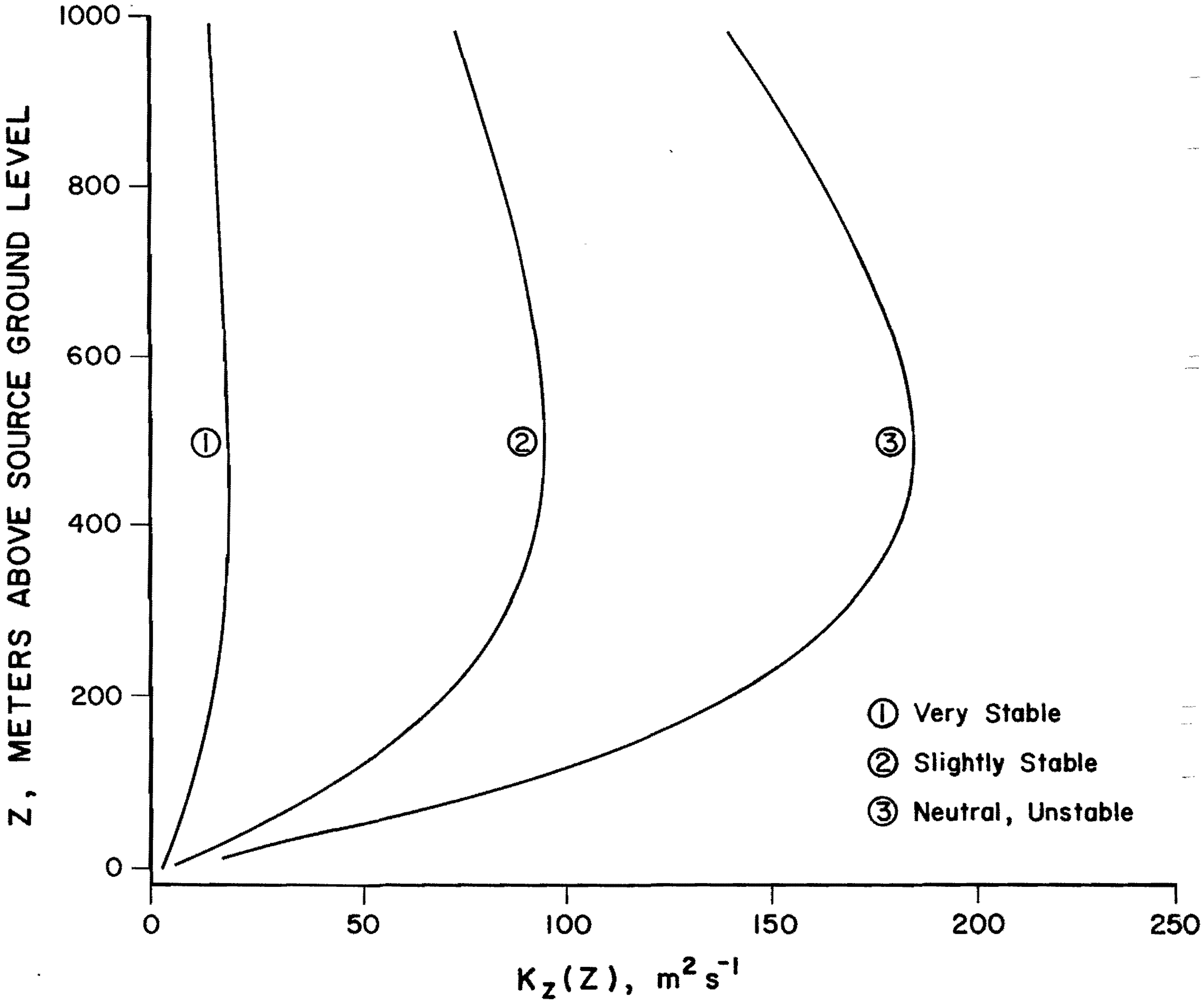

Figure 2.1. Vertical profiles of the vertical diffusivity coefficient derived from (2-6).

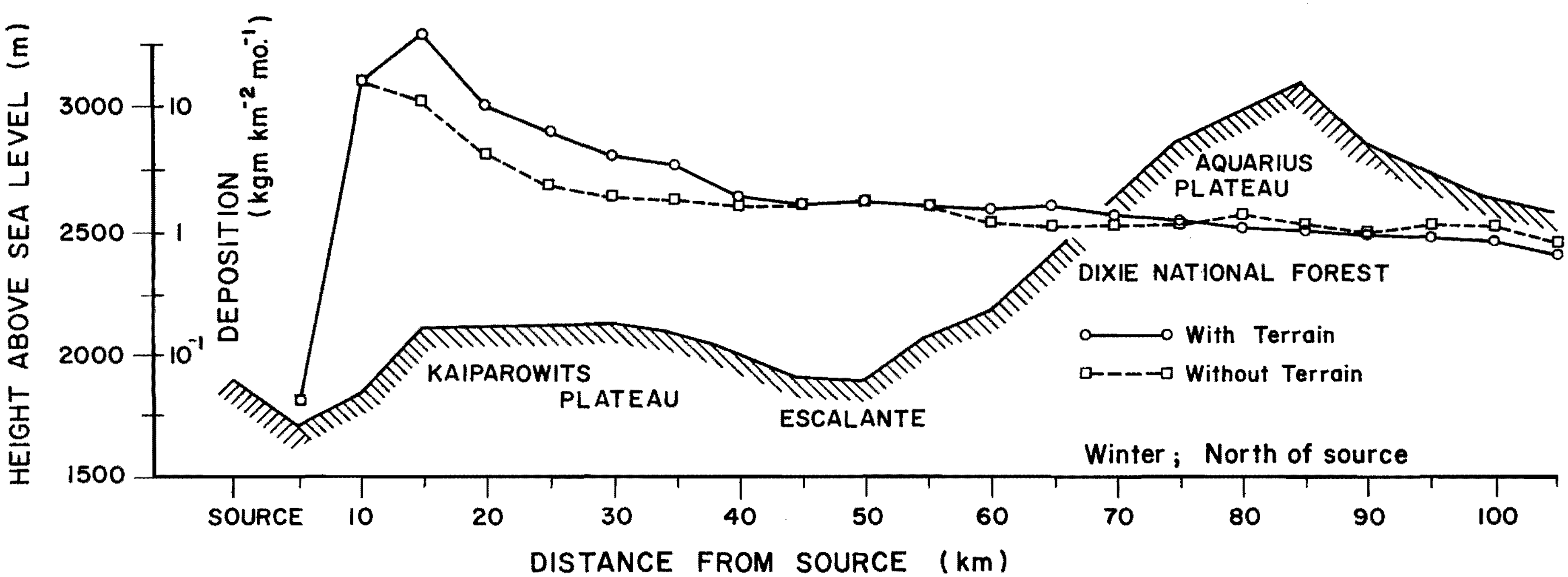

Figure 2.2. Deposition rate as a function of downwind distance to the north of Four Mile Bench. The dashed line represents an hypothetical deposition for level ground. The solid line represents the terrain-corrected deposition.

of these charts, using isopleths of constant monthly mass depositions, are shown in Figures 2.3, 2.4, 2.5, and 2.6 for the area near the hypothetical Four-Mile Bench sites.

The changes in patterns of deposition with season reflect corresponding changes in the wind speed and direction, atmospheric stabilities, and depths of the mixed layer. Lower wind speeds during periods of stable atmospheres cause high deposition to the south-southeast of the stack site.

Greatest deposition occurs on the Kaiparowits Plateau in all seasons, with a second maximum on Smoky Mountain in winter and summer. Deposition is highest in summer, due to larger diffusivity coefficients and light winds in neutral air; lowest values occur in fall under increased stabilities and winds with continued deep mixing layers.

The polar coordinate form of the deposition computations was transformed and translated to produce a cartesian set of mass values, using standard trigonometric relationships. This resulted in a dense network of computation points near the source and a sparse set at greater distances. The size of the area elements selected for this transport model meant that elements close to the source have more than one deposition value per element, and far from the source, less than one.

A simple objective analysis program was designed to average the deposition values within any area element when more than one value was available. Elements which contained one point were assigned that value. Area elements containing no deposition value were assigned values according to values in surrounding elements. Any values which were found in the eight elements immediately adjacent were averaged and assigned to the element in question. If the eight adjacent elements were empty, the search was widened one additional elemental distance around until deposi-

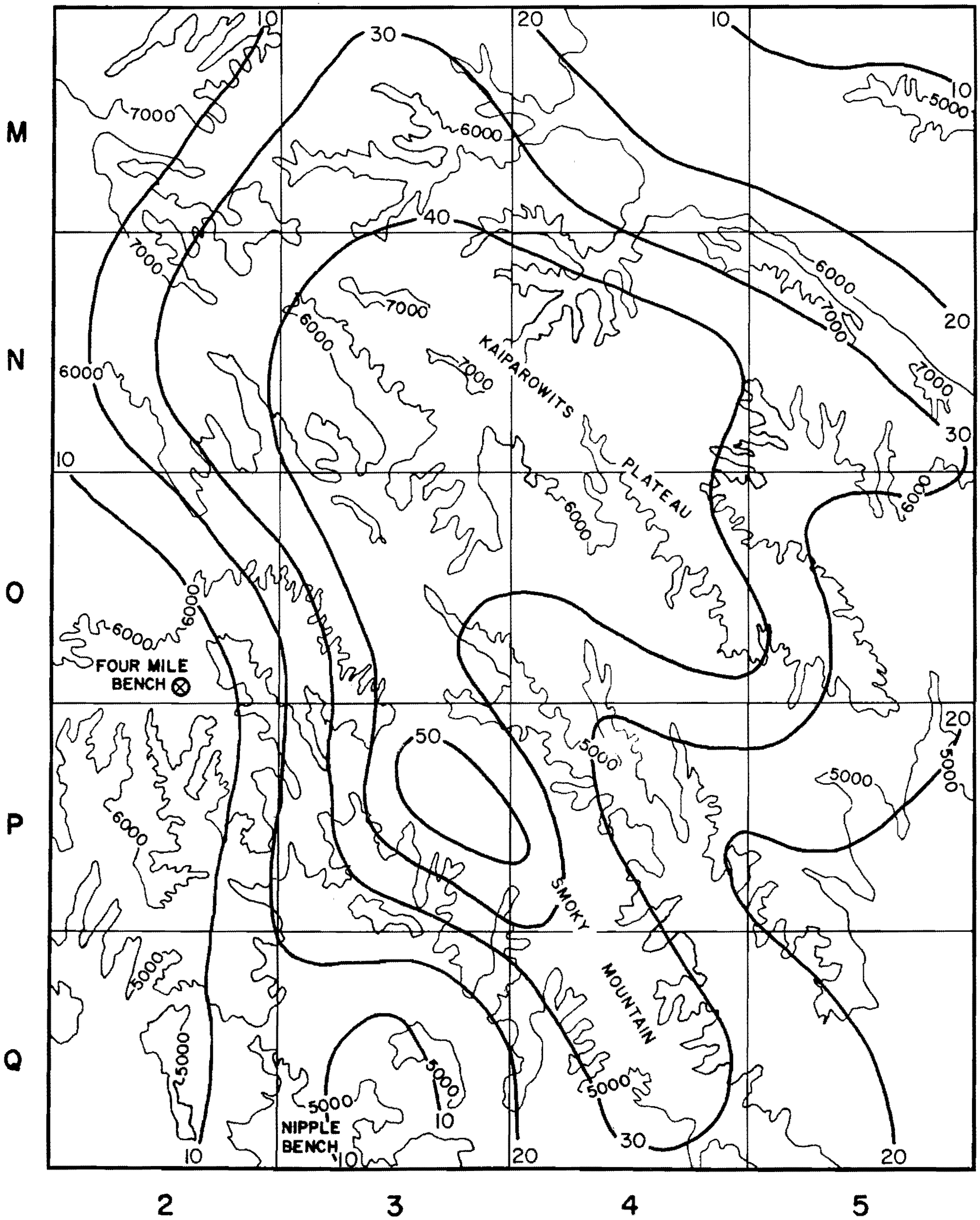

Figure 2.3. Mass deposition isopleths over twenty area elements near the hypothesized Four Mile Bench site in kgm km^{-2} mo^{-1}, for winter months.

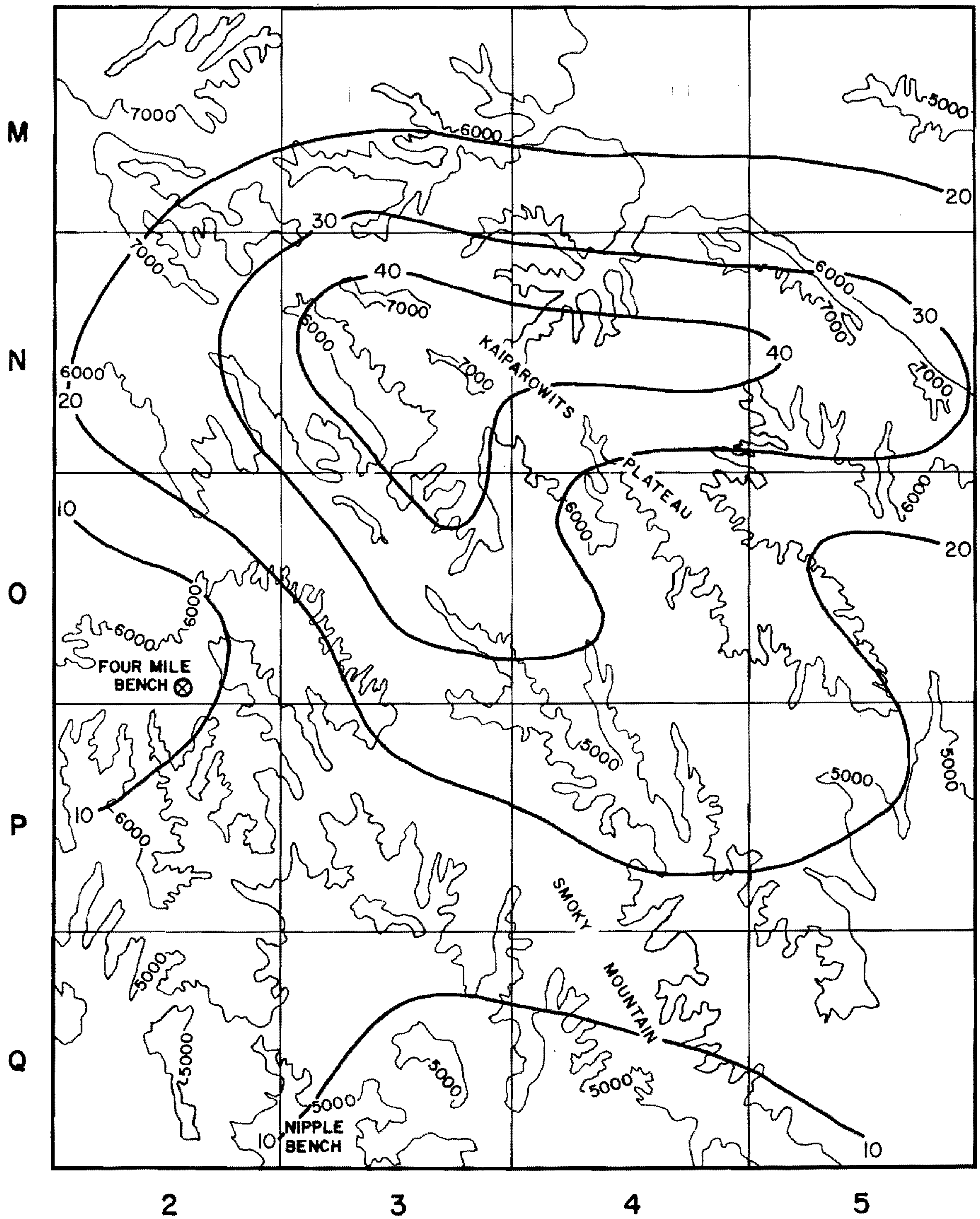

Figure 2.4. Same as Fig. 2.3, except for spring months.

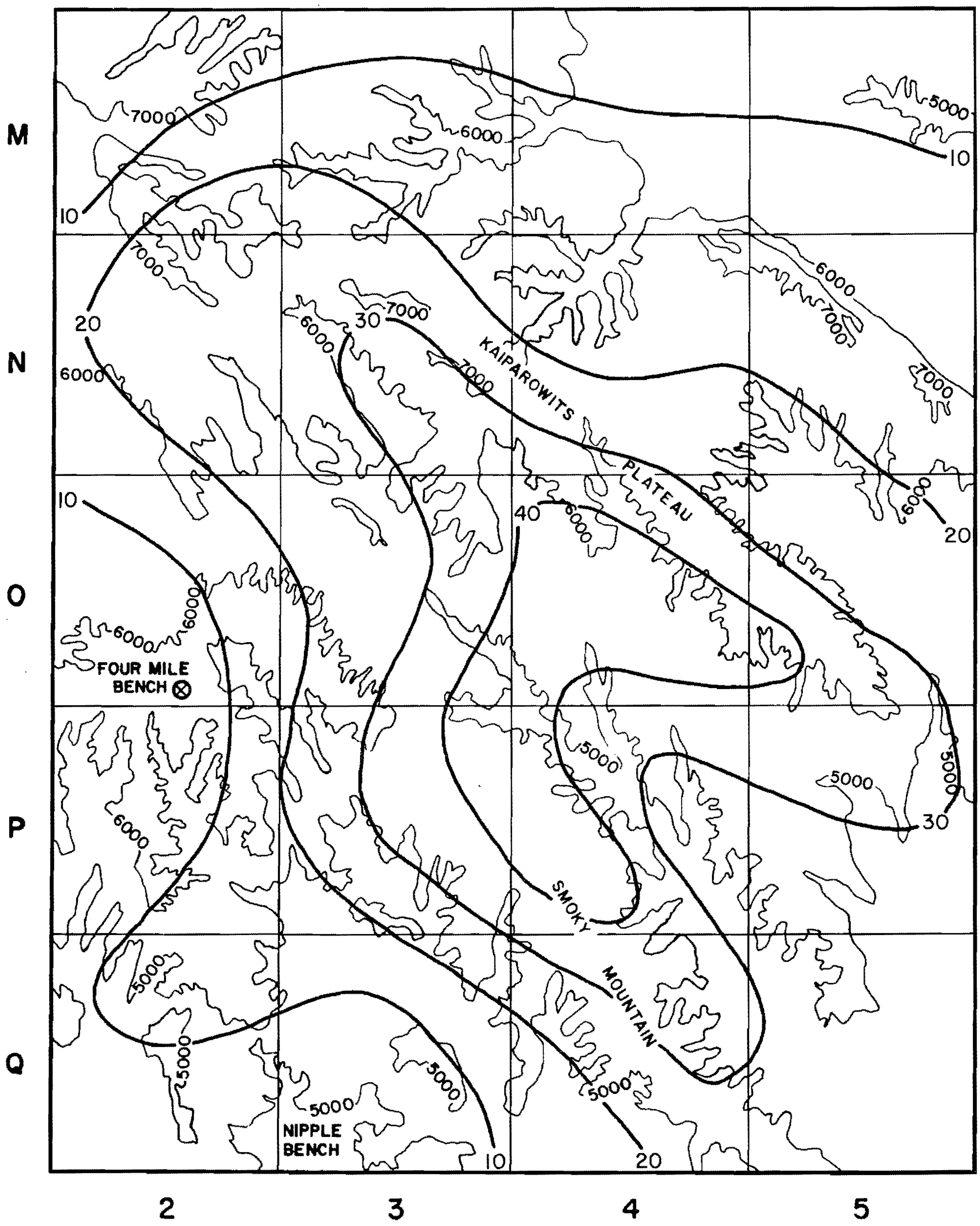

Figure 2.5. Same as Fig. 2.3, except for summer months.

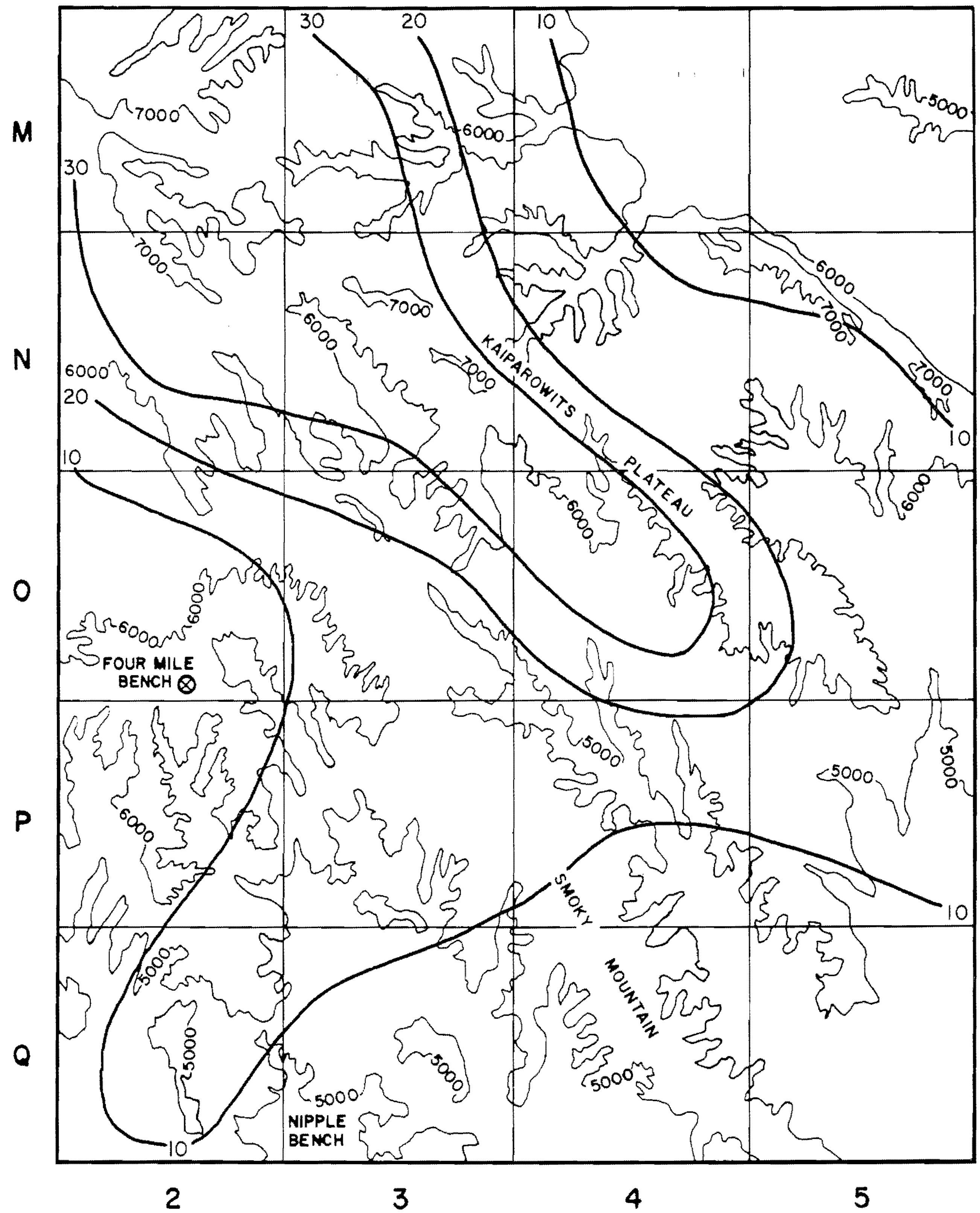

Figure 2.6. Same as Fig. 2.3, except for fall months.

tion values were found, averaged, and assigned to the element. No relaxation of the deposition field was performed.

Comparisons of the objective analyses to subjective analyses revealed good agreement. When deposition masses across the total study area were compared, the two analysis techniques differed by less than 10 percent of mass.

Figure 2.7, the flow chart for the SPEDTEC dispersion/deposition model, outlines the computational procedures. This interfaces with the next phase of the general model by furnishing a single value of deposited mass of total particulates for each area element for each month of four seasons.

Future Modeling Improvements

Accurate dispersion modeling depends on site-specific or site-characteristic profiles of the component diffusivity coefficients for each significant meteorological situation. The profiles employed for these calculatons were deemed site-characteristic within the limits of existing knowledge. Only when many more specific profiles have been measured can characteristic profiles be prepared with an adequate degree of confidence.

A more complete set of wind data using double-theodolite techniques at a proposed site through the lowest four or five kilometers of the atmosphere is required for partitioning into a wind rose. Tower data is of very little use unless the anemometers are high enough to measure wind at effective stack height. Further, the tower data, taken necessarily in the Eulerian frame of reference, is difficult to interpret for purposes of Lagrangian dispersion estimation and yields no information on specific

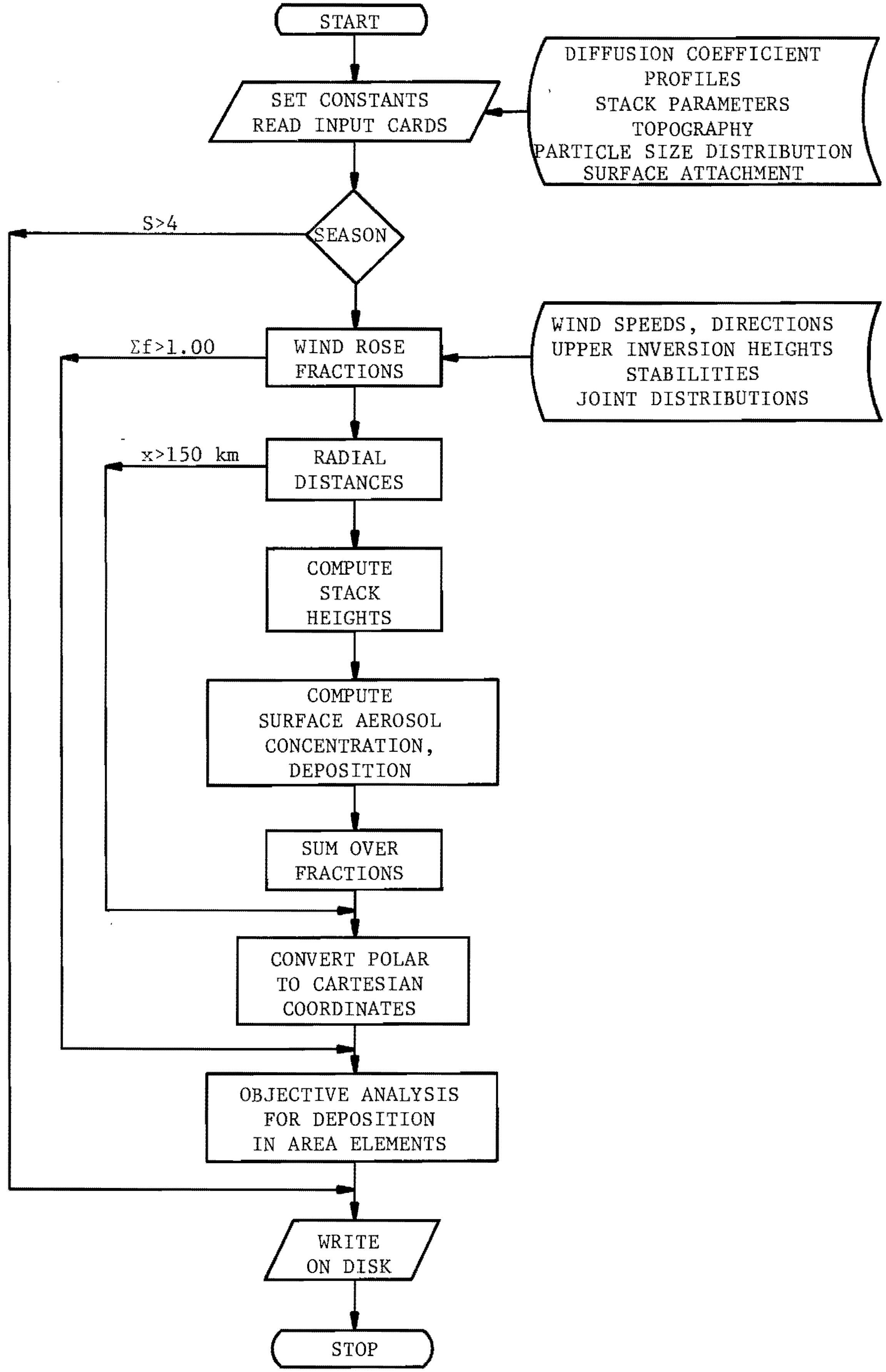

Figure 2.7. Flow chart for the SPEDTEC dispersion/deposition model.

trajectories.

The objective analysis program employed here is only a first step toward transfer of deposition data from dispersion calculations to surface movement of effluent particulates. Significant improvement will occur when a functional relationship between radial distance from the source and an appropriate weighting of deposition values in adjacent elements is applied to attain a deposition value for each area element. A relaxation scheme will then smooth element deposition values to suitable accuracy.

As three-dimensional advection-diffusion models become operational in the next two to five years, surface deposition of gaseous and particulate aerosols can be more realistically simulated. This will result in better calculations of atmospheric gradients and distributions, and better long-range estimates of deposition. Use of the 3-D models will concommitantly demand more and better measurements of 3-D diffusivity coefficients and Lagrangian wind fields. Tracer studies can then be used to better advantage to confirm or correct the dispersion models.

The dispersion model described and applied here may be used to estimate surface concentrations of gaseous aerosols as well as particulates. This assumes that sufficient wind, atmospheric stability, and mixing depth data are available to determine the fractions over which effluent masses are distributed.

ACKNOWLEDGEMENT

The author wishes to acknowledge the substantial contribution of Jackie Lewis to the dispersion modeling effort. Ms. Lewis wrote the computer program and made many helpful suggestions during the course of the work.

CHAPTER 3

A TERRESTRIAL MODEL FOR PREDICTING EROSION FROM AN ARID WILDLAND WATERSHED

R. J. Wagenet

This model provides a quantitative prediction of soil loss via water erosion from a given study site element. The basis of the model is a modified form of the Universal Soil Loss Equation. The model as used in this study is called EROS.

The Universal Soil Loss Equation

The Universal Soil Loss Equation (USLE) (Soil Conservation Service, 1976) is an empirical, linear relationship developed by the U. S. Department of Agriculture to describe soil loss or erosion as a function of a particular set of conditions which include soil type, rainfall, vegetation and topography. To predict the amount of soil erosion by water from a given field site it is necessary to know (a) the capability of the expected rainfall and runoff to detach and transport soil particles, (b) the susceptibility of a given soil to erode and (c) the effectiveness of cover and/or management variables for counteracting the factors causing erosion.

The USLE is defined as

$$A = R \cdot L \cdot S \cdot K \cdot C \cdot P$$

where the soil loss per unit area per unit time (A) is given as the product of factors for rainfall (R), slope length (L), slope steepness (S), soil erodibility (K), cropping, vegetation and management practices (C), and conservation practices (P). The value of A computed in this manner represents only the mass of soil potentially erodible from an area in a certain time span. Determination of the actual mass eroded depends upon the additional influences of topography and channellized transport of sediment as will be discussed. If any of the erosion factors is absent from a particular area, the value of the factor is taken as unity. All of the 6 factors except R are constants over time. The units of the rainfall factor introduce time into the equation, with factor A thereby determinable on a weekly, monthly, yearly, or seasonal basis once values of the other five factors are determined.

The USLE is often misused when applied to complex, large area watersheds through incomplete consideration of the specific interaction of each of the erosion factors (R, L, S, K, C, P) characteristic of subareas within the watershed (Wischmeyer, 1976). The equation can be accurately used to predict losses from a complex watershed only when the area is subdivided into computational units within which valid erosion factors may be determined and used to compute the soil loss A. The summation of A values from individual sub-areas must then be accomplished with consideration for (1) deposition of eroded material during its transport to the watercourse and (2) channelized transport and delivery of eroded material directly to a watercourse from a sub-area well removed from the watercourse. To quantify these processes, it is necessary to determine the hydrologic interactions of adjacent sub-areas, in addition to the erosion factors characteristic of each sub-area.

Determination of erosion from the study impact area selected required that the complex series of watersheds composing the impact area be subdivided into smaller units. These units, hereafter referred to as elements (to be distinguished from heavy metals, which will be referred to as such) were delineated by superimposing a grid system over the impact area. The grid consisted of about 288 elements, each 10 kilometers on a side. The western and southern boundaries of the grid were taken as the drainage area of the Colorado River system north of Glen Canyon Dam, Arizona. The northern and eastern boundaries were determined from the fallout distributions provided by the atmospheric dispersion model. The elements were labelled alphabetically along the north-south axis and numerically along the east-west axis.

Each element (100 km^2) was categorized with respect to composition according to the five factors of the USLE applicable in this study, i.e. rainfall factor (R), slope-length (SL), soil erodibility (K) and vegetative cover (C). An example of this procedure will be described for an area consisting of 20 elements (elements O to S and 6 to 9) from the study site. Figure 3.1 shows the basic grid system of the area and the hydrologic interaction, represented by arrows, which were derived from topography and natural drainage patterns. Figure 3.2 shows the basic grid with the soil type distribution superimposed. Correspondingly, Figures 3.3 and 3.4 show the slope and vegetation distribution patterns, respectively, in the area as related to the basic grid system of the elements. Keys relating the symbolism used on each figure to specific values of erosion factors are included in tables presented below. The factor R appropriate for each element was generated in the manner discussed below. It can be seen that often more than one component of each erosion factor was represented in an element (i.e., two types of vegetation, three types of soil, etc). In this case, the erosion from the element was computed as the summation of the individual components weighted to represent the natural predominance of each factor in the element. The methodology used in the evaluation of each erosion factor is presented below, and is followed by an example (Table 3.3) of how these erosion characteristics were summarized as inputs to the computer model EROS.

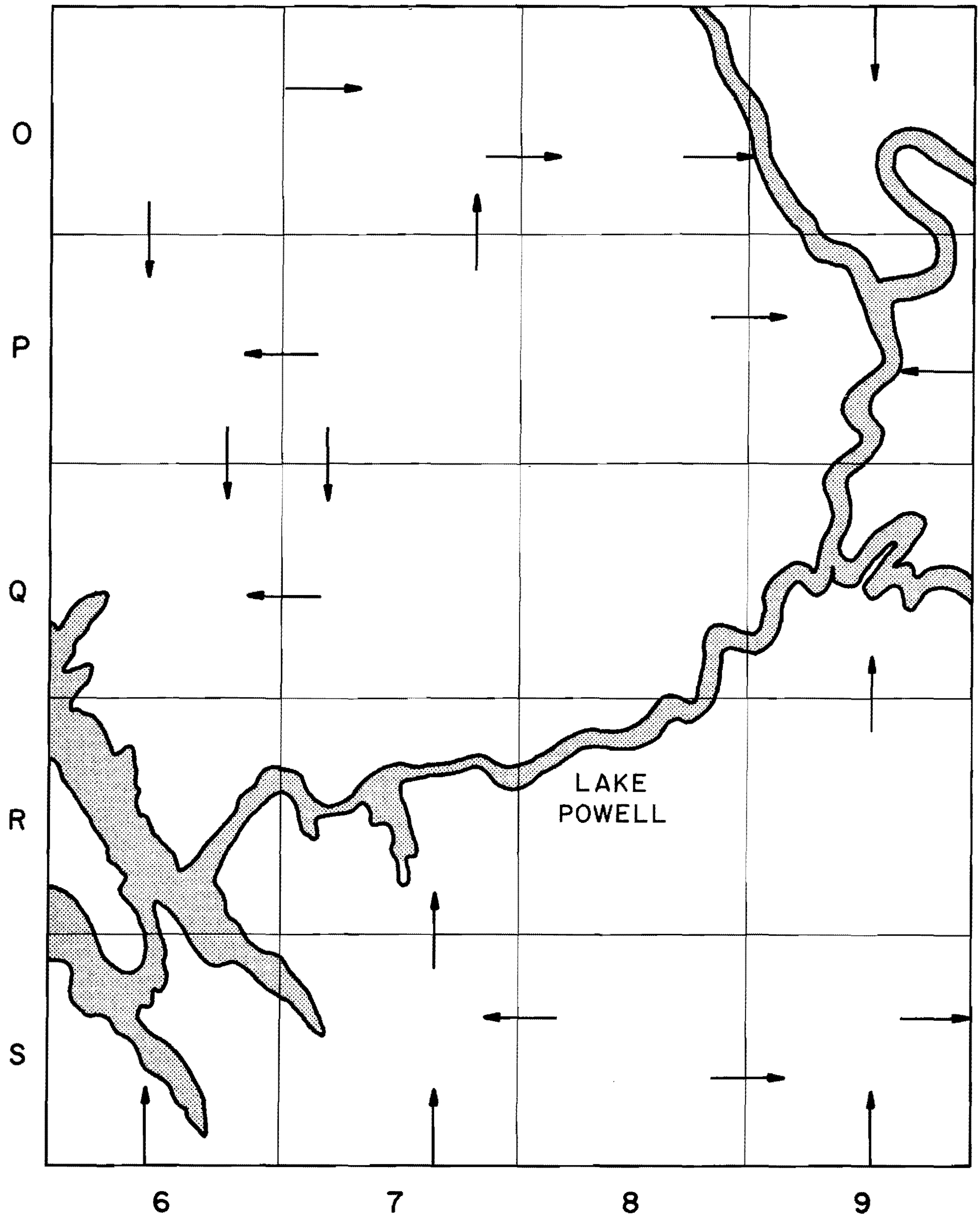

Figure 3.1. A portion of the basic grid system showing hydrologic interaction (arrows) between elements.

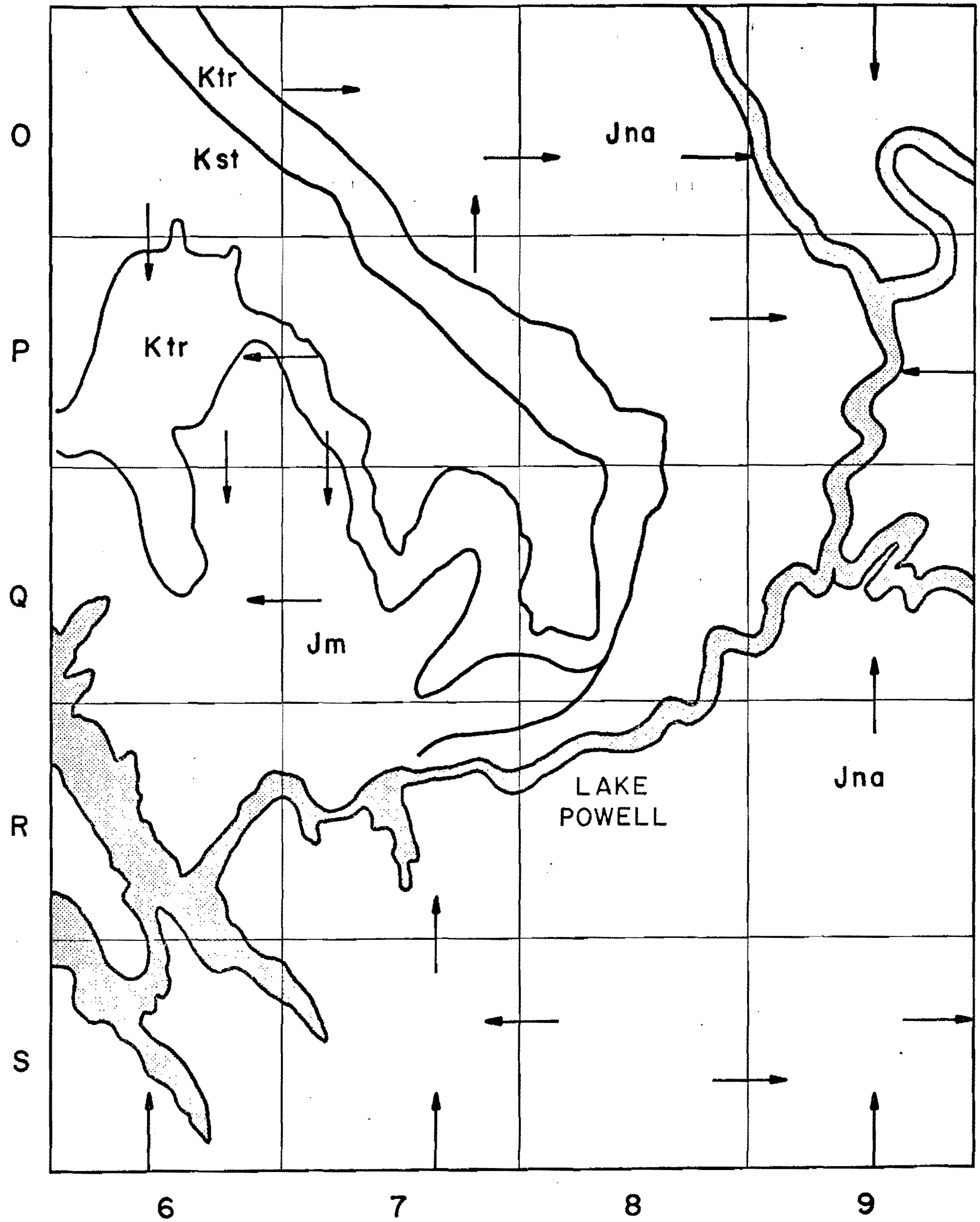

Figure 3.2. A portion of the basic grid system showing hydrologic interactions (arrows) between elements and soil type distribution. See Table 3-1 for soil type coding key.

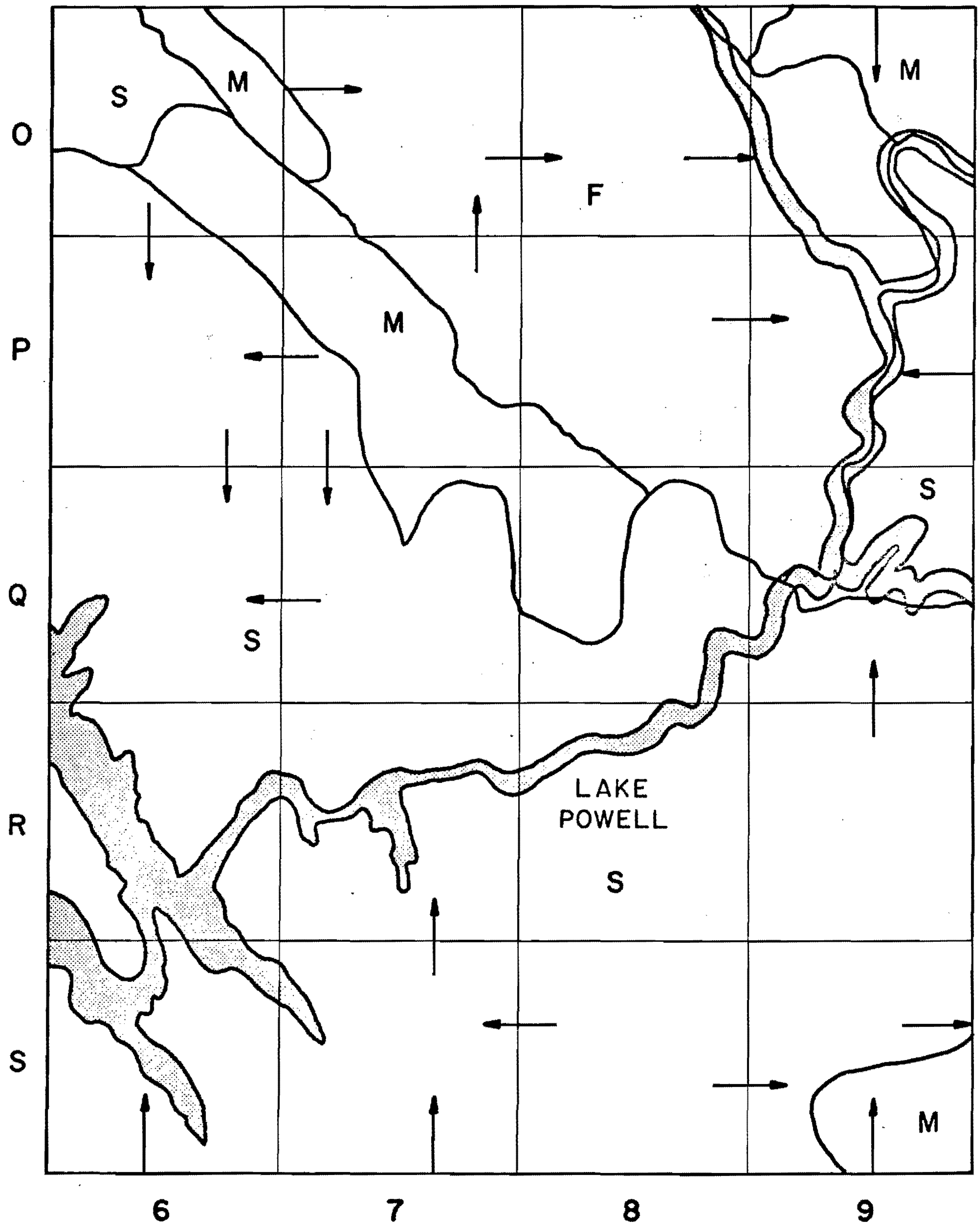

Figure 3.3. A portion of the basic grid system showing hydrologic interaction (arrows) between elements and slope distribution where F = flat slope (<15° slope angle), M = medium slope (15°-40° slope angle), and S = steep slope (>40° slope angle).

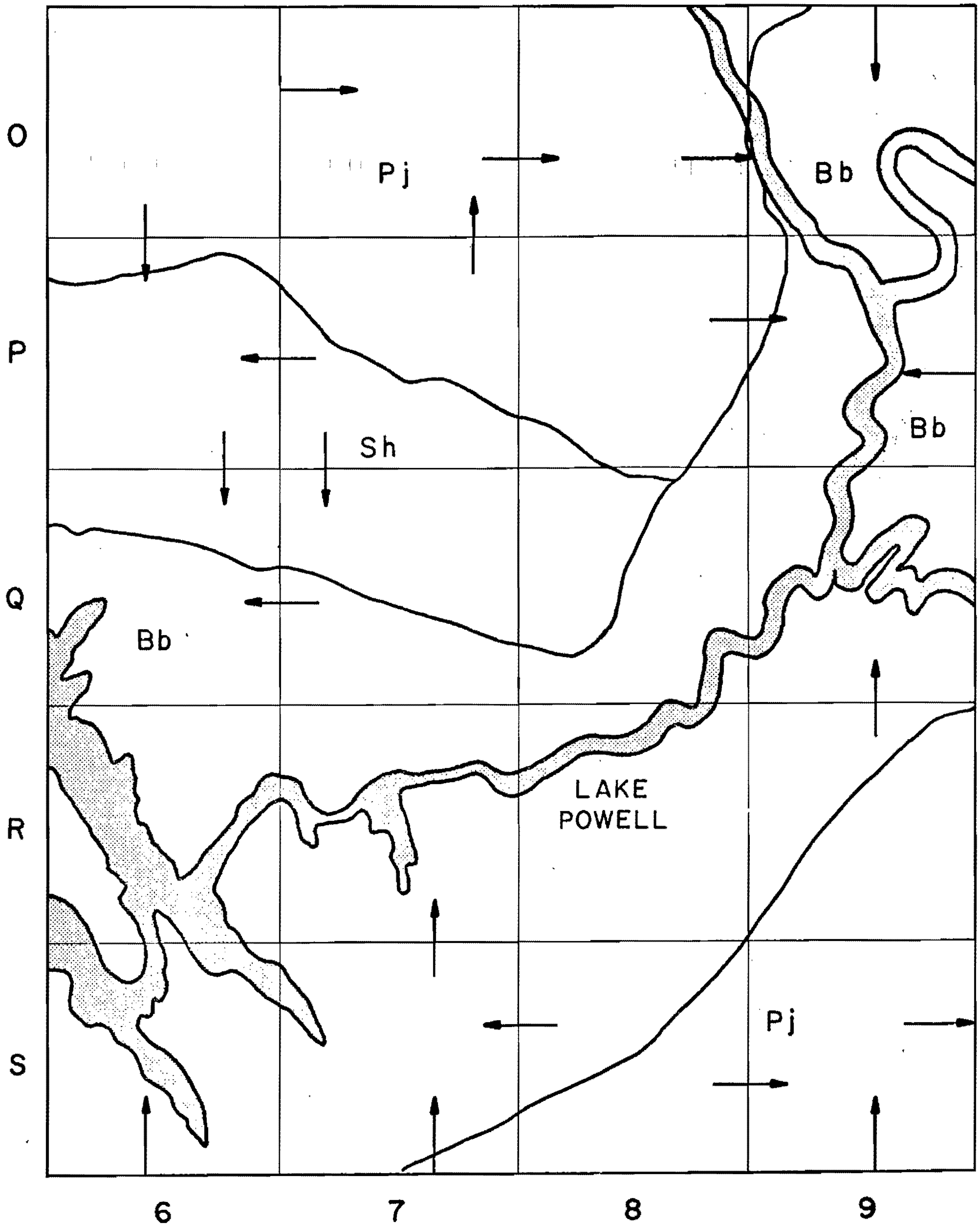

Figure 3.4. A portion of the basic grid system showing hydrologic interaction (arrows) between elements and vegetation distribution. See Table 3-2 for vegetation coding key.

Rainfall Factor (R)

Detaching and transporting soil material requires energy. This energy is supplied by falling raindrops and flowing runoff. Therefore, the capability of a given rainstorm to erode soil depends on the total energy of its raindrops at impact and on the amount and velocity of runoff available to transport detached particles. The rainfall erosion index, EI, is a measure of the total raindrop energy of a storm and its relation to the maximum 30-minute intensity. Soil losses are linearly proportional to the number of EI units. Therefore, storm EI values can either be used on an individual basis or can be summed over time to provide the value of the rainfall factor, R.

Expressed mathematically,

$$R_n = \sum_{i=1}^{n} EI \qquad (3\text{-}1)$$

where i = the increment of time upon which 30-minute intensities are determined (week, month, year) and n is the total number of time increments to be considered in an erosional event. E is the kinetic energy of the storm in units of metric-ton meters per hectare per centimeter of rain, and I is the maximum 30-minute rainfall intensity in cm per hour. The relationship between rainfall kinetic energy and intensity has been given by Wischmeyer and Mannering (1969) as

$$E = 210.3 + 89 \log_{10} I.$$

Therefore, once the intensity of a particular storm is known, it is possible to compute the value of the rainfall erosion index EI for that storm. Generation of these rainfall intensities is accomplished by the precipitation subroutine RAIN3 detailed in Chapter 4. One site specific rainfall event per month, calculated by RAIN3, was imposed on each element in the impact area, with the result being a single value of R to be used in the USLE over the entire area of a particular element for any single monthly computation of erosion.

Slope Length and Steepness Factors (L and S)

The potential of runoff to transport soil particles increases approximately as the fifth power of its velocity and its detachment capability as the square of its velocity (Meyer and Wischmeyer, 1969). The flow velocity of runoff increases as the amount increases, as the flow concentrates, or as the slope steepens. Therefore the erosive potential, up to a slope angle of approximately 20° increases substantially as either slope length or steepness increases. Since most agricultural soils, for which the USLE was originally developed, have slopes less than 20°, a slope-effect chart (Wischmeyer and Smith, 1965) was developed from which the product LS could be obtained for cropland situations. However, in areas characterized by slopes steeper than 20°, such as the study impact area, it is necessary to use an expression of the type presented by Horton (1945) to calculate the interaction of slope angle and length. The expression used in EROS is

$$SL = \frac{10 \sin\theta}{\tan^{0.3}\theta} \qquad (3\text{-}2)$$

where θ is the slope angle in degrees. Comparison of the two equations is presented in Figure 3.5. The Horton-style equation predicts erosion from a watershed to increase linearly in approximately the same manner described by Wischmeyer and Smith (1965) up to a slope of about 20°. However, after this point, the Wischmeyer equation continues to predict

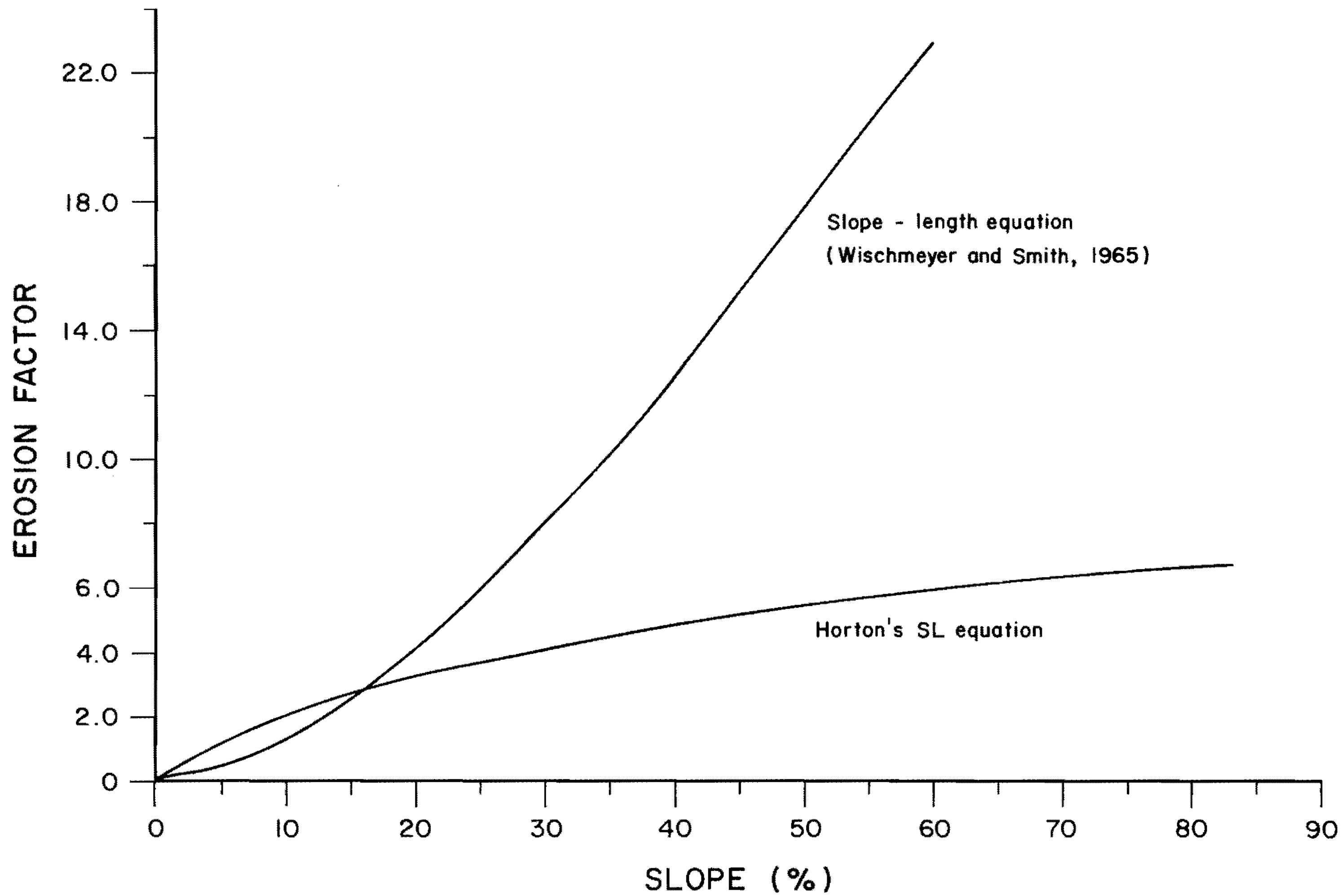

Figure 3.5. Comparison of the Horton and the Wischmeyer and Smith slope-length equations.

a near linear increase in the erosion factor as slope angle increases. In nature, such is not the case, as the net amount of material eroded from a particular slope begins to level off and even decrease as slope angle is increased. This can be intuitively imagined by considering that a slope of 90^{o} (a sheer cliff) will contribute less to an erosional event than a slope of 60^{o}. The modified Horton equation predicts such a physical situation, with an erosion factor of 6.0 at 60^{o} and a factor of 4.8 at 85^{o} (value at 90^{o} is undefined, as the tangent of 90^{o} is undefined). The factor SL was computed for the study impact area using the modified Horton equation. As the value of erosion factor computed by this method is relatively insensitive to small variations in θ, it was possible to use three designations for slope, based upon contour intervals from U. S. Geological Survey topographic maps.

A slope angle of less than 15^{o} (27% slope) was classified as "flat", a slope angle between 15^{o}-40^{o} was classified as "medium" and a slope angle of greater than 40^{o} (84% slope) was considered "steep". Elements were classified by the percent area occupied by flat (f), medium (m) or steep (s) slope. The slope erosion factor was computed by assuming a slope angle of 10^{o} (19% slope) for flat terrain, a slope angle of 25^{o} (47% slope) for medium terrain and a slope angle of 55^{o} (143% slope) for steep topography.

Soil Erodibility Factor (K)

A soil's susceptibility to erosion reflects the complex interactions that occur between its physical and chemical properties. Those that affect surface sealing and crust formation are highly important, but the characteristics of the immediate subsoil are also relevant to erodibility.

No single factor can alone be shown to correlate well with a soil's potential to be eroded. Instead, the factor K may be computed for any particular soil for which information is known of such physical parameters as particle size distribution, percent organic matter, soil moisture (antecedent to erosional event), soil structure, and pH. These factors are related through a multiple-regression equation that combines their primary and interaction effects on erodibility.

Values of the soil erodibility factor as computed through the regression equation are extremely sensitive to two parameters in particular, the particle size distribution and percentage of organic matter. It is therefore possible to estimate the factor K if sufficient information is available concerning the texture of the soil in a particular area. Such information can usually be obtained from a Soil Survey Manual, Geologic Map or combination of the two. The values of K used in EROS were developed using this approach, as detailed field sampling and laboratory analysis of soils in the impact area was not feasible.

There were 13 major soil types and 6 unnamed depositional groups existing in the study impact area (Table 3-1). Other less extensive soil groups were also included in this listing in order to simplify description. Each group was generally categorized with respect to its particle size distribution, degree of consolidation (for depositional areas or sedimentary rocks), and ability to conduct water. Based upon this evaluation, a value of the soil erodibility factor K was assigned to each soil type. These values theoretically range from zero (no erosion potential) to unity (maximum erosion potential). In the case of this particular watershed, values ranged from 0.10 to 0.60. Each erodibility factor was numbered, and this number used on the data input

Table 3-1. Soil types and codings for Kaiparowitz impact area.

Soil Name	Description	Geologic Map Letter Code	Erodibility K	Computer Num. Code
Carmel	Gypsum, limestone, shale sandstone	Jca	0.60	1
Morrison	Sediments	Jm	0.45	3
Salt Wash	Sandstone	Jmsw	0.45	3
Navajo	Sandstone	Jna	0.30	5
Blue Gate	Calcareous shale	Kmbg	0.60	1
Straight Cliffs	Sandstone (coal bearing)	Kst	0.40	4
Tropic	Shale	Ktr	0.60	1
Wahweap + Straight Cliffs	Sandstone	Kwa	0.40	4
Mutual	Quartzite	Pcm	0.30	5
Unnamed	Misc. alluvivm and wind-blown silt	Qco	0.30	5
Unnamed	Siliceous deposits (sand dunes	Qds	0.30	5
Unnamed	Gravel	Qgs	0.10	7
Unnamed	Basalt	T_2bf	0.20	6
Unnamed	Conglomerate deposits	TQu	0.30	5
Chinle	Variegated non-marine sediments	Trc	0.45	3
Moenkopi	Siltstone	Trm	0.50	2
Wingate	Sandstone	Trwi	0.30	5
Unnamed	Volcanic rock	Tvu	0.20	6

card developed for each element.

Vegetative Cover Factor (C)

Annual soil loss from cropland probably never equals the full potential as indicated by the product RLSK. Vegetative cover and (in agricultural situations) crop management patterns influence water intake by soil, help protect the soil from raindrop impact, and increase the soil's ability to resist detachment by erosive agents. In an agricultural sense, C represents a variety of variables such as seeding method, crop sequence, soil tillage, residue disposal, and percent coverage of surface area. For wildlands and similar unmanaged areas, C simply represents a vegetation factor, and reflects the degree to which a particular watershed is covered and protected from precipitation. Values of C are always less than unity, as the physical effect of vegetation is always to reduce the mass of eroded material A below the level predicted by consideration of only the product RLSK.

The vegetation of the impact area was divided into eight major groups (Table 3-2) based upon U. S. Interior Department maps (U. S.

Table 3-2. Vegetation types and coding for Kaiparowits Impact Area.

Vegetation Type	Map Coding	Veg. Factor C	Computer Coding
Blackbrush	Bb	0.30	6
Grassland	Gl	0.06	2
Greasewood	Gw	0.32	7
Mountain brush	Mb	0.04	1
Pinyon juniper	Pj	0.15	4
Sagebrush	Sg	0.18	5
Shadscale	Sh	0.35	8
Subalpine forest	Sf	0.13	3

Interior Dept., 1965). The percentage ground cover of each type was estimated by on-site inspection of the impact areas. Values of the factor C were then obtained using Soil Conservation Service information (SCS, 1976). Computer codings were assigned to each factor C, and these numbers used as inputs to the computer model.

As can be seen from Table 3-2, the effect of vegetation ranged from a C value of 0.04 (mountain brush) to 0.35 (shadscale). This should be interpreted by recalling that as the value of C increases, the effectiveness of the vegetation to limit erosion decreases.

Conservation Practices (P)

This factor is similar to factor C except that P accounts for the erosion control effectiveness of superimposed practices such as contouring, terracing, or stripcropping. As these practices are absent from the soils in the impact areas, the value of the factor P was assumed to be unity for all calculations in the erosion model.

Hydrologic Interactions Among Elements

After the quantity of eroded soil for a particular element has been computed from the preceding inputs, it is necessary to describe its fate. Not all the material eroded from an area during one time increment was deposited in Lake Powell or its tributary streams, nor did it all leave the element. The material can follow four possible pathways. It can be transported to and deposited in an adjacent element, transported to and deposited in a non-adjacent element, subjected to channellized transport and deposited in Lake Powell or a tributary, or not transported and remain within its element of origin. The first, third, and fourth alternatives were quantified by evaluation of topography and the presence of intermittent or permanent stream beds in a particular element. Evaluation of the second alternative was not possible given the resolution of the data at hand.

Therefore, on each data input card developed for an element is given percentages of eroded material and the adjacent element to which it is transported. If applicable, a certain percentage of material was delivered directly to the lake. If the percentages transported do not add to 100% on the data input card, the remainder of material was assumed to have remained in the element of origin. Obviously, the non-transport pathway would be most prevalent in elements of "flat" terrain.

The eroded material was assumed to be spread equally over the element to which it was transported. Similarly, that material not transported was assumed to be spread equally over the element in which it remained. Such assumptions, though not exact in nature, were necessary in order to proceed logically to calculation of erosion during the next time step.

Data Card Organization of Erosion Parameters

A complete listing of all inputs needed to predict erosion, transport, and deposition of soil from each of the 288 elements is included in Appendix A. For those elements presented in Figures 3.1, 3.2, 3.3, and 3.4, these inputs are also presented in Table 3.3, in the exact order that they appear on the data cards. A separate data card was developed for each element.

From Table 3-3, it can be seen that the first three columns of each data card contained the identifying alphabetic and numeric coding of the element. Columns 5-31 present the values of K, SL, C and the percentage of element area characterized by each combination of the factors. For example, in element O-8 the value of K was taken as "5", slope as "F", and vegetation type as "4". This combination of "5F4" was estimated to characterize 90% of the element (Columns 5-10). The remaining 10% of

Table 3-3. Example of Data Card Organization

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

O 6 4S4 50 1M4 25 5F4 15 4M4 10 P 6 35 O 7 25     2  4  3 64 163  36 70        3
O 7 4M4 10 1M4 15 5F4 75        O 8 25            2  4  4 50 173  53 55        2
O 8 5F4 90 5S4 10               O 9  5        15  2  4  4 50 173  59 52        1
O 9 5F6 40 5M6 40 5S6 20                      50  2  4  3 50 173  59 52        1
P 6 4S4 10 4S8 15 1S8 60 3S8 15 Q 6 80            2  4  3 45 132  51 53        2
P 7 5F4 20 1S8 40 4M8 30 3S8 10 Q 7 55 O 7 20     2  4  3 51 142  61 52        3
P 8 4M8 15 1M4 25 5F4 60        P 9 25        10  2  4  3 50 157  57 53        2
P 9 5F6 65 5S6 35                             40  2  4  3 50 173  59 52        1
Q 6 3S6 50 1S8 35 8   15                      80  2  4  3 41 130  73 42        1
Q 7 3S8 40 1S8 25 4M8 20        Q 6 40        40  2  4  3 51 133  84 44        2
Q 8 3S6 10 1S6 10 4M8 25 5S6 55               65  2  4  3 56 157  61 54        2
Q 9 5F6 30 5S6 70                             80  2  4  5 35 173  59 52        1
R 6 3S6 30 5S6 20 8   50                      80  2  4  3 50 148  79 45        1
R 7 3S6 30 5S6 40                             80  2  4  3 50 155  73 47        1
R 8 3S6  5 5S6 85 8   10                      80  2  4  3 50 171  62 51        1
R 9 5S6 45 5S4 55               Q 9 70        10  2  4  5 50 173  59 52        2
S 6 5S6 65 8   35                             80  2  4  3 50 173  59 52        1
S 7 5S6 80 5S4 15 8    5        R 7 40        40  2  4  3 50 173  59 52        1
S 8 5S6 35 5S4 65               S 7 40 S 9 40     2  4  3 50 173  59 52        1
S 9 5S4 75 5M4 25               S10 65            2  4  5 50 173  59 52        4
```

the element was classified "5S4" (Columns 12-17). Columns 18-31 were not needed to characterize this element, as it was uniform enough in erosion parameters to require only 2 characterizations. Element 0-6 on the other hand, required 4 combinations of the erosion parameters in order to be adequately described.

Columns 33-45 summarize the hydrologic interactions of the element. Only the destination of material leaving the element is recorded. The computer program (discussed in Chapter 6) automatically sorts and stores the inputs and outputs of each element based upon this data. In the case of element O-8, Table 3-3 shows that element O-9 was recipient of 5% of the material predicted to be eroded from element O-8. The remaining 95% of the material was assigned to either remain within the element or be delivered directly to the lake. Another example is provided by element P-7, in which 55% of the material was deposited in element Q-7 and 20% in element O-7, leaving 25% to be transported to the lake or remain within the element. These percentages were estimated using the procedures detailed previously.

Columns 47-48 provide the percentage of eroded material delivered directly to the lake or its tributary river systems. This amount varies from 0% to 80% depending upon the slope characteristics of the element, proximity to a waterway, and degree of channelization (estimated from topographic maps and prevalence of dry or occasional stream beds). The sum of the percentages of material delivered directly to the lake system and the material delivered to adjacent elements, when subtracted from 100% gives the percentage of potentially eroded material remaining within its element of origin.

The remainder of the data card is reserved for material needed by the rainfall (RAIN3) and chemical precipitation (CHEM) submodels. These inputs are discussed within Chapters 4 and 5, respectively. The inputs include, in order, mean annual precipitation zone, precipitation distribution zone, hydraulic conductivity rating, porosity percentage, soil bulk density, two parameters needed to describe soil water infiltration and the mean annual rainfall zone. An open spcae on each card between the last two inputs can be used for other data, primarily alteration of element area for use of EROS in cases where equal size elements are not appropriate.

CHAPTER 4

A HYDROLOGIC INPUT MODEL FOR ARID DRAINAGE BASINS

D. George Chadwick, Jr. and J. Paul Riley

The model described in this section provides the maximum 30-minute depth of precipitation for each month as used in EROS to predict soil erosion and to provide estimates of the total monthly infiltration of precipitation. These values are predicted for each element or series of elements for each month of the modeling period. Two options were developed to predict the necessary parameters. The title of this predictive precipitation Subroutine is RAIN3.

MONTHLY 30-MINUTE PRECIPITATION DEPTH

Precipitation Zones (IPZ)

The first step undertaken in formulating the precipitation model was to investigate the possibility of defining within the study area zones of similar precipitation intensity frequency characteristics. Isopluvial information to construct these zones was obtained from the "Precipitation-Frequency Atlas of the West" (National Oceanic and Atmospheric Administration (NOAA), 1973). After overlaying a grid of the elements (100 km^2 each) on an isopluvial map of the area, the elements were inspected and grouped into zones of approximately equal precipitation intensities (Figure 4.1). As shown by Figure 4.1, the elements were grouped into five precipitation zones of increasing intensity. It was determined on the basis of NOAA (1973) the general pattern of isopluvials is essentially the

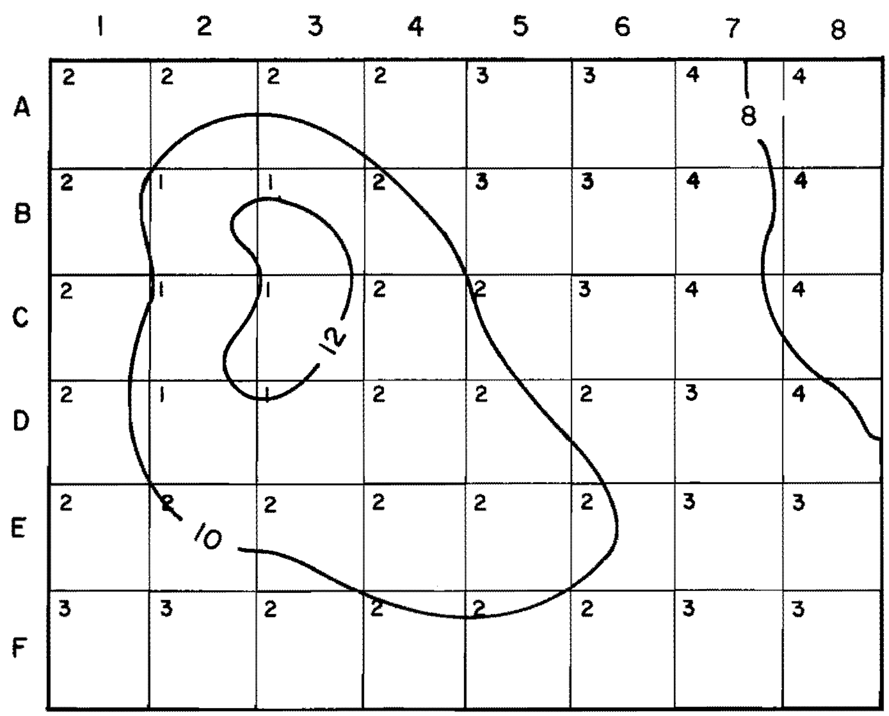

Figure 4.1. Typical precipitation zone groupings from isopluvials on a section of the element grid.

same for all return periods. Thus, groupings do not vary significantly with return period for the set of isopluvial lines used in the analysis. This method of grouping, however, did not always result in zones composed of contiguous elements.

After the precipitation zones were determined, equations were determined which relate frequency of occurrence to depth of precipitation. Using NOAA procedures, 30-minute, 1, 2, 3, 6, 12 and 24-hour depths were determined for at least 4 randomly selected elements within each precipitation zone (NOAA, 1973). For each storm duration, rainfall depths in the elements within each zone were averaged to provide depths which were representative of the entire precipitation zone. For each zone, average depths were determined for the 100-year and 2-year return periods, which corresponded to probabilities of 0.01 and 0.50, respectively, of having the given depth occur in any one year for the particular storm duration.

Since this model is operated on a monthly basis, these percentages were converted to monthly probabilities (Pm). Using the formula $Pm = 1 - (1 - P_{yr})^{1/12}$, yearly probabilities (Pyr) of 0.50 and 0.01 were found to correspond to average monthly probabilities of 0.056 and 0.00083. The average depths for the 2 year and 100 year return periods were plotted on probability - log paper with the 2 year depth at a probabilitity of 0.056 (5.6 percent) and the 100 year depth at a probability of 0.00084 (0.084 percent). Each set of two points was then connected by a straight line which was extrapolated to include other probabilities.

This process was repeated for each of the precipitation zones (Figure 4.2). The resulting lines indicate the probabilities of having different depths of precipitation during an average monthly period for any

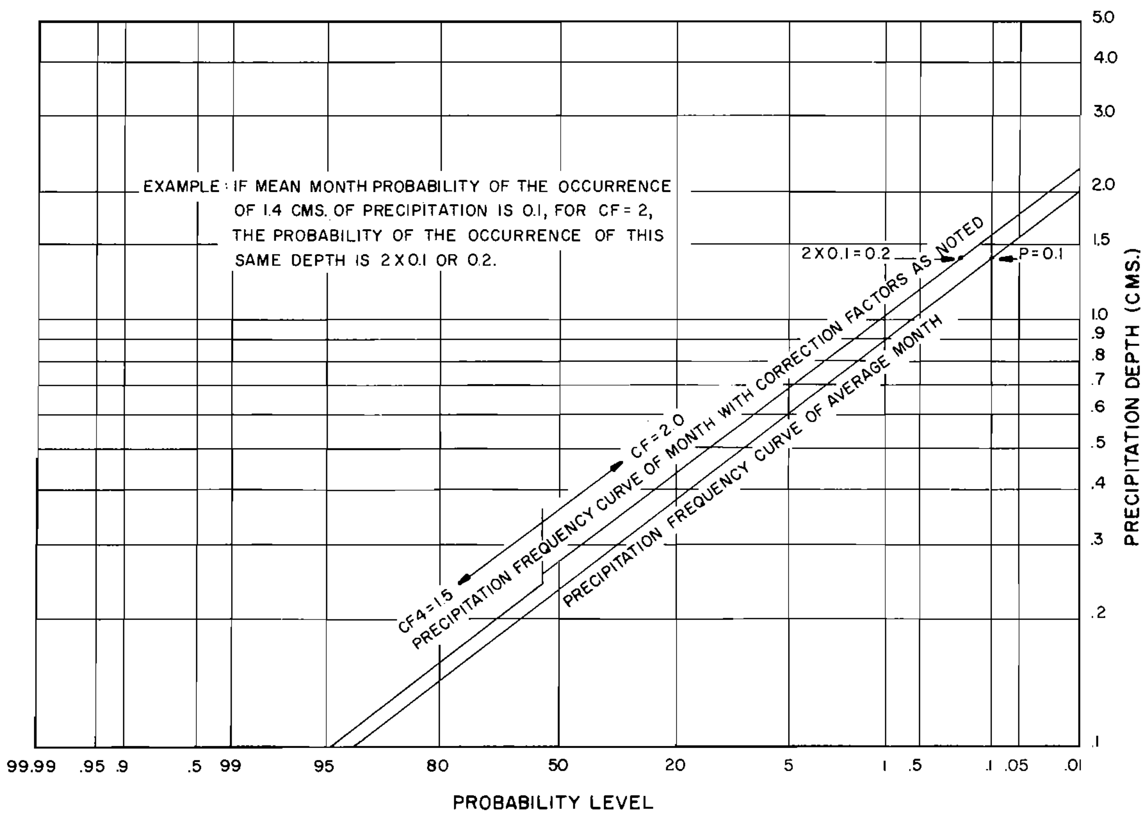

Figure 4.2. Typical precipitation versus frequency lines.

element in a particular precipitation zone. This procedure involves an extensive extrapolation from two relatively close points, and therefore might be expected to introduce some error into the model. Since a line on log paper never reaches zero, precipitation predicted by these lines is, unrealistically, always greater than zero. However, the procedure is relatively accurate at high precipitation intensities, which is the range at which the model is most sensitive. In addition, an arbitrary cut-off probability is applied, so that when a probability of 0.98 or greater is generated, no precipitation or infiltration is predicted.

The next step in the development of the precipitation model involved the postulation of average monthly precipitation frequency distribution functions for each precipitation zone. Equations for these functions are in the form $\log y = kx + \log b$; in which y is the precipitation at a given probability, k is the standard deviation or slope, b is the mean precipitation (0.5 probability), and x is the number of standard deviations from the mean to the given probability (Table 4-1).

Table 4-1. Selected probabilities and corresponding standard deviations.

Probability	Standard deviation
.0001	3.71902
.0100	2.32635
.0200	2.65375
.0500	1.64485
.1000	1.28155
.3000	.52440
.5000	.00000
.7000	- .52440
.9000	-1.28155
.9500	-1.64485
.9800	-2.65375

Distribution Zones (IDZ)

Because precipitation characteristics vary from month to month throughout the year and the isopluvials used do not reflect monthly variations, a procedure was developed to represent the deviation of individual months from the average month based on a probability approach. Because of the scarcity of detailed precipitation information in the Kaiparowits area, the procedure was somewhat crude but nevertheless its application did help to refine the model. In the "Hydrologic Atlas of Utah" (Jeppson et al., 1968), graphs relating weekly rainfall amounts and probabilities of their occurrence are provided for selected sites in Utah. For this study, the sites of Orderville, Bluff, Richfield, and Escalante were selected as being most representative because of their proximity to the study area. Thus, these sites represent precipitation distribution zones (IDZ). From precipitation data available at each of these sites, so-called monthly correction factors (CF) were computed as follows:

1. The average ordinate of the curve for 0.8 inches of rainfall in a week was determined.

2. This same curve was divided into monthly segments and the average ordinate for each month was determined.

3. The monthly CF values were calculated as the ratios of the appropriate monthly average ordinates to the average yearly ordinate (Figure 4.3). Monthly CF values also were determined from the curves of the probabilities of having 0.4 inches of precipitation in a week as established at the four sites listed above. Thus, two CF values were obtained for each month at each of the four sites. As explained in the following paragraph, the value used depends upon the selected average

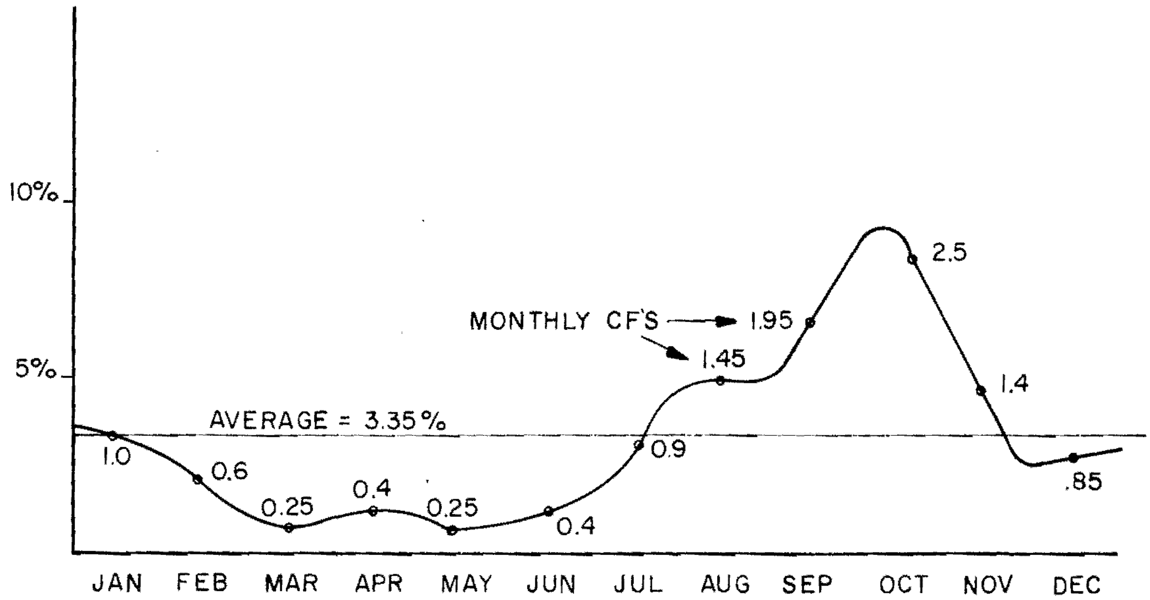

Figure 4.3. Monthly correction factors, Bluff, Utah.

probability of the occurrence of a specific amount of precipitation during the month under consideration. Each element in the study area was assigned the CF values of the site nearest it. This procedure caused an abrupt transition of CF values between distribution zones, but model tests indicated that the effects of this discontinuity are insignificant in terms of output functions.

The basic assumptions in applying these CF included the following:

1. The standard deviation of the storms for each month was equal to the standard deviation of the storm in the average month. This assumption means that on probability - log paper, any monthly line is parallel to the line of the average month.

2. For storms of low probability (high intensity), the ratio of the probability for a given precipitation for a given month to the probability for that same precipitation in the average month is approximately equal to the CF value for the month.

3. The CF values developed from the 0.4 inches of precipitation per week curves apply for average probabilities greater than 0.55 since they represent storms of low intensity, such as those above 0.55 probability. Conversely, CF values from the 0.8 inches of precipitation per week curves are used when predicting precipitation quantities of relatively low probabilities (those of less than 0.55). As an example, if it is assumed that the average month has a probability of 0.01 of having one inch of precipitation in an hour, and if the CF is 2.0, the month under consideration is twice as likely as the average month to have 0.8 inches of precipitation. Thus, one inch of precipitation in one hour is about twice as likely to occur in the month for which CF = 2 as the average month, or the probability is about 2.0 x 0.01 = 0.02 (Figure 4.4).

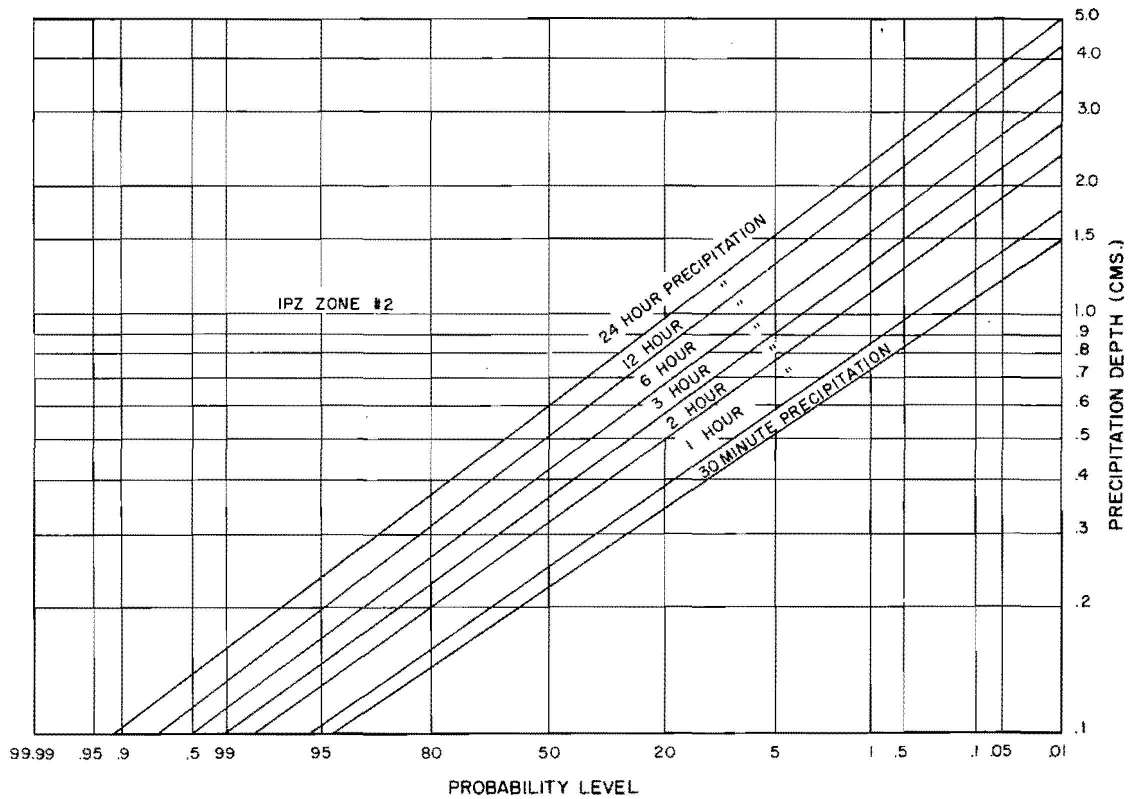

Figure 4.4. An example of the monthly correction factor application.

Using the three above assumptions, the average monthly precipitation distribution curve for each precipitation zone was modified to account for monthly differences as follows.

1. The precipitation at the 0.001 probability level was calculated for the average monthly curve using the formula: $\log Y = kx + \log b$ (at a probability of 0.001, x equals 3.09023).

2. The new probability for a particular month at which the precipitation amount computed in step 1 occurred was found by multiplying 0.001 by the appropriate CF value for the month under consideration.

3. The equation used to relate precipitation and frequency requires the precipitation at the 0.5 probability level. This value for the particular month (obtained by application of the appropriate CF value) was calculated as follows:

   a. The new x associated with the probability determined by step 2 above was determined by interpolation in a set of standard deviation tables;

   b. The new mean precipitation (b) was found by using the equation: $\log b = \log y - kx$.

4. With both constants in the formula: $\log y = kx + \log b$ now determined, unique values of y were found for any value of x. Each value of x was found by using a three point Lagrangian interpolation in a table of probabilities and corresponding standard deviations.

Probabilities

A random number generating routine is used by the computer to select the probability level of each storm. A list of 360 numbers from this routine averaged 0.51 showing the output to be relatively unbiased.

Independence of summer storms (May through September) is assumed. Conversely, the large frontal storms which predominate in winter months cover many elements simultaneously. To account for these storm tendencies, random probabilities are selected for each element for each month from May through September. From October through April, a random probability is applied for all the elements within a precipitation zone in any one month. With the selected random probability, a precipitation depth is calculated from the appropriate 30-minute curve. This process is repeated for each of the curves, producing depths for storm durations of 30 minutes, 1, 2, 3, 6, 12, and 24 hours. The same probability is used for the 30-minute and one hour durations, but the other duration storms are selected separately. These depths represent point amounts and thus are multiplied by an appropriate areal correction factor (obtained from NOAA, 1973) to account for the fact that the maximum area intensities are lower than maximum point intensities. Equations representing this information are used to calculate appropriate areal correction factors for any area up to 400 km^2. The maximum thirty minute areal intensity (P30) for each month is used to calculate erosion rates in the erosion model.

TOTAL MONTHLY INFILTRATION QUANTITY

Using the values of precipitation as calculated above, an imaginary monthly "composite storm" is developed. In this storm the 30-minute intensity is assumed to occur in the first 30-minute period, the difference between the one hour storm and the 30-minute storm in the second 30 minutes, the difference between the two hour storm and all precipitation, and so on. If any value thus determined is less than or equal to zero, no precipitation is assumed to occur for the appropriate time interval. Negative values are expected to occur because of mathematical interactions between probability and intensity.

Infiltration

Infiltration rates are determined for each element by the formula $i = C'\alpha t^{(\alpha - 1)}$; (i in cms/minute, t in minutes, C' and α are dimensionless). Since a composite storm represents a combination of individual storm depths, the infiltration curve is not superimposed upon the composite storm hydrograph. To produce results which correlate with actual runoff, it was necessary to use as the average infiltration rate that which occurs at 170 minutes. Infiltration quantity in a particular time interval is either the precipitation or the infiltration capacity in that interval, whichever is least. The infiltration depths from each time interval (0-30 min., 30-60 min., 1-2 hours, 2-3 hours, 3-6 hours, 6-12 hours, and 12-24 hours) are summed to represent the total infiltration quantity from a single "composite storm".

Correcting for Mean Annual Rainfall

A composite storm is an artificial compilation of typical intensities of arbitrarily selected durations. A procedure must be used to ensure that total predicted precipitation amounts approximate actual values. To this point, infiltration has been calculated for one "composite storm" in each month.

Using the precipitation curves (for example, Figure 4.2) and random probabilities, the average annual rainfall for the elements in each precipitation zone are determined by calculating the average precipitation depth for one composite storm per month. From an isohyetal map, actual mean annual precipitation was determined for each element. The ratio of the actual mean annual precipitation to the predicted mean annual precipitation using only one "composite storm" per month was determined for each element. The elements were then grouped into zones (MAR) composed of elements having approximately equal ratios. Each zone was assigned the ratio (RCF) most representative of its elements. The infiltration quantity predicted by one "composite storm" (as explained above) was multiplied by the ratio assigned to the zone in which the element belongs. The resultant value is the monthly infiltration amount used in the chemistry subroutine of the overall model.

Infiltration Option to Reduce Computing Costs

An option was provided in RAIN3 to reduce computing costs. This option eliminates the need to develop monthly "composite storms", and subsequently to compute infiltration rates (monthly quantities).

Using the precipitation curves (for example, Figure 4.2) and random probabilities, the average 30-minute depth (P30) for each precipitation zone is determined. A new set of factors (RCFOPT) are developed using the same procedures as were used to estimate the rainfall correction factors (RCF) (see earlier section of this chapter) except that the average P30 is used in place of the average "composite storm".

Using this option in RAIN3, the 30 minute depth predicted for a month is multiplied by the RCFOPT associated with the MAR zone to which the element belongs. The result approximates the monthly rainfall. Since surface runoff is a very small portion of total precipitation in the Kaiparowits area, this value is assumed to also approximate the monthly infiltration quantity. This option is actuated by passing the value of IOPT as the integer three. All other values of IOPT actuates the perhaps more realistic but certainly more expensive procedure. Savings in using this option are significant and the loss of accuracy is believed to be minor.

DATA REQUIREMENTS AND OUTPUT

Data required by the model include:

1. Standard deviations and mean precipitation (0.5 probability) of each precipitation-frequency line in each precipitation zone.

2. Monthly CF values for each distribution zone (one set for light storms and one set for heavy storms).

3. a. For the most accurate routine

   i) Rainfall correction factors (RCF)

   ii) Infiltration parameters (CP and ALFA)

   b. For the more economical option--rainfall correction factors (RCFOPT)

RAIN3 requires eight inputs as follows: (1) the precipitation zone (IPZ), (2) the CF zone (IDZ), (3) the mean annual rainfall zone (MAR), (4) the month (MON), (5) the option indicator (IOPT), (6) and (7) the infiltration parameters (CP and ALFA), and (8) the area of the element (AREA). Besides these, the seed number (IDUM) for the random number generator should be initialized as any odd integer from 2^{19} to 2^{21}. The "dummy" variable, MO, should be initialized at zero.

Outputs from RAIN3 are the maximum 30 minute intensity in the particular month (P30) and the infiltration for the month (TOTFIL). These outputs are produced for every element in the model.

ILLUSTRATIVE EXAMPLE

The following example illustrates the procedure of obtaining necessary data for use in the subroutine. A typical grid of 100 km^2 elements is overlayed on an isopluvial map and the elements are grouped into zones (denoted IPZ) of similar intensities (Figure 4.1).

In zone No. 1, elements A1, A2, C4, and D6 are arbitrarily selected as being representative of the entire zone. Using NOAA procedures, one hour depths are computed for 2 year and 100 year return periods (NOAA, 1973). Assume that the results are as shown by Table 4-2. The averages

Table 4-2. One-hour precipitation depths.

	2-year return period	100-year return period
A1	.56	.98
A2	.60	.88
C4	.48	1.01
D6	.52	.93
Average	.54 inches (1.37 cm)	.95 inches (2.41 cm)

are plotted on probability - log paper with 1.37 centimeters and 2.41 centimeters corresponding respectively with probabilities of 5.6 percent and 0.084 percent. A line is drawn connecting these two points and the mean depth (0.50 probability) is observed as 0.81 centimeters (Figure 4.5). The standard deviation (slope) of the line is found by the relationship:

$SDX = \log \dfrac{\text{Precip. 1}}{\text{Precip. 2}}$ number of standard deviations between Precip. 1 and Precip. 2. Using Precip. 1 and Precip. 2 at probabilities of 0.0001 and 0.50 respectively, $SDX = \log \dfrac{2.92}{0.81} / 3.71902 = 0.1494$. This procedure is repeated for each storm duration in each precipitation zone.

Monthly CF values are computed by first selecting sites near the study area for which curves of weekly probabilities of precipitation are available (Jeppson et al., 1968). Using Theissen polygons, the elements are grouped into zones (denoted IDZ) composed of elements in the same polygon.

A weekly probability curve for the occurrence of 0.8 inches of precipitation at Bluff, Utah, is shown in Figure 4.5. The average ordinate of this curve is 3.35 percent. The average ordinates for each of the months are indicated on the graph. Each monthly CF value is the ratio of the monthly average ordinate and the yearly average (Table 4-3). This

Table 4-3. Monthly correction factors for Bluff, Utah.

Month	CF	CF4
January	1.00	1.15
February	0.60	1.25
March	0.25	0.60
April	0.40	0.60
May	0.25	0.60
June	0.40	0.40
July	0.90	0.90
August	1.45	1.25
September	1.95	1.50
October	2.50	1.60
November	1.40	1.10
December	0.85	1.15

procedure is repeated for the curve of the probability of having 0.4 inches of precipitation in a week. After finding these two sets of CF values for one site, the procedure is repeated for all sites selected as being representative of the study area.

The values of the areal reduction factor (AREDFA) are available

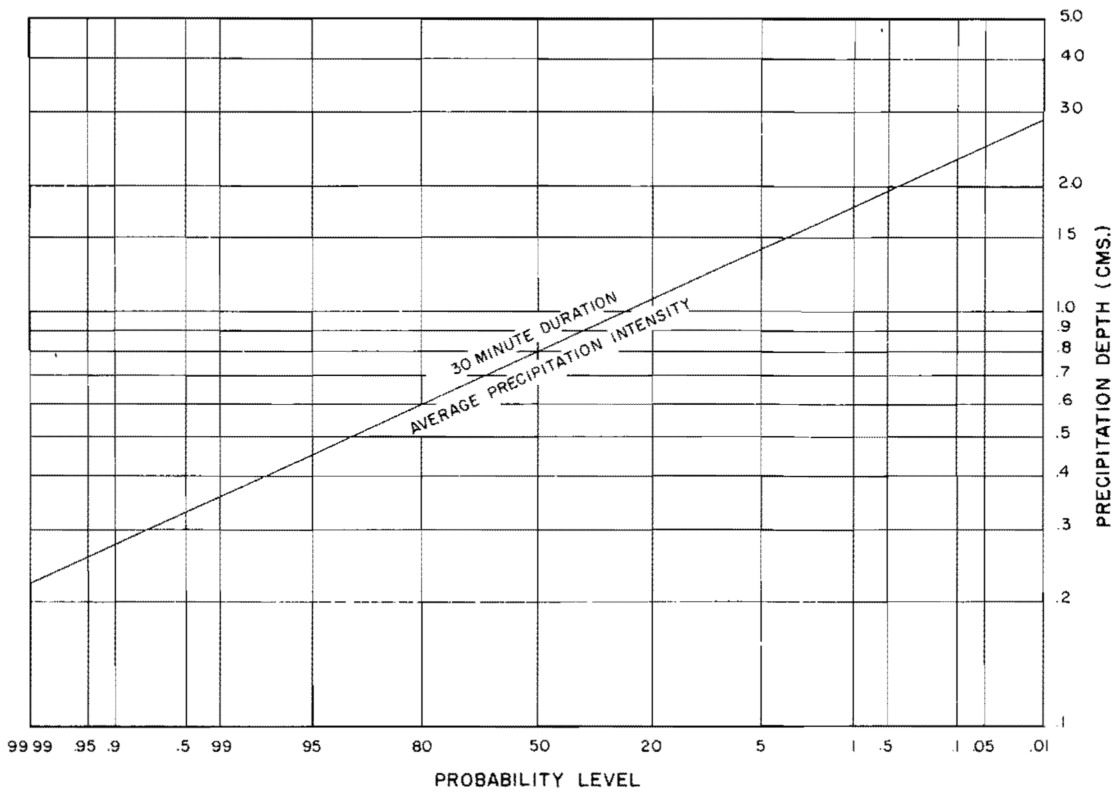

Figure 4.5. Weekly probability curve for the occurrence of 0.8 inches of precipitation in Bluff, Utah.

in the NOAA atlas using the duration curves for 100 km^2 elements (NOAA, 1973).

Mean annual rainfall ratios (RCF) are found by:

1. Running a computer program to determine mean annual rainfall predicted for elements in each precipitation zone.

2. Determining actual mean annual rainfall for each element from an isohyetal map.

3. Computing the ratio of the actual mean annual rainfall to the predicted annual rainfall for each element.

4. Dividing the elements into zones of approximately equal ratios (Figure 4.6).

The ratios needed by the less expensive option discussed earlier are found similarly except that average predicted P30 values are used in place of average predicted yearly quantities.

RESULTS

Figure 4.7 shows the agreement between actual P30 output from RAIN3 as compared to the average monthly precipitation distribution line which is used as input. The small amount of scatter is due to the monthly scatter from the average month.

Actual records from the precipitation station at Escalante for the years 1929-1931 show a standard deviation of monthly precipitation of 2.7 centimeters. The standard deviation of the predicted monthly precipitation output from RAIN3 in the model element containing Escalante was 1.2 centimeters and 1.0 centimeters for the expensive and less expensive options, respectively. However, the standard deviation of monthly precipitation over the 100 km^2 element would be expected to be

	1	2	3	4	5	6	7	8	
A	23 9.5 2.4	19 9.5 2.0	16 9.5 1.7	10 9.5 1.1	7 8 0.9	7 8 0.9	6 7 0.9	8 7 1.1	Mean Rainfall Predicted Rain Ratio
B	21 9.5 2.2	18 11 1.6	14 11 1.3	8 9.5 0.8	7 8 0.9	8 8 1.0	7 7 1.0	9 7 1.3	
C	18 9.5 1.9	18 11 1.6	15 11 1.4	10 9.5 1.1	10 9.5 1.1	9 8 1.1	10 7 1.4	11 7 1.6	
D	15 9.5 1.6	13 11 1.2	14 11 1.3	9 9.5 0.9	9 9.5 0.9	8 9.5 0.8	11 8 1.4	12 7 1.7	
E	10 9.5 1.1	11 9.5 1.2	12 9.5 1.3	11 9.5 1.2	11 9.5 1.2	11 9.5 1.2	13 8 1.6	15 8 1.9	
F	9 8 1.1	11 8 1.4	12 9.5 1.3	12 9.5 1.3	13 9.5 1.4	14 9.5 1.5	17 8 2.1	22 8 2.8	

Ratio	Number of Elements	MAR ZONE	RCF
0.8	2	1	0.85
0.9	7	1	
1.0	2	2	1.05
1.1	7	2	
1.2	5	3	1.25
1.3	6	3	
1.4	5	4	1.45
1.5	1	4	
1.6	5	5	1.65
1.7	2	5	
1.9	2	6	1.95
2.0	1	6	
2.2	1	7	2.2
2.4	1	8	2.4
2.8	1	9	2.8

Figure 4.6. Determination of mean annual rainfall (MAR) zones.

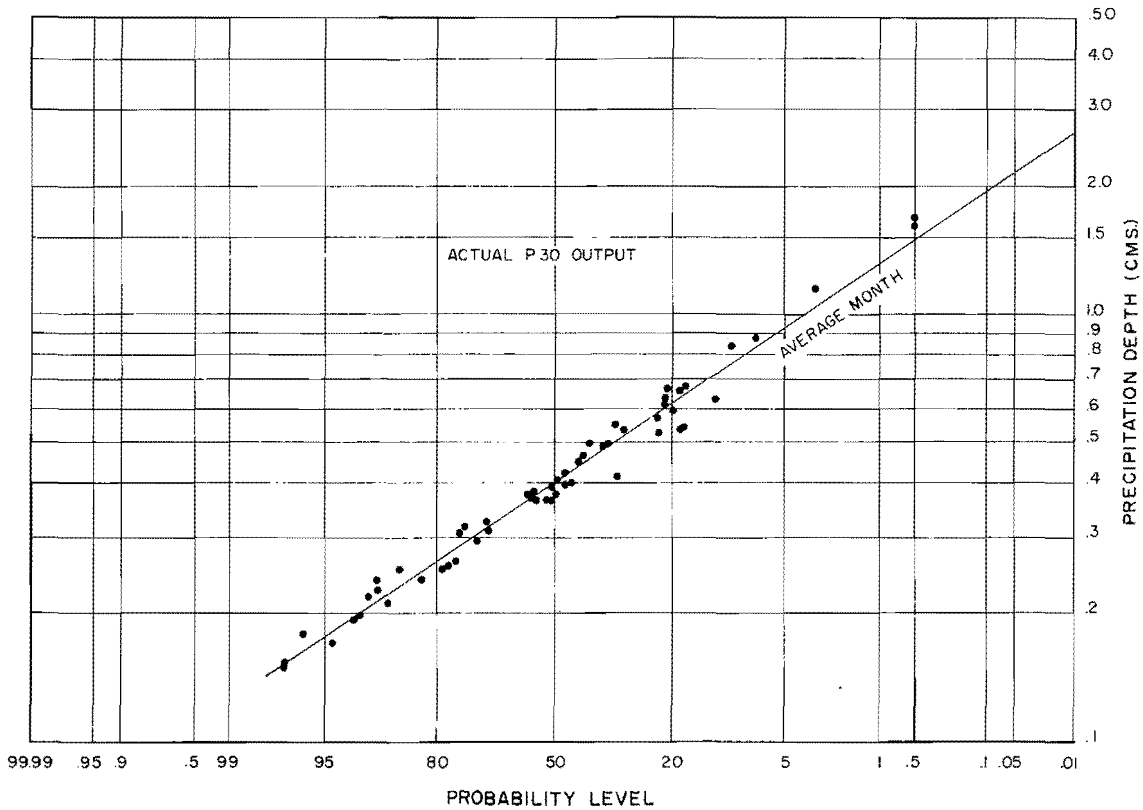

Figure 4.7. The P30 output from RAIN3 compared to the average monthly precipitation distribution line.

lower than 2.7 centimeters for the point. In view of this fact, the standard deviation of RAIN3 output is considered to be close to actual values. Any error resulting from such a discrepancy is assumed to be minor.

The calculated average monthly precipitation for the Escalante element was 2.81 centimeters and 2.44 centimeters for the expensive and inexpensive options, respectively. These values compare to the actual average at Escalante precipitation station of 2.96 centimeters. Adjusting the RCFOPT factors would increase the accuracy of the less expensive option, but such a difference is negligible when applied in the chemistry subroutine (CHEM).

CONCLUSIONS

If the information listed under the heading of Data Requirements is available, the subroutine is operable. However, some limitations on the procedure do exist. The model is not valid in areas of significant snowfall. In the area of this study snowfall is assumed to be insignificant. The small amounts of precipitation which occur in the form of snow are accounted for, but are treated as rainfall.

Another limitation is that the model is not developed with the intent of accurately predicting runoff. In this particular study area, runoff is a very small portion of the total precipitation. Therefore, a large error in predicting runoff is relatively insignificant if the total precipitation is predicted accurately. Runoff was checked in the Fremont River Basin and agreement with observed runoff was good, but this one check does not prove conclusively that the model is capable of adequately predicting runoff.

A further limitation is in the assumption that the 100 km^2 elements are homogenous. Budgetary conditions and the limited availability of data in the Kaiparowits area argue against using smaller elements. The output actually required of RAIN3, that is, monthly maximum 30-minute depths of precipitation and monthly infiltration, are considered of sufficient accuracy for application to the fallout impact area of this study.

CHAPTER 5

A CHEMICAL MODEL FOR HEAVY METAL REACTION WITH SOIL

J. J. Jurinak and A. Van Luik

This submodel chemically reacts the deposited heavy metal containing aerosol with the surface soil of each element and predicts the amount of heavy metal that moves by infiltrating rainfall into the subsoil. It estimates the amount of indigenous plus deposited heavy metal in the adsorbed solid and solution phases and the amount of heavy metal which moves with the eroded soil. This submodel is designated as CHEM.

The submodel CHEM and its subroutines simulate the soil chemistry of Hg, Cd, Pb, Zn and Cr which are added to the soil surface as deposited aerosol. CHEM does not include possible heavy metal uptake or cycling by vegetation. The soils of the study site are considered typical of the semi-arid intermountain west. The soils are calcareous thus are calcium dominated and have a pH of about 8. The organic matter content is low and organic complexation of heavy metals was assumed insignificant. A partial listing of the reactions considered in CHEM as regulating the solubility of heavy metals in the soil is given:

$$M^{2+} + 2OH^- = M(OH)_2 \qquad (5\text{-}1)$$

$$M^{2+} + CO_3^{2-} = MCO_3 \qquad (5\text{-}2)$$

$$3M^{2+} + 2PO_4^{3-} = M_3(PO_4)_2 \qquad (5\text{-}3)$$

$$M^{2+} + CaX = MX + Ca^{2+} \qquad (5\text{-}4)$$

where M^{2+} is a divalent heavy metal cation and X is an adsorption exchange site on the colloid fraction of the soil. If a heavy metal existed as an anion, e.g., CrO_4^{2-}, other reactions were considered. The solubility of heavy metals was quantified by the ion activity products of the various insoluble chemical compounds formed in the soil or the adsorption function for the M^{2+}-Ca exchange reaction.

The movement of heavy metals in the soil is effected by percolating water resulting from infiltrated rainfall. The total amount of heavy metal which is transported downward within the profile is a function of both the total volume of infiltrated rainfall and the concentration of the heavy metals in solution as dictated by the various equilibrium constants of the chemical reactions considered. In CHEM it was assumed that piston flow adequately approximated the miscible displacement process of influent moisture. The initial version of CHEM accounted for both ionic diffusion and dispersion effects in the vertical movement of metal species but this refinement was found unnecessary at the present development stage of TOHM.

All reactions programmed in CHEM were assumed to reach equilibrium correspondingly, the ionic forms of the heavy metals were chosen as the thermodynamically stable form that exists under natural aerobic conditions. The principal ionic forms of the heavy metals were taken as Zn^{2+}, Pb^{2+}, Cd^{2+}, Hg^{2+} and CrO_4^{2-}. The partitioning of Hg and Cr between its various valence states was considered a second order correction to the model. In this regard, the possible formation and movement of metallic Hg was not considered in CHEM.

The heavy metal fallout in the study site was added to the baseline (indigenous) levels of the metals that exist in the soils. The baseline data used were averages of published values for the soils of the area

(Murdock et al., 1975) with the exception of Hg whose baseline value was taken from Garrels et al. (1975). The indigenous concentrations used in this model were: Zn = 20 ppm, Cd = .18 ppm, Pb = 11.4 ppm, Cr = 16 ppm, and Hg = .05 ppm. Baseline concentrations were assumed constant with depth.

Program Inputs to CHEM

CHEM received, on a monthly basis, heavy metal fallout data from SPEDTEC (kg) and rainfall infiltration data (cm^3) from RAIN3. The heavy metal concentration in the surface crust and subsurface soil were received from TOHM and CHEM simulated the chemical reactions between the soil and the heavy metals during a given month and passed the new surface crust and subsurface concentrations back to TOHM. The adjustments for the soil erosion or deposition processes for the month were then made on the surface crust concentrations by TOHM. CHEM then, using the data from TOHM, re-defined the concentrations and physical dimensions of the subsoil to correct for the erosion or deposition that occurred in a given element.

Input Data for CHEM

All necessary soil physical data for CHEM were recorded on the data cards in columns 59-71. The soil of each element in the study site was characterized by defining an "average" soil for the element. The physical parameters considered were porosity, bulk density and parameters, c and α, for the infiltration equation $I = ct^{\alpha}$ where I is the infiltration in cm and t is the time in minutes.

Data that were fixed for all elements for a given time period were entered into DATA statements which formed a common block for TOHM. Included in the DATA statements for CHEM were estimated monthly soil moisture and the chemical properties of the soil. The chemical data were obtained from analyses of saturated extracts from field samples of the eight major soil types found in the study area. Analyses included pH, EC, and concentration in moles/L of Ca, Mg, Na, K, Cl, SO_4, and P. The HCO_3 and CO_3 concentrations were calculated from pH by CHEM assuming equilibrium with atmospheric CO_2. The chemical analyses were done on each of 1 cm depth of soil to a depth of 5 cm for each of the eight soil types. An "average" chemical composition of a representative soil for the total study site then was determined from the chemical analyses and entered into DATA.

SUBMODEL CHEM

The submodel CHEM has three principal subroutines: AION, PPTPH and PPT, the function of each will be discussed separately.

CHEM

CHEM served as the program which interfaced with TOHM. It translated all input into dimensions and variables used in defining the chemistry. CHEM assumed the existence of a column of soil from each element which was divided into five plates each of 1 cm thickness. The dimensions of the column (1 cm x 1 cm x 5 cm) were such to make the volume of each plate 1 cm^3. The upper 1 cm of this column was designated as the surface crust which is formed under natural conditions by raindrop impact. The second plate was called the subsoil. The third to fifth plate also are situated in the subsoil. Calculations in this study involved mainly the upper two plates; however, the program has the capacity to utilize all five plates.

When soil erosion or soil deposition occurred in a given element the result was manifested in the lowering or raising, respectively, of the soil column surface. This information was supplied by TOHM which subtracted (-DELTA) or added (+DELTA) soil to the upper column plate (crust) after each rainfall event. CHEM then relocated the new surface of the representative soil column. This sequence of calculations is necessary to determine if the surface soil crust of a given element was being enriched in the total amount of heavy metal (fallout plus indigenous) or depleted of heavy metal.

The erosion or deposition adjustments relative to the column of soil is schematically shown in Figure 5.1A and 5.1B, respectively.

CHEM also calculated the total depth of water penetration per month (TOTPEN) from the net infiltration of rainfall and the difference in the average monthly soil moisture between two successive events. The average soil moisture values were calculated from monthly rainfall data for the study site and assuming that the field capacity of a soil was equal to about one-half of its porosity. The wettest month then was considered to produce an average soil moisture content of 48 percent of the average field capacity. The average monthly soil moisture for other months were directly proportional to the soil moisture content of the wettest month. Total water penetration was then computed as monthly infiltration either increased or decreased by the soil moisture content between successive months divided by the total void volume in each plate. This approach is considered a reasonable compromise to account for evapotranspiration and unsaturated flow neither of which was considered in this model.

If TOTPEN $\leq$ 1 cm, heavy metal fallout was added to the indigenous or existing mass of heavy metal in the first plate and then returned to TOHM. If TOTPEN > 1 cm, calculations were made to estimate the heavy

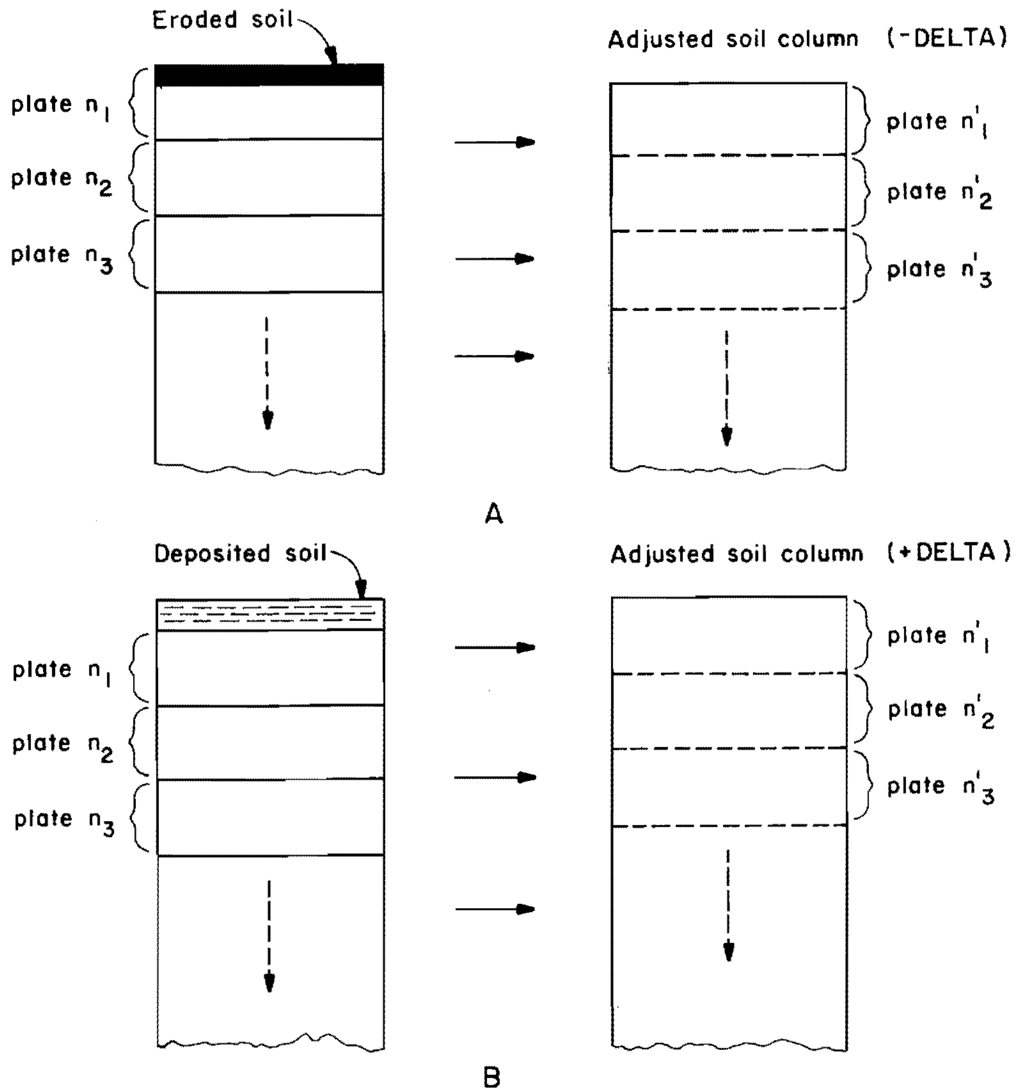

Figure 5.1. A schematic representation of the erosion (-DELTA) and deposition (+DELTA) adjustments made by CHEM on the soil column.

metal movement to the lower soil plates caused by the percolating water. This constituted heavy metal storage. The units are converted to moles/L per cm^2 of surface, fallout and indigenous heavy metal are summed, totally dissolved in the soil moisture and then relayed to the AION subroutine where the concentrations were converted to activities and then reduced by chemical precipitation. If precipitation accounted for less than 99 percent of the total dissolved heavy metal the reduced concentration of heavy metal was further decreased by considering exchange adsorption.

Adsorption Function

The adsorption routine is used when chemical precipitation appears inadequate (data underflow) in removing heavy metals from solution. It was assumed that the soil composition in an element was invariant in any given column platelet and that the exchange complex was saturated with Ca^{2+} ion. Because of the relatively low concentration of heavy metals, the exchange function governing the adsorption and transport of heavy metals was assumed to be linear and of the form (Bolt and Bruggenwert, 1976)

$$X_M = \frac{V}{\theta}\left[1 + km/Ca \cdot R_{D,Ca}\right] \qquad (5\text{-}5)$$

where X_M is the depth of penetration of heavy metal cation M, V is the volume of percolating solution, θ is volume fraction of soil moisture (V/θ is total water penetration), K is the selectivity coefficient for the M-Ca exchange and R_D may be taken as 100. The ratio of X_M to V/θ essentially gives the ratio of the heavy metal in solution to that held by adsorption.

When the system had been corrected for adsorption, all phases (solution, adsorbed and precipitated) containing the given heavy metal were combined for each 1 cm depth and the dimensions changed to read kg/km^2. CHEM thus allowed the computation of the net increase in mass of Hg, Pb, Cd, Zn and Cr per element for each monthly rainfall event as effected by heavy metal fallout in the study site. To account for the heavy metal chemistry in TOHM during any given year CHEM must be called (5 x 288 x 12) = 17,280 times. Figure 5.2 shows a qualitative flow chart for submodel CHEM.

Subroutine AION

AION computed ion activities and ion pair formation for all of the ionic constituents in the soil solution. These data were passed to the precipitation subroutines PPTPH and PPT for calculation of post-precipitation concentrations. These reduced concentrations were returned to AION where they are stored and returned to CHEM.

AION received the concentrations of Zn, Hg, Pb, Cd and CrO_4 in moles/L for each soil platelet from CHEM and baseline data for Ca, Mg, K, Na, Cl, SO_4 and pH from DATA. The HCO_3 and CO_3 activities were calculated using established techniques (Stumm and Morgan, 1970). Initially, the ionic strength μ was calculated from the molar concentrations M_i and valence Z_i of all ith ionic species in solution

$$\mu = 1/2 \sum_{i=1}^{i=n} M_i Z_i^2 \qquad (5\text{-}6)$$

Then the activity coefficient γ_i for each ionic specie i was calculated from (Stumm and Morgan, 1970)

$$\log \gamma_i = -A\, Z_i^2\, \mu^{1/2}/(1 + U^{1/2}) + bU \qquad (5\text{-}7)$$

where A = .509 for an aqueous solution at 25°C, and b has a value of 0.2.

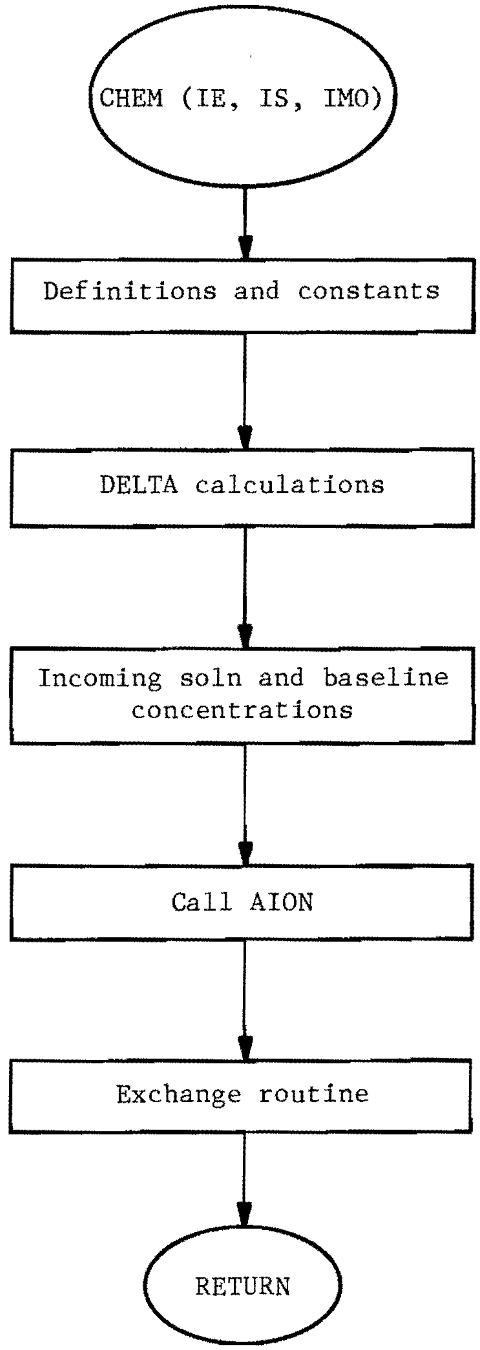

Figure 5.2. Simplified flow chart for CHEM.

When the activity coefficients were estimated, the ion activities (M) were calculated using a mass balance approach which incorporated ion pair formation in the soil solution. For example, the total analytical concentration of heavy metal in solution M_T in terms of the ion pairs considered in this study was given by

$$M_T = [M^{2+}] + [MSO_4{}^{o}] + [MCl^{+}] + [MCO_3{}^{o}] + [MHPO_4{}^{o}] \qquad (5\text{-}8)$$

where [ ] represents concentration in moles/L and $(M_i) = \gamma_i [M_i]$. In terms of activities, where ( ) represents activity, equation 5-8 is written

$$M_T = \frac{(M^{2+})}{\gamma_m} + \frac{(MSO_4{}^{o})}{\gamma_{mso_4}} + \frac{(MCl^{+})}{\gamma_{mcl}} + \frac{(MCO_3{}^{o})}{\gamma_{mco_3}} + \frac{(MHPO_4{}^{o})}{\gamma_{hpo_4}} \qquad (5\text{-}9)$$

In general, for any ion pair of the form MX, we can write

$$MX^{i-j} = M^{i+} + X^{j-}$$

and

$$K_{MX}{}^{i-j} = \frac{(M^{i+})(X^{j-})}{(MX^{i-j})}$$

or

$$(MX^{i-j}) = \frac{(M^{i+})(X^{j-})}{K_{MX}{}^{i-j}} \qquad (5\text{-}10)$$

where $K_{MX}{}^{i-j}$ is the dissociation constant for the ion pair MX^{i-j} and where i+ is the charge on cation M and j- is the charge on anion X. Making the substitution given in (5-10) for all complexes and rearranging equation (5-9) gives

$$(M^{2+}) = M_T \quad \frac{1}{\gamma_m} + \frac{(SO_4)}{\gamma K_{mso_4}} + \frac{(Cl)}{\gamma K_{mcl}} + \frac{(CO_3)}{\gamma K_{mco_3}} + \frac{(HPO_4)}{\gamma K_{mpo_4}} \qquad (5\text{-}11)$$

All anions and cations whose calculations appear in submodel CHEM were treated in this manner. To simplify the FORTRAN expressions the denomination in equation (5-11) were calculated separately for each ionic specie in solution and given a variable name before the calculation of the free ion specie activity.

Each charged ion pair contributed to the ionic strength μ thus, the activities of all ion pairs (MX^{i-j}) were calculated from equation (5-10) after (M^{i+}) and (X^{i-j}) were calculated using expressions of the form given by equation (5-11). Since ionic strength is based on concentrations each calculated ion pair activity was divided by its respective activity coefficient and fed into a new ionic strength expression which incorporated ion pairs in its computation. This process was repeated in an iterative DO loop until successive ionic strength values differed by less than 1×10^{-6}. The computed activities for the heavy metals, CO_3, HCO_3 and the pH and POH were then routed to subroutine PPTPH which calculated the post precipitation concentration of all heavy metals which were precipitated by anions whose activities were pH dependent, e.g. OH^- or CO_3^{2-}. The same activities were also routed, together with the activities of reacting ions into subroutine PPT which calculates the concentration of heavy metals after precipitation occurred with anions whose activities were non-pH dependent e.g., SO_4, Cl. The reduced concentrations from PPTPH and PPT were fed back to AION where they were stored separately and the lowest concentration calculated for each heavy metal returned to CHEM for further manipulation.

This methodology allowed each precipitation reaction to proceed independently to completion and then the model chose the reaction which produced the lowest chemical potential for a given heavy metal to dominate the system.

Figure 5.3 shows the qualitative flow chart for subroutine AION.

Subroutine PPTPH

PPTPH calculated the heavy metal concentrations after precipitation with an ion whose activity is pH sensitive. Under the assumptions of CHEM, PPTPH is straightforward. For example, if the ion activity product of M^{2+} and CO_3^{2-} exceeded the solubility product k_s of MCO_3, precipitation occurred. Since pH was assumed constant, CO_3^{2-} activity was also constant; thus, after precipitation (M^{2+}) is given by

$$(M^{2+}) = k_s/(CO_3^{2-}) \quad . \tag{5-11}$$

The same approach used for the hydroxide form of the heavy metal gives

$$(M^{2+}) = k_s'/(OH^-)^2 \tag{5-12}$$

where k_s' is the solubility product of $M(OH)_2$. All heavy metals that existed as cations were handled in this manner. Figure 5.4 shows the qualitative flow chart for PPTPH.

Subroutine PPT

PPT calculated heavy metal concentrations after precipitation with a anion whose activity was non-pH dependent. Of specific interest in this study was the heavy metal chromium which was assumed to exist as the negative charged CrO_4^{2-} ion. The CrO_4^{2-} ion and the Zn^{2+} ion form the basic zinc chromate $Zn(CrO_4)_{.2}(OH)_{1.6}$. Since both zinc and chromate can limit precipitation, the calculations to determine the amount of basic zinc chromate that precipitates are given.

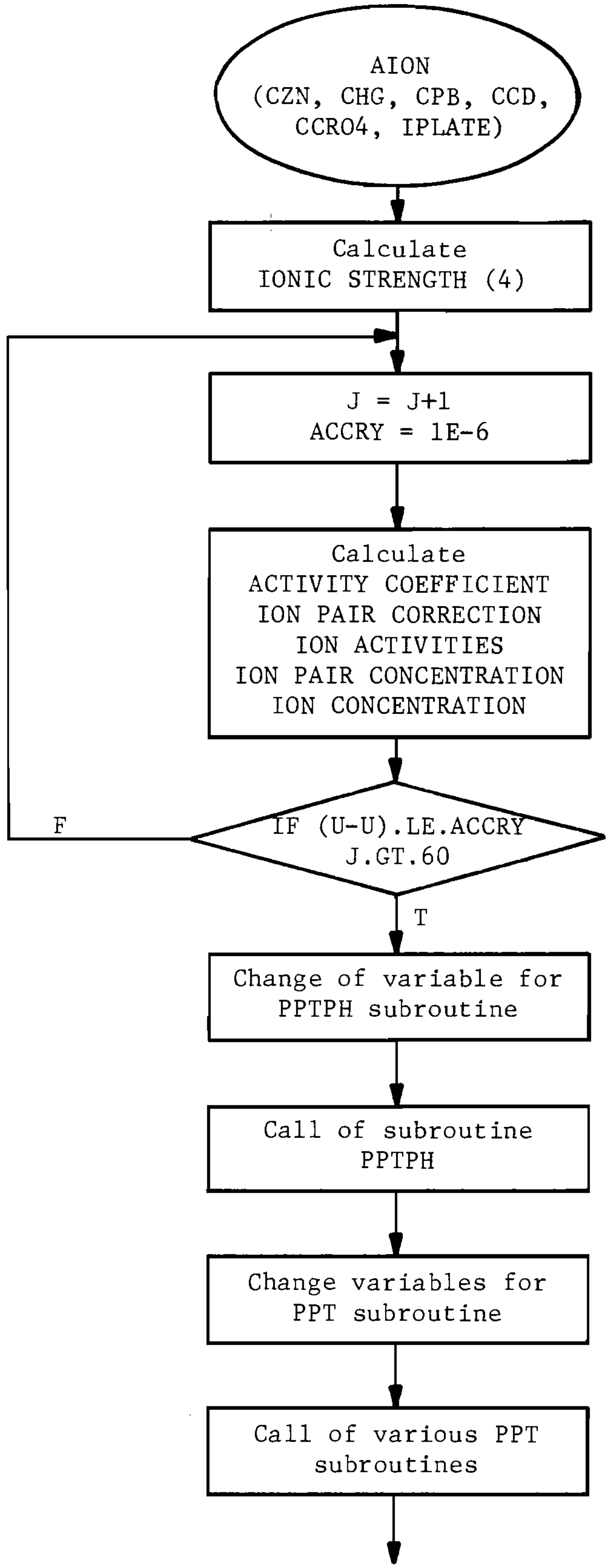

Figure 5.3. Simplified flow chart for AION.

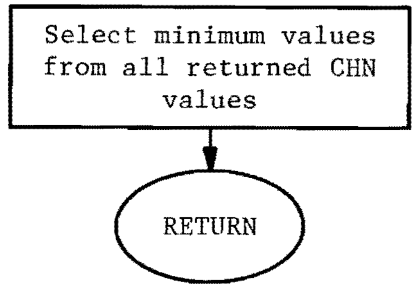

Figure 5.3. (Continued)

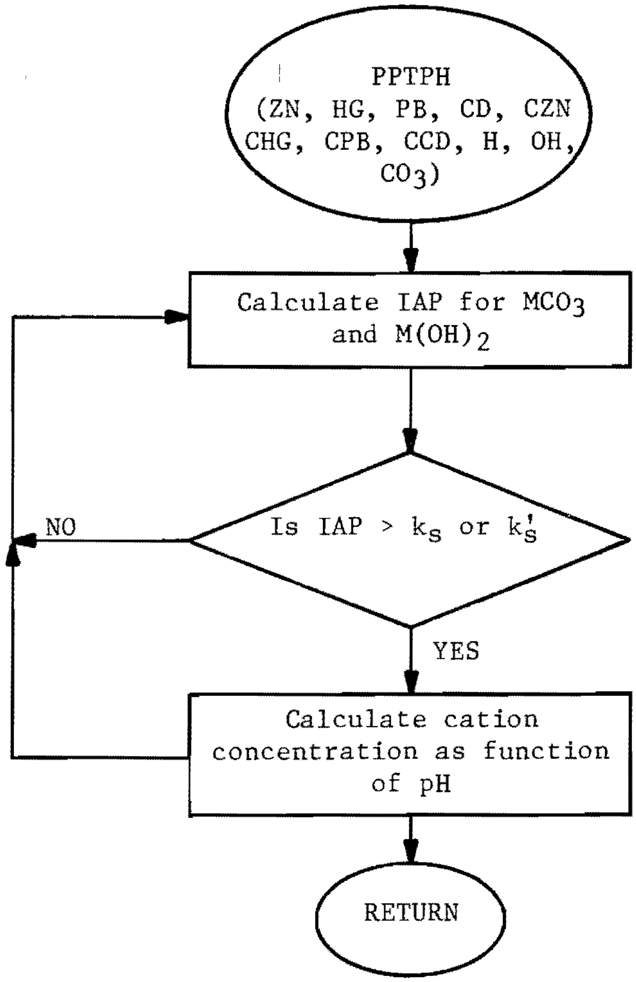

Figure 5.4. Simplified flow chart for PPTPH.

A general type equation for basic zinc chromate is $X_aY_bZ_c$ where X, Y and Z represent Zn, CrO_4 and OH, respectively. The terms a, b and c represent 1, 0.2 and 1.6, respectively. After precipitation of D moles of basic zinc chromate we have

$$(X-D/a)^a(Y-D/b)^b(Z-D/c)^c = k_s = f(D) \qquad (5\text{-}13)$$

where k_s is the solubility product. The only unknown in equation 5-13 is D. A Newton-Raphson iterative scheme is used to find D. The first derivative of equation (5-13) is

$$f'(D) = (x-D/a)^a(y-D/b)^b(-1/c)(c)(z-D/c)^{c-1} + (x-D/a)^a(z-D/c)^c(-1/b)(b)$$
$$(y-D/b)^{b-1} + (y-D/b)^b(z-D/c)^c(-1/a)(a)(x-D/a)^{a-1} .$$

The solution for D is

$$D = D - f(D)/f'(D)$$

which converged at between 1 to 60 iterations for every case encountered in this study. After D is fixed, new values for X, Y and Z (Zn, CrO_4 and OH) are returned to PPTADS. All phosphate compounds e.g., $Pb_3(PO_4)_2$, $Cd_3(PO_4)_2$, etc., were also treated in this manner since both the heavy metal or soil phosphate could limit precipitation. The flow chart for PPT is shown in Figure 5.5. All thermodynamic constants used in CHEM were obtained from Sillen and Martell (1964) and Wagman et al. (1968).

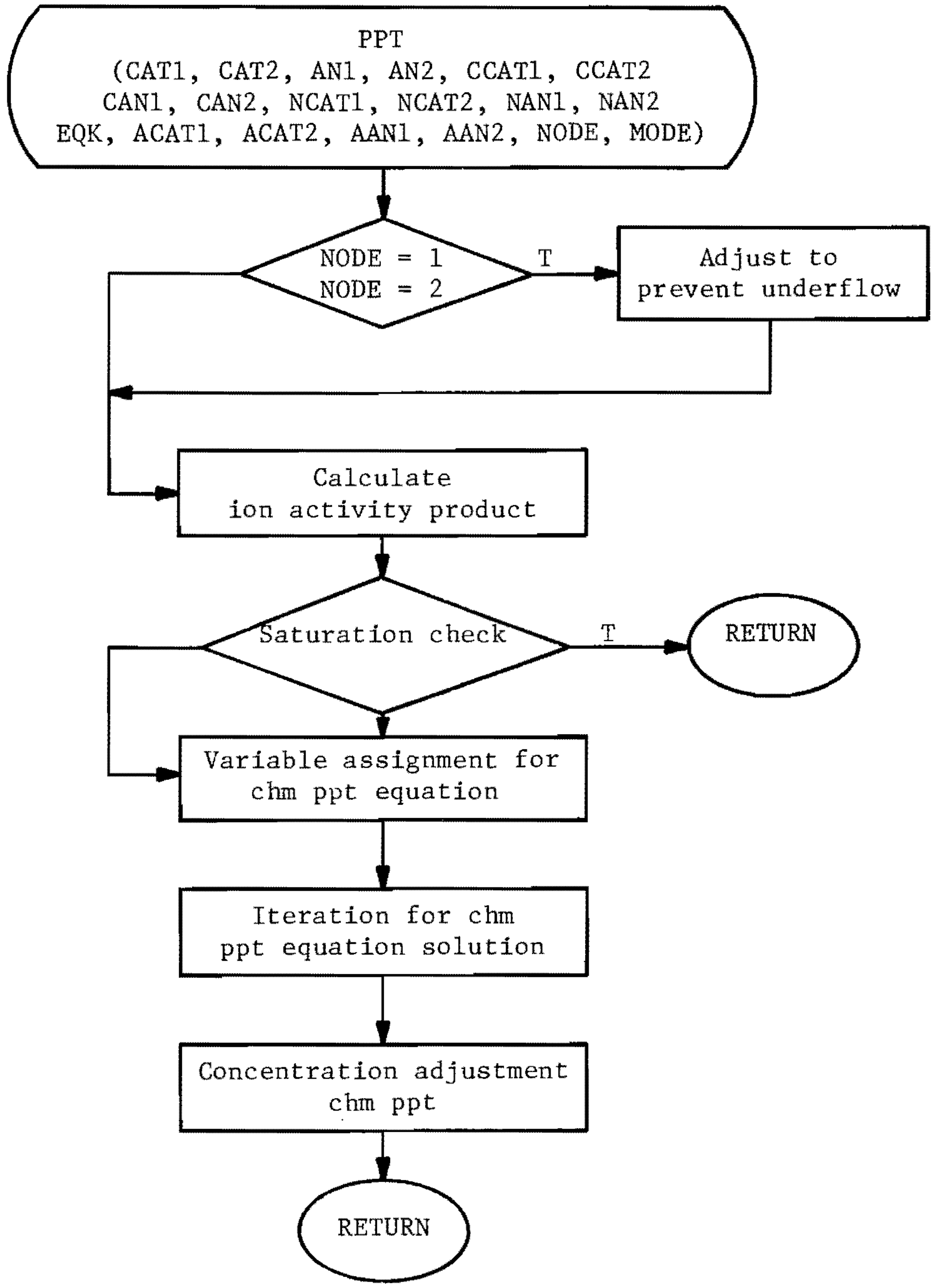

Figure 5.5. Simplified flow chart for PPT.

CHAPTER 6

GENERAL HEAVY METAL TRANSPORT MODEL

W. J. Grenney

The Transport of Heavy Metals (TOHM) model was developed to provide a means of estimating the rate of transport of heavy metals from the stack discharges of power generating plants, through the atmosphere and eventually through the soil-water system to an environmental sink (such as a reservoir). This process can be subdivided into five major components as shown in Figure 6.1. Particulates discharged from the stack are transported downwind and deposited on the surface of the soil. In some situations the fallout rate may be a function of precipitation; however, for the semi-arid intermountain region the storms are localized, infrequent, and of short duration so individual storm events are considered to have little effect on average seasonal fallout rates.

The heavy metals associated with the fallout interact with each other and with the soil constituents depending on the characteristics of the soil matrix. The infiltrating moisture from a storm event may transport the metals deeper into the soil column. The net accumulation of metals near the soil surface is a complex function of the fallout rate, chemical reactions in the interstitial waters, infiltration rate, and previous accumulations or background levels of the metals in the soil column.

The soils in the intermountain west are highly erodable. Rates of as high as 3340 tons per square mile per year have been reported. The soil and associated heavy metals eroded from the surface are transported by means of intermittent streams to relatively large perennial rivers in

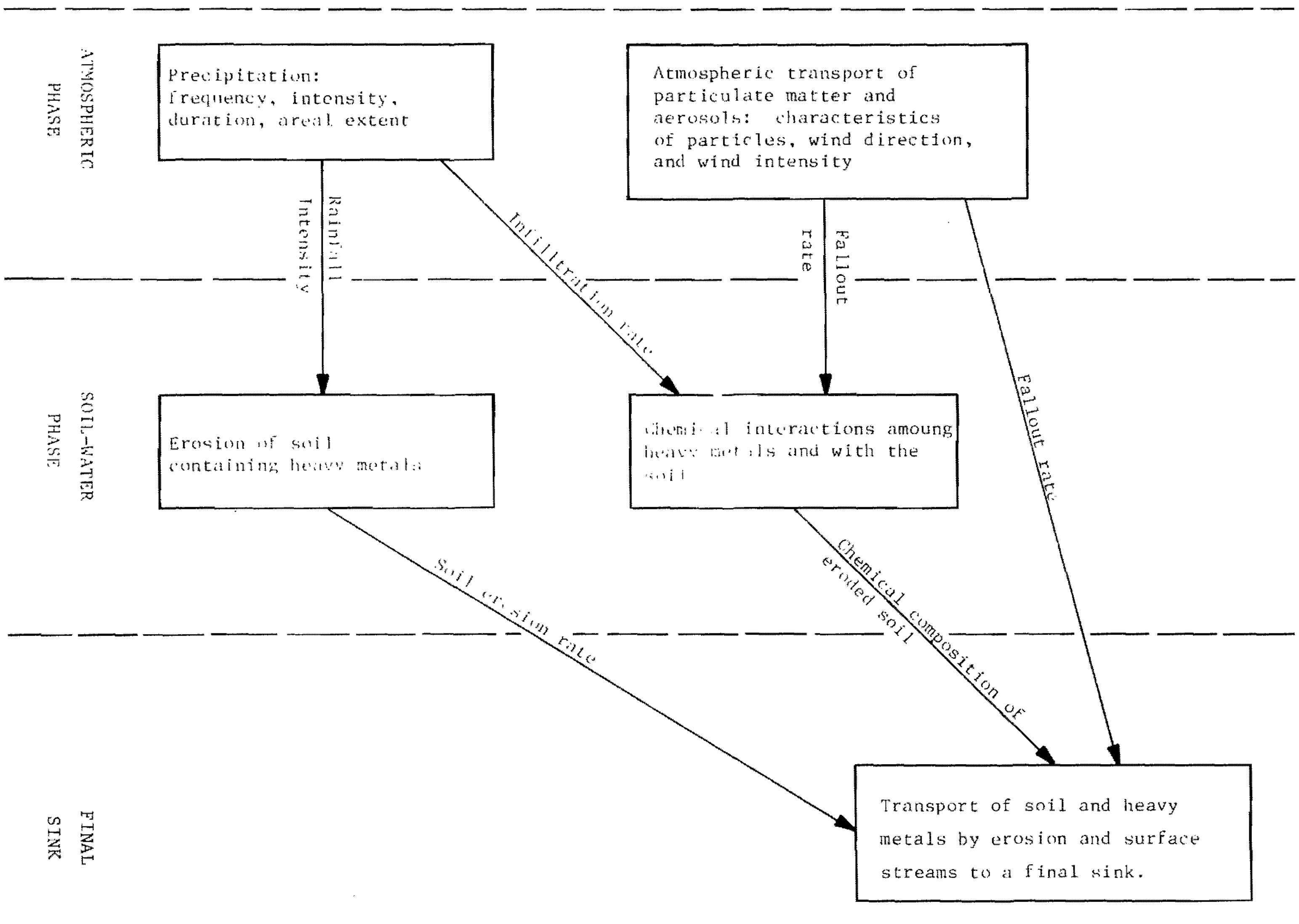

Figure 6.1. Conceptual arrangements of the major components of heavy metal transport process.

which they become part of the total transported sediment load which eventually settles out in a reservoir or other quiescent reaches. The principal strategy in monitoring the movement of heavy metals that are deposited on the surface soil is to define the movement of the eroded soil particles with which they are associated. The erosion process, therefore, is a major component in the heavy metal transport pathway. It is effected by the frequency and intensity of precipitation, slope, vegetation cover, soil type, and distance from a relatively large perennial river.

The mechanisms included in the components of Figure 6.1 are time and space variable. Fallout rates from the atmospheric transport components have significant variations with season and with location depending on predominant wind velocity and direction, orographic features, and on distance from the point of discharge. The mean values of frequency and intensity of precipitation may vary significantly from region to region. Precipitation also has an important stochastic nature and cannot be adequately represented by average parameters. The erodability of soils varies over wide ranges depending on the topography, vegetation cover, and soil type.

The components represented in Figure 6.1 were, therefore, modeled as time and space variable processes. These processes are represented in the model by systems of equations referred to as "process equations". The space domain was incorporated in the model by superimposing a grid over the area of interest. The grid may be made up of irregular "elements"; although for this application 10 km square elements were used. Grid elements should be small enough so that the characteristics of the terrain encompassed by the element are relatively homogeneous. The model process equations are applied to each element and the individual effects integrated together to obtain the overall basin response. In order to reduce the volume of model output, the elements are grouped into hydrologic sub-basins for data output.

The time domain was incorporated in the model by solving the process equations each month and integrating the effects over any time horizon of interest. In order to keep the model output to a managable volume, basin responses are output at a yearly interval. The stochastic nature of precipitation is introduced to the model by generating storm events for each element each month such that the probability distribution over a long period of time will conform to the observed statistical properties of a specified meteorological region.

CONTROL SUBROUTINE

The TOHM model is composed of four major process subroutines representing the components in Figure 6.1; precipitation, atmospheric transport, erosion, and soil chemistry. These subroutines as well as input/output subroutines are interfaced by a master control program. Data input formats, sample input-output, and a program listing are included in appendices A, B, and C, respectively. The program was written in Fortran IV and used on the Bourroughs 6700 computer at Utah State University. Detailed descriptions of the atmospheric transport, precipitation (RAIN3), and chemistry (CHEM) subroutines are included in other sections of this report. The model was segmented into subroutines so that different process equations could be utilized if desired in future applications with a minimum of reprogramming.

PROGRAM DESCRIPTION

Figure 6.2 is a flow chart for the control program (CONTRO). It performs the following tasks:

1. Calls input subroutines and echos data at user's option. Conducts internal checks on input data and sorts it into the proper matrix form.
2. Determines, from user options, which of the eight heavy metals are included in a run and packs matrices for efficient manipulation.
3. Accommodates user options for various combinations of process subroutines.
4. Accounts for the mass transport of materials among elements and it's accumulation within elements.
5. Provides output information on disk or punched cards necessary for model restart.
6. Manages output summaries in accordance with user options.

The model was structured to provide a high degree of flexability for user options. Individual process subroutines may be bypassed or used in a variety of combinations with each other. This allows for the reduction of computer time by including only the optimal combination of process equations for a particular application. Combinations of the following options are available:

1. Precipitation
    a. Call subroutine RAIN3 for each element and each month.
    b. Read in 12 months of typical precipitation data for each element and use these same data for each year

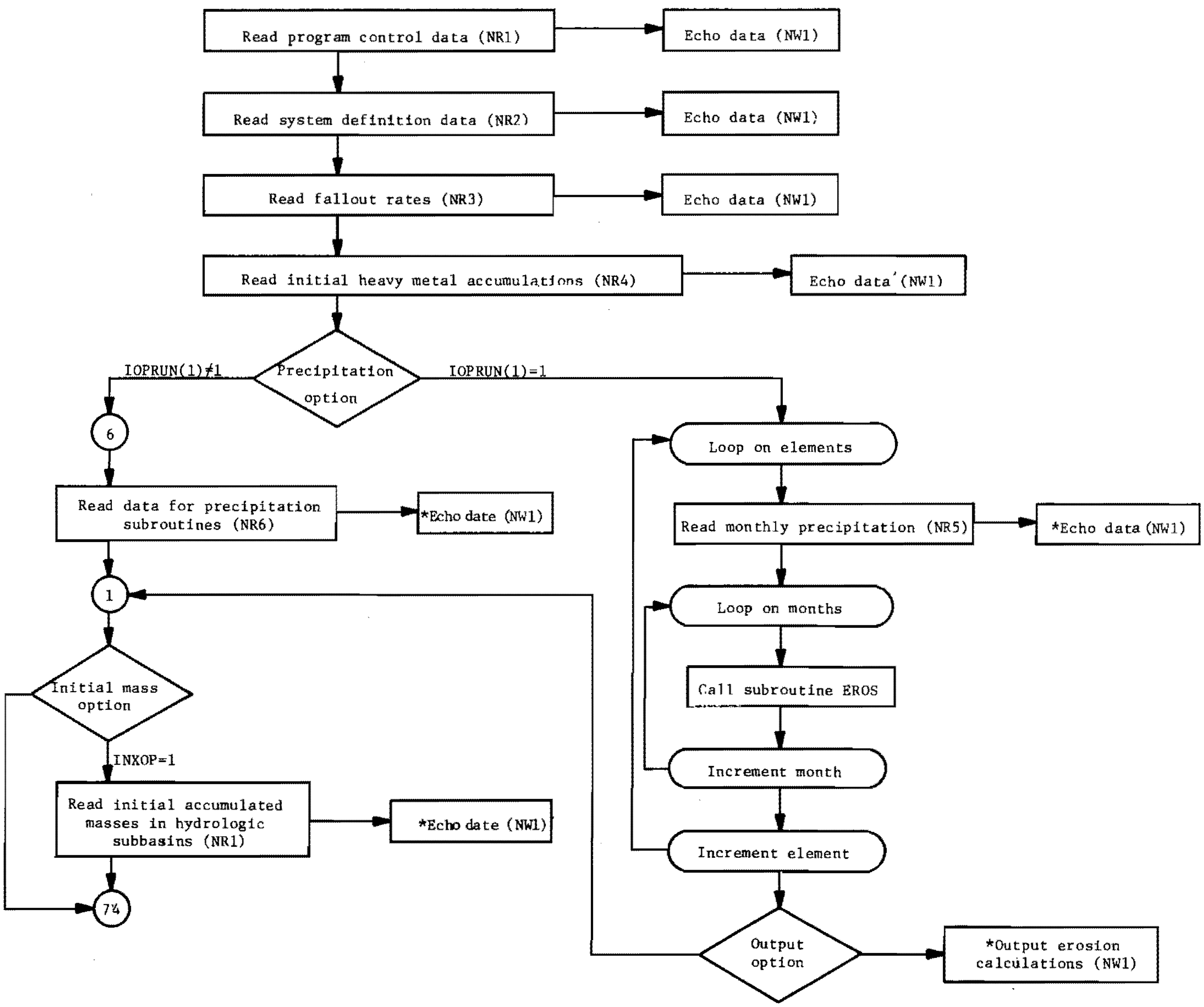

Figure 6.2. Flow chart for the control program (CONTRO).

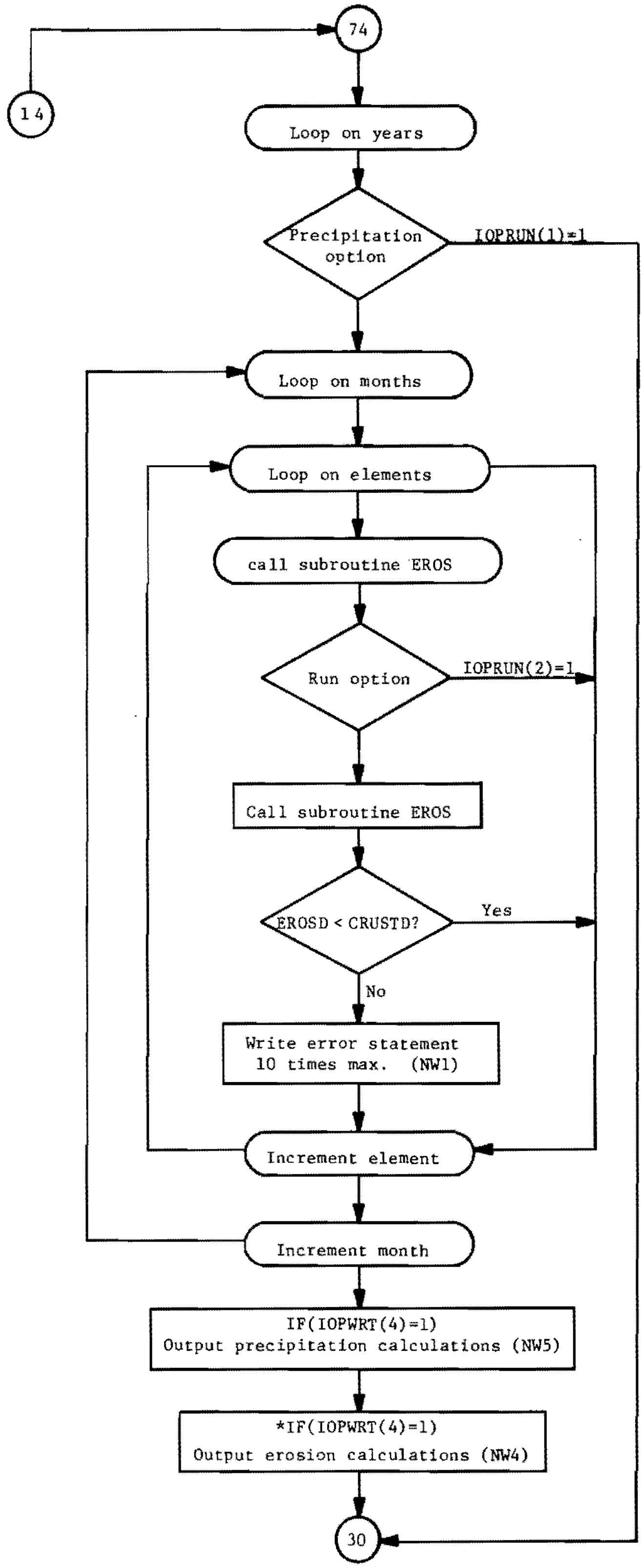

Figure 6.2. (Continued)

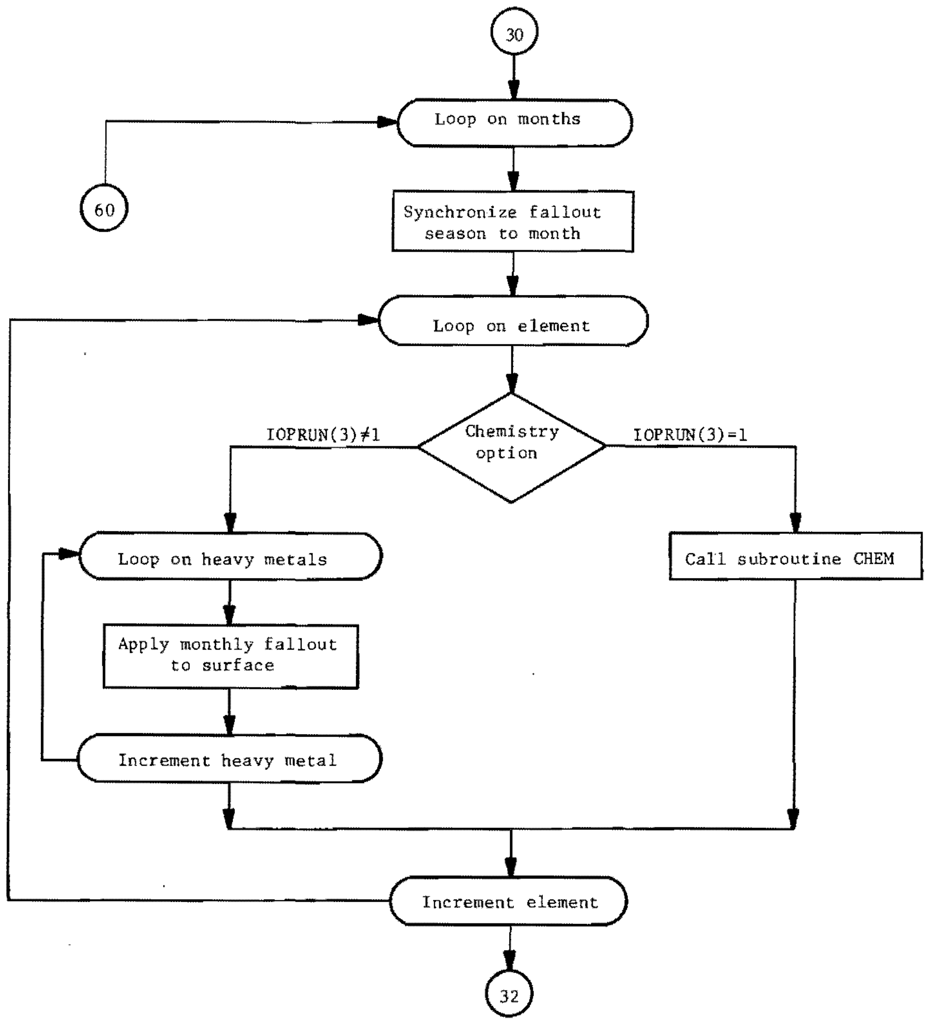

Figure 6.2. (Continued)

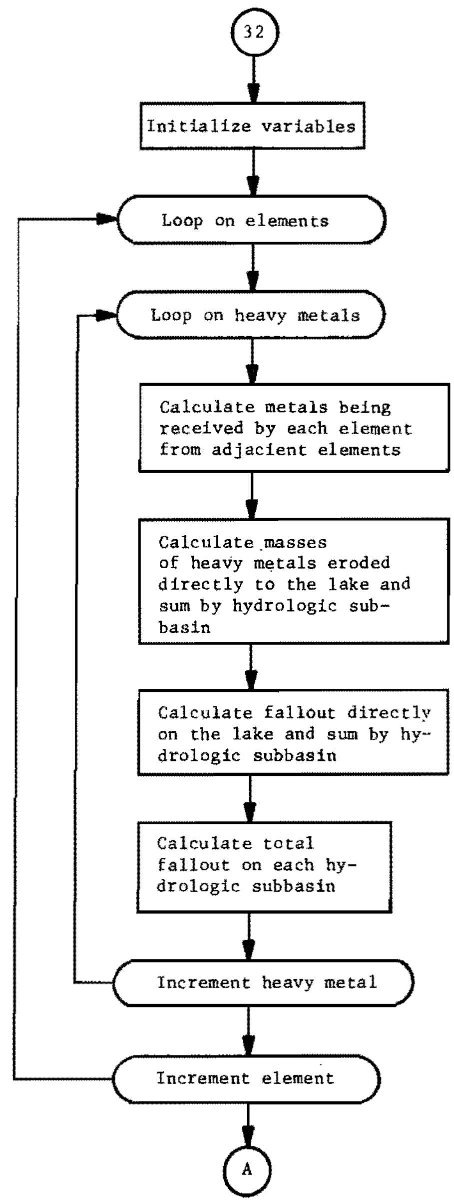

Figure 6.2. (Continued)

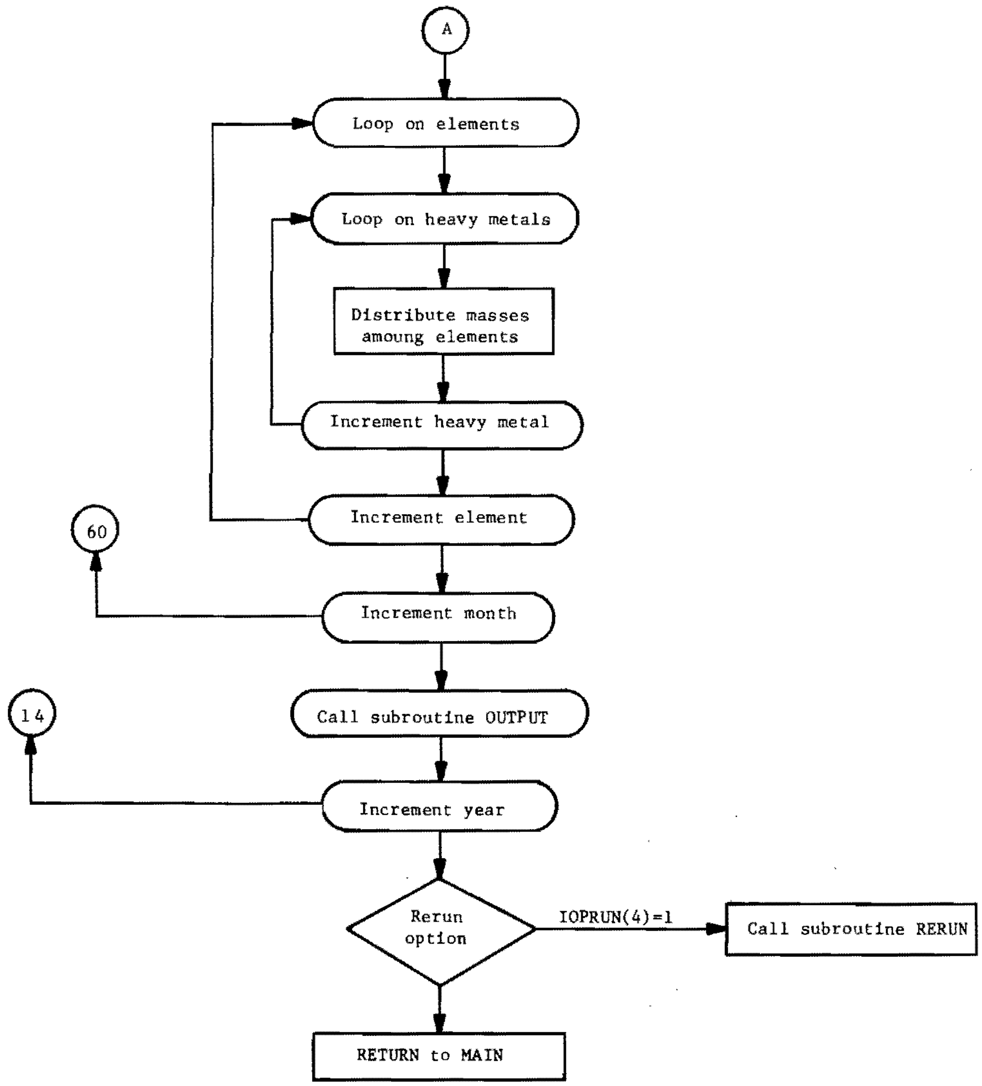

Figure 6.2. (Continued)

of a run. These precipitation data may be generated and stored on disk by an independent run of the model.

2. Soil Chemistry

   a. Call subroutine CHEM for each element and each month.

   b. Bypass CHEM and assume that the fallout behaves as conservative constituents.

3. Erosion

   a. Call subroutine EROS for each element and each year

   b. Use 12 months of typical erosion data for each element and use these same data for each year of a run. This option is automatically used with 1-b above.

Referring to Figure 6.2; control data, system definition data, fallout rate data (linkage with the atmospheric transport model), and initial soil conditions (structured to provide easy restart capabilities) are read from separate files to facilitate model testing and management run combinations. If constant annual precipitation is to be used in a run [IOPRUN(1) = 1], twelve months of data are read in for each element, the effects of this precipitation on erosion is calculated for each month and each element (subroutine EROS), and these values stored for repetitive use during the run. The model then loops through each month and each element calling subroutine RAIN3 (depending on user option IOPRUN(1)) to produce values of precipitation intensity and infiltration, calling subroutine EROS to calculate erosion rates (depending on user option IOPRUN(2)), and storing twelve months of current erosion rates for each element.

The model next loops through on months and elements calling subroutine CHEM to apply fallout to the surface and simulate the chemical reactions occurring in the soil (depending on user option IOPRUN(3)). Resulting heavy metal concentrations in the soil crust are stored for each element. Based on these concentrations and the erosion rates, the amounts of soil and heavy metals transported among elements are calculated. Looping through elements again, transported masses are accumulated in the appropriate elements and heavy metal concentrations in the soil crust are updated. A summary of the model response is written each year by subroutine OUTPUT. If it is anticipated that the model may be restarted for an extension of the current time horizon (determined by user option IOPRUN(4)), then subroutine RERUN is called. Appropriate data are output to a file in the proper format to provide initial conditions for the model restart.

MODEL EQUATIONS

The transport and accumulation of fallout in the various elements is accomplished by a mass balance technique. The principal matrices may be defined in the following terms:

i = element index: $i = 1,I$ ($I \leq 300$)

t = time index: $t = 1,T$ ($T \leq 12$)

k = heavy metal index: $k = 1,K$ ($K \leq 8$)

n = hydrologic subbasin index: $n = 1,N$ ($N \leq 6$)

Δt = a scaler: time increment (months)

d = a scaler: depth of soil crust (cm)

$A = (a_i)$: a vector of soil area in element i (km^2)

$\underline{A} = \text{diag}\,(a_{i,i})$: a diagonal matrix in which the diagonal elements are equal to the corresponding elements in the A vector

$B = (b_i)$: a vector of total area (soil plus reservoir) in element i (km^2)

$\underline{B} = (b_{i,i})$: a diagonal matrix in which the diagonal elements are equal to the corresponding elements in the B vector

$F_t = (f_{i,k})_t$: a matrix of fallout rates of heavy metal k on element i at time t (kg/km^2/mo)

$H = (h_{n,i})$: a zero-one matrix indicating the hydrologic subbasin n encompassing element i; $h_{n,i} = 1$ when i is in n; $h_{n,i} = 0$ otherwise

$M_{i,t} = (m_{\ell,k})_{i,t}$: matrices of the concentration of heavy metal k in the subsoil layer ℓ of element i at time t (kg/km^2/cm)

$P = (p_{\ell,i})$: a matrix of coefficients indicating the fraction of eroded soil which is transported from element i to element ℓ in one time increment (dimensionless)

$S = (s_i)$: a vector of coefficients indicating the fraction of eroded soil which is transported from element i directly to the sink in one time increment (dimensionless)

$\underline{S} = \text{diag}\ (s_{i,i})$: a diagonal matrix in which the diagonal elements are equal to the corresponding elements in the S vector

$W_t = (w_i)_t$: a vector of the net crust depth change due to soil transport into and out of element i during the period Δt; negative values indicate net erosion, positive indicate net deposition (cm)

$X_t = (x_{i,k})_t$: a matrix of the concentration of heavy metal k in the crust of element i at time t (kg/km^2/cm crust depth)

$Y_t = (y_{i,k})_t$: a matrix of the concentration of heavy metal k in the subsoil column of element i at time t (kg/km^2/cm crust depth)

$Z_t = (z_i)_t$: a vector of the average crust depth eroded during the period Δt in element i calculated by subroutine EROS (cm)

$\underline{Z}_t = \text{diag}\ (z_{i,i})$: a diagonal matrix in which the diagonal elements are equal to the corresponding elements in the Z vector

Processes Within Elements

The soil column is conceptualized as consisting of two components; (1) a thin upper crust of some thickness d, and (2) the subsoil column. Y_t is the heavy metal concentration in the subsoil just below the crust. During the time period Δt, fallout is deposited on the soil surface. During the same time period the soil crust, a portion of which had been eroded during the previous time increment, reforms to its normal depth d. The average concentration $(x_{i,k})$ in the newly formed crust is calculated by:

$$X_t = X_t^o - Q_t + F_t\ \Delta t\ \frac{1}{d} + R \qquad (6\text{-}1)$$

where X_t^o is the concentration in the crust remaining from the previous month. The Q matrix represents the mechanical interchange of heavy metals with the subsoil during the reformation of the crust. The elements in the Q matrix are calculated by:

$$Q_t = (q_{i,k})_t = \begin{cases} y_{i,k,t-1} w_{i,t}\ \frac{1}{d} \text{ when } w_i \leq 0 \\ x_{i,k,t-1} w_{i,t}\ \frac{1}{d} \text{ when } w_i > 0 \end{cases} \qquad (6\text{-}2)$$

The R matrix in equation 6-1 is a nonlinear function representing complex chemical reactions and transport to the subsoil by infiltration. These functions are presented in the section of this report describing the chemistry submodel. When the user chooses to supress the effects of the chemistry submodel, then equation 6-1 is replaced by

$$X_t = X_t^o - Q_t + F_t \Delta t \frac{1}{d} . \qquad (6\text{-}3)$$

Processes Among Elements

Heavy metals are transported among elements in proportion to the soil transported by erosion. The soil erosion in an element is calculated by the Universal Soil Loss Equation which is described in the following section. The effects of erosion are represented in the model by the average depth of soil shifted in each element (the Z_t vector). Some of this shifted material will be redeposited within the element and some will be transported to adjacent elements. The amounts of eroded material to be transported out of an element are determined by the coefficients in the P matrix. Some of the shifted material may go directly into the sink (reservoir) as provided by coefficients in the S matrix.

The net change in crust depth due to erosion (W_i) in an element during Δt may be calculated as follows. $\underline{A}Z_t$ is the volume of soil shifted in element i due to erosion. $P(\underline{A}Z_t)$ is the volume of soil redeposited or transported into element i. Assuming that the erosion process has a uniform distribution over element i; then the net change of soil volume in the element can be expressed as:

$$\underline{B}W_t = P(\underline{A}Z_t) - \underline{A}Z_t \qquad (6\text{-}4)$$

which reduces to

$$W_j = \underline{B}^{-1}(P-I)(\underline{A}Z_t)$$

$$\underline{B}^{-1} = \text{diag}\left(\frac{1}{b_{ii}}\right) \tag{6-5}$$

where $\underline{B}^{-1}$ is the inverse of $\underline{B}$ and I is the identity matrix.

The mass of heavy metal in the crust is:

$$\underline{A}\ d\ X_t\ . \tag{6-6}$$

The mass of heavy metal shifted due to erosion within an element during the time increment Δt can be expressed as:

$$\underline{A}[X_t^T\ \underline{Z}_t]^T \tag{6-7}$$

where T indicates the transpose of the matrix. The mass of heavy metal in the eroded soil redeposited and transported into the element can be expressed as:

$$[\underline{A}P^T]^T[X_t^T\ \underline{Z}_t]^T\ . \tag{6-8}$$

Combining terms 6-6 through 6-8, the redistribution of heavy metals among elements due to erosion can be calculated by a mass balance on the system:

$$X_{t+1} = X_t + \frac{1}{d}\underline{B}^{-1}\ [\underline{A}(P-I)^T]^T[X_t^T\ \underline{Z}_t]^T \tag{6-9}$$

The rate at which heavy metals are eroded to the sink (reservoir) from each element during time increment Δt, can be expressed by:

$$\underline{A}\ \underline{Z}_t\ \underline{S}\ X_t + \underline{B}^{-1}\ [\underline{A}(P - I)^T]^T[X_t^T\ \underline{Z}_t]^T\ (\underline{B} - \underline{A}) \tag{6-10}$$

The following identity must be satisfied to preserve a mass balance:

$$\sum_{\ell=1}^{I} p_{\ell,i} + s_i = 1 \qquad i = 1,I. \tag{6-11}$$

Input data values in the P and S matricies are checked internally by the model. Violations to equation 6-11 cause an error statement to be printed and the run is terminated. The rate of mass contributed to the sink (reservoir) from each hydrologic subbasin is:

$$H[\underline{A}\ \underline{Z}_t\ \underline{S}\ X_t] \qquad (6\text{-}12)$$

The rate of fallout directly on the sink (reservoir) is:

$$F_t^T B\ . \qquad (6\text{-}13)$$

The total mass accumulation in the sink, therefore, is the sum of equations 6-10 and 6-13.

The soil column beneath the crust may be devided into four layers; the top layer identical with Y in equation 6-2. The heavy metal concentrations in each layer are contained in the $M_{i,t}$ matrix. The bottom layer, number 4, has a constant concentration. When a new crust is formed by equation 6-1, metals are exchanged between the crust and the subsoil. If erosion had occurred during the previous time step, some metals from the subsoil are captured in the newly formed crust. If deposition had occurred, then metals from the old crust become part of the subsoil when a new crust forms. If the depth of each subsoil layer is d, then this mechanism can be expressed by the expressions:

when $w_i < 0$ (i.e. erosion)

$$m_{\ell,k} = m^o_{\ell,k} + (m^o_{\ell,k} - m^o_{\ell+1,k})\ w_i/d \quad \ell = 1,3;\ k = 1,k;\ i=1,I$$

when $w_i > 0$ (i.e. deposition)

$$m_{\ell,k} = m^o_{\ell,k} + (m^o_{\ell-1,k} - m^o_{\ell,k})\ w_i/d \quad \ell = 3,1;\ k = 1,k;\ i = 1,I$$

where the superscript ^{o} indicates concentrations at the beginning of the operation and $m_{o,k}$ is the concentration in the crust.

PROGRAM TECHNIQUE

The $\underline{A}$, $\underline{B}$, $\underline{S}$, and $\underline{Z}$ are very sparse matrices which make inefficient use of computer memory. Also matrix operations involving them would require a large number of redundent steps. Therefore, the model was programmed so that the operations in the above equations can be performed using the column vectors A, B, S, and Z in place of the diagonal matrices $\underline{A}$, $\underline{B}$, $\underline{S}$, and $\underline{Z}$. For a system containing 300 elements this amounts to a savings of 89,700 storage locations and at least that many redundent computational steps for each matrix operation.

The H and P matrices are also very sparse and so the model was programmed to replace them with several smaller matrices. Each element is given an identification number (i) by the program. They are sequential numbers assigned in the order that the element data cards are read. The P matrix was reduced by imposing the restriction that soil eroded from an element can be transported to a maximum of two other elements plus the sink (S). This transfer information can be contained in two relatively small matrices:

$(\alpha_{i\ell}) = (\alpha_{i,1} \ \ \alpha_{i,2})$: the identification numbers of the two elements receiving eroded material from element i.

$(\gamma_{i\ell}) = (\gamma_{i,1} \ \ \gamma_{i,2})$: the fractions of eroded material transported from element i to elements $\gamma_{i,1}$ and $\gamma_{i,2}$, respectively.

Using this notation, equation 6-5 can be solved as shown in Figure 6.3.

The model is dimensioned to accomodate up to 8 heavy metals simultaneously. However, it is programmed so that processing time will be reduced

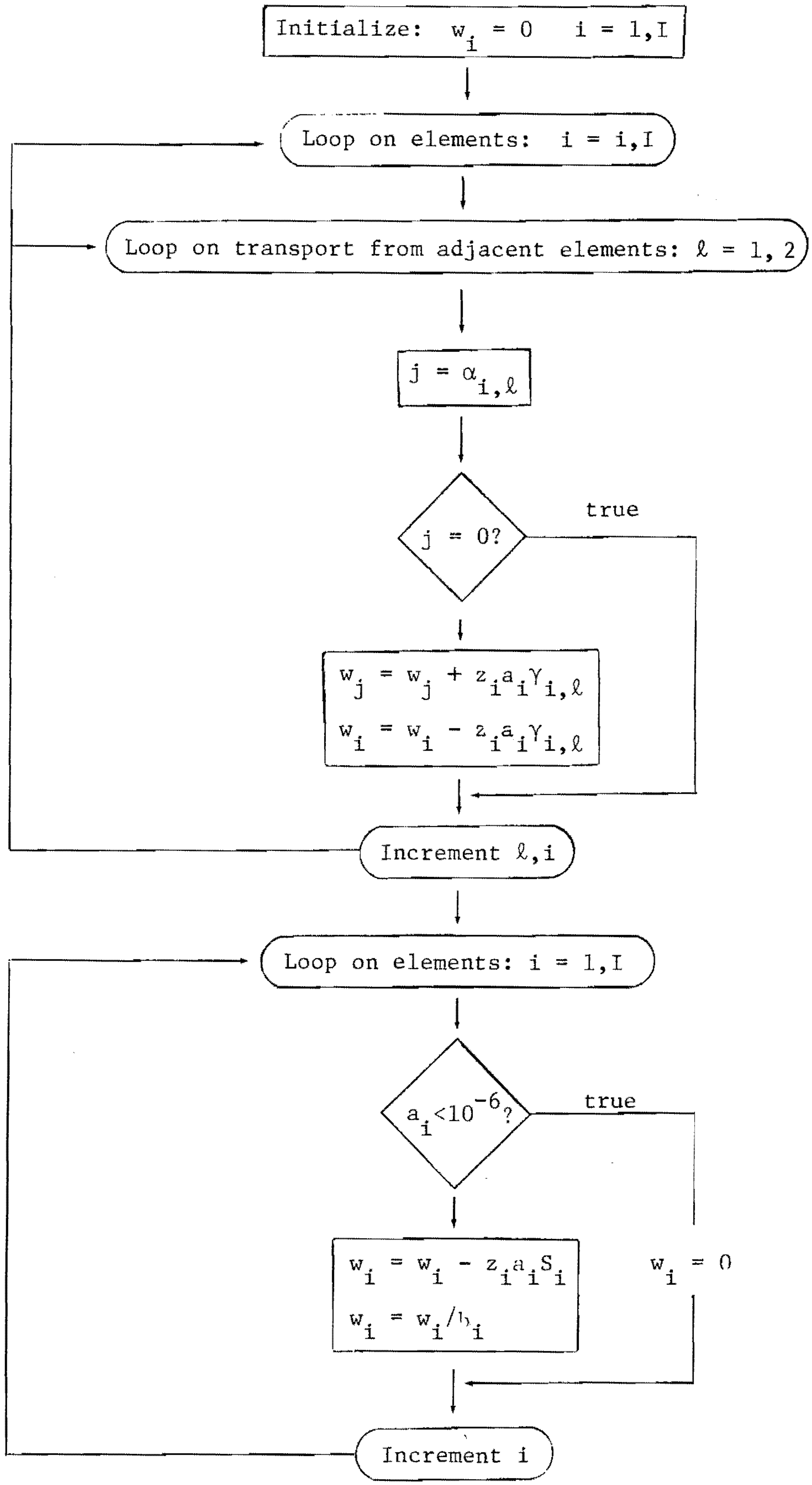

Figure 6.3. Flow chart for the solution to Equation 6-5.

if fewer than 8 are modeled in a run. Each heavy metal has an identification number (1-8). A vector, λg, is defined by the user to indicate which particular heavy metals are to be included in each run.

(λg): the identification number of the gth heavy metal to be modeled in this run; g = 1, G; where G is the total number of heavy metals included in this run ($G \leq 8$).

Let $v_{i,k}$ be the mass of heavy metal (kg/km^2) k which is transported into element i from other elements in the system during time increment Δt. Let $U_{i,k}$ be the mass of heavy metal (kg/km^2) k transported out of element i into other elements during Δt. Then equation 6-9 can be solved as shown in Figure 6.4. Figure 6.4 also shows the calculation for accumulating heavy metals in the sink, q_k.

EROSION SUBROUTINE

Soil erosion in each element is estimated by the universal soil loss equation:

$$e = K_1 K_2 K_3 r \qquad (6\text{-}15)$$

where K_1, K_2, and K_3 are coefficients representing soil type, vegetation cover, and ground slope respectively; r is a coefficient related to rainfall intensity; and e is the rate of soil erosion (tons/acre/month). Values for K_1 and K_2 are shown in Tables 6-1 and 6-2. The value of K_3 is calculated by:

$$K_3 = 10 \sin \theta/(\tan \theta)^{2/3} \qquad (6\text{-}16)$$

where θ is a slope angle measured in degrees (see Table 6.3). The coefficient r (erosivity factor) represents the monthly storm energy and is calculated by:

Table 6-1 Soil-type coefficients used for the erosion submodel (EROS).

Soil type classification	1	2	3	4	5	6	7
Coefficient value	0.60	0.50	0.45	0.40	0.30	0.20	0.10

Table 6-2 Vegetation cover coefficients used for the erosion submodel (EROS).

Vegetation cover classification	1	2	3	4	5	6	7	8
Coefficient value	0.04	0.06	0.13	0.15	0.18	0.30	0.32	0.35

Table 6-3 Slope coefficients used for the erosion submodel (EROS).

Slope classification	Steep (S)	Moderate (M)	Flat (F)
Coefficient value (degrees)	50	25	10

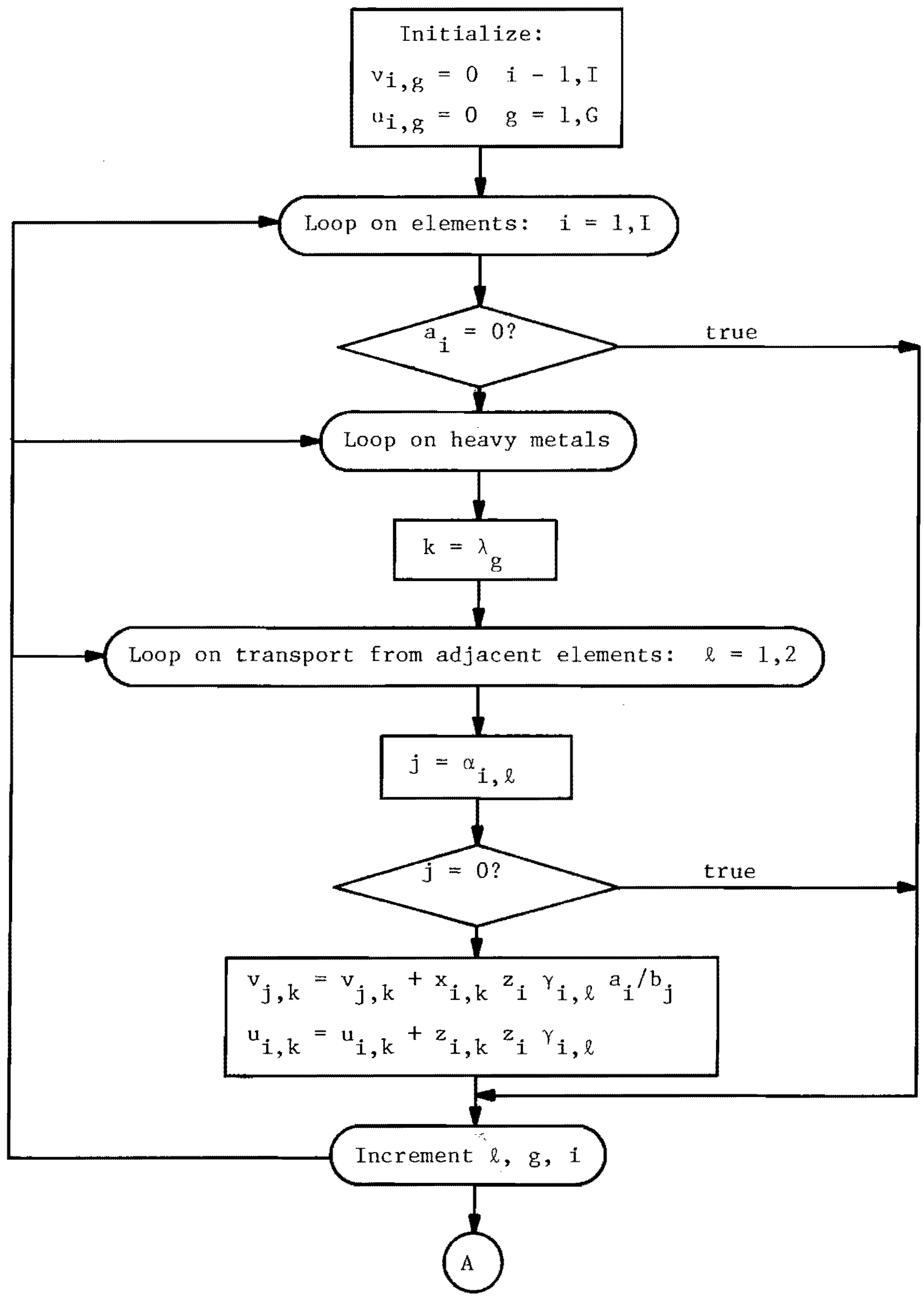

Figure 6.4. Solution to Equation 6-9.

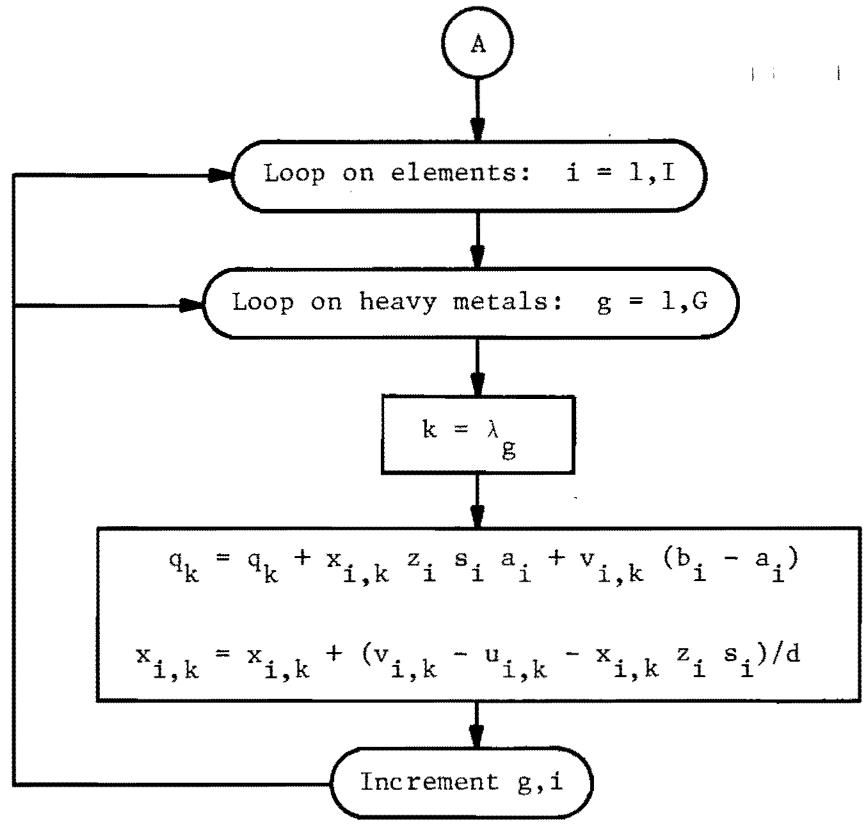

Figure 6.4. (continued)

$$r = \Sigma P_{30} (2.1 + 0.89 \log_{10} P_{30}) \tag{6-17}$$

where P_{30} is the maximum 30 minute intensity of a storm event (in/hr) and r is the sum of all events during the time increment Δt.

Because K_1, K_2, and K_3 are constant during a run, they are calculated in the input subroutine READSC and stored as a single coefficient. Each element can encompass 4 subareas having different characteristics. Therefore, equation (6-18) is repeated for each subarea within each element and passed to the control subprogram CONTRO as the vector of coefficients:

$$C_i = 0 \text{ when } a_i < 10^{-6} \tag{6-18}$$

otherwise,

$$C_i = \sum_{\ell=1}^{4} \frac{a_{i,\ell}}{a_i} K_{1,\ell} K_{2,\ell} K_{3,\ell}$$

where ℓ is the index on the element subarea, $a_{i,\ell}$ is the area of the subarea (km^2), a_i is the total soil area in the element (km^2), and the K's are the coefficients for the subarea.

Subroutine EROS is called for each element during each time step and the erosion rate calculated by:

$$e = C_i \, r \tag{6-19}$$

where r is calculated by equation 6-17 for the value of P_{30} passed from the precipitation subroutine, RAIN3. The average depth of erosion is:

$$z_i = (0.02224) \, e/\rho_b \tag{6-20}$$

where z_i is depth (cm), ρ_b is bulk density of the soil (g/cm^3), and the constant (0.0224) is a unit conversion factor. The vector Z is returned to the control program for use in equations 6-7 to 6-12.

The erosivity factor (r) expresses the erosion potential of average annual rainfall in the locality. It is the summation of the individual storm products of the kinetic energy of rainfall and the maximum 30-minute rainfall intensity for all significant storms on an average annual basis (equation 6-17). The model solves equation 6-19 each month using average monthly values of r and sums up the monthly erosion to obtain annual values. Because the C_i coefficients are constant during a year there is no discrepancy between the definition of r and its use in the model. That is:

$$\Sigma e = C_i \Sigma r = \Sigma C_i \ r \qquad (6\text{-}21)$$

where e and r are calculated for the period Δt and Σ indicates the summation over a year.

ACKNOWLEDGEMENT

The author wishes to acknowledge the substantial contributions of Mr. Brad Finney to the modeling effort. Mr. Finney assisted in programming the model and conducted most of model operations.

CHAPTER 7

RESULTS AND CONCLUSIONS

Evaluation of Erosion Submodel EROS

Soil erosion is considered the principle mechanism for the transport of heavy metals in semi-arid and arid regions of the intermountain west. The erosion component (EROS) of the TOHM model, therefore has a significant impact on the model results.

Considerable study has been directed toward the prediction of the amount of erosion with regard to soil type, slope, vegetation, raindrop impact energy, etc. The Universal Soil Loss Equation as described in Chapter 3 is the most commonly used method for predicting soil eroded from watersheds. This equation is based on a statistical-empirical approach involving 1200 different field plots and many cropping patterns located at 47 research stations in 24 states. Derived primarily for small agricultural watersheds it has however been applied to watersheds as large as 2000 km^2 (Vanoni, 1975).

A more basic mathematical soil-erosion model including the processes of (a) soil detachment by rainfall, (b) transport by rainfall, (c) detachment by runoff and (d) transport by runoff, has been developed by Meyer (1971). The dynamics of the model are evaluated from basic hydraulic, hydrologic, meteorologic and other relationships plus emperical coefficients to account for the soil properties. In this model the erosion process is evaluated in successive slope length increments with the interaction between adjacent increments taken into account. This modeling technique has been modified and applied by the Environmental Protection Agency (Tapp, 1976).

The Meyer technique is considered more accurate than the Universal Soil Loss Equation because it is developed for individual storm events and based on fundamental physical parameters. Both approaches, however require the input of empirical coefficients. In this study, a modified version of the Universal Soil Loss Equation was used because of the greater availability of the coefficients applicable to the study area.

The study impact area included five major hydrologic subbasins: Fremont, Dirty Devil, Colorado, Escalante and San Juan. Using the coefficients given in Tables 6-1 through 6-3, the Universal Soil Loss Equation calculated the average annual erosion rates of 0.16, 0.73, 0.35, 0.10 and 0.16 million kg/km^2 for the Fremont, Dirty Devil, Colorado, Escalante and San Juan subbasins, respectively. Sediment yields in the Upper Colorado River Basin have been estimated to average 0.63 million kg/km^2 with a range of 1.17 maximum and 0.05 minimum (Todd, 1970). The Green River at Green River, Utah, averages 0.19 million kg/km^2 of drainage area and the Colorado River at Cisco, Utah, averages 0.28 million kg/km^2 (Todd, 1970). Comparison of the model results with these values indicate that the model gives, in general, a good estimate of the sediment yield to Lake Powell. It should be noted that these results were obtained without any "adjusting" of the model to fit observations.

Transport of Fallout by Erosion

Model TOHM was tested using an option which suppressed CHEM. Under these conditions, aerosol fallout accumulates on the crust until a storm of sufficient intensity occurs which initiates erosion and subsequent transport.

Figure 7.1 shows the rate at which fallout is eroded to the environmental sink (Lake Powell) versus time from the initiation of fallout on

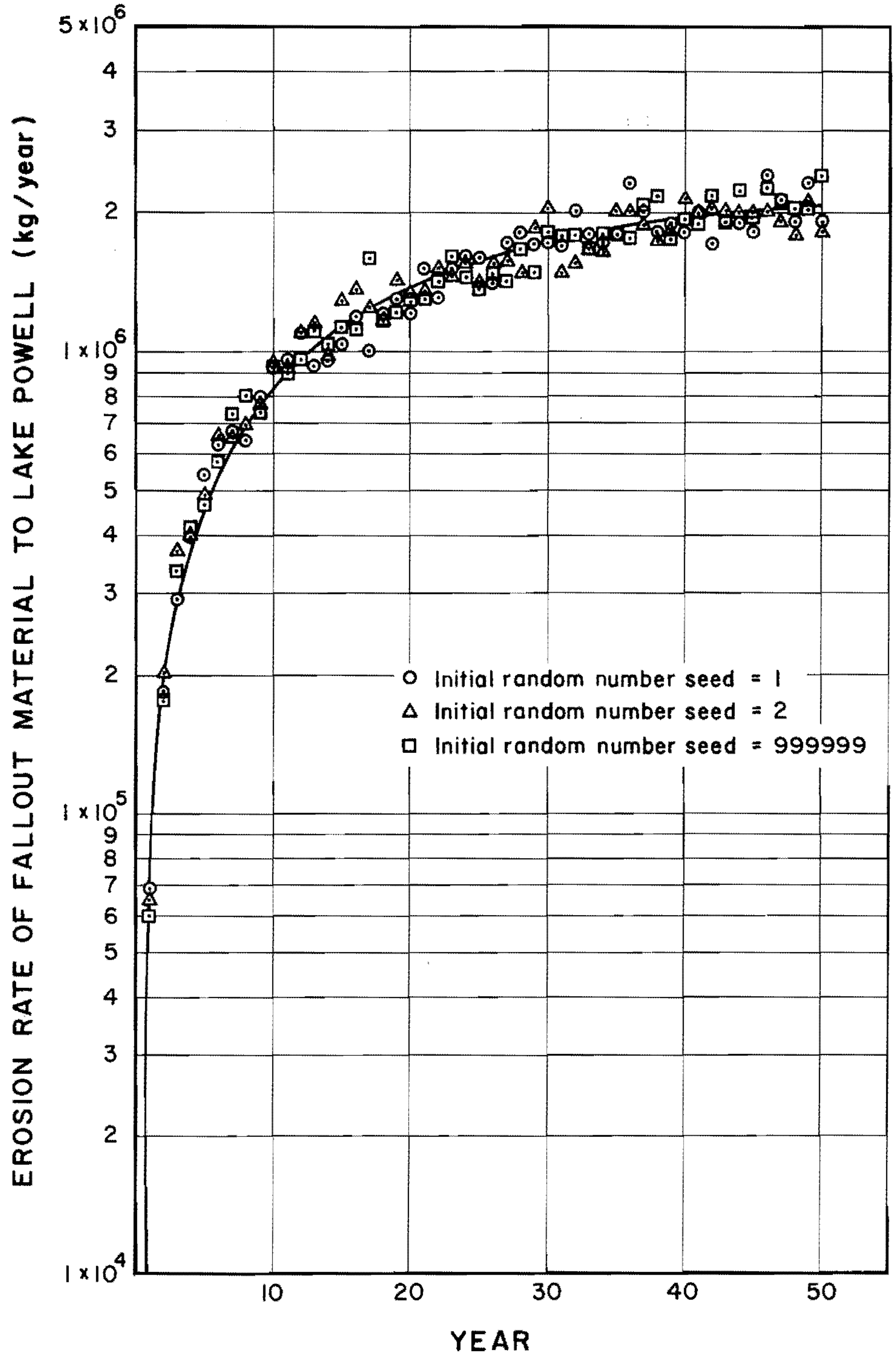

Figure 7.1. The effect of varying the random number seed of RAIN3 on the rate of fallout eroded to the sink.

the basin. The results of three separate computer runs are plotted as separate points on the figure. Each run used a different random number seed for simulating precipitation (RAIN3). These data were fit with a cubic polynomial shown by the solid line in Figure 7.1. Each random number seed generates a different sequence of storm events in space and time. The maximum difference in erosion rates among runs for any given year was 49 percent during the 17th year. However, comparing the cubic polynomial fit to data from each year separately, there was no significant difference in the average erosion rates at the 95 percent confidence level. This result indicated that the selection of the random number seed was not a critical factor. The random number seed 999,999 was used in all subsequent TOHM runs.

Figure 7.2 shows the sensitivity of TOHM to the coefficients used in EROS (C_i in Equation 6-18). The C_i' notation indicates the coefficient value calculated using Tables 6.1 through Tables 6.3. When TOHM was run using these values ($C_i = C_i'$) the dashed line curve resulted. Arbitrarily doubling the coefficient value ($C_i = 2C_i'$) resulted in about a 40 percent increase in the average erosion rate as shown by the solid line curve. An additional 25 percent increase in the coefficient ($C_i = 2.5\ C_i'$) produced an incremental 9 percent increase in erosion rate.

The rate of fallout on the soil (3.4×10^6 kg/yr) as predicted by SPEDTEC is shown in Figure 7.2 by the horizontal line. If the lake is the only sink in the area, then the curve representing the rate of fallout eroded to the lake would eventually coincide with the line representing the rate of fallout on the soil (i.e., steady state is reached).

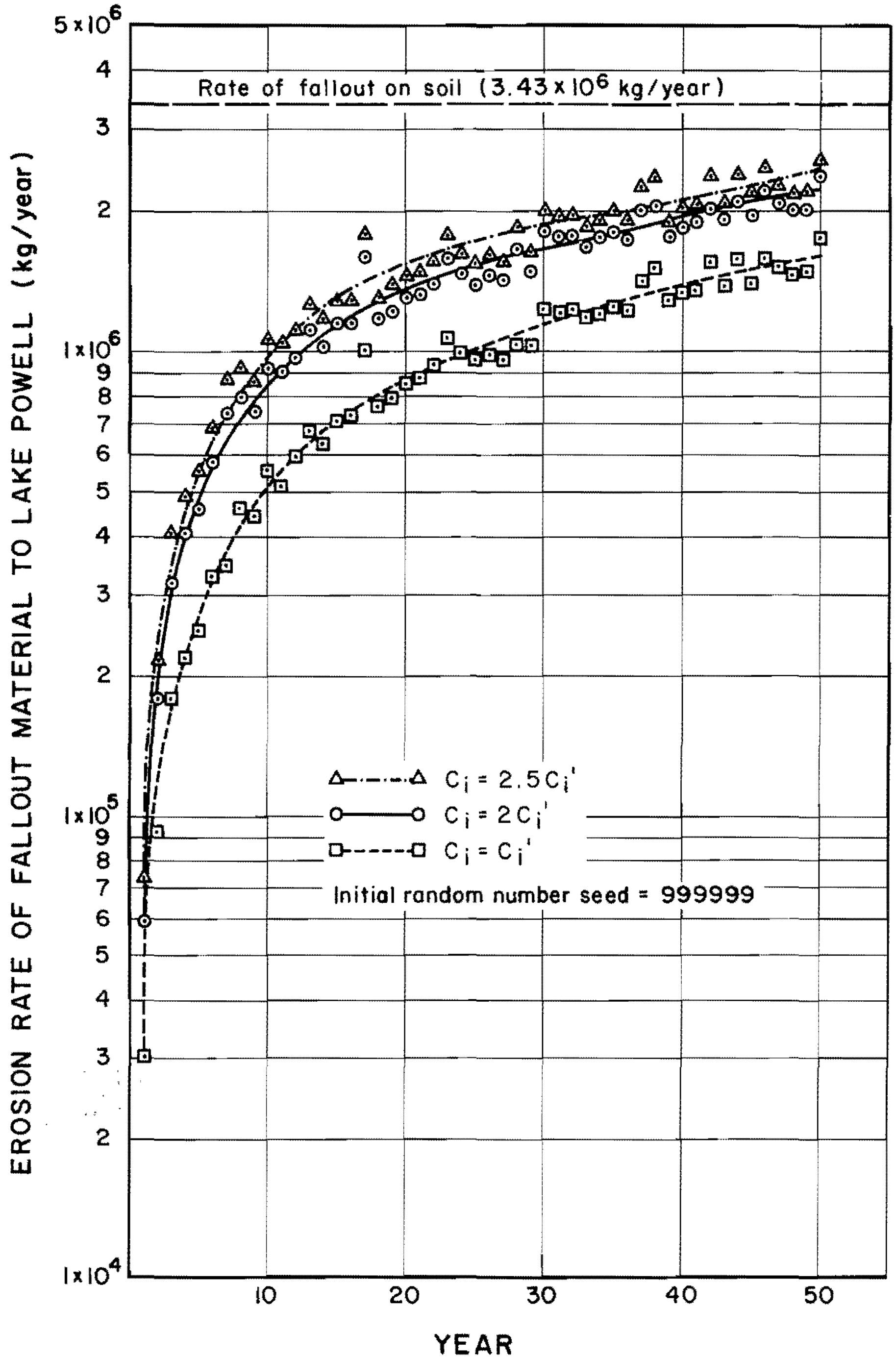

Figure 7.2. Comparison between the fallout rate on the soil and the rate at which fallout material is eroded to the sink.

The comparison of the curve $C_i = C_i'$ and the horizontal fallout line suggests the possibility that (1) the response time of the study basin (i.e., the time to reach steady state) is extremely long, (2) the study basin contains sinks other than the lake, and (3) some combination of the above.

The first possibility leads to the conclusion that it will take about 50 years after the coal-fired electric generating facility has been put into operation before the erosion rate of heavy metals to the lake will equal 50 percent of the fallout rate from the atmosphere. Under these conditions ($C_i = C_i'$) achievement of steady state may not be realized for hundreds of years. The position of the other curves in Figure 7.2 indicate that an increase in the value of C_i (erosion coefficients) would significantly reduce the simulated basin response time.

The second possibility suggests that it will take about 20 years before the rate of erosion of fallout to the lake will reach 50 percent of the erosion rate predicted by the model to exist at the end of a simulated 50 year period (when $C_i = C_i'$). These data would further suggest that unidentified areas of accumulation of fallout may be building up in the study basin.

It is emphasized that the data shown in Figures 7.1 and 7.2 are based on model runs where erosion of accumulated fallout on the soil crust was the only mechanism operative.

Evaluation of the Chemistry Submodel CHEM

CHEM was tested for internal consistency and mass balance on a program written for one element (P5) of the study site. This element is situated 30 km from the hypothetical coal-fired electric generating facility and is in an area of high aerosol deposition (about 3×10^4 kg per year). To eliminate the confounding factor of interaction with adjacent elements, it was assumed all erosion outflow from element P5 went to the environmental sink with no erosional depositional inputs coming from adjacent elements. The terrain of element P5 and its proximity to Lake Powell made the above assumptions reasonable. All input data as provided by SPEDTEC, RAIN3 and EROS for TOHM were used in the test runs. CHEM was run to simulate a 50 year fallout period using various options to test the impact of the generating facility on heavy metal loading of the environmental sink (Lake Powell). The four options tested were:

1. CHEM with heavy metal fallout
2. CHEM without heavy metal fallout
3. DELTA adjustments only, with heavy metal fallout
4. DELTA adjustments plus adsorption function, with heavy metal fallout

Option 1 applied the total CHEM submodel, as described in Chapter 5, on deposited fallout and natural baseline (indigenous) heavy metals and calculated the cumulative amount of heavy metal eroded to the environmental sink during a 50 year period from the test element.

Option 2 applied the total CHEM submodel only to the indigenous heavy metals in the soil. This option calculated the cumulative amount of heavy metal eroded to the sink during a 50 year period from the test element in the absence of deposited aerosol fallout. Option 2 gives the natural input, originating from indigenous heavy metals, into the sink. The difference in heavy metal input between option 1 and option 2 gives the effect of the electric generating facility on the heavy metal loading of the lake.

Option 3 applied only the erosion and deposition adjustment (DELTA) routine of CHEM to the fallout plus indigenous heavy metals. In this option, no soil chemistry was applied to the system and only the physical process of erosion was considered. This is the simplest of the four options run and precludes any knowledge of chemistry except for the natural baseline concentrations of the heavy metals. It calculated the cumulative amount of heavy metal eroded to the sink during a 50 year period from the test element.

Option 4 is similar to option 3 except it added the adsorption function routine of CHEM to the program. This option ignored the chemical refinement of compound precipitation and assumed that exchange adsorption would account for the total interaction of the heavy metal with the soil.

Figure 7.3 shows the four options applied to the test element and the calculated heavy metal loading of Lake Powell during the 50 year period. These data show that for the metals Zn, Cr and Pb, little or no difference could be seen by the application of the four options. In essence the data infer that with regard to Zn, Cr and Pb, the indigenous levels of these metals (20 ppm, 16 ppm and 11 ppm, respectively) which were present in the eroded soil swamped any effect of deposited fallout. During the 50 year period, 3450 kg of Zn was deposited from aerosol fallout on the test element and about 1×10^6 kg total Zn was eroded to Lake Powell; 1910 kg of Cr was deposited and 7.8×10^5 kg total Cr was eroded to Lake Powell; 1140 kg of Pb was deposited and 5×10^5 kg was eroded to Lake Powell. The overwhelming effect of the natural background over the deposited heavy metals is evident. The data further suggest that the subroutines AION, PPTPH and PPT along with the adsorption

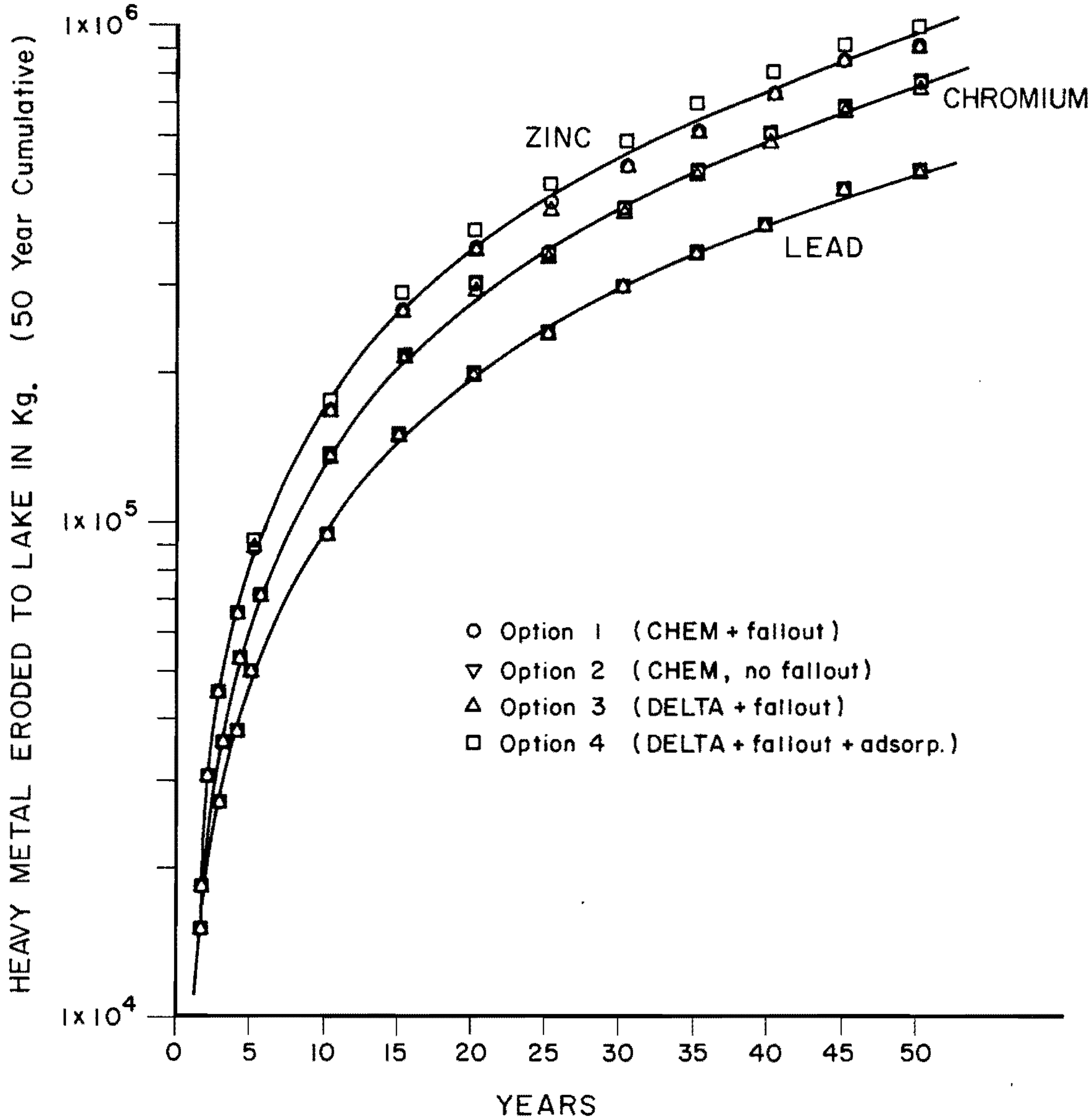

Figure 7.3. Heavy metals eroded to the sink as affected by various options of CHEM applied to the test element.

routine in the CHEM submodel are an unnecessary refinement at this stage of TOHM development. Only an erosion function is needed to predict Zn, Cr and Pb transport to an environmental sink. This conclusion does not preclude the importance of chemistry in TOHM. Indeed, CHEM predicts that both aerosol deposited and indigenous heavy metals, by virtue of their chemistry, will persist in the soil with little downward movement. Thus heavy metal fallout will remain essentially in the surface crust and the natural heavy metal concentration profile in the soil will be invariant. The importance of erosion as the principle vector for heavy metal transport in essence validates CHEM.

The attempt to rigorously calculate a mass balance for the fallout heavy metals was not completely successful because of the relatively large amount of heavy metal eroded and the small amount deposited. Qualitatively, about 90 percent of the fallout could be accounted for in the runs on the test element.

Figure 7.4 shows the data for Cd loading of Lake Powell as affected by the four options of submodel CHEM. Because of less indigenous Cd (.18 ppm) in the soil and the smaller proportion of Cd in the fallout the amount added to the lake is considerably less than Zn, Cr or Pb. Again, little difference is noted between the options used to calculate the data. Cadmium fallout was 308 kg in the test element over the 50 year period which was the lowest amount deposited of the metals but about 1×10^4 kg of Cd was eroded from the element. Again the indigenous amount, although low, dominated Cd transport because of the small amount of Cd fallout.

The case of Hg, as shown in Figure 7.5, is different than that of the other heavy metals studied. The amount of aerosol deposited Hg for

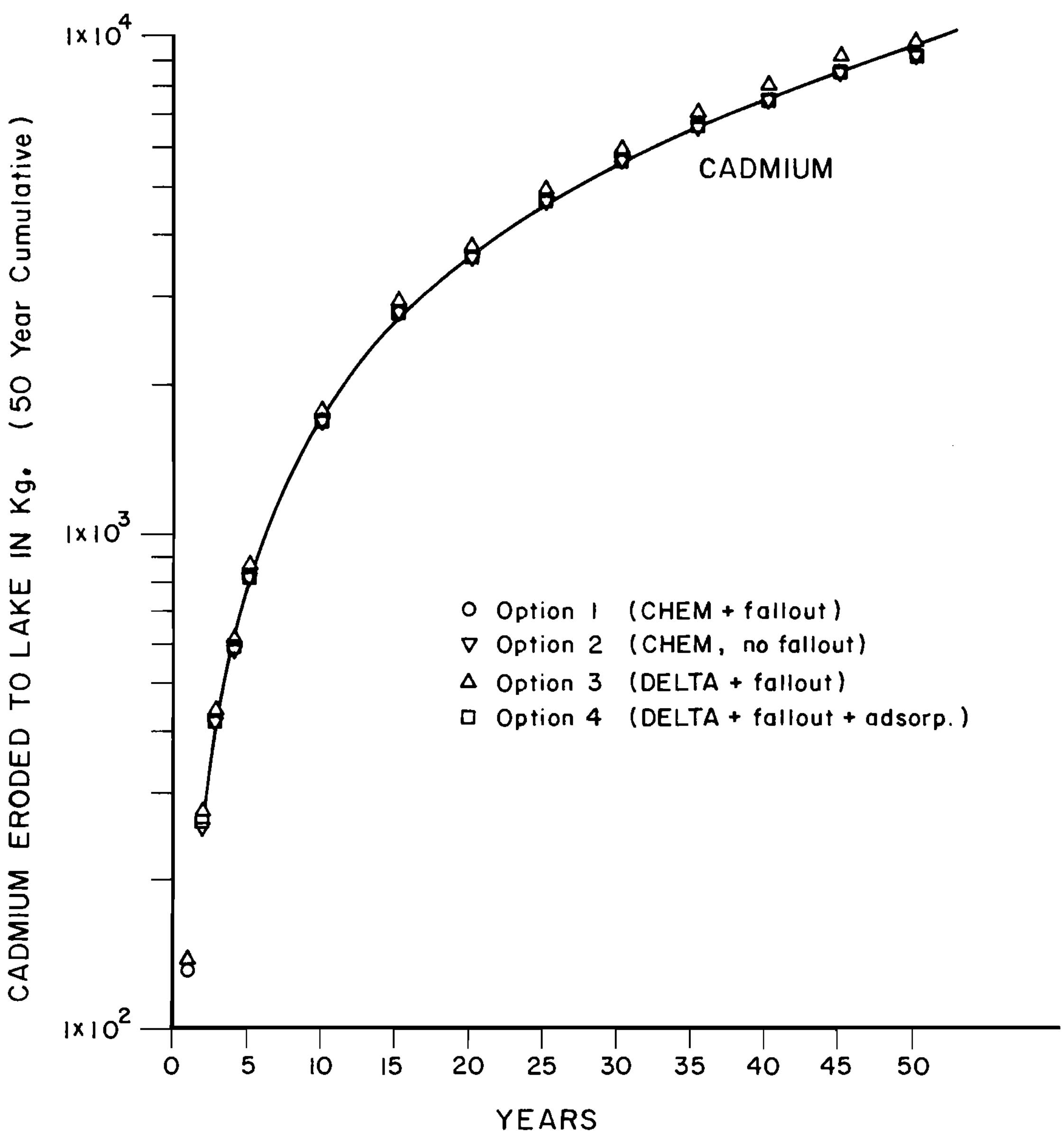

Figure 7.4. Cd eroded to the sink as affected by various options of CHEM applied to the test element.

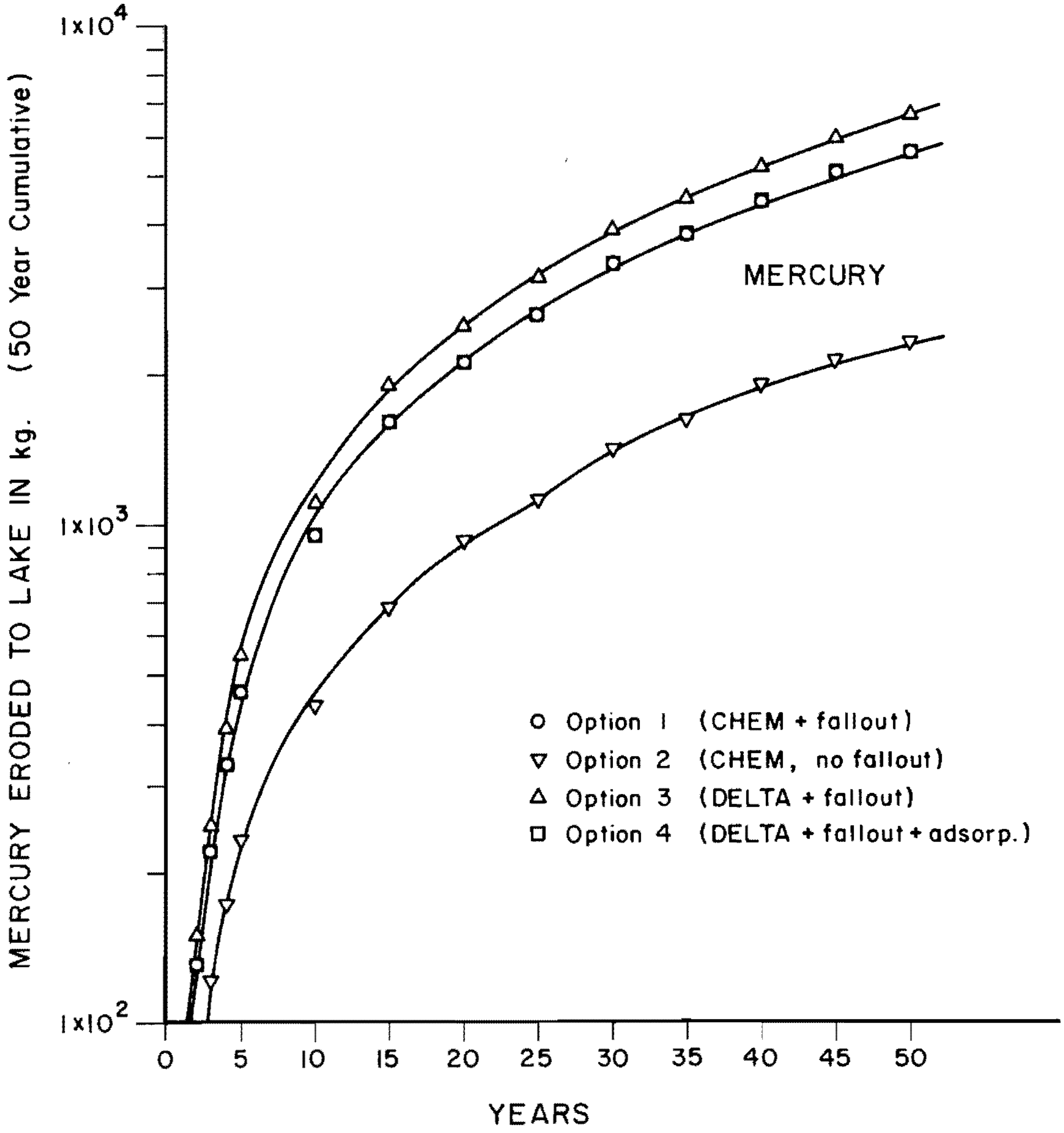

Figure 7.5. Hg eroded to the sink as affected by various options of CHEM applied to the test element.

the 50 year period was 4430 kg in the test element which is the highest amount deposited of the metals studied. The indigenous Hg level, in contrast, was the lowest (0.05 ppm) of the metals studied. The maximum predicted amount of Hg eroded (fallout + indigenous) from the element during the 50 year period is about 6600 kg Hg. This amount is predicted using only the erosion routine (DELTA) of CHEM and is referred to as option 3. The difference in the amount of Hg eroded between option 3 (DELTA + fallout) and option 2 (the natural system) is about 4300 kg Hg which compares with the 4430 kg of Hg fallout which occurred over the 50 year span. About 65 percent of the Hg eroded to the sink after 50 years originates from the fallout on the element. The incorporation of chemistry (options 1 and 4) into CHEM reduced the Hg loading of Lake Powell by about 1000 kg in 50 years (20 kg/yr). The presence of the chemistry routines resulted in a mass balance of 85 percent at the end of 50 years, or approximately an average of a 0.3 percent loss of Hg per year. As a first generation model this is considered a reasonable level of accuracy taking into account the assumptions and the fact that the program was called 600 times during the simulated time period.

The data show in Figure 7.5 that indeed aerosol fallout of Hg can alter the Hg loading of an environmental sink. This effect is due to the relatively large amount of aerosol deposited Hg when compared with the low amounts of indigenous Hg normally found in soils of the study area. These data further show that an erosion model coupled with an aerosol deposition model can produce a good estimate of the movement of Hg to the environmental sink under the conditions of this study. In this respect, the transport of all the heavy metals (Zn, Cr, Pb, Cd and Hg) is similar.

The assumption that heavy metals associated with aerosol deposition essentially remain in the surface soil was validated by CHEM in this study. After 50 year simulation, only 2 percent of Cd fallout moved below the surface 1 cm crust and 0.1 percent of the Hg fallout moved below the crust.

The application of the CHEM submodel in the test element study resulted in the conclusion that the added refinement produced by the incorporation of complex, time-consuming, chemistry sub-routines with TOHM is not justified or required to predict heavy metal transport in semi-arid or arid climatic zones.

Heavy Metal Loading of an Environmental Sink

The previous study has emphasized the importance of erosion as the transport mechanism for heavy metals to the environmental sink and the relative insensitivity of the phenomena to the chemistry of the heavy metals as detailed in submodel CHEM. Therefore, to evaluate the heavy metal loading of the environmental sink (Lake Powell) TOHM was used incorporating only the DELTA function of CHEM. The net result of using this version of TOHM not only provided an excellent predictive model to compute the loading of the environmental sink during any given time span as effected by a hypothetical coal-fired electric generating facility but it resulted in a reduction in computer operational time by about 90% compared to that required when the total CHEM submodel was incorporated into TOHM. The results of applying TOHM to the complete study area (27,570 km^2) will be discussed.

The cumulative loading of Lake Powell by Zn, Cr and Pb due to erosion processes during a 25 year period is shown in Figure 7.6. These data represent

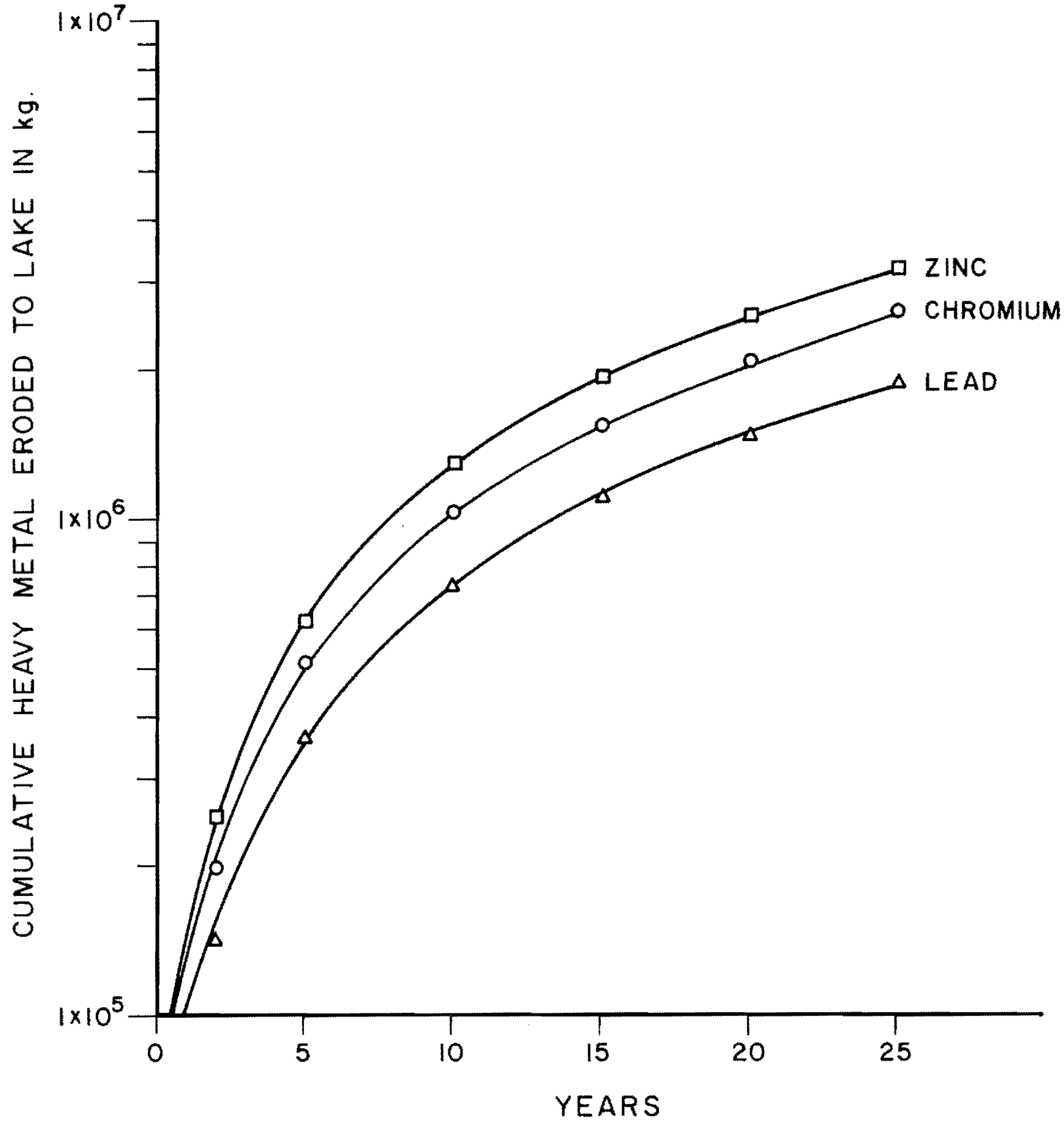

Figure 7.6. Cumulative loading of the environmental sink by Zn, Cr and Pb.

the contribution from both the natural system plus aerosol deposition that occurred on the land surface within the study site. During this period, 3.2×10^6 kg of Zn, 2.6×10^6 kg of Cr and 1.8×10^6 kg of Pb were deposited in the lake. This loading is directly proportional to the indigenous levels of these heavy metals that was assumed to occur in the soil, i.e., Zn = 20 ppm, Cr = 16 ppm and Pb = 11 ppm, respectively. As previously shown (see Figure 7.3) the loading of these particular heavy metals is not significantly affected by the aerosol fallout that occurred. The data in this figure essentially show the contribution of the natural system to the heavy metal loading of Lake Powell. The impact of Zn, Cr and Pb fallout on the loading of the lake is minimal as will be discussed later.

Figure 7.7 shows that the loading of Cd (3.1×10^4 kg) and Hg (3.6×10^4 kg) into Lake Powell during a 25 year period is in the order of 100 times less than the metals Zn, Cr and Pb. Again these data refer to the amounts eroded from the land surfaces and transported to the sink. These heavy metals exist at relatively low indigenous levels in the soil (i.e., Cd = 0.18 ppm and Hg = 0.05 ppm) compared to the other metals studied. The greater slope of the Hg loading curve relative to the Cd loading curve and the eventual intersection of the two curves shows the increasing influence of the high aerosol fallout of Hg (1.9×10^5 kg) compared to the Cd fallout (1.3×10^4 kg) on the land surface of the study basin. The significant impact of Hg fallout is related to the large ratio between the amount of fallout and the indigenous amount of Hg in the soil. This relation is shown in Figure 7.8, where the total Hg eroded to the lake and the contribution of fallout Hg to this total are plotted over a 25 year period. At the end of 25 years, 83 percent of the total

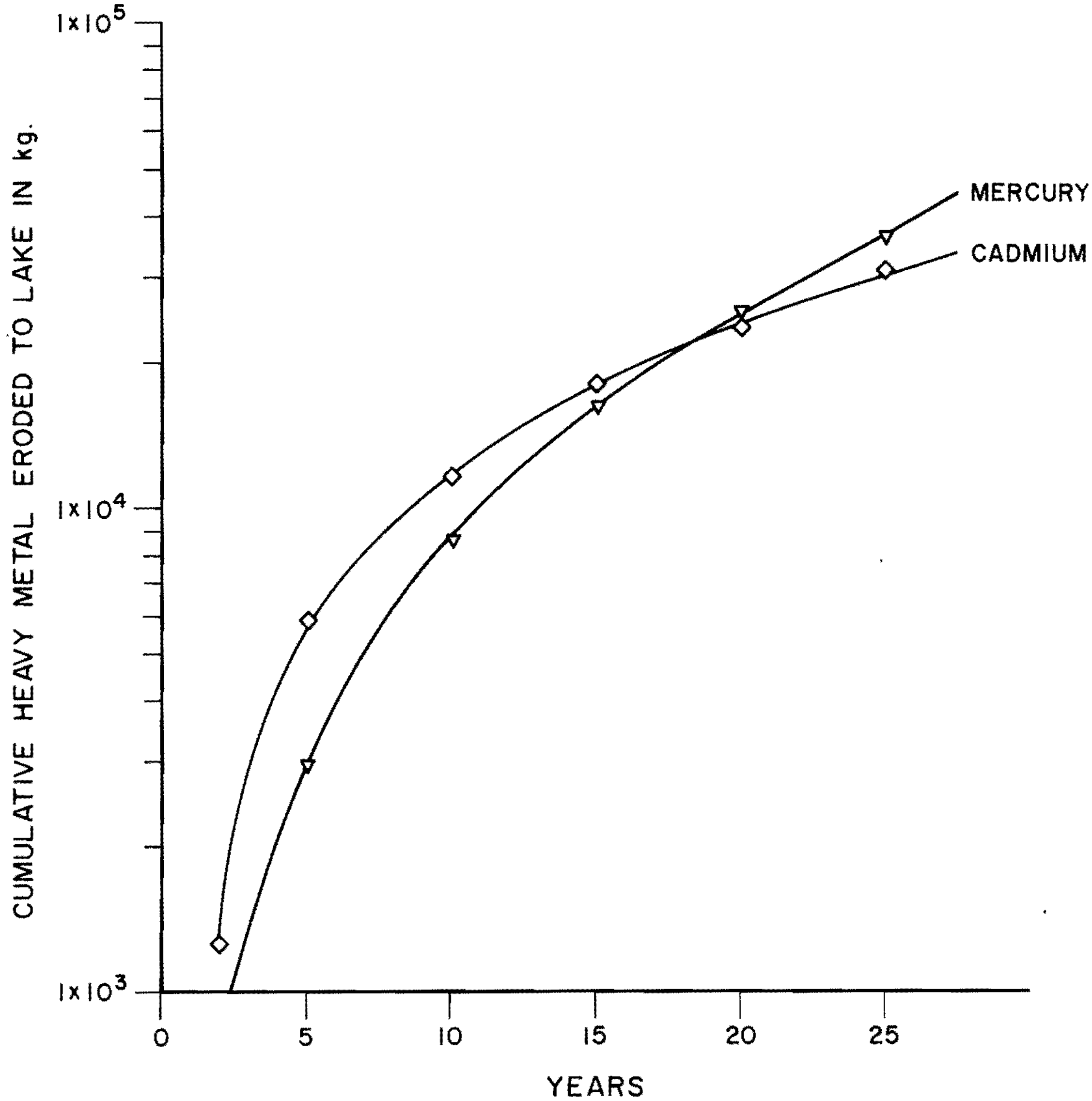

Figure 7.7. Cumulative loading of the environmental sink by Cd and Hg.

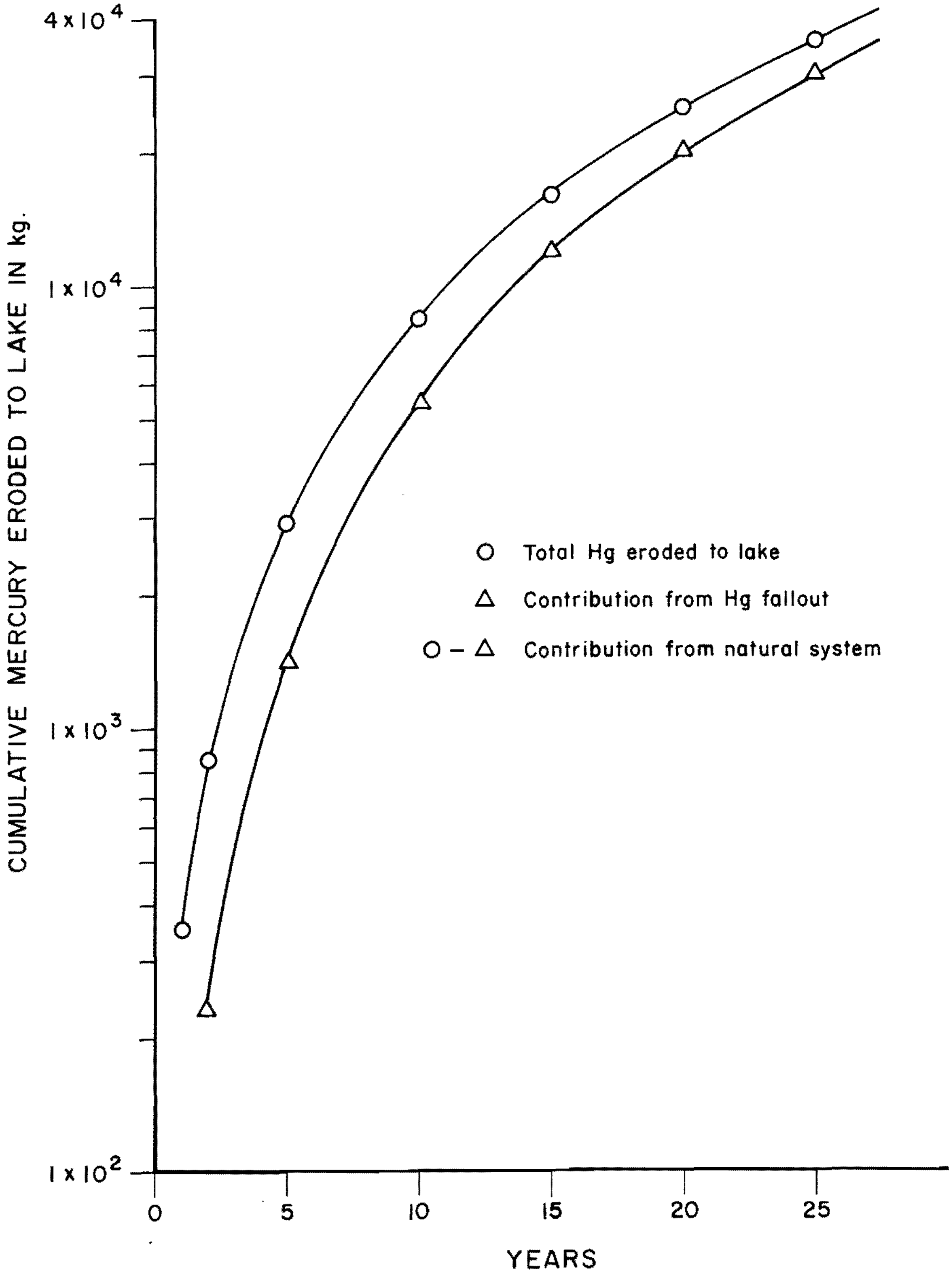

Figure 7.8. The contribution of aerosol deposition and the natural system to the loading of the environmental sink by Hg.

Hg loading of the lake comes directly from aerosol fallout in the study site. This compares to about a 6 percent fallout contribution to the total Cd loading of the lake and a negligible fallout contribution to total Zn, Cr and Pb added to Lake Powell.

Heavy metal loading of Lake Powell by direct interception of fallout on the water surface is shown in Figure 7.9. The relative position of these curves also gives the approximate ratio of the aerosol deposition of each heavy metal in the basin. These data show that only in the case of Hg does direct fallout on the lake materially affect the total loading. About 14 percent of the total Hg input into the lake was due to direct deposition on the water surface.

Table 7-1 summarizes the erosion data predicted by TOHM for a simulated 25 year period for the 5 hydrologic subbasins that occur with the study site basin. The Colorado subbasin contains the environmental sink. The Dirty Devil subbasin although the smallest in area produces a disproportionately large amount of eroded soil. Per unit area, Dirty Devil produces more than twice as much sediment as the other subbasins studied. This result reflects the high erodibility of the soil in this subbasin.

Table 7-2 summarizes a portion of the cumulative 25 year data obtained from TOHM on the heavy metal loading of the environmental sink by hydrologic subbasin. The total values shown in columns 2 through 6 are the data plotted in Figures 7.6 and 7.7. The impact of the hypothetical coal-fired electric generating facility on the heavy metal loading of the environmental sink is shown in columns 7 through 11. The values for the Colorado subbasin also include the aerosol deposition that occurred directly on Lake Powell. The accuracy of the values cited for the

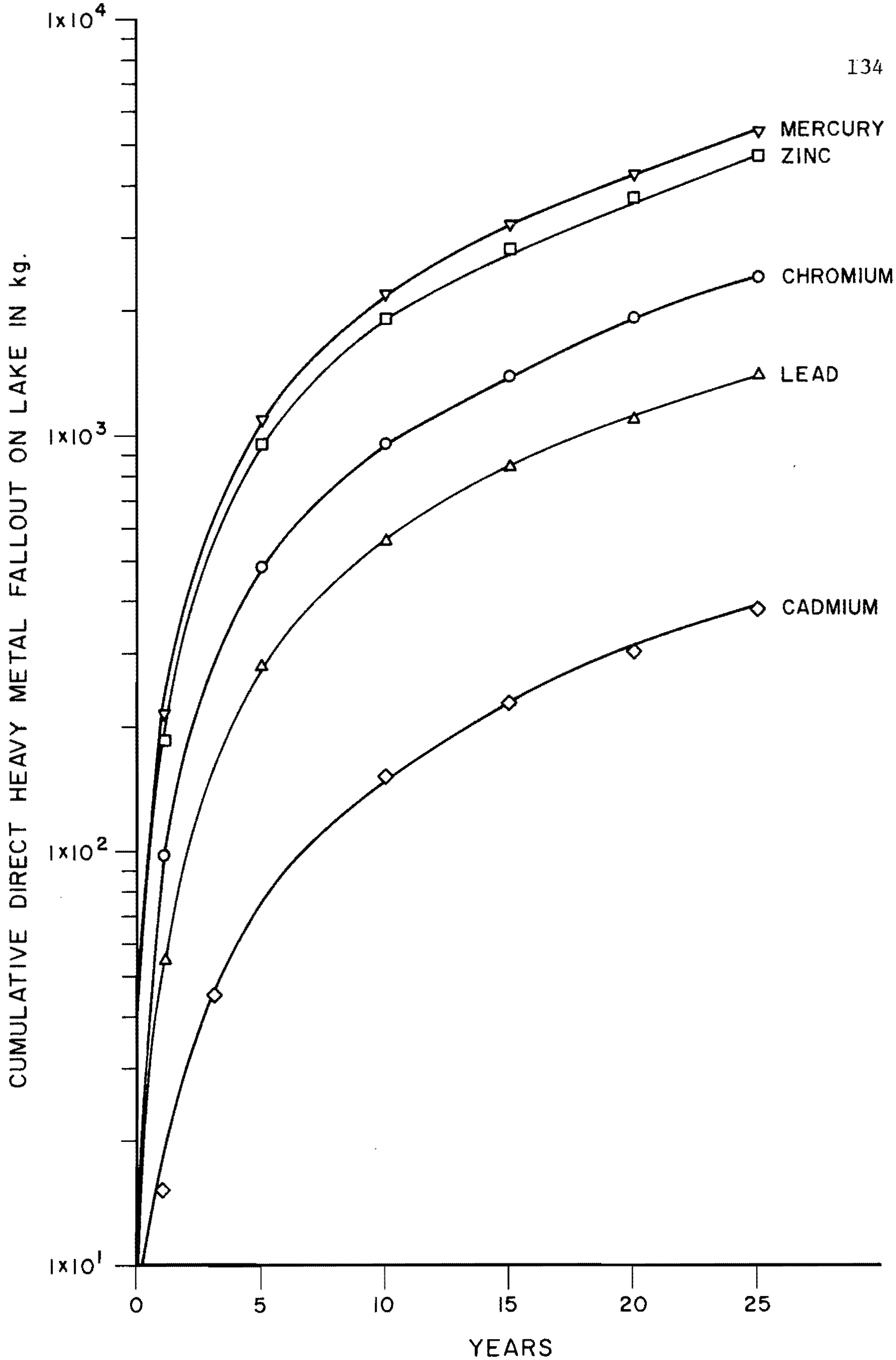

Figure 7.9. Cumulative loading of the environmental sink by heavy metals as the result of direct impact on the water surface.

Table 7-1. Cumulative 25 year erosion data as predicted by TOHM for hydrologic sub-basins.

Sub-basin	Area km^2	% of total study area	Soil eroded kg x 10^{10}	Erosion/km^2 kg x 10^6	Erosion/km^2/yr kg x 10^6
Fremont	6,050	22	2.4	4.0	0.16
Dirty Devil	1,440	5	2.6	18	0.73
Colorado	9,780	36	8.5	8.7	0.35
Escalante	5,600	20	1.4	2.6	0.10
San Juan	4,700	17	1.8	3.9	0.16
Totals	27,570	100	16.7		

Table 7-2. Cumulative 25 year data as predicted by TOHM on heavy metal loading of the environmental sink by hydrologic sub-basins.

Sub-basin	Lake Loading from Natural System and Fallout					Lake Loading from Fallout Only					Total Cumulative Aerosol Fallout				
	Zn	Cr	Pb	Cd	Hg	Zn	Cr	Pb	Cd	Hg	Zn	Cr	Pb	Cd	Hg
	kg x 10^5			kg x 10^3		kg x 10^3					kg x 10^4				
Fremont	5	4	2.9	4.6	2.7	3	<1	<1	0.11	1.6	1.1	0.55	0.32	0.087	1.3
Dirty Devil	4.7	3.8	2.7	4.3	2.2	1	<1	<1	0.08	1.1	0.32	0.16	0.1	0.026	0.37
Colorado	17	13	9.4	16	23	20	10	5	1.4	21	9.2	4.6	2.7	0.73	10
Escalante	2.5	2	1.4	2.4	2.7	2	1	1	0.17	2.5	3.1	1.6	0.93	0.25	3.6
San Juan	3.3	2.7	1.9	3.3	5.2	1	2	1	0.32	4.5	3.9	2	1.1	0.31	4.5
Totals	32.5	25.5	18.3	30.6	35.8	27	≈13	≈7	2.08	30.7	17.6	8.91	5.15	1.40	19.8

contribution of fallout to the loading of Zn, Cr and Pb is not great because of the computational methods used (small differences between large numbers). However, the order of magnitude corroborates the earlier stated conclusion that naturally occurring Zn, Cr and Pb in the soil is the principle source of these metals in the environmental sink. The data for Cd and Hg (columns 10 and 11) are more definitive because of the smaller magnitude of the numbers involved in the computation. The data quantify the impact of aerosol deposition in the study basin on the input of Cd and Hg into the lake. As stated previously, these data show that 83 percent of the Hg that finds its way into the lake originates from aerosol fallout whereas only 6 percent of the Cd loading of the lake originates from aerosol fallout. These data also show that the aerosol fallout increased the Hg loading of the lake by 600 percent over the level contributed by the indigenous Hg found in the natural system whereas Cd loading of the lake is increased about 11 percent above the natural baseline level.

The total aerosol fallout which was deposited in each subbasin during the 25 year period is shown in columns 12 to 16. Comparison of total cumulative fallout with the amount of fallout eroded to the lake shows that only 15 percent of the heavy metals resulting from 25 years of fallout is transported to the lake. The remaining 85 percent of the deposited heavy metals is considered accumulated in the surface soil of the study area. This accumulation of aerosol deposited heavy metals in the surface soil is a natural sequence of the soil chemistry coupled with the low rainfall-low surface runoff encountered in semi-arid regions of the west.

The data simulated by TOHM are considered to give a realistic approximation of the heavy metal loading of an environmental sink resulting from the operation of a coal-fired electric generating facility located in the semi-arid or arid regions of the intermountain west. As a first generation model, TOHM has provided the necessary first step in an integrated approach to solve the complex problem of interacting natural systems. It should be noted that TOHM was applied to an area of about 28×10^3 km^2 in the Upper Colorado River Basin. This study area represents about 10 percent of the Upper Colorado River Basin area (277×10^3 km^2) which drains into Lake Powell. Correspondingly, the TOHM simulated heavy metal loading data as reported in this study represents only a fraction of the total heavy metal loading which occurs in Lake Powell as the result of Upper Colorado River Basin drainage.

Summary of Results

The submodel EROS provides a reasonable simulation of the sediment yield in the study area.

Soil erosion rates predicted by EROS are insensitive to the seed number used for the random number generator in the precipitation submodel (RAIN3).

Soil erosion rates are relatively sensitive to the coefficients (C_i) of the Universal Soil Loss Equation.

The soil erosion option of TOHM was run with fallout input. The results indicated that the rate of heavy metals transported to the environmental sink by erosion will not reach 50 percent of the maximum rate until about 20 to 50 years after the initiation of aerosol deposition.

Submodel CHEM was run on a test element (100 km^2) to show the affect of soil chemistry on the transport of Zn, Cr, Pb, Cd and Hg resulting from aerosol deposition to the environmental sink (Lake Powell).

A 50 year period was simulated. The data show that heavy metal transport is insensitive to the chemistry submodel. This conclusion in essence validates CHEM which predicts essentially all aerosol deposited heavy metals accumulated in the soil surface hence are subject to erosion.

In the test element run, with or without the inclusion of chemistry, it was found that Zn, Cr, Pb and Cd loading of the lake is attributed to the natural (indigenous) level of these metals in the soil. Fallout was insignificant with regard to the total amount of these metals eroded to the lake.

In the test element run, with or without the inclusion of chemistry, it was found that the loading of the lake was materially affected by Hg fallout. About 65 percent of the Hg loading from this element was contributed by fallout. This result is attributed to the low level of indigenous Hg in the soil relative to the amount of fallout.

The general model TOHM was applied to the study site (27,570 km^2) to simulate Zn, Cr, Pb, Cd and Hg loading of the environmental sink over a 25 year period. The conclusions essentially corroborated the findings of the single test element studies. The CHEM routine was suppressed during the TOHM runs.

The loading of Zn, Cr and Pb into the lake could be accounted for by the natural indigenous metal eroded to the lake. Fallout of these heavy metals had an insignificant impact on the loading.

The loading of the lake by Hg was dramatically affected by aerosol fallout. After 25 years, 83 percent of the loading of Hg resulted from fallout. About 6 percent of the loading of the lake by Cd was attributed to fallout in the study area.

Aerosol fallout increased Hg loading of the lake by 600 percent over the level contributed by indigenous Hg in the system. Fallout increased Cd loading of the lake by about 11 percent above the natural baseline level.

The data simulated by TOHM indicated that in 25 years, 15 percent of the heavy metals in the fallout had eroded to the lake leaving 85 percent stored in the surface soil of the study area.

Future Model Refinements and Validation

The importance of soil erosion in the transport of heavy metals requires that consideration be given to the application of more sophisticated soil erosion modeling techniques and field verification of sediment yield in certain critical subbasins. Of interest would be the use of the Meyer Technique (Tapp, 1976) with a concerted effort made to determine the needed specific coefficients values for the selected study area.

Validation of TOHM is the obvious next step if the model is to be of any practical benefit. This study showed that because of the sensitivity of the system to Hg fallout only the transport of Hg in selected subbasins can be realistically validated. This would require a coordinated field study centered in a region with an existing coal-fired electric generating facility with known aerosol output both in quantity and composition. The validation study would require extensive field monitoring of air quality, soil and sediment composition and sediment yield to determine the impact of Hg fallout on the loading of an environmental sink. The degree to which the existing TOHM model must be refined depends on the results of field data. The infamous heterogeneity of nature in semi-arid regions presents a formidable barrier to the validation of TOHM.

LITERATURE CITED

Agee, E. M., D. E. Brown, T. S. Chen, and K. E. Dowell. 1973. A height dependent model of eddy viscosity in the planetary boundary layer. Jour. App. Meteor., 12(2):409-412.

Briggs, C. A. 1969. Plume Rose. U. S. Atomic Energy Commission, Division of Technical Information. Oak Ridge, Tenn. p. 56.

Bolt, G. H. and M. G. M. Bruggenwert, Editors. 1976. Soil Chemistry: Basic Elements. Elsevier Publishing Co., New York. p. 281.

Garrels, R. M., F. T. Mackenzie and C. Hunt. 1975. Chemical Cycles and the Global Environment. Wm. Kaufman, Inc. Los Altos, Calif. p. 206.

Gifford, F. A., Jr. 1962. Surface deposition of airborne material. Nuclear Safety, 3(40):76-80.

Hill, A. C. 1971. Vegetation: A sink for atmospheric pollutants. Jour. Air Poll. Cont. Assoc., 21(6):341-346.

Holzworth, G. C. 1972. Mixing heights, wind speeds, and potential for urban air pollution throughout the contiguous United States. EPA, Office of Air Programs Research, Triangle Park, N. Car. 118 pp.

Horton, R. E. 1945. Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology. Geol. Soc. Amer. Bul. 56:275-370.

Jeppson, Roland W., Gaylen L. Ashcroft, A. Leon Huber, Gayland V. Skogerboe, and Jay M. Bagley. 1968. Utah Water Research Laboratory, Utah Agriculture Experiment Station, Utah State University in cooperation with Division of Water Resources, Utah Department of Natural Resources. November. p. 27-30.

Lee, R. L., Jr., H. L. Christ, A. E. Riley, and K. E. MacLeod. 1975. Concentration and size of trace metal emissions from a power plant, a steel plant, and a cotton gin. Env. Sci. and Tech., 9(7):643-647.

Lewis, J., and G. L. Wooldridge. 1976. Sensitivity analysis of surface deposition in a numerical model of atmospheric dispersion. Preprint of a paper delivered at the Fourth National Conference on Fire and Forest Meteorology held at St. Louis, Mo., Nov. 16-18, 1976.

Meyer, L. D. and W. H. Wischmeyer. 1969. Mathematical Simulation of the Process of Soil Erosion by Water. Trans. Amer. Soc. Agric. Eng. 12:754-762.

Meyer, L. D. 1971. Soil Erosion by Water on Upland Areas. in River Mechanics (H. W. Shen, Editor and Publisher), Fort Collins, Colorado. 27-1, 27-25.

Miller, J. F., R. H. Frederick, and R. J. Tracey. 1973. Precipitation Frequency Atlas of the West, NOAA Atlas 2. Volume VI-Utah, U. S. Department of Commerce, National Oceanic and Atmospheric Admisistration, National Weather Service, Silver Springs, M. D.

Murdock, J. R., S. L. Welch and B. W. Wood. 1975. Navajo-Kaiparowits Environmental Baseline Studies 1971-1974, Chapter 6. Center for Health and Env. Studies, Brigham Young University, Utah.

Pasquill, F. 1974. Atmospheric Diffusion, 2nd Ed. John Wiley and Sons, N. Y. p. 241.

Sillen, L. G. and A. E. Martell. 1964. Stability Constants of Metal-ion Complexes. Special Publ. 17, The Chemical Society, London.

Soil Conservation Service. 1976. Universal Soil Loss Equation, unnumbered technical note.

Stumm, W. and J. J. Morgan. 1970. Aquatic Chemistry. Wiley-Interscience, New York. p. 583.

Tapp, John S. 1976. Erosion Models. Unpublished paper. 13 p.

Tew, R. K. 1973. Estimating Soil Erosion Losses from Utah Watersheds. Forest Service, Division of Soil and Water Management, USDA, ogden, Utah.

Todd, David Keith. 1970. The Water Encyclopedia. Water Information Center, Port Washington, New York. 559 p.

Turner, D. B. 1969. Workbook of Atmospheric Dispersion Estimates. U. S. Dept. of HEW, U. S. Public Health, Cincinatti, Ohio. 84 pp.

U. S. Department of Interior, Bureau of Land Management. 1976. Final Environmental Impact Statement, Proposed Kaiparowits Project: Reference Material.

U. S. Department of Interior, Geological Survey. 1965. Map of Native Vegetation Zones and Irrigated Lands in the San Juan Division of the Upper Colorado River Basin. Professional Paper 441, Plate 9.

Vanoni, Vito A., Editor. 1975. Sedimentation Engineering. American Society of Civil Engineering. 345 East 47th St., New York, New York. 745 p.

Wagman, D. D., W. H. Evans, V. B. Parker, I. Hallow, S. M. Bailey and R. H. Schumm. 1968. Selected values of chemical thermodynamic properties. NBS Tech. Note 270-3.

Walther, Eric G. 1976. Predicting the transport of air pollutants from the Navajo and Kaiparowits generating stations into Lake Powell. Presented at 3rd Syp. on Atmosph. Turbulence, Diffusion and Air Quality, Oct. 19-22, Raleigh, N. Carolina.

Wischmeyer, W. H. 1959. A Rainfall Erosion Index for a Universal Soil-Loss Equation. Soil Sci. Soc. Amer. Proc. 23:246-249.

Wischmeyer, W. H. and D. D. Smith. 1965. Predicting rainfall-erosion losses from cropland--a guide for selection of practices for soil and water conservation. Agr. Handbook No. 282. USDA.

Wischmeyer, W. H. and J. V. Mannering. 1969. Relation of Soil Properties to its Erodibility. Soil Sci. Soc. Amer. Proc. 33: 131-137.

Wischmeyer, W. H. 1971. The erosion equation--a tool for conservation planning. Proc. Soil Cons. Soc. Amer., Aug., pp. 73-78.

Wischmeyer, W. H. 1976. Use and Misuse of the Universal Soil Loss Equation. Journal of Soil and Water Conservation. Feb., pg. 5-9.

Wooldridge, G. L. 1976. Vertical momentum transport and mountain valley circulations. Final Report on project 12-11-204-3 Suppl. 61 to USDA Forest Service. 23 pp.

Wooldridge, G. L. and R. L. Ellis. 1973. Atmospheric dispersion characteristics of a northern Utah mountain valley. Dept. of Soils and Biometeorology Tech. Paper No. 2, Utah State University, Logan, Utah. 55 pp.

Wooldridge, G. L. and J. Lewis. 1975. Dispersion in mountain valleys using measured constants in a modified plume model. Pre-print of a paper presented at the Twelfth AMS Conference on Agriculture and Forest Meteorology held at Tucson, Ariz., April 14-16, 1975. 41-42.

Wooldridge, G. L. and M. J. Orgill. 1975. Airflow and diffusion in high mountainous terrain. Presented at the First AMS Conference on Regional and Mesoscale Modeling, Analysis, and Prediction held at Las Vegas, Nev., May 6-9, 1975. 21 pp.

APPENDIX A

Transport of Heavy Metals (TOHM) Model

Definition of Terms and Formats for Data Input

Definition of Terms in Common Blocks

COMMON (unlabeled)

IB1(IE) Number of B1 coefficients for erosion submodel

TITL(2,20) Title and subtitle

IOPRUN(I) Run options

- I = 1 options for precipitation submodel
- I = 2 options for erosion submodel
- I = 3 options for chemistry submodel
- I = 4 option for restart output
- I = 5 error encountered; stop at the end of this program segment
- I = 6 option for soil erosion output

IOPECH(I) Data echo option

- I = 1 options for system identification data
- I = 2 options for fallout data
- I = 3 options for initial heavy metal concentrations

IOPWRI(I) Output options

- I = 1 options for output by element or sub-basin (NA)
- I = 2 options for output by month or year (NA)
- I = 3 option for output of generated precipitation data
- I = 4 option for output of generated erosion data
- I = 5 option for output of generated soil chemistry data (NA)

IEROW(IE) Element row identification (alphanumeric)

IECOL(IE) Element column identification (integer)

ITRAN(I,IE) Element numbers of adjacent elements receiving erosion from IE (I = 1,2)

PTRAN(I,IE) Percent of eroded material transported to ITRAN(I,IE) (I = 1,2)

PTRAN(3,IE) Percent of eroded material transported directly to the lake

Note: (NA), not available in this version of the model.

IHYDB(IE)	Hydrologic sub-basin containing IE	
NHVM	Number of heavy metals in current run	
IHVM(I)	Identification numbers of heavy metals in the current run (I = 1,8)	
ACCFO(IHM,IHB)	Accumulated fallout over a hydrologic sub-basin	Kg
XLAXD(IHM,IHB)	Heavy metal accumulation in the lake from direct fallout	Kg
XLAXE(IHM,IHB)	Heavy metal accumulation in the lake from erosion	Kg
CRUSTD	Crust depth in basin	Cm
AS(IE)	Area of soil surface in IE	Km^2
AL(IE)	Area of lake surface in IE	Km^2
NELE	Number of elements in the system	
B1(I,IE)	Coefficients for erosion submodel (I = 1,4 sub-elements)	
ISOT(I,IE)	Soil types (I = 1,4 sub-elements)	
P30X (IMO)	30 minute rain intensity (IMO = 1,12 months)	Cm/30 min
MAR(IE)	Mean annual rainfall zone containing IE	
IPZON(IE)	Precipitation zone containing IE	
IDZON(IE)	Precipitation distribution zone containing IE	
SADD(IE)	Temporary storage for soil eroded to IE	Kg
SLAXE(IHB)	Mass of soil eroded to the lake for hydrologic basin IHB = 1,NHYDB	Kg

COMMON/EROS/

PINST(8)	Not used	
RKST(8)	Soil type coefficient	
THATA(3)	Slope coefficient	Degrees
P30MIN	Precipitation threshold for erosion	Cm/30 min
VC(10)	Vegetation cover coefficient	
EROSD(IMO,IE)	Depth of erosion in Cm (IMO = 1,12 months) (IE = 1, number of elements)	Cm

COMMON/CHEM/

FO(IHM,IS,IE) Fallout	$Kg/Km^2/mo$
POR(IE) Average soil porosity	Percent
BD(IE) Average soil bulk density	g/Cm^3
PINF(IMO,IE) Monthly infiltration	Cm
X(1,IHM,IE) Mass of heavy metal in crust	$Kg/Km^2/mo$
X(2,IHM,IE) Mass of heavy metal in subsoil	Kg/Km^2
X(I,IHM,IE) Storage variables for chemistry model (I = 3,5)	
DELTA Change in crust depth due to erosion and deposition (+ or -)	Cm
ALPHA(IE) Coefficient for chemistry submodel	
CEE(IE) Coefficient for chemistry submodel	
Y(8) Storage locations for chemistry submodel	

COMMON/RAIN3/

CF(4,12) Factors which produce monthly scatter of precipitation outputs

CF4(4,12) Factors which produce monthly scatter of precipitation outputs

XBAR(5,7) Mean precipitation of precipitation vs. intensity line

SDX(5,7) Slope of precipitation vs. intensity line on probability log paper

PRO(5,7) Probability level

RCF(9) Factor relating composite storm precipitation to annual precipitation

PR(7) Probability level of precipitation event

RFCFOPT(9) Factor relating annual precipitation to a years P30's

Other Variables in RAIN3

P30	Maximum 30 minute intensity for a given month	Cm/30 min
TOTFIL	Infiltration in a month	Cm
CP	Infiltration coefficient	
ALFA	Infiltration coefficient	
MAR	Zones of similar RCFOPT's and RCF's	
IDZON	Zones of similar monthly scatter of precipitation from the mean month	
IPZON	Zones of similar precipitation intensity	
R(27)	Standard deviations	
P(27)	Probability associated with corresponding R	

COMMON/OUTPUT/

MONTH(12)	The name of each month	
IYEAR	The year number	
PECHB(12, IHB)	Monthly 30 minute intensity precipitation accumulated by hydrologic basins (IHB = 1, number of hydrologic basins)	Cm/30 min
PINFHB(12,IHB)	Monthly infiltration accumulated by hydrologic basin (IHB = 1, number of hydrologic basins)	Cm
PEC30(12,IE)	Monthly 30 minute intensity precipitation for element IE	Cm/30 min

COMMON/TOTAL/

TI(8,6)	Temporary storage of ACFOT
T2(8,6)	Temporary storage of XLADT
T3(8,6)	Temporary storage of XLADT
T4(8,6)	Temporary storage of Y1
T5(8,6)	Temporary storage of Y2
SLAEPT(6)	Temporary storage of SLAXET

COMMON/STAT/

ACFOT(IHVM,IYEAR)	Total of fallout during year IYEAR IHVM = 1,NHVM IYEAR = 1, NYEARS	Kg
XLADT(IHVM,IYEAR)	Total of fallout during year IYEAR falling directly on the lake	Kg
XLAET(IHVM,IYEAR)	Total of heavy metals eroded to the lake during year IYEAR	Kg
YIT(IHVM,IYEAR)	Total heavy metal change in soil crust during year IYEAR	Kg
Y2T(IHVM,IYEAR)	Total heavy metal change in subsoil during year IYEAR	Kg
SLAXET(IYEAR)	Total soil eroded to the lake during year IYEAR	Kg
IYSTRT	Start year number	
NR	Read file for subroutine "LASTOP" option card	

Other Input Variables in Program

NR1	Read file	
NW1	Write file	
NYEARS	Number of year to be run	
IRADUM	Seed number for random number generator	
NHYDB	Number of hydrologic basins	
NR6	Read for precipitation model data	
NR2	Read file for subroutine "READSC"	
NW2	Not used	
AREA	Area of standard element	
INXOPT	Input option for initial ACCFO, XLAVD, XLAXE, SLAXE	Km^2
NR5	Read file for precipitation data	
RW5	Write file for precipitation echo	

NR3 Read file for fallout data

NHVT Total number of heavy metals on input file

NR4 Read file for initial heavy metal accumulations in soil

NR4 Write file for erosion data

FORMATS FOR DATA INPUTS

The formats for data input are included in Table A-1. The table includes a comprehensive list of several desirable model options even though the scope of this project did not allow for their inclusion in this version of the model. In such cases a notation is made in the Table. It was felt that if provisions were made now, the inclusion of these options at a future time would be simplified.

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
MAIN CONTROL	1	NR1	1	I1	NOP	Number of problems to be run	
	2	NR1	1-80	20A4	TITL(1,I)	Run Title	
	3	NR1	1-80	20A4	TITL(2,I)	Run subtitle	
	4	NR1	2	I1	IOPRUN(1)	Option for precipitation submodel = 1: use one set of precipitation data for all years (read from NR3) = 2: generate precipitation data for each year using simulated storms = 3: generate precipitation data for each year using P30	
			4-5	I2	NR5	Read-file for precipitation data [IOPRUN(1) = 1]	
			7-8	I2	NW5	Write-file for precipitation echo	
			10	I1	IOPRUN(2)	Option for erosion submodel = blank: run erosion submodel = 1: skip erosion submodel	
			12	I1	IOPRUN(3)	Option for soil chemistry submodel = blank: run soil chemistry submodel = 1: skip soil chemistry submodel = 2: skip soil chemistry submodel and set initial soil concentrations to zero = 3: same as 2 and also prevent transfer between crust and subsoil	

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			14	I1	IOPECH(1)	Option for echo of system identification data (write on NW1) = blank: echo input data = 1: supress echo of input data	
			16	I1	IOPECH(2)	Option for echo of fallout data (write on NW1) = blank: echo input data = 1: supress echo of input data	
			18	I1	IOPECH(3)	Option for echo of initial heavy metal concentration = blank: echo input data = 1: supress echo of input data	
			20	I1	IOPWRT(1)	Output option for elements (write on NW1) = blank: output for hydrologic basins and lake = 1: output for each element, hydrologic basins, and lake (not included in the version of the model)	

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			22	I1	IOPWRT(2)	Output option for time (write on NW1) = blank: output accumulated yearly values = 1: output monthly values and accumulated yearly values (not included in this version of the model)	
			24	I1	IOPWRT(3)	Output option for precipitation subroutine = blank: supress output = 1: output precipitation data as generated on NW5	
			26	I1	IOPWRT(4)	Output option for erosion submodel = blank: supress output = 1: output erosion data as generated on NW4	
			28	I1	IOPWRT(5)	Output option for chemistry submodel (write on NW1) = blank: supress output = 1: output soil chemistry data as generated (not included in this version)	
			30-31	I2	NR1	Read file NR1	
			33-34	I2	NW1	Write file NW1	

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			36-37	I2	NYEARS	Number of years in this run	
			39-53	I15	IRADUM	Initial random number for RAIN3 (odd integer between 6 x 10^5 - 5 x 10^6)	
			55	I1	NHYDB	Number of hydrologic basins (max of 6)	
			57	I1	IOPRUN(4)	1 = make a punched deck of data needed to restart the program 0 = supress the above	
			59	I1	IOPRUN(6)	1 = print mass of soil eroded to lake as yearly output 0 = supress mass of soil eroded to lake	
			61-64	I4	IYSTRT	Starting year number	
			66-67	I2	NR6	Read file for precipitation model data	
SYSTEM DEFINITION	1	NR1	2-3	I2	NR2	Read file for system definition input data	
			5-6	I2	NW2	Write file for monthly output	
			8-10	I3	NELE	Number of elements	
			12-17	F6.0	AREA	Area of standard element	Km^2
			19	I1	INXOP	1 = Input initial ACCFO, XLAXO, XLAXE, and IF IOPRUN(4) = 1 input SLAXE 0 = not the above	

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
	2	NR2	1	A1	IEROW(IE)	Row identification for element IE	
			2-3	I2	IECOL(IE)	Column identification for element IE	
			5	I1	ISOT(1,IE)	Sub-element 1: soil type	
			6	A1	ISLOP(1)	Sub-element 1: slope S: steep (50°) M: moderate (25°) F: flat (10°)	
			7	I1	IVEG(1)	Sub-element 1: vegetation type	
			8-10	F3.2	PA(1)	Sub-element 1: percent area	percent
			12	I1	ISOT(2,IE)		
			13	A1	ISLOP(2)		
			14	I1	IVEG(2)		
			15-17	F3.2	PA(2)		
			19	I1	ISOT(3,IE)		
			20	A1	ISLOP(3)	Up to 4 sub-elements may be included	
			21	I1	IVEG(3)		
			22-24	F3.2	PA(3)		
			26	I1	ISOT(4,IE)		
			27	A1	ISLOP(4)		
			28	I1	IVEG(4)		
			29-31	F3.2	PA(4)		

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			33	A1	FO(1,1,IE)	Row identification of an adjacent element receiving eroded material from element IE	
			34-35	I2	ITRAN(1,IE)	Column identification of an adjacent element receiving material from element IE	
			36-38	F3.2	PTRAN(1,IE)	Percent of eroded material actually transported	percent
			40	A1	FO(1,2,IE)	Row identification of another adjacent element receiving material from element IE	
			41-42	I2	ITRAN(2,IE)	Column identification of another adjacent element receiving material from element IE	
			43-45	F.32	PTRAN(2,IE)	Percent of eroded material actually transported	percent
			46-48	F.32	PTRAN(3,IE)	Percent transported directly to the lake	percent
			50-51	I1	IDZON(IE)	Precipitation distribution zone for element IE	
			53-54	I2	IPZON(IE)	Precipitation zone for element IE	
			56-57	I2	IHYDB(IE)	Hydrologic basin for element IE	
			58-60	F3.2	POR(IE)	Porosity	percent
			62-64	F3.2	BD(IE)	Bulk density	g/Cm^3
			66-68	F3.2	CEE(IE)	Initial infiltration coefficient (C')	
			69-71	F3.2	ALPHA(IE)	Long term infiltration coefficient (2)	

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			72-77	F6.0	ELAR	Element area if different from the standard	Km^2
			80	I1	MAR(IE)	Mean annual rainfall zone I.D.	
FALLOUT DATA CONTROL	1	NR1	2-3	I2	NR3	Read file for fallout data	
			5	I1	NHVM	Number of heavy metals to be modeled in in this run (≤8)	
			7	I1	IHVM(1)	Identification of first heavy metal to be modeled	
			9	I1	IHVM(2)	Identification of second heavy metal to be modeled	
			21	I1	IHVM(8)	Identification of eighth heavy metal to be modeled	
			23	I1	NHVT	Total number of heavy metals on input file (≤8)	
			25-26	I2	NR4	Read-file for initial heavy metal accumulations in soil	
			28-29	I2	NW4	Write-file for erosion data	
FALLOUT DATA INPUT	2	NR3	1	A1	IDUM	"F"	
			3	A1	IDUM1	Row identification for element IE	
			4-5	I2	IDUM2	Column identification for element IE	
			6-14	E9.3	FO(1,1,IE)	Fallout, heavy metal #1, season #1, element IE	$Kg/Km^2/mo$

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			69-77	E9.3	FO(8,2,IE)	Fallout, heavy metal #8, season #2, element IE	$Kg/Km^2/mo$
INITIAL HEAVY METAL ACCUMULATIONS IN THE SOIL	1	NR4	1	A1	IDUM	"C"	
			3	A1	IDUM1	Row identification for element IE	
			4-5	I2	IDUM2	Column identification for element IE	
			7-15	E9.3	X(1,1,IE)	Mass of heavy metal #1 in the crust of element IE	$Kg/Cm/Km^2$
			16-24	E9.3	X(1,2,IE)	Mass of heavy metal #2 in the crust of element IE	$Kg/Cm/Km^2$
			25-33	E9.3	X(1,3,IE)		
			34-42	E9.3	X(1,4,IE)		
			43-51	E9.3	X(1,5,IE)		
			52-60	E9.3	X(1,6,IE)		
			61-69	E9.3	X(1,7,IE)		
			70-78	E9.3	X(1,8,IE)	Mass of heavy metal #8 in the crust of element IE	$Kg/Cm/Km^2$
	2		1	A1	IDUM	"S"	
			3	A1	IDUM1	Row identification for element IE	

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			15-23	E9.3	FO(2,1,IE)	Fallout, heavy metal #2, season #1, element IE	$Kg/Km^2/mo$
			24-32	E9.3	FO(3,1,IE)	Fallout heavy metal #3, season #1, element IE	$Kg/Km^2/mo$
			33-41	E9.3	FO(4,1,IE)	Fallout heavy metal #4, season #1, element IE	$Kg/Km^2/mo$
			42-50	E9.3	FO(5,1,IE)	Fallout, heavy metal #5, season #1, element IE	$Kg/Km^2/mo$
			51-59	E9.3	FO(6,1,IE)	Fallout, heavy metal #6, season #1, element IE	$Kg/Km^2/mo$
			60-68	E9.3	FO(7,1,IE)	Fallout, heavy metal #7, season #1, element IE	$Kg/Km^2/mo$
			69-77	E9.3	FO(8,1,IE)	Fallout, heavy metal #8, season #1, element IE	$Kg/Km^2/mo$
	3	NR3	1	A1	IDUM	"F"	
			3	A1	IDUM	Row identification for element	
			4-5	I2	IDUM2	Column identification for element	$Kg/Km^2/mo$
			6-14	E9.2	FO(1,2,IE)	Fallout, heavy metal #1, season #2, element IE	$Kg/Km^2/mo$
			15-23	E9.3	FO(2,2,IE)	Fallout, heavy metal #2, season #2, element IE	$Kg/Km^2/mo$
			∘ ∘	∘ ∘	∘ ∘	∘ ∘	∘ ∘

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			4-5	I2	IDUM2	Column identification for element IE	
			7-15	E9.3	X(2,1,IE)	Mass of heavy metal #1 beneath crust of element IE	$Kg/Cm/Km^2$
			16-24	E9.3	X(2,2,IE)	Mass of heavy metal #2 beneath crust of element IE	$Kg/Cm/Km^2$
			25-33	E9.3	X(2,3,IE)	Mass of heavy metal #3 beneath crust of element IE	$Kg/Cm/Km^2$
			34-42	E9.3	X(2,4,IE)	Mass of heavy metal #4 beneath crust of element IE	$Kg/Cm/Km^2$
			43-51	E9.3	X(2,5,IE)	Mass of heavy metal #5 beneath crust of element IE	$Kg/Cm/Km^2$
			52-60	E9.3	X(2,6,IE)	Mass of heavy metal #6 beneath crust of element IE	$Kg/Cm/Km^2$
			61-69	E9.3	X(2,7,IE)	Mass of heavy metal #7 beneath crust of element IE	$Kg/Cm/Km^2$
			70-78	E9.3	X(2,8,IE)	Mass of heavy metal #8 beneath crust of element IE	$Kg/Cm/Km^2$
INITIAL MASS BALANCE CONDITIONS NEEDED IF INXOP = 1	1	NR1	1-8	E8.3	ACCFO(1,IHB)	Mass of accumulated fallout for heavy metal #1 in hydrologic basin IHB	Kg
ONE CARD FOR EACH HYDROLOGIC BASIN			11-18	E8.3	ACCFO(2,IHB)	Mass of accumulated fallout for heavy metal #2 in hydrologic basin IHB	Kg
			21-28	E8.3	ACCFO(3,IHB)	Mass of accumulated fallout for heavy metal #3 in hydrologic basin IHB	Kg

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			31-38	E8.3	ACCFO(4,IHB)	Mass of accumulated fallout for heavy metal #4 in hydrologic basin IHB	Kg
			41-48	E8.3	ACCFO(5,IHB)	Mass of accumulated fallout for heavy metal #5 in hydrologic basin IHB	Kg
			51-58	E8.9	ACCFO(6,IHB)	Mass of accumulated fallout for heavy metal #6 in hydrologic basin IHB	Kg
			61-68	E8.3	ACCFO(7,IHB)	Mass of accumulated fallout for heavy metal #7 in hydrologic basin IHB	Kg
			71-78	E8.3	ACCFO(8,IHB)	Mass of accumulated fallout for heavy metal #8 in hydrologic basin IHB	Kg
	o o NHYDB					Repeat for each hydrologic basin	
INITIAL ACCUMULATED FALLOUT DIRECTLY ON THE LAKE (NEEDED IF IOXIOP = 1) ONE CARD FOR EACH HYDRO-LOGIC BASIN	1	NR1	1-8	E8.3	XLAXD(1,1)	Mass of accumulated fallout directly on the lake for heavy metal #1, hydrologic basin 1	Kg
			11-18	E8.3	XLAXD(2,1)	Mass of accumulated fallout directly on the lake for heavy metal #2, hydrologic basin 1	Kg
			21-28	E8.3	XLAXD(3,1)	Mass of accumulated fallout directly on the lake for heavy metal #3, hydrologic basin 1	Kg
			31-38	E8.3	XLAXD(4,1)	Mass of accumulated fallout directly on the lake for heavy metal #4, hydrologic basin 1	Kg
			41-48	E8.3	XLAXD(5,1)	Mass of accumulated fallout directly on the lake for heavy metal #5, hydrologic basin 1	Kg
			51-58	E8.3	XLAXD(6,1)	Mass of accumulated fallout directly on the lake for heavy metal #6, hydrologic basin 1	Kg

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			61-68	E8.3	XLAXD(7,1)	Mass of accumulated fallout directly on the lake for heavy metal #7, hydrologic basin 1	Kg
			71-78	E8.3	XLAXD(8,1)	Mass of accumulated fallout directly on the lake for heavy metal #8, hydrologic basin 1	Kg
	2 ⋮ NHYDB		1-8	E8.3	XLAXD(1,NHYDB)	Mass of accumulated fallout directly on the lake for heavy metal #1, hydrologic basin NHYDB	Kg
			11-18	E8.3	XLAXD(2,NHYDB)	Mass of accumulated fallout directly on the lake for heavy metal #2, hydrologic basin NHYDB	Kg
			21-28	E8.3	XLAXD(3,NHYDB)	Mass of accumulated fallout directly on the lake for heavy metal #3, hydrologic basin NHYDB	Kg
			31-38	E8.3	XLAXD(4,NHYDB)	Mass of accumulated fallout directly on the lake for heavy metal #4, hydrologic basin NHYDB	Kg
			41-48	E8.3	XLAXD(5,NHYDB)	Mass of accumulated fallout directly on the lake for heavy metal #5, hydrologic basin NHYDB	Kg
			51-58	E8.3	XLAXD(6,NHYDB)	Mass of accumulated fallout directly on the lake for heavy meatl #6, hydrologic basin NHYDB	Kg
			61-68	E8.3	XLAXD(7,NHYDB)	Mass of accumulated fallout directly on the lake for heavy metal #7, hydrologic basin NHYDB	Kg

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			71-78	E8.3	XLAXD(8,NHYDB)	Mass of accumulated fallout directly on the make for heavy metal #8, hydrologic basin NHYDB)	Kg
INITIAL ACCUMULATED HEAVY METALS ERODED TO THE LAKE (NEEDED IF IOXIOP = 1) ONE CARD FOR EACH HYDROLOGIC BASIN	1	NR1	1-8	E8.3	XLAXE(1,1)	Mass of heavy metal #1 eroded to the lake from hydrologic basin 1	Kg
			11-18	E8.3	XLAXE(2,1)	Mass of heavy metal #2 eroded to the lake from hydrologic basin 1	Kg
			21-28	E8.3	XLAXE(3,1)	Mass of heavy metal #3 eroded to the lake from hydrologic basin 1	Kg
			31-38	E8.3	XLAXE(4,1)	Mass of heavy metal #4 eroded to the lake from hydrologic basin 1	Kg
			41-48	E8.3	XLAXE(5,1)	Mass of heavy metal #5 eroded to the lake from hydrologic basin 1	Kg
			51-58	E8.3	XLAXE(6,1)	Mass of heavy metal #6 eroded to the lake from hydrologic basin 1	Kg
			61-68	E8.3	XLAXE(7,1)	Mass of heavy metal #7 eroded to the lake from hydrologic basin 1	Kg
			71-78	E8.3	XLAXE(8,1)	Mass of heavy metal #8 eroded to the lake from hydrologic basin 1	Kg
	2 ° ° NHYDB		1-8	E8.3	XLAXE(1,NHYDB)	Mass of heavy metal #1 eroded to the lake from hydrologic basin NHYDB	Kg
			11-18	E8.3	XLAXE(2,NHYDB)	Mass of heavy metal #2 eroded to the lake from hydrologic basin NHYDB	Kg

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
			21-28	E8.3	XLAXE(3,NHYDB)	Mass of heavy metal #3 eroded to the lake from hydrologic basin NHYDB	Kg
			31-38	E8.3	XLAXE(4,NHYDB)	Mass of heavy metal #4 eroded to the lake from hydrologic basin NHYDB	Kg
			41-48	E8.3	XLAXE(5,NHYDB)	Mass of heavy metal #5 eroded to the lake from hydrologic basin NHYDB	Kg
			51-58	E8.3	XLAXE(6,NHYDB)	Mass of heavy metal #6 eroded to the lake from hydrologic basin NHYDB	Kg
			61-68	E8.3	XLAXE(7,NHYDB)	Mass of heavy metal #7 eroded to the lake from hydrologic basin NHYDB	Kg
			71-78	E8.3	XLAXE(8,NHYDB)	Mass of heavy metal #8 eroded to the lake from hydrologic basin NHYDB	Kg
INITIAL ACCUMULATED SOIL ERODED TO THE LAKE (NEEDED IF IOXIOP = 1 AND IOPRUN(6) = 1)	1	NR1	1-8	E8.3	SLAXE(1)	Mass of soil eroded to the lake from hydrologic basin 1	Kg
			11-18	E8.3	SLAXE(2)	Mass of soil eroded to the lake from hydrologic basin 2	Kg
			21-28	E8.3	SLAXE(3)	Mass of soil eroded to the lake from hydrologic basin 3	Kg
			31-38	E8.3	SLAXE(4)	Mass of soil eroded to the lake from hydrologic basin 4	Kg
			41-48	E8.3	SLAXE(5)	Mass of soil eroded to the lake from hydrologic basin 5	Kg
			51-58	E8.3	SLAXE(6)	Mass of soil eroded to the lake from hydrologic basin 6	Kg

DATA SEGMENT	CARD TYPE IN DATA SEGMENT	READ FILE	CARD COLUMNS	INPUT FORMAT	SYMBOL	DESCRIPTION	INPUT UNITS
YEARLY TOTALS SUMMARY OUTPUT OPTION	1	NR1	1	I1	IOP	IF IOP = 1; yearly totals of fallout, fallout on the lake, heavy metals eroded to the lake, heavy metals left in the crust, and heavy metals left in the subsoil for heavy metal #2 through heavy metal NHVM will be set equal to heavy metal #1 and be multiplied by the concentration factor XC - Kg heavy metal/Kg fallout	
			2	I1	NHM	The number of heavy metals that are to be multiplied by the inputed concentration factor of KG heavy metalI/Kg fallout	
			3-4	I2	NW	Print file number	
			6-7	I2	NP	Punch file number	
			9-16	E8.3	XC(1)	Kg heavy metal #1/Kg fallout	
			18-25	E8.3	XC(2)	Kg heavy metal #2/Kg fallout	
			27-34	E8.3	XC(3)	Kg heavy metal #3/Kg fallout	
			36-43	E8.3	XC(4)	Kg heavy metal #4/Kg fallout	
			45-52	E8.3	XC(5)	Kg heavy metal #5/Kg fallout	
			54-61	E8.3	XC(6)	Kg heavy metal #6/Kg fallout	
			63-70	E8.3	XC(7)	Kg heavy metal #7/Kg fallout	
			72-79	E8.3	XC(8)	Kg heavy metal #8/Kg fallout	

APPENDIX B

SAMPLE OF MODEL OUTPUT

This appendix includes a sample of the computer printout. The principal segments of the printout include:

I. Echo of control cards and system definition information

II. Internally generated coefficients

III. Echo of heavy metal fallout data

IV. Echo of initial heavy metal concentrations in the surface crust

V. Echo of initial heavy metal concentrations in the subsurface

VI. Model output for one year

PRINTOUT SEGMENT I

Echo of control cards and system definition information. The output conforms to the input specifications in Appendix A; "Main Control" and "System Definition."

```
LAKE POWELL STUDY AREA
OCTOBER 1976

IOPRUN(1)= 3   NR5=  5   NW5=  6   IOPRUN(2)= 0   IOPRUN(3)= 1   IOPECH(1)= 0   IOPECH(2)= 0   IOPECH(3)= 0

IOPWRT(1)= 0   IOPWRT(2)= 0   IOPWRT(3)= 0   IOPWRT(4)= 0   IOPWRT(5)= 0   NR1=  5   NW1=  6   NYEARS=  1

IRADUM =          999999   NHYDB = 5   IOPRUN(4) = 0   IOPRUN(6) = 1   IYSTRT =    1   NR6 = 23

NR2= 21   NW2=  6   NELE= 288   AREA=  100,00   INXOPT = 0

  HEAVY METAL 1 = ZINC
  HEAVY METAL 2 = MERCURY
  HEAVY METAL 3 = LEAD
  HEAVY METAL 4 = CADMIUM
  HEAVY METAL 5 = CHROMATE
  HEAVY METAL 6 = ORTHO PHOSPHATE

  HYDROLOGIC SUB-BASIN 1 = FREMONT
  HYDROLOGIC SUB-BASIN 2 = DIRTY DEVIL
  HYDROLOGIC SUB-BASIN 3 = COLORADO
  HYDROLOGIC SUB-BASIN 4 = ESCALANTE
  HYDROLOGIC SUB-BASIN 5 = SAN JUAN
```

1	A	1	6	S	3	1,00	0		0	0,00	0		0	0,00	0		0	0,00		0	0,00		0	0,00	0,00	1	4	1	0,48	1,37	0,34	0,70	100,00	8
2	A	2	6	S	3	0,70	6	S	4	0,30	0		0	0,00	0		0	0,00		0	0,00		0	0,00	0,00	1	3	1	0,48	1,37	0,34	0,70	100,00	7
3	A	3	6	S	3	0,50	6	S	4	0,50	0		0	0,00	0		0	0,00	B	3	0,75		0	0,00	0,05	1	3	1	0,48	1,37	0,34	0,70	100,00	9
4	A	4	6	S	4	0,33	7	S	4	0,67	0		0	0,00	0		0	0,00	B	4	0,80		0	0,00	0,00	1	4	1	0,39	1,61	0,46	0,70	100,00	5
5	A	5	7	S	4	0,25	1	F	4	0,75	0		0	0,00	0		0	0,00	B	5	0,40		0	0,00	0,00	1	5	1	0,46	1,40	1,35	0,44	80,00	4
6	A	6	1	F	2	1,00	0		0	0,00	0		0	0,00	0		0	0,00	B	6	0,10		0	0,00	0,00	1	5	1	0,50	1,32	1,35	0,44	50,00	3
7	A	7	1	F	2	1,00	0		0	0,00	0		0	0,00	0		0	0,00	B	7	0,04		0	0,00	0,00	1	5	1	0,50	1,32	1,35	0,44	25,00	3
8	B	1	6	S	3	0,80	6	S	4	0,20	0		0	0,00	0		0	0,00		0	0,00		0	0,00	0,00	1	4	1	0,48	1,37	0,34	0,70	100,00	9
9	B	2	6	S	3	0,50	6	M	3	0,50	0		0	0,00	0		0	0,00	B	3	0,30		0	0,00	0,10	1	3	1	0,48	1,37	0,34	0,70	100,00	7
10	B	3	6	M	3	0,40	6	S	3	0,45	6	F	3	0,15	0		0	0,00		0	0,00		0	0,00	0,60	1	4	1	0,48	1,37	0,34	0,70	100,00	6
11	B	4	6	S	3	0,30	7	S	3	0,40	1	F	4	0,30	0		0	0,00	B	5	0,50		0	0,00	0,00	1	5	1	0,43	1,50	0,44	0,70	100,00	7
12	B	5	1	F	4	0,85	1	F	3	0,15	0		0	0,00	0		0	0,00	C	5	0,20		0	0,00	0,00	1	5	1	0,50	1,32	1,32	0,44	100,00	4
13	B	6	1	F	4	0,33	1	F	2	0,67	0		0	0,00	0		0	0,00	B	7	0,25	C	6	0,25	0,00	1	5	1	0,50	1,32	1,32	0,44	100,00	3
14	B	7	1	F	2	1,00	0		0	0,00	0		0	0,00	0		0	0,00	C	7	0,20		0	0,00	0,00	1	5	1	0,50	1,32	1,32	0,44	100,00	3
15	B	8	1	F	2	0,57	1	F	8	0,43	0		0	0,00	0		0	0,00	C	8	0,15		0	0,00	0,00	2	5	1	0,50	1,32	1,32	0,44	70,00	2
16	B	9	1	F	8	0,50	3	F	8	0,50	0		0	0,00	0		0	0,00	C	9	0,06		0	0,00	0,00	2	5	1	0,48	1,39	0,57	0,42	30,00	2

17	C 1	6 S 4	0,15	6 F 4	0,85	0 0	0,00	0 0	0,00	C 2	0,20	0	0,00	0,00	1	4	1	0,48	1,37	0,34	0,70	100,00	5
18	C 2	6 M 3	0,20	6 F 4	0,25	6 M 5	0,40	5 F 5	0,15	C 3	0,20	D 2	0,10	0,10	1	5	1	0,48	1,37	0,34	0,70	100,00	5
19	C 3	7 F 4	0,50	7 F 4	0,50	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,30	1	4	1	0,35	1,73	0,51	0,70	100,00	6
20	C 4	7 S 3	1,00	0 0	0,00	0 0	0,00	0 0	0,00	C 5	0,80	0	0,00	0,00	1	3	1	0,35	1,73	0,51	0,70	100,00	8
21	C 5	5 S 3	0,15	6 F 3	0,40	6 F 4	0,45	0 0	0,00	C 6	0,35	0	0,00	0,00	1	5	1	0,48	1,38	0,43	0,70	100,00	5
22	C 6	6 F 4	0,60	6 F 2	0,40	0 0	0,00	0 0	0,00	D 6	0,20	0	0,00	0,00	2	5	1	0,50	1,32	0,46	0,70	100,00	3
23	C 7	6 F 2	0,90	6 F 4	0,10	0 0	0,00	0 0	0,00	C 8	0,20	0	0,00	0,00	2	5	1	0,50	1,32	0,46	0,70	100,00	3
24	C 8	6 F 8	0,60	6 F 2	0,30	1 F 8	0,10	0 0	0,00	D 8	0,20	0	0,00	0,00	2	5	1	0,51	1,31	0,43	0,70	100,00	2
25	C 9	1 F 8	0,80	3 F 8	0,20	0 0	0,00	0 0	0,00	D 9	0,20	0	0,00	0,00	2	5	1	0,52	1,26	0,50	0,44	100,00	2
26	C10	3 F 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	D10	0,07	0	0,00	0,07	2	5	1	0,40	1,59	0,65	0,41	70,00	1
27	C11	3 F 7	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	2	5	1	0,40	1,59	0,65	0,41	20,00	1
28	D 1	5 F 5	0,70	5 F 4	0,30	0 0	0,00	0 0	0,00	D 2	0,20	0	0,00	0,00	1	4	1	0,40	1,59	0,59	0,52	100,00	5
29	D 2	5 F 5	1,00	0 0	0,00	0 0	0,00	0 0	0,00	D 3	0,15	0	0,00	0,05	1	5	1	0,40	1,59	0,59	0,52	100,00	3
30	D 3	5 F 5	0,20	7 F 5	0,30	7 S 3	0,20	5 S 4	0,30	0	0,00	0	0,00	0,40	1	5	1	0,36	1,70	0,58	0,61	100,00	5
31	D 4	2 S 4	0,15	5 S 3	0,75	7 S 3	0,10	0 0	0,00	E 4	0,60	0	0,00	0,20	2	4	1	0,37	1,67	0,64	0,52	100,00	5
32	D 5	2 F 4	0,10	5 S 4	0,70	5 S 3	0,20	0 0	0,00	D 6	0,50	0	0,00	0,30	2	5	1	0,36	1,69	0,59	0,52	100,00	6
33	D 6	5 S 4	0,40	1 F 4	0,60	0 0	0,00	0 0	0,00	D 7	0,40	0	0,00	0,10	2	5	1	0,44	1,48	0,95	0,48	100,00	3
34	D 7	1 F 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	E 7	0,10	0	0,00	0,10	2	5	1	0,50	1,32	1,32	0,44	100,00	2
35	D 8	1 F 4	0,60	1 F 8	0,20	1 F 7	0,20	0 0	0,00	0	0,00	0	0,00	0,20	2	5	1	0,52	1,26	0,99	0,44	100,00	2
36	D 9	1 F 8	0,40	1 F 7	0,60	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	5	1	0,55	1,18	0,48	0,44	100,00	2
37	D10	3 F 7	0,80	3 F 8	0,20	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	5	1	0,40	1,59	0,65	0,41	100,00	1
38	D11	3 F 7	0,70	3 F 8	0,30	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	5	2	0,40	1,59	0,65	0,41	100,00	1
39	D12	3 F 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	2	5	2	0,40	1,59	0,65	0,41	40,00	1
40	E 1	5 F 4	0,40	5 F 5	0,60	0 0	0,00	0 0	0,00	E 2	0,20	0	0,00	0,00	2	4	1	0,40	1,59	0,59	0,52	100,00	5
41	E 2	5 F 5	1,00	0 0	0,00	0 0	0,00	0 0	0,00	E 3	0,15	0	0,00	0,05	2	5	1	0,40	1,59	0,59	0,52	100,00	5
42	E 3	5 F 5	0,30	7 M 4	0,30	5 F 4	0,20	7 F 4	0,20	D 3	0,10	0	0,00	0,30	2	5	1	0,38	1,70	0,58	0,61	100,00	6
43	E 4	7 M 4	0,50	2 F 4	0,50	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,45	2	5	1	0,43	1,53	0,63	0,59	100,00	5
44	E 5	2 M 4	0,85	2 F 4	0,15	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,50	2	5	1	0,50	1,32	0,67	0,49	100,00	3
45	E 6	2 M 4	0,30	5 S 4	0,70	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,75	2	5	1	0,40	1,61	0,62	0,51	100,00	4
46	E 7	1 F 4	0,80	1 F 7	0,20	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	5	1	0,51	1,29	1,16	0,44	100,00	3
47	E 8	1 F 7	0,90	1 F 4	0,10	0 0	0,00	0 0	0,00	E 9	0,20	0	0,00	0,00	2	5	1	0,54	1,19	0,56	0,44	100,00	3

48	E 9	1 F 7	0,95	1 F 8	0,05	0 0	0,00	0 0	0,00	D 9	0,10	0	0,00	0,10	2	5	1	0,55	1,18	0,48	0,44	100,00	3
49	E10	1 F 7	0,10	3 F 8	0,80	3 F 7	0,10	0 0	0,00	D10	0,10	0	0,00	0,10	2	5	1	0,42	1,55	0,63	0,41	100,00	3
50	E11	3 F 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	D11	0,10	E12	0,10	0,10	2	5	2	0,40	1,59	0,65	0,41	100,00	3
51	E12	3 F 8	0,50	5 F 8	0,50	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	5	2	0,43	1,53	0,65	0,46	100,00	2
52	E13	5 S 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	2	5	2	0,35	1,73	0,59	0,52	50,00	2
53	F 1	5 F 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	F 2	0,20	0	0,00	0,00	2	4	1	0,40	1,59	0,59	0,52	100,00	6
54	F 2	5 F 4	0,85	5 F 5	0,15	0 0	0,00	0 0	0,00	E 2	0,20	0	0,00	0,00	2	4	1	0,40	1,59	0,59	0,52	100,00	5
55	F 3	5 F 4	0,40	6 M 4	0,40	7 M 4	0,20	0 0	0,00	E 3	0,35	0	0,00	0,00	2	3	4	0,40	1,62	0,57	0,60	100,00	9
56	F 4	6 F 4	0,50	7 M 4	0,50	0 0	0,00	0 0	0,00	F 5	0,25	0	0,00	0,10	2	3	4	0,38	1,66	0,46	0,70	100,00	8
57	F 5	2 M 4	0,15	5 M 4	0,50	7 M 4	0,20	6 F 4	0,15	F 6	0,50	0	0,00	0,00	2	4	1	0,38	1,65	0,54	0,59	100,00	5
58	F 6	2 M 4	0,70	5 M 4	0,15	5 S 4	0,15	0 0	0,00	F 7	0,60	0	0,00	0,00	2	5	1	0,40	1,61	0,65	0,50	100,00	5
59	F 7	5 S 4	0,30	1 F 7	0,70	0 0	0,00	0 0	0,00	E 7	0,30	0	0,00	0,15	2	5	1	0,49	1,35	0,35	0,46	100,00	3
60	F 8	1 F 7	0,25	1 M 7	0,40	1 M 4	0,15	1 M 8	0,20	E 8	0,45	0	0,00	0,05	2	5	1	0,55	1,18	0,48	0,44	100,00	3
61	F 9	1 F 8	0,40	1 M 8	0,25	1 S 8	0,15	1 F 7	0,20	E 9	0,35	0	0,00	0,05	2	4	1	0,55	1,18	0,48	0,44	100,00	4
62	F10	1 F 8	0,33	3 F 8	0,50	6 S 1	0,17	0 0	0,00	F11	0,25	E10	0,20	0,05	2	4	1	0,45	1,45	0,55	0,48	100,00	5
63	F11	3 F 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	F12	0,10	E11	0,05	0,05	2	5	2	0,40	1,59	0,65	0,41	100,00	2
64	F12	3 F 8	0,40	5 F 8	0,60	0 0	0,00	0 0	0,00	G12	0,15	0	0,00	0,05	2	5	3	0,37	1,67	0,67	0,46	100,00	2
65	F13	5 S 8	0,70	5 F 8	0,30	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,80	2	5	2	0,35	1,73	0,59	0,52	100,00	2
66	F14	5 S 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	3	5	2	0,35	1,73	0,59	0,52	40,00	2
67	G 1	5 F 4	0,30	6 F 3	0,70	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	2	3	1	0,40	1,59	0,47	0,64	100,00	7
68	G 2	5 F 4	0,40	6 F 4	0,30	6 F 3	0,30	0 0	0,00	0	0,00	0	0,00	0,00	2	2	1	0,40	1,59	0,33	0,72	100,00	6
69	G 3	5 F 4	0,15	5 M 4	0,20	6 F 4	0,50	6 F 3	0,15	0	0,00	0	0,00	0,00	2	1	4	0,40	1,59	0,50	0,62	100,00	7
70	G 4	6 F 4	0,40	6 F 3	0,40	7 M 3	0,20	0 0	0,00	0	0,00	0	0,00	0,00	2	1	4	0,39	1,62	0,42	0,70	100,00	6
71	G 5	6 F 4	0,10	6 F 3	0,20	7 M 3	0,60	5 M 3	0,10	0	0,00	0	0,00	0,00	2	3	1	0,36	1,69	0,47	0,69	100,00	7
72	G 6	5 M 3	0,40	5 M 4	0,35	5 S 3	0,25	0 0	0,00	0	0,00	0	0,00	0,00	2	4	1	0,35	1,73	0,59	0,52	100,00	4
73	G 7	5 S 4	0,45	1 F 4	0,55	0 0	0,00	0 0	0,00	F 7	0,40	0	0,00	0,05	2	5	1	0,46	1,43	0,55	0,48	100,00	4
74	G 8	1 M 4	0,80	1 F 4	0,20	0 0	0,00	0 0	0,00	F 8	0,45	0	0,00	0,05	2	5	1	0,55	1,18	0,48	0,44	100,00	4
75	G 9	1 M 4	0,70	6 S 1	0,30	0 0	0,00	0 0	0,00	F 9	0,25	G 8	0,30	0,10	2	3	1	0,50	1,30	0,60	0,47	100,00	5
76	G10	6 S 1	1,00	0 0	0,00	0 0	0,00	0 0	0,00	G11	0,75	0	0,00	0,00	2	4	2	0,40	1,59	0,40	0,70	100,00	8
77	G11	3 F 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	G12	0,20	0	0,00	0,00	2	5	2	0,40	1,59	0,65	0,41	100,00	4
78	G12	3 F 8	0,35	5 F 8	0,65	0 0	0,00	0 0	0,00	H12	0,05	0	0,00	0,15	2	5	2	0,37	1,68	0,68	0,46	100,00	2

79	G13	5 F 8	0,30	5 S 8	0,50	2 S 8	0,20	0 0	0,00	0	0,00	0	0,00	0,70	2	5	2	0,38	1,65	0,62	0,51	100,00	2
80	G14	2 S 8	0,33	2 M 8	0,67	0 0	0,00	0 0	0,00	G13	0,25	H14	0,25	0,00	3	5	2	0,50	1,32	0,67	0,49	90,00	3
81	G15	2 M 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	3	5	2	0,50	1,32	0,67	0,49	20,00	3
82	H 1	6 F 3	1,00	0 0	0,00	0 0	0,00	0 0	0,00	H 2	0,20	0	0,00	0,00	2	3	4	0,40	1,59	0,40	0,70	100,00	8
83	H 2	6 F 3	0,60	7 M 3	0,40	0 0	0,00	0 0	0,00	I 2	0,35	0	0,00	0,00	2	2	4	0,38	1,65	0,44	0,70	100,00	6
84	H 3	6 F 3	0,30	7 M 3	0,70	0 0	0,00	0 0	0,00	I 3	0,25	H 2	0,20	0,00	2	3	4	0,36	1,69	0,48	0,70	100,00	6
85	H 4	7 M 3	1,00	0 0	0,00	0 0	0,00	0 0	0,00	I 4	0,50	0	0,00	0,00	2	3	4	0,35	1,73	0,51	0,70	100,00	7
86	H 5	7 M 3	0,35	5 M 3	0,65	0 0	0,00	0 0	0,00	I 5	0,50	0	0,00	0,00	2	3	4	0,35	1,21	0,55	0,60	100,00	5
87	H 6	5 S 3	0,40	2 M 3	0,40	2 M 3	0,20	0 0	0,00	I 6	0,70	0	0,00	0,00	2	3	4	0,44	1,48	0,65	0,50	100,00	4
88	H 7	2 M 4	0,25	5 S 4	0,35	1 M 4	0,40	0 0	0,00	G 7	0,25	I 7	0,25	0,00	2	4	1	0,47	1,26	0,24	0,48	100,00	4
89	H 8	1 M 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	G 8	0,25	H 7	0,25	0,00	2	5	1	0,55	1,18	0,48	0,44	100,00	4
90	H 9	1 M 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	I 9	0,60	0	0,00	0,00	2	4	3	0,55	1,18	0,48	0,44	100,00	4
91	H10	6 S 1	0,80	3 F 1	0,20	0 0	0,00	0 0	0,00	H11	0,75	0	0,00	0,00	2	3	2	0,40	1,59	0,48	0,63	100,00	6
92	H11	3 F 1	0,20	3 F 4	0,80	0 0	0,00	0 0	0,00	H12	0,20	0	0,00	0,00	2	5	2	0,40	1,59	0,65	0,41	100,00	4
93	H12	3 F 4	0,25	5 F 4	0,40	5 S 4	0,35	0 0	0,00	H13	0,20	I12	0,20	0,20	2	5	3	0,36	1,70	0,67	0,47	100,00	2
94	H13	5 S 4	0,70	5 S 8	0,15	2 S 6	0,15	0 0	0,00	0	0,00	0	0,00	0,80	3	5	2	0,37	1,67	0,62	0,51	100,00	2
95	H14	2 M 8	0,85	2 M 4	0,15	0 0	0,00	0 0	0,00	H15	0,10	I14	0,20	0,20	3	5	3	0,50	1,32	0,67	0,49	100,00	3
96	H15	2 M 8	0,67	5 M 6	0,33	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,25	3	5	3	0,47	1,41	0,67	0,49	60,00	3
97	I 1	7 M 3	0,70	6 M 3	0,15	4 S 3	0,15	0 0	0,00	J 1	0,60	0	0,00	0,00	2	2	4	0,37	1,67	0,47	0,71	100,00	5
98	I 2	7 M 3	0,40	4 M 3	0,40	5 M 3	0,20	0 0	0,00	J 2	0,55	0	0,00	0,00	2	3	4	0,39	1,62	0,62	0,62	100,00	7
99	I 3	7 S 3	0,30	7 M 3	0,30	5 S 3	0,40	0 0	0,00	I 4	0,65	0	0,00	0,00	2	3	4	0,35	1,73	0,46	0,68	100,00	6
100	I 4	7 M 3	0,25	5 M 3	0,75	0 0	0,00	0 0	0,00	J 4	0,50	0	0,00	0,00	2	3	4	0,35	1,73	0,54	0,59	100,00	4
101	I 5	5 M 3	0,75	5 M 4	0,25	0 0	0,00	0 0	0,00	J 5	0,60	0	0,00	0,00	2	3	4	0,35	1,73	0,59	0,52	100,00	3
102	I 6	5 S 4	0,20	2 S 3	0,15	2 M 4	0,65	0 0	0,00	J 6	0,60	0	0,00	0,00	2	4	4	0,47	1,40	0,65	0,50	100,00	3
103	I 7	2 M 4	0,85	5 S 4	0,15	0 0	0,00	0 0	0,00	I 6	0,50	0	0,00	0,00	2	4	4	0,48	1,38	0,65	0,50	100,00	3
104	I 8	5 S 4	0,15	1 M 4	0,85	0 0	0,00	0 0	0,00	J 8	0,30	I 9	0,25	0,00	2	4	4	0,52	1,26	0,48	0,46	100,00	3
105	I 9	1 M 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	J 9	0,50	0	0,00	0,00	2	4	3	0,55	1,18	0,48	0,44	100,00	3
106	I10	1 M 4	0,40	6 S 1	0,50	3 F 1	0,10	0 0	0,00	J10	0,65	0	0,00	0,00	2	3	3	0,46	1,43	0,50	0,56	100,00	5
107	I11	6 S 1	0,35	3 F 1	0,20	3 M 4	0,45	0 0	0,00	J11	0,70	0	0,00	0,00	2	4	3	0,40	1,59	0,63	0,49	100,00	5
108	I12	3 M 4	0,45	5 S 4	0,35	5 M 4	0,20	0 0	0,00	J12	0,35	0	0,00	0,00	2	4	3	0,37	1,67	0,63	0,47	100,00	2
109	I13	5 S 4	0,70	5 S 6	0,15	5 M 6	0,15	0 0	0,00	0	0,00	0	0,00	0,80	3	5	3	0,36	1,71	0,59	0,52	100,00	2

110	I14	2 M 4	0,35	5 M 6	0,65	0	0	0,00	0	0	0,00	0	0,00	0	0,00	0,50	3	5	3	0,44	1,50	0,62	0,51	100,00	3
111	I15	5 M 6	1,00	0	0	0,00	0	0	0,00	0	0,00	0	0,00	0,50	3	5	3	0,40	1,59	0,65	0,50	90,00	3
112	I16	5 M 6	1,00	0	0	0,00	0	0	0,00	0	0,00	0	0,00	0,00	3	4	3	0,40	1,59	0,65	0,50	15,00	4
113	J 1	4 S 3	0,90	4 S 4	0,10	0	0,00	0	0,00	J 2	0,80	0	0,00	0,00	2	3	4	0,45	1,45	0,41	0,73	100,00	6
114	J 2	4 M 3	0,25	4 S 4	0,20	4 M 4	0,20	5 M 4	0,35	J 3	0,30	0	0,00	0,30	2	3	4	0,42	1,55	0,36	0,73	100,00	4
115	J 3	5 M 4	0,40	5 S 4	0,40	5 S 3	0,10	5 M 3	0,10	0	0,00	0	0,00	0,80	2	3	4	0,35	1,73	0,65	0,50	100,00	4
116	J 4	5 M 4	0,80	5 S 4	0,20	0	0,00	0	0,00	0	0,00	0	0,00	0,55	2	3	4	0,35	1,73	0,65	0,50	100,00	4
117	J 5	5 M 4	1,00	0	0,00	0	0,00	0	0,00	K 5	0,25	0	0,00	0,25	2	3	4	0,35	1,73	0,65	0,50	100,00	3
118	J 6	5 M 4	0,20	2 S 4	0,25	2 M 4	0,55	0	0,00	K 6	0,40	0	0,00	0,30	2	4	4	0,47	1,40	0,65	0,50	100,00	3
119	J 7	2 M 4	1,00	0	0,00	0	0,00	0	0,00	J 6	0,50	0	0,00	0,00	2	4	4	0,50	1,32	0,67	0,49	100,00	7
120	J 8	2 M 4	0,25	5 S 4	0,35	3 M 4	0,20	1 M 4	0,20	K 8	0,70	0	0,00	0,00	2	4	4	0,44	1,49	0,68	0,45	100,00	2
121	J 9	3 M 4	0,40	1 M 4	0,60	0	0,00	0	0,00	K 9	0,50	0	0,00	0,00	2	4	3	0,49	1,34	0,53	0,43	100,00	2
122	J10	1 M 4	0,70	3 M 4	0,30	0	0,00	0	0,00	K10	0,50	0	0,00	0,00	2	4	3	0,51	1,30	0,53	0,43	100,00	3
123	J11	3 M 4	0,60	3 M 1	0,40	0	0,00	0	0,00	K11	0,55	0	0,00	0,00	2	4	3	0,40	1,59	0,65	0,41	100,00	3
124	J12	3 M 4	0,20	3 S 4	0,30	5 S 6	0,30	5 S 4	0,20	K12	0,30	J13	0,30	0,20	2	4	3	0,38	1,66	0,64	0,46	100,00	3
125	J13	5 S 6	0,25	2 S 6	0,25	5 M 6	0,35	5 S 4	0,15	0	0,00	0	0,00	0,65	3	5	3	0,41	1,58	0,59	0,52	100,00	2
126	J14	5 M 6	0,45	5 S 6	0,30	2 S 6	0,25	0	0,00	J13	0,00	0	0,00	0,65	3	5	3	0,42	1,52	0,59	0,52	100,00	3
127	J15	5 M 6	1,00	0	0,00	0	0,00	0	0,00	H15	0,25	K15	0,25	0,00	3	4	3	0,40	1,59	0,59	0,52	100,00	3
128	J16	5 M 6	1,00	0	0,00	0	0,00	0	0,00	J15	0,25	0	0,00	0,00	3	4	3	0,40	1,59	0,59	0,52	50,00	4
129	K 1	4 S 3	0,33	4 S 4	0,67	0	0,00	0	0,00	J 1	0,80	0	0,00	0,00	2	3	4	0,45	1,45	0,41	0,73	100,00	5
130	K 2	4 S 4	0,65	4 M 4	0,20	4 F 4	0,15	0	0,00	K 3	0,70	0	0,00	0,00	2	3	4	0,45	1,45	0,41	0,73	100,00	4
131	K 3	4 S 4	0,15	1 S 4	0,10	5 F 4	0,75	0	0,00	K 4	0,30	0	0,00	0,00	2	4	4	0,38	1,64	0,56	0,55	100,00	4
132	K 4	5 F 4	0,80	5 M 4	0,20	0	0,00	0	0,00	L 4	0,20	0	0,00	0,00	2	4	4	0,35	1,73	0,59	0,52	100,00	3
133	K 5	5 F 4	0,70	5 M 4	0,30	0	0,00	0	0,00	0	0,00	0	0,00	0,35	2	4	4	0,35	1,73	0,59	0,52	100,00	3
134	K 6	5 M 4	0,85	5 F 4	0,15	0	0,00	0	0,00	0	0,00	0	0,00	0,55	2	4	4	0,35	1,73	0,59	0,52	100,00	2
135	K 7	5 S 4	0,20	2 M 4	0,80	0	0,00	0	0,00	K 6	0,20	L 7	0,25	0,20	2	4	4	0,47	1,40	0,67	0,49	100,00	1
136	K 8	2 M 4	0,80	5 S 4	0,20	0	0,00	0	0,00	L 8	0,30	K 9	0,35	0,00	2	4	4	0,47	1,40	0,67	0,49	100,00	2
137	K 9	3 M 4	0,90	5 S 4	0,10	0	0,00	0	0,00	L 9	0,50	0	0,00	0,00	2	4	3	0,40	1,60	0,64	0,42	100,00	2
138	K10	3 M 4	0,90	1 M 4	0,10	0	0,00	0	0,00	L10	0,50	0	0,00	0,00	2	4	3	0,42	1,55	0,63	0,41	100,00	2
139	K11	3 M 4	0,70	3 F 4	0,20	3 S 4	0,10	0	0,00	L11	0,50	0	0,00	0,00	2	4	3	0,40	1,59	0,65	0,41	100,00	2
140	K12	3 S 4	0,30	3 F 4	0,20	5 S 6	0,25	3 S 6	0,25	L12	0,20	0	0,00	0,30	2	4	3	0,39	1,63	0,64	0,44	100,00	2

141	K13	5 S 6	0,45	2 S 6	0,55	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,80	3	5	3	0,43	1,50	0,62	0,51	100,00	1
142	K14	2 S 6	0,75	5 S 6	0,25	0 0	0,00	0 0	0,00	J 4	0,50	L14	0,30	0,00	3	4	3	0,48	1,39	0,65	0,50	100,00	2
143	K15	5 M 6	0,85	5 S 6	0,15	0 0	0,00	0 0	0,00	K 4	0,50	0	0,00	0,00	3	4	3	0,40	1,59	0,59	0,52	100,00	2
144	K16	5 M 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	K 5	0,40	0	0,00	0,00	3	3	3	0,40	1,59	0,59	0,52	85,00	4
145	L 1	4 S 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	K 1	0,80	0	0,00	0,00	2	3	4	0,45	1,45	0,41	0,73	100,00	6
146	L 2	4 S 4	0,55	4 M 4	0,20	4 S 4	0,15	4 M 4	0,10	K 2	0,65	0	0,00	0,00	2	3	4	0,42	1,53	0,34	0,73	100,00	4
147	L 3	4 S 4	0,10	4 M 4	0,40	1 M 4	0,15	5 M 4	0,35	M 3	0,25	L 4	0,40	0,00	2	3	4	0,41	1,55	0,45	0,62	100,00	4
148	L 4	4 S 4	0,10	1 M 4	0,10	5 F 4	0,70	5 M 4	0,10	L 5	0,25	0	0,00	0,05	2	4	4	0,37	1,69	0,47	0,55	100,00	3
149	L 5	5 F 4	0,70	5 F 2	0,30	0 0	0,00	0 0	0,00	L 6	0,10	0	0,00	0,10	2	4	4	0,35	1,73	0,59	0,52	100,00	3
150	L 6	5 F 2	0,40	5 F 4	0,30	5 M 4	0,30	0 0	0,00	0	0,00	0	0,00	0,30	2	4	4	0,35	1,73	0,59	0,52	100,00	2
151	L 7	5 M 4	0,40	5 S 4	0,25	2 S 4	0,35	0 0	0,00	L 6	0,60	M 7	0,10	0,00	2	4	4	0,40	1,59	0,62	0,51	100,00	2
152	L 8	2 S 4	0,20	2 M 4	0,40	5 S 4	0,40	0 0	0,00	M 8	0,50	0	0,00	0,20	2	4	4	0,44	1,48	0,62	0,51	100,00	2
153	L 9	5 S 4	0,35	3 M 4	0,65	0 0	0,00	0 0	0,00	L10	0,30	M 9	0,30	0,10	2	4	3	0,38	1,64	0,63	0,45	100,00	1
154	L10	3 M 4	0,80	3 F 4	0,20	0 0	0,00	0 0	0,00	L11	0,15	M10	0,15	0,10	2	4	3	0,40	1,59	0,65	0,41	100,00	1
155	L11	3 F 4	0,60	3 F 6	0,40	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,40	1,59	0,65	0,41	100,00	1
156	L12	3 F 6	0,25	5 F 6	0,35	5 M 6	0,40	0 0	0,00	0	0,00	0	0,00	0,65	3	5	3	0,36	1,70	0,59	0,50	100,00	2
157	L13	5 M 6	0,75	2 S 6	0,25	0 0	0,00	0 0	0,00	K13	0,10	L12	0,35	0,20	3	4	3	0,39	1,63	0,62	0,51	100,00	1
158	L14	2 S 6	0,50	2 S 4	0,50	0 0	0,00	0 0	0,00	L13	0,60	0	0,00	0,20	3	4	3	0,50	1,32	0,67	0,49	100,00	2
159	L15	2 S 6	0,75	5 M 6	0,25	0 0	0,00	0 0	0,00	M15	0,80	0	0,00	0,00	3	4	3	0,48	1,39	0,65	0,50	100,00	3
160	L16	5 M 6	0,80	2 S 6	0,20	0 0	0,00	0 0	0,00	L15	0,50	0	0,00	0,00	3	4	3	0,42	1,54	0,65	0,50	100,00	4
161	M 1	4 S 4	0,20	4 S 4	0,40	4 M 4	0,40	0 0	0,00	L 1	0,65	0	0,00	0,00	2	3	4	0,36	1,69	0,18	0,73	100,00	5
162	M 2	4 S 4	0,10	4 S 4	0,80	4 M 4	0,10	0 0	0,00	L 2	0,75	0	0,00	0,00	2	3	4	0,35	1,72	0,16	0,73	100,00	5
163	M 3	4 M 4	0,35	4 S 4	0,50	4 M 4	0,15	0 0	0,00	M 4	0,60	0	0,00	0,00	2	4	4	0,41	1,56	0,31	0,73	100,00	4
164	M 4	4 S 4	0,35	1 M 4	0,25	5 M 4	0,40	0 0	0,00	M 5	0,60	0	0,00	0,00	2	4	4	0,43	1,51	0,46	0,61	100,00	3
165	M 5	1 M 4	0,20	5 F 4	0,80	0 0	0,00	0 0	0,00	M 6	0,20	0	0,00	0,05	2	4	4	0,38	1,64	0,59	0,50	100,00	2
166	M 6	5 F 4	0,40	5 F 2	0,60	0 0	0,00	0 0	0,00	M 7	0,15	0	0,00	0,05	2	4	4	0,35	1,73	0,59	0,52	100,00	2
167	M 7	5 F 2	0,25	5 F 4	0,35	5 S 4	0,15	5 M 4	0,25	0	0,00	0	0,00	0,30	2	4	4	0,35	1,73	0,59	0,52	100,00	2
168	M 8	5 S 4	0,50	5 M 4	0,50	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,80	2	4	4	0,35	1,73	0,59	0,52	100,00	1
169	M 9	5 S 4	0,40	5 M 4	0,40	3 M 4	0,20	0 0	0,00	N 9	0,20	M10	0,30	0,10	2	4	4	0,47	1,70	0,61	0,50	100,00	1
170	M10	3 M 4	0,20	5 F 4	0,15	3 F 4	0,40	3 F 6	0,25	N10	0,25	0	0,00	0,00	2	5	3	0,37	1,61	0,56	0,46	100,00	2
171	M11	3 F 4	0,15	3 F 6	0,40	5 F 6	0,30	5 M 6	0,15	0	0,00	0	0,00	0,35	2	5	3	0,42	1,65	0,64	0,46	100,00	2

172	M12	5	M	6	1,00	0		0	0,00	0		0	0,00	0		0	0,00	N12	0,25	M11	0,10	0,15	3	4	3	0,50	1,73	0,59	0,52	100,00	1
173	M13	5	M	6	1,00	0		0	0,00	0		0	0,00	0		0	0,00	N13	0,25	M12	0,15	0,10	3	4	3	0,50	1,73	0,59	0,52	100,00	2
174	M14	5	M	6	0,30	5	S	6	0,40	2	S	6	0,30	0		0	0,00	M13	0,75	0	0,00	0,00	3	4	3	0,50	1,61	0,59	0,52	100,00	2
175	M15	5	S	6	0,10	2	S	6	0,90	0		0	0,00	0		0	0,00	M14	0,80	0	0,00	0,00	3	4	3	0,50	1,36	0,67	0,49	100,00	3
176	M16	2	S	6	0,35	2	M	6	0,25	2	F	4	0,40	0		0	0,00	N16	0,40	0	0,00	0,00	3	4	5	0,50	1,43	0,65	0,50	100,00	4
177	N 1	4	S	4	0,30	4	M	4	0,70	0		0	0,00	0		0	0,00	O 1	0,55	0	0,00	0,00	2	3	3	0,25	1,75	0,13	0,73	100,00	4
178	N 2	4	M	4	0,70	4	S	4	0,30	0		0	0,00	0		0	0,00	O 2	0,35	N 3	0,30	0,00	2	3	3	0,25	1,75	0,13	0,73	100,00	4
179	N 3	4	S	4	0,35	4	M	4	0,30	4	M	4	0,35	0		0	0,00	O 3	0,65	0	0,00	0,00	2	4	3	0,45	1,65	0,23	0,73	100,00	4
180	N 4	4	M	4	0,70	4	S	4	0,30	0		0	0,00	0		0	0,00	O 4	0,30	N 5	0,30	0,00	2	4	3	0,82	1,45	0,41	0,73	100,00	4
181	N 5	4	S	4	0,70	1	M	4	0,20	5	F	4	0,10	0		0	0,00	O 5	0,55	N 6	0,15	0,00	2	4	3	0,68	1,44	0,42	0,68	100,00	3
182	N 6	4	S	4	0,10	1	M	4	0,15	5	F	4	0,75	0		0	0,00	N 7	0,35	0	0,00	0,00	2	4	4	0,50	1,63	0,53	0,55	100,00	2
183	N 7	5	F	4	0,80	5	F	2	0,20	0		0	0,00	0		0	0,00	N 8	0,15	0	0,00	0,05	2	4	4	0,50	1,73	0,59	0,52	100,00	2
184	N 8	5	F	4	0,50	5	S	4	0,50	0		0	0,00	0		0	0,00	0	0,00	0	0,00	0,65	2	4	4	0,50	1,73	0,59	0,52	100,00	1
185	N 9	5	S	4	0,40	5	M	4	0,60	0		0	0,00	0		0	0,00	N 8	0,15	O 9	0,30	0,20	2	4	3	0,50	1,73	0,59	0,52	100,00	1
186	N10	5	M	4	0,25	5	F	4	0,25	3	F	6	0,25	5	F	6	0,25	0	0,00	0	0,00	0,35	2	4	3	0,46	1,70	0,57	0,51	100,00	1
187	N11	3	F	6	0,15	5	F	6	0,85	0		0	0,00	0		0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,48	1,71	0,59	0,51	100,00	1
188	N12	5	F	6	0,60	5	M	6	0,40	0		0	0,00	0		0	0,00	N11	0,10	0	0,00	0,20	3	4	3	0,50	1,73	0,59	0,52	100,00	2
189	N13	5	F	6	0,60	5	S	6	0,20	5	M	6	0,20	0		0	0,00	N12	0,10	O13	0,15	0,05	3	4	3	0,50	1,73	0,59	0,52	100,00	2
190	N14	5	S	6	0,80	5	S	4	0,15	5	F	4	0,05	0		0	0,00	N13	0,80	0	0,00	0,00	3	4	5	0,50	1,70	0,59	0,52	100,00	3
191	N15	5	S	6	0,20	2	S	6	0,15	5	F	4	0,65	0		0	0,00	N14	0,15	O15	0,20	0,00	3	[illegible]	5	0,50	1,58	0,59	0,52	100,00	3
192	N16	5	F	4	1,00	0		0	0,00	0		0	0,00	0		0	0,00	N15	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	3
193	O 1	4	M	4	0,90	4	M	4	0,10	0		0	0,00	0		0	0,00	P 1	0,50	0	0,00	0,00	2	3	3	0,31	1,72	0,16	0,73	100,00	4
194	O 2	4	M	4	1,00	0		0	0,00	0		0	0,00	0		0	0,00	P 2	0,25	O 3	0,25	0,00	2	3	3	0,25	1,75	0,13	0,73	100,00	4
195	O 3	4	M	4	0,35	4	S	4	0,40	4	M	4	0,25	0		0	0,00	O 4	0,60	0	0,00	0,00	2	4	3	0,39	1,68	0,20	0,73	100,00	3
196	O 4	4	M	4	0,55	4	S	4	0,30	4	S	8	0,15	0		0	0,00	P 4	0,60	0	0,00	0,00	2	4	3	0,82	1,45	0,41	0,73	100,00	3
197	O 5	4	S	4	0,85	4	M	4	0,15	0		0	0,00	0		0	0,00	P 6	0,80	0	0,00	0,00	2	4	3	0,82	1,44	0,41	0,73	100,00	3
198	O 6	4	S	4	0,50	1	M	4	0,25	5	F	4	0,15	4	M	4	0,10	P 6	0,35	O 7	0,25	0,00	2	4	3	0,64	1,63	0,36	0,70	100,00	3
199	O 7	4	M	4	0,10	1	M	4	0,15	5	F	4	0,75	0		0	0,00	O 8	0,25	0	0,00	0,00	2	4	4	0,50	1,73	0,53	0,55	100,00	2
200	O 8	5	F	4	0,90	5	S	4	0,10	0		0	0,00	0		0	0,00	O 9	0,05	0	0,00	0,15	2	4	4	0,50	1,73	0,59	0,52	100,00	1
201	O 9	5	F	6	0,40	5	M	6	0,40	5	S	6	0,20	0		0	0,00	0	0,00	0	0,00	0,50	2	4	3	0,50	1,73	0,59	0,52	100,00	1
202	O10	5	M	6	0,65	5	F	6	0,25	5	S	6	0,10	0		0	0,00	0	0,00	0	0,00	0,50	2	4	3	0,50	1,73	0,59	0,52	100,00	1

203	O11	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	P11	0,15	0	0,00	0,05	2	4	5	0,50	1,73	0,59	0,52	100,00	1
204	O12	5 F 6	0,85	5 S 6	0,15	0 0	0,00	0 0	0,00	N12	0,15	P12	0,05	0,05	3	4	5	0,50	1,73	0,59	0,52	100,00	2
205	O13	5 F 6	0,20	5 S 6	0,60	5 S 4	0,20	0 0	0,00	O12	0,40	0	0,00	0,40	3	4	5	0,50	1,73	0,59	0,52	100,00	2
206	O14	5 S 6	0,20	5 F 4	0,50	5 F 6	0,15	5 S 4	0,15	P14	0,30	0	0,00	0,00	3	4	5	0,50	1,64	0,59	0,52	100,00	2
207	O15	5 F 4	0,50	5 F 6	0,25	5 M 6	0,25	0 0	0,00	0	0,00	0	0,00	0,60	3	4	5	0,50	1,59	0,59	0,52	100,00	2
208	O16	5 F 4	0,25	5 M 6	0,40	5 F 6	0,35	0 0	0,00	O15	0,55	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	2
209	P 1	4 M 4	0,80	4 M 4	0,20	0 0	0,00	0 0	0,00	Q 1	0,50	0	0,00	0,00	2	3	3	0,71	1,51	0,36	0,73	100,00	3
210	P 2	4 S 4	0,30	4 M 4	0,30	4 M 8	0,20	4 F 8	0,20	Q 2	0,30	P 3	0,35	0,00	2	4	3	0,48	1,63	0,24	0,73	100,00	3
211	P 3	4 S 4	0,25	4 M 4	0,25	4 F 8	0,30	4 M 4	0,20	Q 3	0,40	0	0,00	0,00	2	4	3	0,54	1,60	0,27	0,73	100,00	3
212	P 4	4 M 4	0,50	4 S 8	0,35	1 S 8	0,15	0 0	0,00	P 5	0,60	0	0,00	0,00	2	4	3	0,74	1,42	0,40	0,71	100,00	2
213	P 5	4 S 8	0,40	1 S 8	0,30	3 S 8	0,15	4 S 4	0,15	Q 5	0,80	0	0,00	0,00	2	4	3	0,61	1,37	0,52	0,60	100,00	2
214	P 6	4 S 4	0,10	4 S 8	0,15	1 S 8	0,60	3 S 8	0,15	Q 6	0,80	0	0,00	0,00	2	4	3	0,45	1,32	0,51	0,53	100,00	2
215	P 7	5 F 4	0,20	1 S 8	0,40	4 M 8	0,30	3 S 8	0,10	Q 7	0,55	O 7	0,20	0,00	2	4	3	0,51	1,42	0,61	0,52	100,00	3
216	P 8	4 M 8	0,15	1 M 4	0,25	5 F 4	0,60	0 0	0,00	P 9	0,25	0	0,00	0,10	2	4	3	0,50	1,57	0,57	0,53	100,00	2
217	P 9	5 F 6	0,65	5 S 6	0,35	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,40	2	4	3	0,50	1,73	0,59	0,52	100,00	1
218	P10	5 S 6	0,30	5 F 6	0,70	0 0	0,00	0 0	0,00	Q10	0,30	P 9	0,10	0,00	2	4	3	0,50	1,73	0,59	0,52	100,00	1
219	P11	5 F 6	0,40	5 S 6	0,40	5 S 6	0,20	0 0	0,00	0	0,00	0	0,00	0,75	3	4	5	0,52	1,67	0,62	0,52	100,00	1
220	P12	5 S 6	0,60	5 S 6	0,25	5 S 4	0,15	0 0	0,00	0	0,00	0	0,00	0,80	3	4	5	0,52	1,66	0,62	0,52	100,00	1
221	P13	5 S 4	0,30	5 S 6	0,25	5 F 6	0,45	0 0	0,00	0	0,00	0	0,00	0,60	3	4	5	0,52	1,59	0,62	0,52	100,00	1
222	P14	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	3	4	5	0,50	1,59	0,59	0,52	100,00	1
223	P15	5 F 6	0,85	5 M 6	0,15	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	3	4	5	0,50	1,59	0,59	0,52	100,00	1
224	P16	5 F 6	0,45	5 M 6	0,55	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,35	3	4	5	0,50	1,59	0,59	0,52	100,00	2
225	Q 1	4 M 4	0,30	4 M 8	0,20	5 F 8	0,50	0 0	0,00	0	0,00	0	0,00	0,00	2	3	3	0,66	1,59	0,50	0,63	100,00	3
226	Q 2	5 F 8	0,20	4 M 8	0,50	4 F 8	0,30	0 0	0,00	0	0,00	0	0,00	0,00	2	4	3	0,76	1,51	0,51	0,66	100,00	3
227	Q 3	4 F 8	0,55	4 M 8	0,35	1 M 8	0,10	0 0	0,00	0	0,00	0	0,00	0,10	2	4	3	0,77	1,43	0,44	0,70	100,00	2
228	Q 4	4 S 8	0,40	1 S 6	0,35	3 F 6	0,25	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,56	1,35	0,61	0,54	100,00	2
229	Q 5	4 S 6	0,15	1 S 8	0,35	3 S 6	0,40	8 0	0,10	0	0,00	0	0,00	0,80	2	4	3	0,47	1,32	0,69	0,47	100,00	1
230	Q 6	3 S 6	0,50	1 S 8	0,35	8 0	0,15	0 0	0,00	0	0,00	0	0,00	0,80	2	4	3	0,41	1,30	0,73	0,42	100,00	1
231	Q 7	3 S 8	0,45	1 S 8	0,30	4 M 8	0,25	0 0	0,00	Q 6	0,40	0	0,00	0,40	2	4	3	0,51	1,33	0,84	0,44	100,00	2
232	Q 8	3 S 6	0,10	1 S 6	0,10	4 M 8	0,25	5 S 6	0,55	0	0,00	0	0,00	0,65	2	4	3	0,56	1,57	0,61	0,54	100,00	2
233	Q 9	5 F 6	0,30	5 S 6	0,70	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,80	2	4	5	0,35	1,73	0,59	0,52	100,00	1

234	Q10	5 S 6	0,80	5 F 6	0,20	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,80	2	4	5	0,50	1,73	0,59	0,52	100,00	1
235	Q11	5 S 6	0,60	5 M 4	0,25	5 S 6	0,15	0 0	0,00	0	0,00	0	0,00	0,80	3	4	5	0,51	1,69	0,61	0,52	100,00	1
236	Q12	5 S 6	0,75	5 S 4	0,20	5 M 4	0,05	0 0	0,00	0	0,00	0	0,00	0,80	3	4	5	0,60	1,45	0,71	0,52	100,00	1
237	Q13	5 S 6	0,20	5 F 6	0,70	5 S 4	0,10	0 0	0,00	P13	0,10	Q12	0,10	0,20	3	4	5	0,53	1,54	0,63	0,52	100,00	1
238	Q14	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	P14	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
239	Q15	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	P15	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
240	Q16	5 F 6	0,95	5 M 6	0,05	0 0	0,00	0 0	0,00	P16	0,20	0	0,00	0,00	3	5	5	0,50	1,59	0,59	0,52	100,00	2
241	R 1	5 F 8	1,00	0 0	0,00	0 0	0,00	0 0	0,00	R 2	0,20	0	0,00	0,00	4	3	3	0,50	1,73	0,59	0,52	100,00	3
242	R 2	5 F 8	0,65	1 F 8	0,15	4 M 8	0,20	0 0	0,00	R 3	0,30	0	0,00	0,00	2	4	3	0,53	1,60	0,54	0,56	100,00	3
243	R 3	3 M 6	0,35	1 M 8	0,25	4 M 8	0,20	4 F 8	0,20	S 3	0,10	R 4	0,10	0,60	2	4	3	0,54	1,28	0,62	0,53	100,00	2
244	R 4	3 F 6	0,75	1 M 6	0,15	8 0	0,10	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,46	1,31	0,82	0,42	100,00	1
245	R 5	3 F 6	0,60	1 F 6	0,15	4 F 6	0,05	8 0	0,20	0	0,00	0	0,00	0,20	2	4	3	0,48	1,31	0,86	0,42	100,00	1
246	R 6	3 S 6	0,30	5 S 6	0,20	8 0	0,50	0 0	0,00	0	0,00	0	0,00	0,80	2	4	3	0,50	1,48	0,79	0,45	100,00	1
247	R 7	3 S 6	0,30	5 S 6	0,40	8 0	0,30	0 0	0,00	0	0,00	0	0,00	0,80	2	4	3	0,50	1,55	0,73	0,47	100,00	1
248	R 8	3 S 6	0,05	5 S 6	0,85	8 0	0,10	0 0	0,00	0	0,00	0	0,00	0,80	2	4	3	0,50	1,71	0,62	0,51	100,00	1
249	R 9	5 S 6	0,45	5 S 4	0,55	0 0	0,00	0 0	0,00	Q 9	0,70	0	0,00	0,10	2	4	5	0,50	1,73	0,59	0,52	100,00	2
250	R10	5 S 4	0,55	5 M 4	0,45	0 0	0,00	0 0	0,00	Q10	0,15	R11	0,30	0,10	2	4	5	0,50	1,73	0,59	0,52	100,00	2
251	R11	5 M 4	0,55	5 M 6	0,20	5 S 4	0,25	0 0	0,00	Q11	0,50	0	0,00	0,20	3	4	5	0,50	1,73	0,59	0,52	100,00	1
252	R12	5 M 4	0,20	2 S 6	0,65	5 S 4	0,05	5 M 6	0,10	Q12	0,60	0	0,00	0,10	3	4	5	0,58	1,49	0,75	0,50	100,00	1
253	R13	5 F 4	0,05	5 F 4	0,35	5 F 6	0,60	0 0	0,00	Q13	0,15	0	0,00	0,05	3	4	5	0,50	1,58	0,59	0,52	100,00	1
254	R14	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	Q14	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
255	R15	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	Q15	0,20	0	0,00	0,00	3	5	5	0,50	1,59	0,59	0,52	100,00	1
256	R16	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	R15	0,20	0	0,00	0,00	3	5	5	0,50	1,59	0,59	0,52	95,00	2
257	S 1	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	4	3	3	0,50	1,73	0,59	0,52	100,00	3
258	S 2	5 F 6	0,40	5 F 4	0,60	0 0	0,00	0 0	0,00	S 3	0,04	0	0,00	0,00	2	3	3	0,50	1,73	0,59	0,52	100,00	2
259	S 3	5 F 4	0,40	5 F 6	0,20	3 M 6	0,15	8 0	0,25	0	0,00	0	0,00	0,20	2	4	3	0,50	1,65	0,65	0,50	100,00	2
260	S 4	3 F 6	0,25	5 F 6	0,10	8 0	0,65	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,50	1,44	0,73	0,47	100,00	1
261	S 5	3 F 6	0,25	5 S 6	0,40	8 0	0,35	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,50	1,57	0,65	0,50	100,00	1
262	S 6	5 S 6	0,65	8 0	0,35	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,80	2	4	3	0,50	1,73	0,59	0,52	100,00	1
263	S 7	5 S 6	0,80	5 S 4	0,15	8 0	0,05	0 0	0,00	R 7	0,40	0	0,00	0,40	2	4	3	0,50	1,73	0,59	0,52	100,00	1
264	S 8	5 S 6	0,35	5 S 4	0,65	0 0	0,00	0 0	0,00	S 7	0,40	S 9	0,40	0,00	2	4	3	0,50	1,73	0,59	0,52	100,00	1

265	S 9	5 S 4	0,75	5 M 4	0,25	0 0	0,00	0 0	0,00	S10	0,65	0	0,00	0,00	2	4	5	0,50	1,73	0,59	0,52	100,00	4
266	S10	5 S 4	0,15	5 M 4	0,40	5 M 6	0,45	0 0	0,00	R10	0,50	0	0,00	0,00	3	4	5	0,50	1,73	0,59	0,52	100,00	4
267	S11	5 S 6	0,35	5 M 6	0,40	5 M 4	0,25	0 0	0,00	R11	0,45	0	0,00	0,15	3	4	5	0,50	1,73	0,59	0,52	100,00	2
268	S12	5 M 6	0,60	5 S 6	0,20	5 M 6	0,20	0 0	0,00	R12	0,45	0	0,00	0,00	3	4	5	0,58	1,49	0,69	0,52	100,00	1
269	S13	5 M 6	0,25	5 M 6	0,60	5 F 4	0,15	0 0	0,00	R13	0,45	0	0,00	0,00	3	4	5	0,52	1,55	0,62	0,52	100,00	1
270	S14	5 F 6	0,90	5 M 6	0,10	0 0	0,00	0 0	0,00	R14	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
271	S15	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	S14	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
272	S16	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	S15	0,15	0	0,00	0,00	3	5	5	0,50	1,59	0,59	0,52	75,00	2
273	T 1	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	4	3	3	0,50	1,73	0,59	0,52	100,00	3
274	T 2	5 F 6	0,90	5 F 4	0,10	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	4	4	3	0,50	1,73	0,59	0,52	100,00	2
275	T 3	5 F 6	0,35	5 F 4	0,65	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,00	2	4	3	0,50	1,73	0,59	0,52	100,00	2
276	T 4	5 F 6	0,90	8 0	0,10	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,50	1,73	0,59	0,52	100,00	1
277	T 5	5 F 6	0,80	5 S 6	0,20	0 0	0,00	0 0	0,00	0	0,00	0	0,00	0,20	2	4	3	0,50	1,73	0,59	0,52	100,00	1
278	T 6	5 S 4	0,40	5 S 6	0,60	0 0	0,00	0 0	0,00	S 6	0,80	0	0,00	0,00	2	4	3	0,50	1,73	0,59	0,52	100,00	1
279	T 7	5 S 4	0,90	5 S 6	0,10	0 0	0,00	0 0	0,00	S 7	0,40	T 6	0,40	0,00	2	4	3	0,50	1,73	0,59	0,52	100,00	1
280	T 8	5 S 4	1,00	0 0	0,00	0 0	0,00	0 0	0,00	T 7	0,80	0	0,00	0,00	2	4	3	0,50	1,73	0,59	0,52	100,00	1
281	T 9	5 S 4	0,50	5 M 6	0,35	5 S 6	0,15	0 0	0,00	S 9	0,60	0	0,00	0,00	2	4	5	0,50	1,73	0,59	0,52	100,00	3
282	T10	5 M 6	0,90	5 S 4	0,10	0 0	0,00	0 0	0,00	S10	0,50	0	0,00	0,00	3	4	5	0,50	1,73	0,59	0,52	100,00	3
283	T11	5 M 6	0,90	5 S 6	0,10	0 0	0,00	0 0	0,00	S11	0,50	0	0,00	0,00	3	4	5	0,50	1,73	0,59	0,52	100,00	2
284	T12	5 M 6	0,85	5 M 6	0,15	0 0	0,00	0 0	0,00	S12	0,50	0	0,00	0,00	3	4	5	0,59	1,48	0,70	0,52	100,00	1
285	T13	5 M 6	0,45	5 M 6	0,55	0 0	0,00	0 0	0,00	T12	0,50	0	0,00	0,00	3	4	5	0,54	1,52	0,64	0,52	100,00	1
286	T14	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	S14	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
287	T15	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	S15	0,20	0	0,00	0,00	3	4	5	0,50	1,59	0,59	0,52	100,00	1
288	T16	5 F 6	1,00	0 0	0,00	0 0	0,00	0 0	0,00	T15	0,10	0	0,00	0,00	3	5	5	0,50	1,59	0,59	0,52	30,00	2

PRINTOUT SEGMENT II

Optional output to display internally generated coefficients. The 15 columns contain the following information:

1. Element number
2. Row identification
3. Column identification
4. One element receiving eroded material from this element
5. Fraction of eroded material transported to the element identified in 4
6. Second element receiving eroded material from this element
7. Fraction of eroded material transported to the element identified in 6
8. Fraction of eroded material transported directly to the sink
9. Lake area in element
10. Soil area in element
11. Number of beta coefficients for the erosion subroutine

12.-15. The values of the beta coefficients.

1	A	1	0	0.00	0	0.00	0.00	0.	.10E+03	1	.19E+00	0.	0.	0.	
2	A	2	0	0.00	0	0.00	0.00	0.	.10E+03	2	.19E+00	.22E+00	0.	0.	
3	A	3	10	0.75	0	0.00	0.05	0.	.10E+03	2	.19E+00	.22E+00	0.	0.	
4	A	4	11	0.80	0	0.00	0.00	0.	.10E+03	2	.22E+00	.11E+00	0.	0.	
5	A	5	12	0.40	0	0.00	0.00	0.	.80E+02	2	.11E+00	.26E+00	0.	0.	
6	A	6	13	0.10	0	0.00	-0.00	0.	.50E+02	1	.11E+00	0.	0.	0.	
7	A	7	14	0.04	0	0.00	0.00	0.	.25E+02	1	.11E+00	0.	0.	0.	
8	B	1	0	0.00	0	0.00	0.00	0.	.10E+03	2	.19E+00	.22E+00	0.	0.	
9	B	2	10	0.30	0	0.00	0.10	0.	.10E+03	2	.19E+00	.14E+00	0.	0.	
10	B	3	0	0.00	0	0.00	0.60	0.	.10E+03	3	.14E+00	.19E+00	.76E-01	0.	
11	B	4	12	0.50	0	0.00	0.00	0.	.10E+03	3	.19E+00	.94E-01	.26E+00	0.	
12	B	5	21	0.20	0	0.00	0.00	0.	.10E+03	2	.26E+00	.23E+00	0.	0.	
13	B	6	14	0.25	22	0.25	0.00	0.	.10E+03	2	.26E+00	.11E+00	0.	0.	
14	B	7	23	0.20	0	0.00	0.00	0.	.10E+03	1	.11E+00	0.	0.	0.	
15	B	8	24	0.15	0	0.00	0.00	0.	.70E+02	2	.11E+00	.61E+00	0.	0.	
16	B	9	25	0.06	0	0.00	0.00	0.	.30E+02	2	.61E+00	.46E+00	0.	0.	
17	C	1	18	0.20	0	0.00	0.00	0.	.10E+03	2	.22E+00	.88E-01	0.	0.	
18	C	2	19	0.20	29	0.10	0.10	0.	.10E+03	4	.14E+00	.88E-01	.19E+00	.16E+00	
19	C	3	0	0.00	0	0.00	0.30	0.	.10E+03	2	.44E-01	.44E-01	0.	0.	
20	C	4	21	0.80	0	0.00	0.00	0.	.10E+03	1	.94E-01	0.	0.	0.	
21	C	5	22	0.35	0	0.00	0.00	0.	.10E+03	3	.28E+00	.76E-01	.88E-01	0.	
22	C	6	33	0.20	0	0.00	0.00	0.	.10E+03	2	.88E-01	.35E-01	0.	0.	
23	C	7	24	0.20	0	0.00	0.00	0.	.10E+03	2	.35E-01	.88E-01	0.	0.	
24	C	8	35	0.20	0	0.00	0.00	0.	.10E+03	3	.20E+00	.35E-01	.61E+00	0.	
25	C	9	36	0.20	0	0.00	0.00	0.	.10E+03	2	.61E+00	.46E+00	0.	0.	
26	C	10	37	0.07	0	0.00	0.07	0.	.70E+02	1	.46E+00	0.	0.	0.	
27	C	11	0	0.00	0	0.00	0.00	0.	.20E+02	1	.42E+00	0.	0.	0.	
28	D	1	29	0.20	0	0.00	0.00	0.	.10E+03	2	.16E+00	.13E+00	0.	0.	
29	D	2	30	0.15	0	0.00	0.05	0.	.10E+03	1	.16E+00	0.	0.	0.	
30	D	3	0	0.00	0	0.00	0.40	0.	.10E+03	4	.16E+00	.53E-01	.94E-01	.33E+00	
31	D	4	43	0.60	0	0.00	0.20	0.	.10E+03	3	.55E+00	.28E+00	.94E-01	0.	
32	D	5	33	0.50	0	0.00	0.30	0.	.10E+03	3	.22E+00	.33E+00	.28E+00	0.	
33	D	6	34	0.40	0	0.00	0.10	0.	.10E+03	2	.33E+00	.26E+00	0.	0.	
34	D	7	46	0.10	0	0.00	0.10	0.	.10E+03	1	.26E+00	0.	0.	0.	
35	D	8	0	0.00	0	0.00	0.20	0.	.10E+03	3	.26E+00	.61E+00	.56E+00	0.	
36	D	9	0	0.00	0	0.00	0.20	0.	.10E+03	2	.61E+00	.56E+00	0.	0.	
37	D	10	0	0.00	0	0.00	0.20	0.	.10E+03	2	.42E+00	.46E+00	0.	0.	
38	D	11	0	0.00	0	0.00	0.20	0.	.10E+03	2	.42E+00	.46E+00	0.	0.	

39	D	12	0	0.00	0	0.00	0.00	0.	.40E+02	1	.46E+00	0.	0.	0.
40	E	1	41	0.20	0	0.00	0.00	0.	.10E+03	2	.13E+00	.16E+00	0.	0.
41	E	2	42	0.15	0	0.00	0.05	0.	.10E+03	1	.16E+00	0.	0.	0.
42	E	3	30	0.10	0	0.00	0.30	0.	.10E+03	4	.16E+00	.80E-01	.13E+00	.44E-01
43	E	4	0	0.00	0	0.00	0.45	0.	.10E+03	2	.80E-01	.22E+00	0.	0.
44	E	5	0	0.00	0	0.00	0.50	0.	.10E+03	2	.40E+00	.22E+00	0.	0.
45	E	6	0	0.00	0	0.00	0.75	0.	.10E+03	2	.40E+00	.33E+00	0.	0.
46	E	7	0	0.00	0	0.00	0.20	0.	.10E+03	2	.26E+00	.56E+00	0.	0.
47	E	8	48	0.20	0	0.00	0.00	0.	.10E+03	2	.56E+00	.26E+00	0.	0.
48	E	9	36	0.10	0	0.00	0.10	0.	.10E+03	2	.56E+00	.61E+00	0.	0.
49	E	10	37	0.10	0	0.00	0.10	0.	.10E+03	3	.56E+00	.46E+00	.42E+00	0.
50	E	11	38	0.10	51	0.10	0.10	0.	.10E+03	1	.46E+00	0.	0.	0.
51	E	12	0	0.00	0	0.00	0.20	0.	.10E+03	2	.46E+00	.31E+00	0.	0.
52	E	13	0	0.00	0	0.00	0.00	0.	.50E+02	1	.76E+00	0.	0.	0.
53	F	1	54	0.20	0	0.00	0.00	0.	.10E+03	1	.13E+00	0.	0.	0.
54	F	2	41	0.20	0	0.00	0.00	0.	.10E+03	2	.13E+00	.16E+00	0.	0.
55	F	3	42	0.35	0	0.00	0.00	0.	.10E+03	3	.13E+00	.16E+00	.80E-01	0.
56	F	4	57	0.25	0	0.00	0.10	0.	.10E+03	2	.88E-01	.80E-01	0.	0.
57	F	5	58	0.50	0	0.00	0.00	0.	.10E+03	4	.40E+00	.24E+00	.80E-01	.88E-01
58	F	6	59	0.60	0	0.00	0.00	0.	.10E+03	3	.40E+00	.24E+00	.33E+00	0.
59	F	7	46	0.30	0	0.00	0.15	0.	.10E+03	2	.33E+00	.56E+00	0.	0.
60	F	8	47	0.45	0	0.00	0.05	0.	.10E+03	4	.56E+00	.10E+01	.48E+00	.11E+01
61	F	9	48	0.35	0	0.00	0.05	0.	.10E+03	4	.61E+00	.11E+01	.15E+01	.56E+00
62	F	10	63	0.25	49	0.20	0.05	0.	.10E+03	3	.61E+00	.46E+00	.58E-01	0.
63	F	11	64	0.10	50	0.05	0.05	0.	.10E+03	1	.46E+00	0.	0.	0.
64	F	12	78	0.15	0	0.00	0.05	0.	.10E+03	2	.46E+00	.31E+00	0.	0.
65	F	13	0	0.00	0	0.00	0.80	0.	.10E+03	2	.76E+00	.31E+00	0.	0.
66	F	14	0	0.00	0	0.00	0.00	0.	.40E+02	1	.76E+00	0.	0.	0.
67	G	1	0	0.00	0	0.00	0.00	0.	.10E+03	2	.13E+00	.76E-01	0.	0.
68	G	2	0	0.00	0	0.00	0.00	0.	.10E+03	3	.13E+00	.88E-01	.76E-01	0.
69	G	3	0	0.00	0	0.00	0.00	0.	.10E+03	4	.13E+00	.24E+00	.88E-01	.76E-01

70	G	4	0	0,00	0	0,00	0,00	0.	.10E+03	3	.88E-01	.76E-01	.69E-01	0.
71	G	5	0	0,00	0	0,00	0,00	0.	.10E+03	4	.88E-01	.76E-01	.69E-01	.21E+00
72	G	6	0	0,00	0	0,00	0,00	0.	.10E+03	3	.21E+00	.24E+00	.28E+00	0.
73	G	7	59	0,40	0	0,00	0,05	0.	.10E+03	2	.33E+00	.26E+00	0.	0.
74	G	8	60	0,45	0	0,00	0,05	0.	.10E+03	2	.48E+00	.26E+00	0.	0.
75	G	9	61	0,25	74	0,30	0,10	0.	.10E+03	2	.48E+00	.58E-01	0.	0.
76	G	10	77	0,75	0	0,00	0,00	0.	.10E+03	1	.58E-01	0.	0.	0.
77	G	11	78	0,20	0	0,00	0,00	0.	.10E+03	1	.46E+00	0.	0.	0.
78	G	12	93	0,05	0	0,00	0,15	0.	.10E+03	2	.46E+00	.31E+00	0.	0.
79	G	13	0	0,00	0	0,00	0,70	0.	.10E+03	3	.31E+00	.76E+00	.13E+01	0.
80	G	14	79	0,25	95	0,25	0,00	0.	.90E+02	2	.13E+01	.93E+00	0.	0.
81	G	15	0	0,00	0	0,00	0,00	0.	.20E+02	1	.93E+00	0.	0.	0.
82	H	1	83	0,20	0	0,00	0,00	0.	.10E+03	1	.76E-01	0.	0.	0.
83	H	2	98	0,35	0	0,00	0,00	0.	.10E+03	2	.76E-01	.69E-01	0.	0.
84	H	3	99	0,25	83	0,20	0,00	0.	.10E+03	2	.76E-01	.69E-01	0.	0.
85	H	4	100	0,50	0	0,00	0,00	0.	.10E+03	1	.69E-01	0.	0.	0.
86	H	5	101	0,50	0	0,00	0,00	0.	.10E+03	2	.69E-01	.21E+00	0.	0.
87	H	6	102	0,70	0	0,00	0,00	0.	.10E+03	3	.28E+00	.35E+00	.35E+00	0.
88	H	7	73	0,25	103	0,25	0,00	0.	.10E+03	3	.40E+00	.33E+00	.48E+00	0.
89	H	8	74	0,25	88	0,25	0,00	0.	.10E+03	1	.48E+00	0.	0.	0.
90	H	9	105	0,60	0	0,00	0,00	0.	.10E+03	1	.48E+00	0.	0.	0.
91	H	10	92	0,75	0	0,00	0,00	0.	.10E+03	2	.58E-01	.53E-01	0.	0.
92	H	11	93	0,20	0	0,00	0,00	0.	.10E+03	2	.53E-01	.20E+00	0.	0.
93	H	12	94	0,20	108	0,20	0,20	0.	.10E+03	3	.20E+00	.13E+00	.33E+00	0.
94	H	13	0	0,00	0	0,00	0,80	0.	.10E+03	3	.33E+00	.76E+00	.11E+01	0.
95	H	14	96	0,10	110	0,20	0,20	0.	.10E+03	2	.93E+00	.40E+00	0.	0.
96	H	15	0	0,00	0	0,00	0,25	0.	.60E+02	2	.93E+00	.48E+00	0.	0.
97	I	1	113	0,60	0	0,00	0,00	0.	.10E+03	3	.69E-01	.14E+00	.38E+00	0.
98	I	2	114	0,55	0	0,00	0,00	0.	.10E+03	3	.69E-01	.28E+00	.21E+00	0.
99	I	3	100	0,65	0	0,00	0,00	0.	.10E+03	3	.94E-01	.69E-01	.28E+00	0.
100	I	4	116	0,50	0	0,00	0,00	0.	.10E+03	2	.69E-01	.21E+00	0.	0.

101	I	5	117	0,60	0	0,00	0,00	0.	.10E+03	2	.21E+00	.24E+00	0.	0.
102	I	6	118	0,60	0	0,00	0,00	0.	.10E+03	3	.33E+00	.47E+00	.40E+00	0.
103	I	7	102	0,50	0	0,00	0,00	0.	.10E+03	2	.40E+00	.33E+00	0.	0.
104	I	8	120	0,30	105	0,25	0,00	0.	.10E+03	2	.33E+00	.48E+00	0.	0.
105	I	9	121	0,50	0	0,00	0,00	0.	.10E+03	1	.48E+00	0.	0.	0.
106	I	10	122	0,65	0	0,00	0,00	0.	.10E+03	3	.48E+00	.58E-01	.53E-01	0.
107	I	11	123	0,70	0	0,00	0,00	0.	.10E+03	3	.58E-01	.53E-01	.36E+00	0.
108	I	12	124	0,35	0	0,00	0,00	0.	.10E+03	3	.36E+00	.33E+00	.24E+00	0.
109	I	13	0	0,00	0	0,00	0,80	0.	.10E+03	3	.33E+00	.65E+00	.48E+00	0.
110	I	14	0	0,00	0	0,00	0,50	0.	.10E+03	2	.40E+00	.48E+00	0.	0.
111	I	15	0	0,00	0	0,00	0,50	0.	.90E+02	1	.48E+00	0.	0.	0.
112	I	16	0	0,00	0	0,00	0,00	0.	.15E+02	1	.48E+00	0.	0.	0.
113	J	1	114	0,80	0	0,00	0,00	0.	.10E+03	2	.38E+00	.44E+00	0.	0.
114	J	2	115	0,30	0	0,00	0,30	0.	.10E+03	4	.28E+00	.44E+00	.32E+00	.24E+00
115	J	3	0	0,00	0	0,00	0,80	0.	.10E+03	4	.24E+00	.33E+00	.28E+00	.21E+00
116	J	4	0	0,00	0	0,00	0,55	0.	.10E+03	2	.24E+00	.33E+00	0.	0.
117	J	5	133	0,25	0	0,00	0,25	0.	.10E+03	1	.24E+00	0.	0.	0.
118	J	6	134	0,40	0	0,00	0,30	0.	.10E+03	3	.24E+00	.55E+00	.40E+00	0.
119	J	7	118	0,50	0	0,00	0,00	0.	.10E+03	1	.40E+00	0.	0.	0.
120	J	8	136	0,70	0	0,00	0,00	0.	.10E+03	4	.40E+00	.33E+00	.36E+00	.48E+00
121	J	9	137	0,50	0	0,00	0,00	0.	.10E+03	2	.36E+00	.48E+00	0.	0.
122	J	10	138	0,50	0	0,00	0,00	0.	.10E+03	2	.48E+00	.36E+00	0.	0.
123	J	11	139	0,55	0	0,00	0,00	0.	.10E+03	2	.36E+00	.96E-01	0.	0.
124	J	12	140	0,30	125	0,30	0,20	0.	.10E+03	4	.36E+00	.49E+00	.65E+00	.33E+00
125	J	13	0	0,00	0	0,00	0,65	0.	.10E+03	4	.65E+00	.11E+01	.48E+00	.33E+00
126	J	14	125	0,00	0	0,00	0,65	0.	.10E+03	3	.48E+00	.65E+00	.11E+01	0.
127	J	15	96	0,25	143	0,25	0,00	0.	.10E+03	1	.48E+00	0.	0.	0.
128	J	16	127	0,25	0	0,00	0,00	0.	.50E+02	1	.48E+00	0.	0.	0.
129	K	1	113	0,80	0	0,00	0,00	0.	.10E+03	2	.38E+00	.44E+00	0.	0.
130	K	2	131	0,70	0	0,00	0,00	0.	.10E+03	3	.44E+00	.32E+00	.18E+00	0.
131	K	3	132	0,30	0	0,00	0,00	0.	.10E+03	3	.44E+00	.65E+00	.13E+00	0.

132	K	4	148	0,20	0	0,00	0,00	0,	,10E+03	2	,13E+00	,24E+00	0,	0,
133	K	5	0	0,00	0	0,00	0,35	0,	,10E+03	2	,13E+00	,24E+00	0,	0,
134	K	6	0	0,00	0	0,00	0,55	0,	,10E+03	2	,24E+00	,13E+00	0,	0,
135	K	7	134	0,20	151	0,25	0,20	0,	,10E+03	2	,33E+00	,40E+00	0,	0,
136	K	8	152	0,30	137	0,35	0,00	0,	,10E+03	2	,40E+00	,33E+00	0,	0,
137	K	9	153	0,50	0	0,00	0,00	0,	,10E+03	2	,36E+00	,33E+00	0,	0,
138	K	10	154	0,50	0	0,00	0,00	0,	,10E+03	2	,36E+00	,48E+00	0,	0,
139	K	11	155	0,50	0	0,00	0,00	0,	,10E+03	3	,36E+00	,20E+00	,49E+00	0,
140	K	12	156	0,20	0	0,00	0,30	0,	,10E+03	4	,49E+00	,20E+00	,65E+00	,98E+00
141	K	13	0	0,00	0	0,00	0,80	0,	,10E+03	2	,65E+00	,11E+01	0,	0,
142	K	14	116	0,50	158	0,30	0,00	0,	,10E+03	2	,11E+01	,65E+00	0,	0,
143	K	15	132	0,50	0	0,00	0,00	0,	,10E+03	2	,48E+00	,65E+00	0,	0,
144	K	16	133	0,40	0	0,00	0,00	0,	,85E+02	1	,48E+00	0,	0,	0,
145	L	1	129	0,80	0	0,00	0,00	0,	,10E+03	1	,44E+00	0,	0,	0,
146	L	2	130	0,65	0	0,00	0,00	0,	,10E+03	4	,44E+00	,32E+00	,44E+00	,32E+00
147	L	3	163	0,25	148	0,40	0,00	0,	,10E+03	4	,44E+00	,32E+00	,48E+00	,24E+00
148	L	4	149	0,25	0	0,00	0,05	0,	,10E+03	4	,44E+00	,48E+00	,13E+00	,24E+00
149	L	5	150	0,10	0	0,00	0,10	0,	,10E+03	2	,13E+00	,53E-01	0,	0,
150	L	6	0	0,00	0	0,00	0,30	0,	,10E+03	3	,53E-01	,13E+00	,24E+00	0,
151	L	7	150	0,60	167	0,10	0,00	0,	,10E+03	3	,24E+00	,33E+00	,55E+00	0,
152	L	8	168	0,50	0	0,00	0,20	0,	,10E+03	3	,55E+00	,40E+00	,33E+00	0,
153	L	9	154	0,30	169	0,30	0,10	0,	,10E+03	2	,33E+00	,36E+00	0,	0,
154	L	10	155	0,15	170	0,15	0,10	0,	,10E+03	2	,36E+00	,20E+00	0,	0,
155	L	11	0	0,00	0	0,00	0,20	0,	,10E+03	2	,20E+00	,39E+00	0,	0,
156	L	12	0	0,00	0	0,00	0,65	0,	,10E+03	3	,39E+00	,26E+00	,48E+00	0,
157	L	13	141	0,10	156	0,35	0,20	0,	,10E+03	2	,48E+00	,11E+01	0,	0,
158	L	14	157	0,60	0	0,00	0,20	0,	,10E+03	2	,11E+01	,55E+00	0,	0,
159	L	15	175	0,80	0	0,00	0,00	0,	,10E+03	2	,11E+01	,48E+00	0,	0,
160	L	16	159	0,50	0	0,00	0,00	0,	,10E+03	2	,48E+00	,11E+01	0,	0,
161	M	1	145	0,65	0	0,00	0,00	0,	,10E+03	3	,44E+00	,44E+00	,32E+00	0,
162	M	2	146	0,75	0	0,00	0,00	0,	,10E+03	3	,44E+00	,44E+00	,32E+00	0,

163	M	3	164	0,60	0	0,00	0,00	0,	,10E+03	3	,32E+00	,44E+00	,32E+00	0,
164	M	4	165	0,60	0	0,00	0,00	0,	,10E+03	3	,44E+00	,48E+00	,24E+00	0,
165	M	5	166	0,20	0	0,00	0,05	0,	,10E+03	2	,48E+00	,13E+00	0,	0,
166	M	6	167	0,15	0	0,00	0,05	0,	,10E+03	2	,13E+00	,53E-01	0,	0,
167	M	7	0	0,00	0	0,00	0,30	0,	,10E+03	4	,53E-01	,13E+00	,33E+00	,24E+00
168	M	8	0	0,00	0	0,00	0,80	0,	,10E+03	2	,33E+00	,24E+00	0,	0,
169	M	9	185	0,20	170	0,30	0,10	0,	,10E+03	3	,33E+00	,24E+00	,36E+00	0,
170	M	10	186	0,25	0	0,00	0,00	0,	,10E+03	4	,36E+00	,13E+00	,20E+00	,39E+00
171	M	11	0	0,00	0	0,00	0,35	0,	,10E+03	4	,20E+00	,39E+00	,26E+00	,48E+00
172	M	12	188	0,25	171	0,10	0,15	0,	,10E+03	1	,48E+00	0,	0,	0,
173	M	13	189	0,25	172	0,15	0,10	0,	,10E+03	1	,48E+00	0,	0,	0,
174	M	14	173	0,75	0	0,00	0,00	0,	,10E+03	3	,48E+00	,65E+00	,11E+01	0,
175	M	15	174	0,80	0	0,00	0,00	0,	,10E+03	2	,65E+00	,11E+01	0,	0,
176	M	16	192	0,40	0	0,00	0,00	0,	,10E+03	3	,11E+01	,80E+00	,22E+00	0,
177	N	1	193	0,55	0	0,00	0,00	0,	,10E+03	2	,44E+00	,32E+00	0,	0,
178	N	2	194	0,35	179	0,30	0,00	0,	,10E+03	2	,32E+00	,44E+00	0,	0,
179	N	3	195	0,65	0	0,00	0,00	0,	,10E+03	3	,44E+00	,32E+00	,32E+00	0,
180	N	4	196	0,30	181	0,30	0,00	0,	,10E+03	2	,32E+00	,44E+00	0,	0,
181	N	5	197	0,55	182	0,15	0,00	0,	,10E+03	3	,44E+00	,48E+00	,13E+00	0,
182	N	6	183	0,35	0	0,00	0,00	0,	,10E+03	3	,44E+00	,48E+00	,13E+00	0,
183	N	7	184	0,15	0	0,00	0,05	0,	,10E+03	2	,13E+00	,53E-01	0,	0,
184	N	8	0	0,00	0	0,00	0,65	0,	,10E+03	2	,13E+00	,33E+00	0,	0,
185	N	9	184	0,15	201	0,30	0,20	0,	,10E+03	2	,33E+00	,24E+00	0,	0,
186	N	10	0	0,00	0	0,00	0,35	0,	,10E+03	4	,24E+00	,13E+00	,39E+00	,26E+00
187	N	11	0	0,00	0	0,00	0,20	0,	,10E+03	2	,39E+00	,26E+00	0,	0,
188	N	12	187	0,10	0	0,00	0,20	0,	,10E+03	2	,26E+00	,48E+00	0,	0,
189	N	13	188	0,10	205	0,15	0,05	0,	,10E+03	3	,26E+00	,65E+00	,48E+00	0,
190	N	14	189	0,80	0	0,00	0,00	0,	,10E+03	3	,65E+00	,33E+00	,13E+00	0,
191	N	15	190	0,15	207	0,20	0,00	0,	,10E+03	3	,65E+00	,11E+01	,13E+00	0,
192	N	16	191	0,20	0	0,00	0,00	0,	,10E+03	1	,13E+00	0,	0,	0,
193	O	1	209	0,50	0	0,00	0,00	0,	,10E+03	2	,32E+00	,32E+00	0,	0,

194	O	2	210	0,25	195	0,25	0,00	0.	.10E+03	1	.32E+00	0.	0.	0.	
195	O	3	196	0,60	0	0,00	0,00	0.	.10E+03	3	.32E+00	.44E+00	.32E+00	0.	
196	O	4	212	0,60	0	0,00	0,00	0.	.10E+03	3	.32E+00	.44E+00	.10E+01	0.	
197	O	5	214	0,80	0	0,00	0,00	0.	.10E+03	2	.44E+00	.32E+00	0.	0.	
198	O	6	214	0,35	199	0,25	0,00	0.	.10E+03	4	.44E+00	.48E+00	.13E+00	.32E+00	
199	O	7	200	0,25	0	0,00	0,00	0.	.10E+03	3	.32E+00	.48E+00	.13E+00	0.	
200	O	8	201	0,05	0	0,00	0,15	0.	.10E+03	2	.13E+00	.33E+00	0.	0.	
201	O	9	0	0,00	0	0,00	0,50	0.	.10E+03	3	.26E+00	.48E+00	.65E+00	0.	
202	O	10	0	0,00	0	0,00	0,50	0.	.10E+03	3	.48E+00	.26E+00	.65E+00	0.	
203	O	11	219	0,15	0	0,00	0,05	0.	.10E+03	1	.26E+00	0.	0.	0.	
204	O	12	188	0,15	220	0,05	0,05	0.	.10E+03	2	.26E+00	.65E+00	0.	0.	
205	O	13	204	0,40	0	0,00	0,40	0.	.10E+03	3	.26E+00	.65E+00	.33E+00	0.	
206	O	14	222	0,30	0	0,00	0,00	0.	.10E+03	4	.65E+00	.13E+00	.26E+00	.33E+00	
207	O	15	0	0,00	0	0,00	0,60	0.	.10E+03	3	.13E+00	.26E+00	.48E+00	0.	
208	O	16	207	0,55	0	0,00	0,00	0.	.10E+03	3	.13E+00	.48E+00	.26E+00	0.	
209	P	1	225	0,50	0	0,00	0,00	0.	.10E+03	2	.32E+00	.32E+00	0.	0.	
210	P	2	226	0,30	211	0,35	0,00	0.	.10E+03	4	.44E+00	.32E+00	.74E+00	.41E+00	
211	P	3	227	0,40	0	0,00	0,00	0.	.10E+03	4	.44E+00	.32E+00	.41E+00	.32E+00	
212	P	4	213	0,60	0	0,00	0,00	0.	.10E+03	3	.32E+00	.10E+01	.15E+01	0.	
213	P	5	229	0,80	0	0,00	0,00	0.	.10E+03	4	.10E+01	.15E+01	.11E+01	.44E+00	
214	P	6	230	0,80	0	0,00	0,00	0.	.10E+03	4	.44E+00	.10E+01	.15E+01	.11E+01	
215	P	7	231	0,55	199	0,20	0,00	0.	.10E+03	4	.13E+00	.15E+01	.74E+00	.11E+01	
216	P	8	217	0,25	0	0,00	0,10	0.	.10E+03	3	.74E+00	.48E+00	.13E+00	0.	
217	P	9	0	0,00	0	0,00	0,40	0.	.10E+03	2	.26E+00	.65E+00	0.	0.	
218	P	10	234	0,30	217	0,10	0,00	0.	.10E+03	2	.65E+00	.26E+00	0.	0.	
219	P	11	0	0,00	0	0,00	0,75	0.	.10E+03	3	.26E+00	.65E+00	.65E+00	0.	
220	P	12	0	0,00	0	0,00	0,80	0.	.10E+03	3	.65E+00	.65E+00	.33E+00	0.	
221	P	13	0	0,00	0	0,00	0,60	0.	.10E+03	3	.33E+00	.65E+00	.26E+00	0.	
222	P	14	0	0,00	0	0,00	0,20	0.	.10E+03	1	.26E+00	0.	0.	0.	
223	P	15	0	0,00	0	0,00	0,20	0.	.10E+03	2	.26E+00	.48E+00	0.	0.	
224	P	16	0	0,00	0	0,00	0,35	0.	.10E+03	2	.26E+00	.48E+00	0.	0.	

225	Q	1	0	0,00	0	0,00	0,00	0.	,10E+03	3	,32E+00	,74E+00	,31E+00	0.
226	Q	2	0	0,00	0	0,00	0,00	0.	,10E+03	3	,31E+00	,74E+00	,41E+00	0.
227	Q	3	0	0,00	0	0,00	0,10	0.	,10E+03	3	,41E+00	,74E+00	,11E+01	0.
228	Q	4	0	0,00	0	0,00	0,20	0.	,10E+03	3	,10E+01	,13E+01	,39E+00	0.
229	Q	5	0	0,00	0	0,00	0,80	,10E+02	,90E+02	4	,87E+00	,15E+01	,98E+00	0.
230	Q	6	0	0,00	0	0,00	0,80	,15E+02	,85E+02	3	,98E+00	,15E+01	0.	0.
231	Q	7	230	0,40	0	0,00	0,40	0.	,10E+03	3	,11E+01	,15E+01	,74E+00	0.
232	Q	8	0	0,00	0	0,00	0,65	0.	,10E+03	4	,98E+00	,13E+01	,74E+00	,65E+00
233	Q	9	0	0,00	0	0,00	0,80	0.	,10E+03	2	,26E+00	,65E+00	0.	0.
234	Q	10	0	0,00	0	0,00	0,80	0.	,10E+03	2	,65E+00	,26E+00	0.	0.
235	Q	11	0	0,00	0	0,00	0,80	0.	,10E+03	3	,65E+00	,24E+00	,65E+00	0.
236	Q	12	0	0,00	0	0,00	0,80	0.	,10E+03	3	,65E+00	,33E+00	,24E+00	0.
237	Q	13	221	0,10	236	0,10	0,20	0.	,10E+03	3	,65E+00	,26E+00	,33E+00	0.
238	Q	14	222	0,20	0	0,00	0,00	0.	,10E+03	1	,26E+00	0.	0.	0.
239	Q	15	223	0,20	0	0,00	0,00	0.	,10E+03	1	,26E+00	0.	0.	0.
240	Q	16	224	0,20	0	0,00	0,00	0.	,10E+03	2	,26E+00	,48E+00	0.	0.
241	R	1	242	0,20	0	0,00	0,00	0.	,10E+03	1	,31E+00	0.	0.	0.
242	R	2	243	0,30	0	0,00	0,00	0.	,10E+03	3	,31E+00	,61E+00	,74E+00	0.
243	R	3	259	0,10	244	0,10	0,60	0.	,10E+03	4	,72E+00	,11E+01	,74E+00	,41E+00
244	R	4	0	0,00	0	0,00	0,20	,10E+02	,90E+02	3	,39E+00	,96E+00	0.	0.
245	R	5	0	0,00	0	0,00	0,20	,20E+02	,80E+02	4	,39E+00	,53E+00	,35E+00	0.
246	R	6	0	0,00	0	0,00	0,80	,50E+02	,50E+02	3	,98E+00	,65E+00	0.	0.
247	R	7	0	0,00	0	0,00	0,80	,30E+02	,70E+02	3	,98E+00	,65E+00	0.	0.
248	R	8	0	0,00	0	0,00	0,80	,10E+02	,90E+02	3	,98E+00	,65E+00	0.	0.
249	R	9	233	0,70	0	0,00	0,10	0.	,10E+03	2	,65E+00	,33E+00	0.	0.
250	R	10	234	0,15	251	0,30	0,10	0.	,10E+03	2	,33E+00	,24E+00	0.	0.
251	R	11	235	0,50	0	0,00	0,20	0.	,10E+03	3	,24E+00	,48E+00	,33E+00	0.
252	R	12	236	0,60	0	0,00	0,10	0.	,10E+03	4	,24E+00	,11E+01	,33E+00	,48E+00
253	R	13	237	0,15	0	0,00	0,05	0.	,10E+03	3	,13E+00	,13E+00	,26E+00	0.
254	R	14	238	0,20	0	0,00	0,00	0.	,10E+03	1	,26E+00	0.	0.	0.
255	R	15	239	0,20	0	0,00	0,00	0.	,10E+03	1	,26E+00	0.	0.	0.

PRINTOUT SEGMENT III

Echo of heavy metal fallout data.

256	R	16	255	0,20	0	0,00	0,00	0.	.95E+02	1	.26E+00	0.	0.	0.
257	S	1	0	0,00	0	0,00	0,00	0.	.10E+03	1	.26E+00	0.	0.	0.
258	S	2	259	0,04	0	0,00	0,00	0.	.10E+03	2	.26E+00	.13E+00	0.	0.
259	S	3	0	0,00	0	0,00	0,20	.25E+02	.75E+02	4	.13E+00	.26E+00	.72E+00	0.
260	S	4	0	0,00	0	0,00	0,20	.65E+02	.35E+02	3	.39E+00	.26E+00	0.	0.
261	S	5	0	0,00	0	0,00	0,20	.35E+02	.65E+02	3	.39E+00	.65E+00	0.	0.
262	S	6	0	0,00	0	0,00	0,80	.35E+02	.65E+02	2	.65E+00	0.	0.	0.
263	S	7	247	0,40	0	0,00	0,40	.50E+01	.95E+02	3	.65E+00	.33E+00	0.	0.
264	S	8	263	0,40	265	0,40	0,00	0.	.10E+03	2	.65E+00	.33E+00	0.	0.
265	S	9	266	0,65	0	0,00	0,00	0.	.10E+03	2	.33E+00	.24E+00	0.	0.
266	S	10	250	0,50	0	0,00	0,00	0.	.10E+03	3	.33E+00	.24E+00	.48E+00	0.
267	S	11	251	0,45	0	0,00	0,15	0.	.10E+03	3	.65E+00	.48E+00	.24E+00	0.
268	S	12	252	0,45	0	0,00	0,00	0.	.10E+03	3	.48E+00	.65E+00	.48E+00	0.
269	S	13	253	0,45	0	0,00	0,00	0.	.10E+03	3	.48E+00	.48E+00	.13E+00	0.
270	S	14	254	0,20	0	0,00	0,00	0.	.10E+03	2	.26E+00	.48E+00	0.	0.
271	S	15	270	0,20	0	0,00	0,00	0.	.10E+03	1	.26E+00	0.	0.	0.
272	S	16	271	0,15	0	0,00	0,00	0.	.75E+02	1	.26E+00	0.	0.	0.
273	T	1	0	0,00	0	0,00	0,00	0.	.10E+03	1	.26E+00	0.	0.	0.
274	T	2	0	0,00	0	0,00	0,00	0.	.10E+03	2	.26E+00	.13E+00	0.	0.
275	T	3	0	0,00	0	0,00	0,00	0.	.10E+03	2	.26E+00	.13E+00	0.	0.
276	T	4	0	0,00	0	0,00	0,20	.10E+02	.90E+02	2	.26E+00	0.	0.	0.
277	T	5	0	0,00	0	0,00	0,20	0.	.10E+03	2	.26E+00	.65E+00	0.	0.
278	T	6	262	0,80	0	0,00	0,00	0.	.10E+03	2	.33E+00	.65E+00	0.	0.
279	T	7	263	0,40	278	0,40	0,00	0.	.10E+03	2	.33E+00	.65E+00	0.	0.
280	T	8	279	0,80	0	0,00	0,00	0.	.10E+03	1	.33E+00	0.	0.	0.
281	T	9	265	0,60	0	0,00	0,00	0.	.10E+03	3	.33E+00	.48E+00	.65E+00	0.
282	T	10	266	0,50	0	0,00	0,00	0.	.10E+03	2	.48E+00	.33E+00	0.	0.
283	T	11	267	0,50	0	0,00	0,00	0.	.10E+03	2	.48E+00	.65E+00	0.	0.
284	T	12	268	0,50	0	0,00	0,00	0.	.10E+03	2	.48E+00	.48E+00	0.	0.
285	T	13	284	0,50	0	0,00	0,00	0.	.10E+03	2	.48E+00	.48E+00	0.	0.
286	T	14	270	0,20	0	0,00	0,00	0.	.10E+03	1	.26E+00	0.	0.	0.
287	T	15	271	0,20	0	0,00	0,00	0.	.10E+03	1	.26E+00	0.	0.	0.
288	T	16	287	0,10	0	0,00	0,00	0.	.30E+02	1	.26E+00	0.	0.	0.

READ FILE (NR3) = 20   NUMBER OF HEAVY METALS THIS RUN = 8   TOTAL HEAVY METALS = 8

NO. OF ELEMENTS=288
NO. OF HEAVY METALS TO BE RUN IN THIS RUN= 8

ELEMENT	METAL 1	METAL 2	METAL 3	METAL 4	METAL 5	METAL 6	METAL 7	METAL 8
F A 1	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 1	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 1	.210E-02	.241E-02	.620E-03	.168E-03	.234E-02	.190E+00	.105E+01	.105E+01
F A 1	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F A 2	.100E-02	.115E-02	.295E-03	.800E-04	.112E-02	.905E-01	.500E+00	.500E+00
F A 2	.366E-02	.421E-02	.108E-02	.293E-03	.408E-02	.331E+00	.183E+01	.183E+01
F A 2	.410E-02	.471E-02	.121E-02	.328E-03	.457E-02	.371E+00	.205E+01	.205E+01
F A 2	.572E-02	.658E-02	.169E-02	.458E-03	.638E-02	.518E+00	.286E+01	.286E+01
F A 3	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 3	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 3	.210E-02	.241E-02	.620E-03	.168E-03	.234E-02	.190E+00	.105E+01	.105E+01
F A 3	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F A 4	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 4	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 4	.210E-02	.241E-02	.620E-03	.168E-03	.234E-02	.190E+00	.105E+01	.105E+01
F A 4	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F A 5	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 5	.105E-02	.121E-02	.311E-03	.843E-04	.118E-02	.954E-01	.527E+00	.527E+00
F A 5	.210E-02	.241E-02	.620E-03	.168E-03	.234E-02	.190E+00	.105E+01	.105E+01
F A 5	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F A 6	.362E-02	.416E-02	.107E-02	.290E-03	.404E-02	.328E+00	.181E+01	.181E+01
F A 6	.362E-02	.416E-02	.107E-02	.290E-03	.404E-02	.328E+00	.181E+01	.181E+01
F A 6	.726E-02	.835E-02	.214E-02	.581E-03	.809E-02	.657E+00	.363E+01	.363E+01
F A 6	.145E-01	.167E-01	.428E-02	.116E-02	.162E-01	.131E+01	.726E+01	.726E+01
F A 7	.370E-02	.426E-02	.109E-02	.296E-03	.413E-02	.335E+00	.185E+01	.185E+01
F A 7	.370E-02	.426E-02	.109E-02	.296E-03	.413E-02	.335E+00	.185E+01	.185E+01
F A 7	.742E-02	.853E-02	.219E-02	.594E-03	.827E-02	.672E+00	.371E+01	.371E+01
F A 7	.148E-01	.170E-01	.437E-02	.119E-02	.165E-01	.134E+01	.741E+01	.741E+01

F	B	1	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	1	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	1	.220E-02	.253E-02	.649E-03	.176E-03	.245E-02	.199E+00	.110E+01	.110E+01
F	B	1	.442E-02	.508E-02	.130E-02	.354E-03	.493E-02	.400E+00	.221E+01	.221E+01
F	B	2	.111E-02	.127E-02	.326E-03	.885E-04	.123E-02	.100E+00	.553E+00	.553E+00
F	B	2	.444E-02	.511E-02	.131E-02	.355E-03	.495E-02	.402E+00	.222E+01	.222E+01
F	B	2	.546E-02	.628E-02	.161E-02	.437E-03	.609E-02	.494E+00	.273E+01	.273E+01
F	B	2	.762E-02	.876E-02	.225E-02	.610E-03	.850E-02	.690E+00	.381E+01	.381E+01
F	B	3	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	3	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	3	.220E-02	.253E-02	.649E-03	.176E-03	.245E-02	.199E+00	.110E+01	.110E+01
F	B	3	.442E-02	.508E-02	.130E-02	.354E-03	.493E-02	.400E+00	.221E+01	.221E+01
F	B	4	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	4	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	4	.220E-02	.253E-02	.649E-03	.176E-03	.245E-02	.199E+00	.110E+01	.110E+01
F	B	4	.442E-02	.508E-02	.130E-02	.354E-03	.493E-02	.400E+00	.221E+01	.221E+01
F	B	5	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	5	.110E-02	.127E-02	.326E-03	.883E-04	.123E-02	.999E-01	.552E+00	.552E+00
F	B	5	.220E-02	.253E-02	.649E-03	.176E-03	.245E-02	.199E+00	.110E+01	.110E+01
F	B	5	.442E-02	.508E-02	.130E-02	.354E-03	.493E-02	.400E+00	.221E+01	.221E+01
F	B	6	.370E-02	.426E-02	.109E-02	.296E-03	.413E-02	.335E+00	.185E+01	.185E+01
F	B	6	.370E-02	.426E-02	.109E-02	.296E-03	.413E-02	.335E+00	.185E+01	.185E+01
F	B	6	.742E-02	.853E-02	.219E-02	.594E-03	.827E-02	.672E+00	.371E+01	.371E+01
F	B	6	.148E-01	.171E-01	.438E-02	.119E-02	.165E-01	.134E+01	.742E+01	.742E+01
F	B	7	.362E-02	.416E-02	.107E-02	.290E-03	.404E-02	.328E+00	.181E+01	.181E+01
F	B	7	.590E-02	.679E-02	.174E-02	.472E-03	.658E-02	.534E+00	.295E+01	.295E+01
F	B	7	.952E-02	.109E-01	.281E-02	.762E-03	.106E-01	.862E+00	.476E+01	.476E+01
F	B	7	.122E-01	.141E-01	.360E-02	.978E-03	.136E-01	.111E+01	.611E+01	.611E+01
F	B	8	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	B	8	.624E-02	.718E-02	.184E-02	.499E-03	.696E-02	.565E+00	.312E+01	.312E+01
F	B	8	.836E-02	.961E-02	.247E-02	.669E-03	.932E-02	.757E+00	.418E+01	.418E+01

F	B	8	.874E-02	.101E-01	.258E-02	.699E-03	.975E-02	.791E+00	.437E+01	.437E+01
F	B	9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	B	9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	B	9	.756E-02	.869E-02	.223E-02	.605E-03	.843E-02	.684E+00	.378E+01	.378E+01
F	B	9	.151E-01	.174E-01	.447E-02	.121E-02	.169E-01	.137E+01	.757E+01	.757E+01
F	C	1	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	1	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	1	.230E-02	.264E-02	.678E-03	.184E-03	.256E-02	.208E+00	.115E+01	.115E+01
F	C	1	.460E-02	.529E-02	.136E-02	.368E-03	.513E-02	.416E+00	.230E+01	.230E+01
F	C	2	.120E-02	.138E-02	.355E-03	.963E-04	.134E-02	.109E+00	.602E+00	.602E+00
F	C	2	.502E-02	.577E-02	.148E-02	.402E-03	.560E-02	.454E+00	.251E+01	.251E+01
F	C	2	.630E-02	.724E-02	.186E-02	.504E-03	.702E-02	.570E+00	.315E+01	.315E+01
F	C	2	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01
F	C	3	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	3	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	3	.230E-02	.264E-02	.678E-03	.184E-03	.256E-02	.208E+00	.115E+01	.115E+01
F	C	3	.460E-02	.529E-02	.136E-02	.368E-03	.513E-02	.416E+00	.230E+01	.230E+01
F	C	4	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	4	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	4	.230E-02	.264E-02	.678E-03	.184E-03	.256E-02	.208E+00	.115E+01	.115E+01
F	C	4	.460E-02	.529E-02	.136E-02	.368E-03	.513E-02	.416E+00	.230E+01	.230E+01
F	C	5	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	5	.115E-02	.132E-02	.339E-03	.920E-04	.128E-02	.104E+00	.575E+00	.575E+00
F	C	5	.230E-02	.264E-02	.678E-03	.184E-03	.256E-02	.208E+00	.115E+01	.115E+01
F	C	5	.460E-02	.529E-02	.136E-02	.368E-03	.513E-02	.416E+00	.230E+01	.230E+01
F	C	6	.368E-02	.423E-02	.109E-02	.294E-03	.410E-02	.333E+00	.184E+01	.184E+01
F	C	6	.368E-02	.423E-02	.109E-02	.294E-03	.410E-02	.333E+00	.184E+01	.184E+01
F	C	6	.736E-02	.846E-02	.217E-02	.589E-03	.821E-02	.666E+00	.368E+01	.368E+01
F	C	6	.147E-01	.170E-01	.435E-02	.118E-02	.164E-01	.133E+01	.737E+01	.737E+01
F	C	7	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	C	7	.566E-02	.651E-02	.167E-02	.453E-03	.631E-02	.512E+00	.283E+01	.283E+01

F	C 7	.938E-02	.108E-01	.277E-02	.750E-03	.105E-01	.849E+00	.469E+01	.469E+01
F	C 7	.986E-02	.113E-01	.291E-02	.789E-03	.110E-01	.892E+00	.493E+01	.493E+01
F	C 8	.370E-02	.426E-02	.109E-02	.296E-03	.413E-02	.335E+00	.185E+01	.185E+01
F	C 8	.370E-02	.426E-02	.109E-02	.296E-03	.413E-02	.335E+00	.185E+01	.185E+01
F	C 8	.742E-02	.853E-02	.219E-02	.594E-03	.827E-02	.672E+00	.371E+01	.371E+01
F	C 8	.148E-01	.171E-01	.438E-02	.119E-02	.165E-01	.134E+01	.742E+01	.742E+01
F	C 9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	C 9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	C 9	.756E-02	.869E-02	.223E-02	.605E-03	.843E-02	.684E+00	.378E+01	.378E+01
F	C 9	.151E-01	.174E-01	.447E-02	.121E-02	.169E-01	.137E+01	.757E+01	.757E+01
F	C 10	.394E-02	.453E-02	.116E-02	.315E-03	.439E-02	.357E+00	.197E+01	.197E+01
F	C 10	.394E-02	.453E-02	.116E-02	.315E-03	.439E-02	.357E+00	.197E+01	.197E+01
F	C 10	.786E-02	.904E-02	.232E-02	.629E-03	.876E-02	.711E+00	.393E+01	.393E+01
F	C 10	.157E-01	.181E-01	.464E-02	.126E-02	.175E-01	.142E+01	.786E+01	.786E+01
F	C 11	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	C 11	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	C 11	.830E-02	.954E-02	.245E-02	.664E-03	.925E-02	.751E+00	.415E+01	.415E+01
F	C 11	.166E-01	.191E-01	.490E-02	.133E-02	.185E-01	.150E+01	.831E+01	.831E+01
F	D 1	.122E-02	.141E-02	.361E-03	.979E-04	.136E-02	.111E+00	.612E+00	.612E+00
F	D 1	.122E-02	.141E-02	.361E-03	.979E-04	.136E-02	.111E+00	.612E+00	.612E+00
F	D 1	.244E-02	.281E-02	.720E-03	.195E-03	.272E-02	.221E+00	.122E+01	.122E+01
F	D 1	.490E-02	.564E-02	.145E-02	.392E-03	.546E-02	.443E+00	.245E+01	.245E+01
F	D 2	.129E-02	.148E-02	.380E-03	.103E-03	.144E-02	.117E+00	.644E+00	.644E+00
F	D 2	.594E-02	.683E-02	.175E-02	.475E-03	.662E-02	.538E+00	.297E+01	.297E+01
F	D 2	.698E-02	.803E-02	.206E-02	.558E-03	.778E-02	.632E+00	.349E+01	.349E+01
F	D 2	.101E-01	.116E-01	.299E-02	.810E-03	.113E-01	.916E+00	.506E+01	.506E+01
F	D 3	.122E-02	.141E-02	.361E-03	.979E-04	.136E-02	.111E+00	.612E+00	.612E+00
F	D 3	.122E-02	.141E-02	.361E-03	.979E-04	.136E-02	.111E+00	.612E+00	.612E+00
F	D 3	.244E-02	.281E-02	.720E-03	.195E-03	.272E-02	.221E+00	.122E+01	.122E+01
F	D 3	.490E-02	.564E-02	.145E-02	.392E-03	.546E-02	.443E+00	.245E+01	.245E+01
F	D 4	.122E-02	.141E-02	.361E-03	.979E-04	.136E-02	.111E+00	.612E+00	.612E+00

F	D 4	.122E-02	.141E-02	.361E-03	.979E-04	.136E-02	.111E+00	.612E+00	.612E+00
F	D 4	.244E-02	.281E-02	.720E-03	.195E-03	.272E-02	.221E+00	.122E+01	.122E+01
F	D 4	.490E-02	.564E-02	.145E-02	.392E-03	.546E-02	.443E+00	.245E+01	.245E+01
F	D 5	.170E-02	.196E-02	.503E-03	.136E-03	.190E-02	.154E+00	.852E+00	.852E+00
F	D 5	.170E-02	.196E-02	.503E-03	.136E-03	.190E-02	.154E+00	.852E+00	.852E+00
F	D 5	.340E-02	.391E-02	.100E-02	.272E-03	.379E-02	.308E+00	.170E+01	.170E+01
F	D 5	.682E-02	.784E-02	.201E-02	.546E-03	.760E-02	.617E+00	.341E+01	.341E+01
F	D 6	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	D 6	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	D 6	.758E-02	.872E-02	.224E-02	.606E-03	.845E-02	.686E+00	.379E+01	.379E+01
F	D 6	.151E-01	.174E-01	.447E-02	.121E-02	.169E-01	.137E+01	.757E+01	.757E+01
F	D 7	.364E-02	.419E-02	.107E-02	.291E-03	.406E-02	.329E+00	.182E+01	.182E+01
F	D 7	.594E-02	.683E-02	.175E-02	.475E-03	.662E-02	.538E+00	.297E+01	.297E+01
F	D 7	.106E-01	.122E-01	.312E-02	.846E-03	.118E-01	.957E+00	.529E+01	.529E+01
F	D 7	.108E-01	.124E-01	.318E-02	.862E-03	.120E-01	.976E+00	.539E+01	.539E+01
F	D 8	.372E-02	.428E-02	.110E-02	.298E-03	.415E-02	.337E+00	.186E+01	.186E+01
F	D 8	.372E-02	.428E-02	.110E-02	.298E-03	.415E-02	.337E+00	.186E+01	.186E+01
F	D 8	.744E-02	.856E-02	.219E-02	.595E-03	.830E-02	.673E+00	.372E+01	.372E+01
F	D 8	.149E-01	.171E-01	.440E-02	.119E-02	.166E-01	.135E+01	.745E+01	.745E+01
F	D 9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	D 9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	D 9	.756E-02	.869E-02	.223E-02	.605E-03	.843E-02	.684E+00	.378E+01	.378E+01
F	D 9	.151E-01	.174E-01	.447E-02	.121E-02	.169E-01	.137E+01	.757E+01	.757E+01
F	D 10	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	D 10	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	D 10	.754E-02	.867E-02	.222E-02	.603E-03	.841E-02	.682E+00	.377E+01	.377E+01
F	D 10	.151E-01	.173E-01	.444E-02	.120E-02	.168E-01	.136E+01	.753E+01	.753E+01
F	D 11	.408E-02	.469E-02	.120E-02	.326E-03	.455E-02	.369E+00	.204E+01	.204E+01
F	D 11	.408E-02	.469E-02	.120E-02	.326E-03	.455E-02	.369E+00	.204E+01	.204E+01
F	D 11	.816E-02	.938E-02	.241E-02	.653E-03	.910E-02	.738E+00	.408E+01	.408E+01
F	D 11	.163E-01	.188E-01	.481E-02	.131E-02	.182E-01	.148E+01	.816E+01	.816E+01

F	D 12	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	D 12	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	D 12	.830E-02	.954E-02	.245E-02	.664E-03	.925E-02	.751E+00	.415E+01	.415E+01
F	D 12	.166E-01	.191E-01	.490E-02	.133E-02	.185E-01	.150E+01	.831E+01	.831E+01
F	E 1	.934E-03	.107E-02	.276E-03	.747E-04	.104E-02	.845E-01	.467E+00	.467E+00
F	E 1	.654E-03	.752E-03	.193E-03	.523E-04	.729E-03	.592E-01	.327E+00	.327E+00
F	E 1	.111E-02	.128E-02	.328E-03	.890E-04	.124E-02	.101E+00	.556E+00	.556E+00
F	E 1	.189E-02	.218E-02	.558E-03	.151E-03	.211E-02	.171E+00	.946E+00	.946E+00
F	E 2	.152E-02	.175E-02	.450E-03	.122E-03	.170E-02	.138E+00	.762E+00	.762E+00
F	E 2	.660E-02	.759E-02	.195E-02	.528E-03	.736E-02	.597E+00	.330E+01	.330E+01
F	E 2	.774E-02	.890E-02	.228E-02	.619E-03	.863E-02	.700E+00	.387E+01	.387E+01
F	E 2	.116E-01	.133E-01	.342E-02	.926E-03	.129E-01	.105E+01	.579E+01	.579E+01
F	E 3	.134E-02	.154E-02	.394E-03	.107E-03	.149E-02	.121E+00	.668E+00	.668E+00
F	E 3	.134E-02	.154E-02	.394E-03	.107E-03	.149E-02	.121E+00	.668E+00	.668E+00
F	E 3	.268E-02	.308E-02	.791E-03	.214E-03	.299E-02	.243E+00	.134E+01	.134E+01
F	E 3	.534E-02	.614E-02	.158E-02	.427E-03	.595E-02	.483E+00	.267E+01	.267E+01
F	E 4	.134E-02	.154E-02	.394E-03	.107E-03	.149E-02	.121E+00	.668E+00	.668E+00
F	E 4	.134E-02	.154E-02	.394E-03	.107E-03	.149E-02	.121E+00	.668E+00	.668E+00
F	E 4	.268E-02	.308E-02	.791E-03	.214E-03	.299E-02	.243E+00	.134E+01	.134E+01
F	E 4	.534E-02	.614E-02	.158E-02	.427E-03	.595E-02	.483E+00	.267E+01	.267E+01
F	E 5	.214E-02	.246E-02	.631E-03	.171E-03	.239E-02	.194E+00	.107E+01	.107E+01
F	E 5	.214E-02	.246E-02	.631E-03	.171E-03	.239E-02	.194E+00	.107E+01	.107E+01
F	E 5	.428E-02	.492E-02	.126E-02	.342E-03	.477E-02	.387E+00	.214E+01	.214E+01
F	E 5	.856E-02	.984E-02	.253E-02	.685E-03	.954E-02	.775E+00	.428E+01	.428E+01
F	E 6	.410E-02	.471E-02	.121E-02	.328E-03	.457E-02	.371E+00	.205E+01	.205E+01
F	E 6	.708E-02	.814E-02	.209E-02	.566E-03	.789E-02	.641E+00	.354E+01	.354E+01
F	E 6	.111E-01	.128E-01	.328E-02	.890E-03	.124E-01	.101E+01	.556E+01	.556E+01
F	E 6	.138E-01	.158E-01	.407E-02	.110E-02	.154E-01	.125E+01	.689E+01	.689E+01
F	E 7	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	E 7	.648E-02	.745E-02	.191E-02	.518E-03	.723E-02	.586E+00	.324E+01	.324E+01
F	E 7	.116E-01	.134E-01	.343E-02	.930E-03	.130E-01	.105E+01	.581E+01	.581E+01

F	E	7	.145E-01	.167E-01	.428E-02	.116E-02	.162E-01	.131E+01	.726E+01	.726E+01
F	E	8	.372E-02	.428E-02	.110E-02	.298E-03	.415E-02	.337E+00	.186E+01	.186E+01
F	E	8	.372E-02	.428E-02	.110E-02	.298E-03	.415E-02	.337E+00	.186E+01	.186E+01
F	E	8	.744E-02	.856E-02	.219E-02	.595E-03	.830E-02	.673E+00	.372E+01	.372E+01
F	E	8	.149E-01	.171E-01	.440E-02	.119E-02	.166E-01	.135E+01	.745E+01	.745E+01
F	E	9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	E	9	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	E	9	.756E-02	.869E-02	.223E-02	.605E-03	.843E-02	.684E+00	.378E+01	.378E+01
F	E	9	.151E-01	.174E-01	.447E-02	.121E-02	.169E-01	.137E+01	.757E+01	.757E+01
F	E	10	.304E-02	.350E-02	.897E-03	.243E-03	.339E-02	.275E+00	.152E+01	.152E+01
F	E	10	.304E-02	.350E-02	.897E-03	.243E-03	.339E-02	.275E+00	.152E+01	.152E+01
F	E	10	.608E-02	.699E-02	.179E-02	.486E-03	.678E-02	.550E+00	.304E+01	.304E+01
F	E	10	.121E-01	.140E-01	.358E-02	.971E-03	.135E-01	.110E+01	.607E+01	.607E+01
F	E	11	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	E	11	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	E	11	.752E-02	.865E-02	.222E-02	.602E-03	.838E-02	.681E+00	.376E+01	.376E+01
F	E	11	.150E-01	.173E-01	.444E-02	.120E-02	.168E-01	.136E+01	.752E+01	.752E+01
F	E	12	.408E-02	.469E-02	.120E-02	.326E-03	.455E-02	.369E+00	.204E+01	.204E+01
F	E	12	.642E-02	.738E-02	.189E-02	.514E-03	.716E-02	.581E+00	.321E+01	.321E+01
F	E	12	.874E-02	.101E-01	.258E-02	.699E-03	.975E-02	.791E+00	.437E+01	.437E+01
F	E	12	.942E-02	.108E-01	.278E-02	.754E-03	.105E-01	.853E+00	.471E+01	.471E+01
F	E	13	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	E	13	.664E-02	.764E-02	.196E-02	.531E-03	.740E-02	.601E+00	.332E+01	.332E+01
F	E	13	.878E-02	.101E-01	.259E-02	.702E-03	.979E-02	.795E+00	.439E+01	.439E+01
F	E	13	.942E-02	.108E-01	.278E-02	.754E-03	.105E-01	.853E+00	.471E+01	.471E+01
F	F	1	.928E-03	.107E-02	.274E-03	.742E-04	.103E-02	.840E-01	.464E+00	.464E+00
F	F	1	.464E-03	.534E-03	.137E-03	.371E-04	.517E-03	.420E-01	.232E+00	.232E+00
F	F	1	.696E-03	.800E-03	.205E-03	.557E-04	.776E-03	.630E-01	.348E+00	.348E+00
F	F	1	.104E-02	.120E-02	.308E-03	.835E-04	.116E-02	.945E-01	.522E+00	.522E+00
F	F	2	.189E-02	.218E-02	.558E-03	.151E-03	.211E-02	.171E+00	.946E+00	.946E+00
F	F	2	.722E-02	.830E-02	.213E-02	.578E-03	.805E-02	.653E+00	.361E+01	.361E+01

F	F	2	.936E-02	.108E-01	.276E-02	.749E-03	.104E-01	.847E+00	.468E+01	.468E+01
F	F	2	.151E-01	.174E-01	.446E-02	.121E-02	.169E-01	.137E+01	.756E+01	.756E+01
F	F	3	.186E-02	.213E-02	.548E-03	.148E-03	.207E-02	.168E+00	.928E+00	.928E+00
F	F	3	.186E-02	.213E-02	.548E-03	.148E-03	.207E-02	.168E+00	.928E+00	.928E+00
F	F	3	.372E-02	.428E-02	.110E-02	.298E-03	.415E-02	.337E+00	.186E+01	.186E+01
F	F	3	.742E-02	.853E-02	.219E-02	.594E-03	.827E-02	.672E+00	.371E+01	.371E+01
F	F	4	.186E-02	.213E-02	.548E-03	.148E-03	.207E-02	.168E+00	.928E+00	.928E+00
F	F	4	.186E-02	.213E-02	.548E-03	.148E-03	.207E-02	.168E+00	.928E+00	.928E+00
F	F	4	.372E-02	.428E-02	.110E-02	.298E-03	.415E-02	.337E+00	.186E+01	.186E+01
F	F	4	.742E-02	.853E-02	.219E-02	.594E-03	.827E-02	.672E+00	.371E+01	.371E+01
F	F	5	.350E-02	.402E-02	.103E-02	.280E-03	.390E-02	.317E+00	.175E+01	.175E+01
F	F	5	.350E-02	.402E-02	.103E-02	.280E-03	.390E-02	.317E+00	.175E+01	.175E+01
F	F	5	.698E-02	.803E-02	.206E-02	.558E-03	.778E-02	.632E+00	.349E+01	.349E+01
F	F	5	.140E-01	.161E-01	.412E-02	.112E-02	.156E-01	.127E+01	.699E+01	.699E+01
F	F	6	.502E-02	.577E-02	.148E-02	.402E-03	.560E-02	.454E+00	.251E+01	.251E+01
F	F	6	.816E-02	.938E-02	.241E-02	.653E-03	.910E-02	.738E+00	.408E+01	.408E+01
F	F	6	.116E-01	.134E-01	.343E-02	.930E-03	.130E-01	.105E+01	.581E+01	.581E+01
F	F	6	.119E-01	.136E-01	.350E-02	.949E-03	.132E-01	.107E+01	.593E+01	.593E+01
F	F	7	.480E-02	.552E-02	.142E-02	.384E-03	.535E-02	.434E+00	.240E+01	.240E+01
F	F	7	.480E-02	.552E-02	.142E-02	.384E-03	.535E-02	.434E+00	.240E+01	.240E+01
F	F	7	.958E-02	.110E-01	.283E-02	.766E-03	.107E-01	.867E+00	.479E+01	.479E+01
F	F	7	.192E-01	.220E-01	.565E-02	.153E-02	.214E-01	.173E+01	.958E+01	.958E+01
F	F	8	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	F	8	.378E-02	.435E-02	.112E-02	.302E-03	.421E-02	.342E+00	.189E+01	.189E+01
F	F	8	.756E-02	.869E-02	.223E-02	.605E-03	.843E-02	.684E+00	.378E+01	.378E+01
F	F	8	.151E-01	.174E-01	.446E-02	.121E-02	.169E-01	.137E+01	.756E+01	.756E+01
F	F	9	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	F	9	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	F	9	.752E-02	.865E-02	.222E-02	.602E-03	.838E-02	.681E+00	.376E+01	.376E+01
F	F	9	.150E-01	.173E-01	.443E-02	.120E-02	.167E-01	.136E+01	.751E+01	.751E+01
F	F	10	.334E-02	.384E-02	.985E-03	.267E-03	.372E-02	.302E+00	.167E+01	.167E+01

F	F 10	.334E-02	.384E-02	.985E-03	.267E-03	.372E-02	.302E+00	.167E+01	.167E+01
F	F 10	.668E-02	.768E-02	.197E-02	.534E-03	.745E-02	.605E+00	.334E+01	.334E+01
F	F 10	.134E-01	.154E-01	.394E-02	.107E-02	.149E-01	.121E+01	.668E+01	.668E+01
F	F 11	.304E-02	.350E-02	.897E-03	.243E-03	.339E-02	.275E+00	.152E+01	.152E+01
F	F 11	.552E-02	.635E-02	.163E-02	.442E-03	.615E-02	.500E+00	.276E+01	.276E+01
F	F 11	.800E-02	.920E-02	.236E-02	.640E-03	.892E-02	.724E+00	.400E+01	.400E+01
F	F 11	.842E-02	.968E-02	.248E-02	.674E-03	.939E-02	.762E+00	.421E+01	.421E+01
F	F 12	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	F 12	.580E-02	.667E-02	.171E-02	.464E-03	.647E-02	.525E+00	.290E+01	.290E+01
F	F 12	.672E-02	.773E-02	.198E-02	.538E-03	.749E-02	.608E+00	.336E+01	.336E+01
F	F 12	.498E-02	.573E-02	.147E-02	.398E-03	.555E-02	.451E+00	.249E+01	.249E+01
F	F 13	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	F 13	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	F 13	.832E-02	.957E-02	.245E-02	.666E-03	.928E-02	.753E+00	.416E+01	.416E+01
F	F 13	.166E-01	.191E-01	.490E-02	.133E-02	.185E-01	.150E+01	.831E+01	.831E+01
F	F 14	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	F 14	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	F 14	.846E-02	.973E-02	.250E-02	.677E-03	.943E-02	.766E+00	.423E+01	.423E+01
F	F 14	.169E-01	.195E-01	.499E-02	.135E-02	.189E-01	.153E+01	.846E+01	.846E+01
F	G 1	.558E-03	.642E-03	.165E-03	.446E-04	.622E-03	.505E-01	.279E+00	.279E+00
F	G 1	.140E-03	.161E-03	.412E-04	.112E-04	.156E-03	.126E-01	.698E-01	.698E-01
F	G 1	.175E-03	.201E-03	.515E-04	.140E-04	.195E-03	.158E-01	.873E-01	.873E-01
F	G 1	.218E-03	.251E-03	.643E-04	.174E-04	.243E-03	.197E-01	.109E+00	.109E+00
F	G 2	.216E-02	.248E-02	.637E-03	.173E-03	.241E-02	.195E+00	.108E+01	.108E+01
F	G 2	.828E-02	.952E-02	.244E-02	.662E-03	.923E-02	.749E+00	.414E+01	.414E+01
F	G 2	.110E-01	.126E-01	.324E-02	.880E-03	.123E-01	.996E+00	.550E+01	.550E+01
F	G 2	.162E-01	.187E-01	.479E-02	.130E-02	.181E-01	.147E+01	.812E+01	.812E+01
F	G 3	.224E-02	.258E-02	.661E-03	.179E-03	.250E-02	.203E+00	.112E+01	.112E+01
F	G 3	.224E-02	.258E-02	.661E-03	.179E-03	.250E-02	.203E+00	.112E+01	.112E+01
F	G 3	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	G 3	.894E-02	.103E-01	.264E-02	.715E-03	.997E-02	.809E+00	.447E+01	.447E+01

F	G 4	.352E-02	.405E-02	.104E-02	.282E-03	.392E-02	.319E+00	.176E+01	.176E+01
F	G 4	.352E-02	.405E-02	.104E-02	.282E-03	.392E-02	.319E+00	.176E+01	.176E+01
F	G 4	.704E-02	.810E-02	.208E-02	.563E-03	.785E-02	.637E+00	.352E+01	.352E+01
F	G 4	.141E-01	.162E-01	.415E-02	.113E-02	.157E-01	.127E+01	.704E+01	.704E+01
F	G 5	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	G 5	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	G 5	.846E-02	.973E-02	.250E-02	.677E-03	.943E-02	.766E+00	.423E+01	.423E+01
F	G 5	.169E-01	.195E-01	.499E-02	.135E-02	.189E-01	.153E+01	.846E+01	.846E+01
F	G 6	.628E-02	.722E-02	.185E-02	.502E-03	.700E-02	.568E+00	.314E+01	.314E+01
F	G 6	.992E-02	.114E-01	.293E-02	.794E-03	.111E-01	.898E+00	.496E+01	.496E+01
F	G 6	.139E-01	.160E-01	.411E-02	.112E-02	.155E-01	.126E+01	.697E+01	.697E+01
F	G 6	.143E-01	.165E-01	.422E-02	.115E-02	.160E-01	.130E+01	.716E+01	.716E+01
F	G 7	.564E-02	.649E-02	.166E-02	.451E-03	.629E-02	.510E+00	.282E+01	.282E+01
F	G 7	.564E-02	.649E-02	.166E-02	.451E-03	.629E-02	.510E+00	.282E+01	.282E+01
F	G 7	.113E-01	.130E-01	.333E-02	.902E-03	.126E-01	.102E+01	.564E+01	.564E+01
F	G 7	.226E-01	.260E-01	.667E-02	.181E-02	.252E-01	.205E+01	.113E+02	.113E+02
F	G 8	.638E-02	.734E-02	.188E-02	.510E-03	.711E-02	.577E+00	.319E+01	.319E+01
F	G 8	.638E-02	.734E-02	.188E-02	.510E-03	.711E-02	.577E+00	.319E+01	.319E+01
F	G 8	.128E-01	.147E-01	.376E-02	.102E-02	.142E-01	.115E+01	.638E+01	.638E+01
F	G 8	.256E-01	.294E-01	.755E-02	.205E-02	.285E-01	.232E+01	.128E+02	.128E+02
F	G 9	.486E-02	.559E-02	.143E-02	.389E-03	.542E-02	.440E+00	.243E+01	.243E+01
F	G 9	.486E-02	.559E-02	.143E-02	.389E-03	.542E-02	.440E+00	.243E+01	.243E+01
F	G 9	.974E-02	.112E-01	.287E-02	.779E-03	.109E-01	.881E+00	.487E+01	.487E+01
F	G 9	.195E-01	.224E-01	.575E-02	.156E-02	.217E-01	.176E+01	.974E+01	.974E+01
F	G 10	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	G 10	.658E-02	.757E-02	.194E-02	.526E-03	.734E-02	.595E+00	.329E+01	.329E+01
F	G 10	.100E-01	.115E-01	.295E-02	.800E-03	.112E-01	.905E+00	.500E+01	.500E+01
F	G 10	.109E-01	.125E-01	.322E-02	.872E-03	.122E-01	.986E+00	.545E+01	.545E+01
F	G 11	.322E-02	.370E-02	.950E-03	.258E-03	.359E-02	.291E+00	.161E+01	.161E+01
F	G 11	.610E-02	.702E-02	.180E-02	.488E-03	.680E-02	.552E+00	.305E+01	.305E+01
F	G 11	.790E-02	.909E-02	.233E-02	.632E-03	.881E-02	.715E+00	.395E+01	.395E+01

F	G 11	.592E-02	.681E-02	.175E-02	.474E-03	.660E-02	.536E+00	.296E+01	.296E+01
F	G 12	.348E-02	.400E-02	.103E-02	.278E-03	.388E-02	.315E+00	.174E+01	.174E+01
F	G 12	.348E-02	.400E-02	.103E-02	.278E-03	.388E-02	.315E+00	.174E+01	.174E+01
F	G 12	.696E-02	.800E-02	.205E-02	.557E-03	.776E-02	.630E+00	.348E+01	.348E+01
F	G 12	.139E-01	.160E-01	.410E-02	.111E-02	.155E-01	.126E+01	.695E+01	.695E+01
F	G 13	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	G 13	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	G 13	.832E-02	.957E-02	.245E-02	.666E-03	.928E-02	.753E+00	.416E+01	.416E+01
F	G 13	.167E-01	.192E-01	.491E-02	.133E-02	.186E-01	.151E+01	.833E+01	.833E+01
F	G 14	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	G 14	.416E-02	.478E-02	.123E-02	.333E-03	.464E-02	.376E+00	.208E+01	.208E+01
F	G 14	.832E-02	.957E-02	.245E-02	.666E-03	.928E-02	.753E+00	.416E+01	.416E+01
F	G 14	.166E-01	.191E-01	.490E-02	.133E-02	.185E-01	.150E+01	.831E+01	.831E+01
F	G 15	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	G 15	.422E-02	.485E-02	.124E-02	.338E-03	.471E-02	.382E+00	.211E+01	.211E+01
F	G 15	.846E-02	.973E-02	.250E-02	.677E-03	.943E-02	.766E+00	.423E+01	.423E+01
F	G 15	.169E-01	.195E-01	.499E-02	.135E-02	.189E-01	.153E+01	.846E+01	.846E+01
F	H 1	.338E-02	.389E-02	.997E-03	.270E-03	.377E-02	.306E+00	.169E+01	.169E+01
F	H 1	.338E-02	.389E-02	.997E-03	.270E-03	.377E-02	.306E+00	.169E+01	.169E+01
F	H 1	.676E-02	.777E-02	.199E-02	.541E-03	.754E-02	.612E+00	.338E+01	.338E+01
F	H 1	.135E-01	.156E-01	.399E-02	.108E-02	.151E-01	.123E+01	.677E+01	.677E+01
F	H 2	.212E-02	.244E-02	.625E-03	.170E-03	.236E-02	.192E+00	.106E+01	.106E+01
F	H 2	.850E-02	.977E-02	.251E-02	.680E-03	.948E-02	.769E+00	.425E+01	.425E+01
F	H 2	.109E-01	.125E-01	.322E-02	.872E-03	.122E-01	.986E+00	.545E+01	.545E+01
F	H 2	.158E-01	.182E-01	.467E-02	.127E-02	.176E-01	.143E+01	.791E+01	.791E+01
F	H 3	.338E-02	.389E-02	.997E-03	.270E-03	.377E-02	.306E+00	.169E+01	.169E+01
F	H 3	.338E-02	.389E-02	.997E-03	.270E-03	.377E-02	.306E+00	.169E+01	.169E+01
F	H 3	.676E-02	.777E-02	.199E-02	.541E-03	.754E-02	.612E+00	.338E+01	.338E+01
F	H 3	.135E-01	.156E-01	.399E-02	.108E-02	.151E-01	.123E+01	.677E+01	.677E+01
F	H 4	.444E-02	.511E-02	.131E-02	.355E-03	.495E-02	.402E+00	.222E+01	.222E+01
F	H 4	.444E-02	.511E-02	.131E-02	.355E-03	.495E-02	.402E+00	.222E+01	.222E+01

F	H	4	.888E-02	.102E-01	.262E-02	.710E-03	.990E-02	.804E+00	.444E+01	.444E+01
F	H	4	.177E-01	.204E-01	.523E-02	.142E-02	.198E-01	.161E+01	.887E+01	.887E+01
F	H	5	.738E-02	.849E-02	.218E-02	.590E-03	.823E-02	.668E+00	.369E+01	.369E+01
F	H	5	.115E-01	.132E-01	.340E-02	.922E-03	.128E-01	.104E+01	.576E+01	.576E+01
F	H	5	.150E-01	.173E-01	.443E-02	.120E-02	.167E-01	.136E+01	.751E+01	.751E+01
F	H	5	.144E-01	.166E-01	.425E-02	.115E-02	.161E-01	.131E+01	.721E+01	.721E+01
F	H	6	.646E-02	.743E-02	.191E-02	.517E-03	.720E-02	.585E+00	.323E+01	.323E+01
F	H	6	.646E-02	.743E-02	.191E-02	.517E-03	.720E-02	.585E+00	.323E+01	.323E+01
F	H	6	.129E-01	.148E-01	.381E-02	.103E-02	.144E-01	.117E+01	.645E+01	.645E+01
F	H	6	.258E-01	.297E-01	.761E-02	.206E-02	.288E-01	.233E+01	.129E+02	.129E+02
F	H	7	.656E-02	.754E-02	.194E-02	.525E-03	.731E-02	.594E+00	.328E+01	.328E+01
F	H	7	.656E-02	.754E-02	.194E-02	.525E-03	.731E-02	.594E+00	.328E+01	.328E+01
F	H	7	.131E-01	.151E-01	.388E-02	.105E-02	.147E-01	.119E+01	.657E+01	.657E+01
F	H	7	.262E-01	.301E-01	.773E-02	.210E-02	.292E-01	.237E+01	.131E+02	.131E+02
F	H	8	.722E-02	.830E-02	.213E-02	.578E-03	.805E-02	.653E+00	.361E+01	.361E+01
F	H	8	.722E-02	.830E-02	.213E-02	.578E-03	.805E-02	.653E+00	.361E+01	.361E+01
F	H	8	.145E-01	.166E-01	.427E-02	.116E-02	.161E-01	.131E+01	.723E+01	.723E+01
F	H	8	.290E-01	.333E-01	.856E-02	.232E-02	.323E-01	.262E+01	.145E+02	.145E+02
F	H	9	.638E-02	.734E-02	.188E-02	.510E-03	.711E-02	.577E+00	.319E+01	.319E+01
F	H	9	.111E-01	.128E-01	.328E-02	.890E-03	.124E-01	.101E+01	.556E+01	.556E+01
F	H	9	.150E-01	.173E-01	.444E-02	.120E-02	.168E-01	.136E+01	.752E+01	.752E+01
F	H	9	.162E-01	.186E-01	.477E-02	.129E-02	.180E-01	.146E+01	.808E+01	.808E+01
F	H	10	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	H	10	.602E-02	.692E-02	.178E-02	.482E-03	.671E-02	.545E+00	.301E+01	.301E+01
F	H	10	.686E-02	.789E-02	.202E-02	.549E-03	.765E-02	.621E+00	.343E+01	.343E+01
F	H	10	.578E-02	.665E-02	.171E-02	.462E-03	.644E-02	.523E+00	.289E+01	.289E+01
F	H	11	.382E-02	.439E-02	.113E-02	.306E-03	.426E-02	.346E+00	.191E+01	.191E+01
F	H	11	.382E-02	.439E-02	.113E-02	.306E-03	.426E-02	.346E+00	.191E+01	.191E+01
F	H	11	.764E-02	.879E-02	.225E-02	.611E-03	.852E-02	.691E+00	.382E+01	.382E+01
F	H	11	.153E-01	.175E-01	.450E-02	.122E-02	.170E-01	.138E+01	.763E+01	.763E+01
F	H	12	.322E-02	.370E-02	.950E-03	.258E-03	.359E-02	.291E+00	.161E+01	.161E+01

F	H 12	.322E-02	.370E-02	.950E-03	.258E-03	.359E-02	.291E+00	.161E+01	.161E+01
F	H 12	.646E-02	.743E-02	.191E-02	.517E-03	.720E-02	.585E+00	.323E+01	.323E+01
F	H 12	.129E-01	.149E-01	.381E-02	.103E-02	.144E-01	.117E+01	.646E+01	.646E+01
F	H 13	.394E-02	.453E-02	.116E-02	.315E-03	.439E-02	.357E+00	.197E+01	.197E+01
F	H 13	.394E-02	.453E-02	.116E-02	.315E-03	.439E-02	.357E+00	.197E+01	.197E+01
F	H 13	.788E-02	.906E-02	.232E-02	.630E-03	.879E-02	.713E+00	.394E+01	.394E+01
F	H 13	.158E-01	.181E-01	.465E-02	.126E-02	.176E-01	.143E+01	.788E+01	.788E+01
F	H 14	.434E-02	.499E-02	.128E-02	.347E-03	.484E-02	.393E+00	.217E+01	.217E+01
F	H 14	.434E-02	.499E-02	.128E-02	.347E-03	.484E-02	.393E+00	.217E+01	.217E+01
F	H 14	.868E-02	.998E-02	.256E-02	.694E-03	.968E-02	.786E+00	.434E+01	.434E+01
F	H 14	.174E-01	.200E-01	.513E-02	.139E-02	.194E-01	.157E+01	.869E+01	.869E+01
F	H 15	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	H 15	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	H 15	.880E-02	.101E-01	.260E-02	.704E-03	.981E-02	.796E+00	.440E+01	.440E+01
F	H 15	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	I 1	.548E-02	.630E-02	.162E-02	.438E-03	.611E-02	.496E+00	.274E+01	.274E+01
F	I 1	.808E-02	.929E-02	.238E-02	.646E-03	.901E-02	.731E+00	.404E+01	.404E+01
F	I 1	.100E-01	.115E-01	.296E-02	.802E-03	.112E-01	.907E+00	.501E+01	.501E+01
F	I 1	.179E-01	.206E-01	.529E-02	.144E-02	.200E-01	.162E+01	.897E+01	.897E+01
F	I 2	.970E-03	.112E-02	.286E-03	.776E-04	.108E-02	.878E-01	.485E+00	.485E+00
F	I 2	.376E-02	.432E-02	.111E-02	.301E-03	.419E-02	.340E+00	.188E+01	.188E+01
F	I 2	.482E-02	.554E-02	.142E-02	.386E-03	.537E-02	.436E+00	.241E+01	.241E+01
F	I 2	.730E-02	.839E-02	.215E-02	.584E-03	.814E-02	.661E+00	.365E+01	.365E+01
F	I 3	.506E-02	.582E-02	.149E-02	.405E-03	.564E-02	.458E+00	.253E+01	.253E+01
F	I 3	.506E-02	.582E-02	.149E-02	.405E-03	.564E-02	.458E+00	.253E+01	.253E+01
F	I 3	.101E-01	.116E-01	.299E-02	.810E-03	.113E-01	.916E+00	.506E+01	.506E+01
F	I 3	.202E-01	.232E-01	.596E-02	.162E-02	.225E-01	.183E+01	.101E+02	.101E+02
F	I 4	.544E-02	.626E-02	.160E-02	.435E-03	.607E-02	.492E+00	.272E+01	.272E+01
F	I 4	.544E-02	.626E-02	.160E-02	.435E-03	.607E-02	.492E+00	.272E+01	.272E+01
F	I 4	.109E-01	.125E-01	.320E-02	.869E-03	.121E-01	.983E+00	.543E+01	.543E+01
F	I 4	.218E-01	.251E-01	.643E-02	.174E-02	.243E-01	.197E+01	.109E+02	.109E+02

F	I 5	.570E-02	.656E-02	.168E-02	.456E-03	.636E-02	.516E+00	.285E+01	.285E+01
F	I 5	.904E-02	.104E-01	.267E-02	.723E-03	.101E-01	.818E+00	.452E+01	.452E+01
F	I 5	.175E-01	.201E-01	.516E-02	.140E-02	.195E-01	.158E+01	.875E+01	.875E+01
F	I 5	.186E-01	.213E-01	.548E-02	.148E-02	.207E-01	.168E+01	.928E+01	.928E+01
F	I 6	.694E-02	.798E-02	.205E-02	.555E-03	.774E-02	.628E+00	.347E+01	.347E+01
F	I 6	.694E-02	.798E-02	.205E-02	.555E-03	.774E-02	.628E+00	.347E+01	.347E+01
F	I 6	.139E-01	.160E-01	.409E-02	.111E-02	.155E-01	.126E+01	.694E+01	.694E+01
F	I 6	.278E-01	.320E-01	.820E-02	.222E-02	.310E-01	.252E+01	.139E+02	.139E+02
F	I 7	.812E-02	.934E-02	.240E-02	.650E-03	.905E-02	.735E+00	.406E+01	.406E+01
F	I 7	.812E-02	.934E-02	.240E-02	.650E-03	.905E-02	.735E+00	.406E+01	.406E+01
F	I 7	.162E-01	.187E-01	.478E-02	.130E-02	.181E-01	.147E+01	.811E+01	.811E+01
F	I 7	.324E-01	.373E-01	.956E-02	.259E-02	.361E-01	.293E+01	.162E+02	.162E+02
F	I 8	.686E-02	.789E-02	.202E-02	.549E-03	.765E-02	.621E+00	.343E+01	.343E+01
F	I 8	.113E-01	.130E-01	.335E-02	.907E-03	.126E-01	.103E+01	.567E+01	.567E+01
F	I 8	.143E-01	.165E-01	.422E-02	.115E-02	.160E-01	.130E+01	.716E+01	.716E+01
F	I 8	.127E-01	.146E-01	.375E-02	.102E-02	.142E-01	.115E+01	.636E+01	.636E+01
F	I 9	.844E-02	.971E-02	.249E-02	.675E-03	.941E-02	.764E+00	.422E+01	.422E+01
F	I 9	.136E-01	.157E-01	.402E-02	.109E-02	.152E-01	.123E+01	.681E+01	.681E+01
F	I 9	.174E-01	.200E-01	.513E-02	.139E-02	.194E-01	.157E+01	.870E+01	.870E+01
F	I 9	.182E-01	.210E-01	.537E-02	.146E-02	.203E-01	.165E+01	.911E+01	.911E+01
F	I 10	.642E-02	.738E-02	.189E-02	.514E-03	.716E-02	.581E+00	.321E+01	.321E+01
F	I 10	.642E-02	.738E-02	.189E-02	.514E-03	.716E-02	.581E+00	.321E+01	.321E+01
F	I 10	.129E-01	.148E-01	.379E-02	.103E-02	.143E-01	.116E+01	.643E+01	.643E+01
F	I 10	.258E-01	.297E-01	.761E-02	.206E-02	.288E-01	.233E+01	.129E+02	.129E+02
F	I 11	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	I 11	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	I 11	.894E-02	.103E-01	.264E-02	.715E-03	.997E-02	.809E+00	.447E+01	.447E+01
F	I 11	.179E-01	.205E-01	.527E-02	.143E-02	.199E-01	.162E+01	.893E+01	.893E+01
F	I 12	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 12	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 12	.880E-02	.101E-01	.260E-02	.704E-03	.981E-02	.796E+00	.440E+01	.440E+01

F	I 12	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	I 13	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 13	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 13	.880E-02	.101E-01	.260E-02	.704E-03	.981E-02	.796E+00	.440E+01	.440E+01
F	I 13	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	I 14	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 14	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 14	.880E-02	.101E-01	.260E-02	.704E-03	.981E-02	.796E+00	.440E+01	.440E+01
F	I 14	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	I 15	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 15	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	I 15	.880E-02	.101E-01	.260E-02	.704E-03	.981E-02	.796E+00	.440E+01	.440E+01
F	I 15	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	I 16	.434E-02	.499E-02	.128E-02	.347E-03	.484E-02	.393E+00	.217E+01	.217E+01
F	I 16	.434E-02	.499E-02	.128E-02	.347E-03	.484E-02	.393E+00	.217E+01	.217E+01
F	I 16	.868E-02	.998E-02	.256E-02	.694E-03	.968E-02	.786E+00	.434E+01	.434E+01
F	I 16	.174E-01	.200E-01	.512E-02	.139E-02	.194E-01	.157E+01	.868E+01	.868E+01
F	J 1	.722E-02	.830E-02	.213E-02	.578E-03	.805E-02	.653E+00	.361E+01	.361E+01
F	J 1	.938E-02	.108E-01	.277E-02	.750E-03	.105E-01	.849E+00	.469E+01	.469E+01
F	J 1	.976E-02	.112E-01	.288E-02	.781E-03	.109E-01	.883E+00	.488E+01	.488E+01
F	J 1	.200E-01	.230E-01	.589E-02	.160E-02	.223E-01	.181E+01	.998E+01	.998E+01
F	J 2	.438E-02	.504E-02	.129E-02	.350E-03	.488E-02	.396E+00	.219E+01	.219E+01
F	J 2	.137E-01	.157E-01	.403E-02	.109E-02	.152E-01	.124E+01	.683E+01	.683E+01
F	J 2	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	J 2	.308E-01	.354E-01	.909E-02	.246E-02	.343E-01	.279E+01	.154E+02	.154E+02
F	J 3	.524E-02	.603E-02	.155E-02	.419E-03	.584E-02	.474E+00	.262E+01	.262E+01
F	J 3	.418E-02	.481E-02	.123E-02	.334E-03	.466E-02	.378E+00	.209E+01	.209E+01
F	J 3	.754E-02	.867E-02	.222E-02	.603E-03	.841E-02	.682E+00	.377E+01	.377E+01
F	J 3	.136E-01	.156E-01	.401E-02	.109E-02	.151E-01	.123E+01	.679E+01	.679E+01
F	J 4	.740E-02	.851E-02	.218E-02	.592E-03	.825E-02	.670E+00	.370E+01	.370E+01
F	J 4	.109E-01	.126E-01	.322E-02	.874E-03	.122E-01	.988E+00	.546E+01	.546E+01

F	J 4	.220E-01	.253E-01	.649E-02	.176E-02	.245E-01	.199E+01	.110E+02	.110E+02
F	J 4	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	J 5	.652E-02	.750E-02	.192E-02	.522E-03	.727E-02	.590E+00	.326E+01	.326E+01
F	J 5	.652E-02	.750E-02	.192E-02	.522E-03	.727E-02	.590E+00	.326E+01	.326E+01
F	J 5	.130E-01	.150E-01	.385E-02	.104E-02	.145E-01	.118E+01	.652E+01	.652E+01
F	J 5	.260E-01	.299E-01	.767E-02	.208E-02	.290E-01	.235E+01	.130E+02	.130E+02
F	J 6	.674E-02	.775E-02	.199E-02	.539E-03	.752E-02	.610E+00	.337E+01	.337E+01
F	J 6	.674E-02	.775E-02	.199E-02	.539E-03	.752E-02	.610E+00	.337E+01	.337E+01
F	J 6	.135E-01	.155E-01	.398E-02	.108E-02	.150E-01	.122E+01	.674E+01	.674E+01
F	J 6	.270E-01	.310E-01	.797E-02	.216E-02	.301E-01	.244E+01	.135E+02	.135E+02
F	J 7	.772E-02	.888E-02	.228E-02	.618E-03	.861E-02	.699E+00	.386E+01	.386E+01
F	J 7	.128E-01	.147E-01	.378E-02	.102E-02	.143E-01	.116E+01	.640E+01	.640E+01
F	J 7	.160E-01	.184E-01	.473E-02	.128E-02	.179E-01	.145E+01	.801E+01	.801E+01
F	J 7	.130E-01	.149E-01	.383E-02	.104E-02	.145E-01	.117E+01	.649E+01	.649E+01
F	J 8	.976E-02	.112E-01	.288E-02	.781E-03	.109E-01	.883E+00	.488E+01	.488E+01
F	J 8	.158E-01	.181E-01	.466E-02	.126E-02	.176E-01	.143E+01	.789E+01	.789E+01
F	J 8	.210E-01	.242E-01	.620E-02	.168E-02	.234E-01	.190E+01	.105E+02	.105E+02
F	J 8	.226E-01	.260E-01	.667E-02	.181E-02	.252E-01	.205E+01	.113E+02	.113E+02
F	J 9	.836E-02	.961E-02	.247E-02	.669E-03	.932E-02	.757E+00	.418E+01	.418E+01
F	J 9	.836E-02	.961E-02	.247E-02	.669E-03	.932E-02	.757E+00	.418E+01	.418E+01
F	J 9	.167E-01	.192E-01	.493E-02	.134E-02	.186E-01	.151E+01	.835E+01	.835E+01
F	J 9	.334E-01	.384E-01	.985E-02	.267E-02	.372E-01	.302E+01	.167E+02	.167E+02
F	J 10	.844E-02	.971E-02	.249E-02	.675E-03	.941E-02	.764E+00	.422E+01	.422E+01
F	J 10	.844E-02	.971E-02	.249E-02	.675E-03	.941E-02	.764E+00	.422E+01	.422E+01
F	J 10	.169E-01	.194E-01	.498E-02	.135E-02	.188E-01	.153E+01	.844E+01	.844E+01
F	J 10	.338E-01	.389E-01	.997E-02	.270E-02	.377E-01	.306E+01	.169E+02	.169E+02
F	J 11	.704E-02	.810E-02	.208E-02	.563E-03	.785E-02	.637E+00	.352E+01	.352E+01
F	J 11	.704E-02	.810E-02	.208E-02	.563E-03	.785E-02	.637E+00	.352E+01	.352E+01
F	J 11	.141E-01	.162E-01	.416E-02	.113E-02	.157E-01	.128E+01	.705E+01	.705E+01
F	J 11	.282E-01	.324E-01	.832E-02	.226E-02	.314E-01	.255E+01	.141E+02	.141E+02
F	J 12	.504E-02	.580E-02	.149E-02	.403E-03	.562E-02	.456E+00	.252E+01	.252E+01

F	J 12	.504E-02	.580E-02	.149E-02	.403E-03	.562E-02	.456E+00	.252E+01	.252E+01
F	J 12	.101E-01	.116E-01	.297F-02	.806E-03	.112E-01	.912E+00	.504E+01	.504E+01
F	J 12	.202E-01	.232E-01	.596E-02	.162E-02	.225E-01	.183E+01	.101E+02	.101E+02
F	J 13	.504E-02	.580E-02	.149E-02	.403E-03	.562E-02	.456E+00	.252E+01	.252E+01
F	J 13	.504E-02	.580E-02	.149E-02	.403E-03	.562E-02	.456E+00	.252E+01	.252E+01
F	J 13	.101E-01	.116E-01	.297E-02	.806E-03	.112E-01	.912E+00	.504E+01	.504E+01
F	J 13	.202E-01	.232E-01	.596E-02	.162E-02	.225E-01	.183E+01	.101E+02	.101E+02
F	J 14	.452E-02	.520E-02	.133E-02	.362E-03	.504E-02	.409E+00	.226E+01	.226E+01
F	J 14	.854E-02	.982E-02	.252E-02	.683E-03	.952E-02	.773E+00	.427E+01	.427E+01
F	J 14	.130E-01	.150E-01	.384E-02	.104E-02	.145E-01	.118E+01	.651E+01	.651E+01
F	J 14	.142E-01	.163E-01	.418E-02	.113E-02	.158E-01	.128E+01	.709E+01	.709E+01
F	J 15	.440E-02	.506E-02	.130E-02	.352E-03	.491E-02	.398E+00	.220E+01	.220E+01
F	J 15	.686E-02	.789E-02	.202E-02	.549E-03	.765E-02	.621E+00	.343E+01	.343E+01
F	J 15	.790E-02	.909E-02	.233E-02	.632E-03	.881E-02	.715E+00	.395E+01	.395E+01
F	J 15	.522E-02	.600E-02	.154E-02	.418E-03	.582E-02	.472E+00	.261E+01	.261E+01
F	J 16	.428E-02	.492E-02	.126E-02	.342E-03	.477E-02	.387E+00	.214E+01	.214E+01
F	J 16	.714E-02	.821E-02	.211E-02	.571E-03	.796E-02	.646E+00	.357E+01	.357E+01
F	J 16	.948E-02	.109E-01	.280E-02	.758E-03	.106E-01	.858E+00	.474E+01	.474E+01
F	J 16	.102E-01	.117E-01	.300E-02	.813E-03	.113E-01	.919E+00	.508E+01	.508E+01
F	K 1	.876E-02	.101E-01	.258E-02	.701E-03	.977E-02	.793E+00	.438E+01	.438E+01
F	K 1	.125E-01	.144E-01	.369E-02	.100E-02	.140E-01	.113E+01	.626E+01	.626E+01
F	K 1	.134E-01	.155E-01	.396E-02	.108E-02	.150E-01	.122E+01	.672E+01	.672E+01
F	K 1	.278E-01	.320E-01	.820E-02	.222E-02	.310E-01	.252E+01	.139E+02	.139E+02
F	K 2	.484E-02	.557E-02	.143E-02	.387E-03	.540E-02	.438E+00	.242E+01	.242E+01
F	K 2	.177E-01	.204E-01	.522E-02	.142E-02	.197E-01	.160E+01	.885E+01	.885E+01
F	K 2	.320E-01	.368E-01	.944E-02	.256E-02	.357E-01	.290E+01	.160E+02	.160E+02
F	K 2	.434E-01	.499E-01	.128E-01	.347E-02	.484E-01	.393E+01	.217E+02	.217E+02
F	K 3	.185E-02	.213E-02	.546E-03	.148E-03	.206E-02	.168E+00	.926E+00	.926E+00
F	K 3	.370E-03	.425E-03	.109E-03	.296E-04	.413E-03	.335E-01	.185E+00	.185E+00
F	K 3	.444E-03	.511E-03	.131E-03	.355E-04	.495E-03	.402E-01	.222E+00	.222E+00
F	K 3	.534E-03	.614E-03	.158E-03	.427E-04	.595E-03	.483E-01	.267E+00	.267E+00

F	K 4	.110E-01	.127E-01	.326E-02	.883E-03	.123E-01	.999E+00	.552E+01	.552E+01
F	K 4	.163E-01	.188E-01	.481E-02	.131E-02	.182E-01	.148E+01	.816E+01	.816E+01
F	K 4	.314E-01	.361E-01	.926E-02	.251E-02	.350E-01	.284E+01	.157E+02	.157E+02
F	K 4	.308E-01	.354E-01	.909E-02	.246E-02	.343E-01	.279E+01	.154E+02	.154E+02
F	K 5	.942E-02	.108E-01	.278E-02	.754E-03	.105E-01	.853E+00	.471E+01	.471E+01
F	K 5	.942E-02	.108E-01	.278E-02	.754E-03	.105E-01	.853E+00	.471E+01	.471E+01
F	K 5	.188E-01	.216E-01	.555E-02	.151E-02	.210E-01	.170E+01	.941E+01	.941E+01
F	K 5	.376E-01	.432E-01	.111E-01	.301E-02	.419E-01	.340E+01	.188E+02	.188E+02
F	K 6	.714E-02	.821E-02	.211E-02	.571E-03	.796E-02	.646E+00	.357E+01	.357E+01
F	K 6	.162E-01	.186E-01	.478E-02	.130E-02	.181E-01	.147E+01	.810E+01	.810E+01
F	K 6	.232E-01	.267E-01	.684E-02	.186E-02	.259E-01	.210E+01	.116E+02	.116E+02
F	K 6	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	K 7	.638E-02	.734E-02	.188E-02	.510E-03	.711E-02	.577E+00	.319E+01	.319E+01
F	K 7	.140E-01	.161E-01	.412E-02	.112E-02	.156E-01	.126E+01	.698E+01	.698E+01
F	K 7	.200E-01	.230E-01	.590E-02	.160E-02	.223E-01	.181E+01	.100E+02	.100E+02
F	K 7	.210E-01	.242E-01	.620E-02	.168E-02	.234E-01	.190E+01	.105E+02	.105E+02
F	K 8	.930E-02	.107E-01	.274E-02	.744E-03	.104E-01	.842E+00	.465E+01	.465E+01
F	K 8	.930E-02	.107E-01	.274E-02	.744E-03	.104E-01	.842E+00	.465E+01	.465E+01
F	K 8	.186E-01	.214E-01	.548E-02	.149E-02	.207E-01	.168E+01	.929E+01	.929E+01
F	K 8	.372E-01	.428E-01	.110E-01	.298E-02	.415E-01	.337E+01	.186E+02	.186E+02
F	K 9	.109E-01	.126E-01	.323E-02	.875E-03	.122E-01	.990E+00	.547E+01	.547E+01
F	K 9	.109E-01	.126E-01	.323E-02	.875E-03	.122E-01	.990E+00	.547E+01	.547E+01
F	K 9	.218E-01	.251E-01	.643E-02	.174E-02	.243E-01	.197E+01	.109E+02	.109E+02
F	K 9	.438E-01	.504E-01	.129E-01	.350E-02	.488E-01	.396E+01	.219E+02	.219E+02
F	K 10	.108E-01	.124E-01	.318E-02	.862E-03	.120E-01	.976E+00	.539E+01	.539E+01
F	K 10	.108E-01	.124E-01	.318E-02	.862E-03	.120E-01	.976E+00	.539E+01	.539E+01
F	K 10	.216E-01	.248E-01	.637E-02	.173E-02	.241E-01	.195E+01	.108E+02	.108E+02
F	K 10	.432E-01	.497E-01	.127E-01	.346E-02	.482E-01	.391E+01	.216E+02	.216E+02
F	K 11	.870E-02	.100E-01	.257E-02	.696E-03	.970E-02	.787E+00	.435E+01	.435E+01
F	K 11	.870E-02	.100E-01	.257E-02	.696E-03	.970E-02	.787E+00	.435E+01	.435E+01
F	K 11	.174E-01	.200E-01	.513E-02	.139E-02	.194E-01	.157E+01	.870E+01	.870E+01

F	K 11	.348E-01	.400E-01	.103E-01	.278E-02	.388E-01	.315E+01	.174E+02	.174E+02
F	K 12	.704E-02	.810E-02	.208E-02	.563E-03	.785E-02	.637E+00	.352E+01	.352E+01
F	K 12	.138E-01	.159E-01	.407E-02	.110E-02	.154E-01	.125E+01	.690E+01	.690E+01
F	K 12	.177E-01	.204E-01	.522E-02	.142E-02	.197E-01	.160E+01	.885E+01	.885E+01
F	K 12	.140E-01	.161E-01	.414E-02	.112E-02	.157E-01	.127E+01	.702E+01	.702E+01
F	K 13	.536E-02	.616E-02	.158E-02	.429E-03	.598E-02	.485E+00	.268E+01	.268E+01
F	K 13	.108E-01	.124E-01	.319E-02	.864E-03	.120E-01	.977E+00	.540E+01	.540E+01
F	K 13	.147E-01	.170E-01	.435E-02	.118E-02	.164E-01	.133E+01	.737E+01	.737E+01
F	K 13	.116E-01	.133E-01	.342E-02	.928E-03	.129E-01	.105E+01	.580E+01	.580E+01
F	K 14	.464E-02	.534E-02	.137E-02	.371E-03	.517E-02	.420E+00	.232E+01	.232E+01
F	K 14	.906E-02	.104E-01	.267E-02	.725E-03	.101E-01	.820E+00	.453E+01	.453E+01
F	K 14	.140E-01	.161E-01	.412E-02	.112E-02	.156E-01	.127E+01	.699E+01	.699E+01
F	K 14	.152E-01	.174E-01	.447E-02	.121E-02	.169E-01	.137E+01	.758E+01	.758E+01
F	K 15	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	K 15	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	K 15	.892E-02	.103E-01	.263E-02	.714E-03	.995E-02	.807E+00	.446E+01	.446E+01
F	K 15	.178E-01	.205E-01	.526E-02	.143E-02	.199E-01	.161E+01	.892E+01	.892E+01
F	K 16	.434E-02	.499E-02	.128E-02	.347E-03	.484E-02	.393E+00	.217E+01	.217E+01
F	K 16	.434E-02	.499E-02	.128E-02	.347E-03	.484E-02	.393E+00	.217E+01	.217E+01
F	K 16	.868E-02	.998E-02	.256E-02	.694E-03	.968E-02	.786E+00	.434E+01	.434E+01
F	K 16	.174E-01	.200E-01	.512E-02	.139E-02	.194E-01	.157E+01	.868E+01	.868E+01
F	L 1	.958E-02	.110E-01	.283E-02	.766E-03	.107E-01	.867E+00	.479E+01	.479E+01
F	L 1	.165E-01	.190E-01	.487E-02	.132E-02	.184E-01	.150E+01	.826E+01	.826E+01
F	L 1	.185E-01	.212E-01	.545E-02	.148E-02	.206E-01	.167E+01	.923E+01	.923E+01
F	L 1	.396E-01	.455E-01	.117E-01	.317E-02	.442E-01	.358E+01	.198E+02	.198E+02
F	L 2	.854E-02	.982E-02	.252E-02	.683E-03	.952E-02	.773E+00	.427E+01	.427E+01
F	L 2	.340E-01	.391E-01	.100E-01	.272E-02	.379E-01	.308E+01	.170E+02	.170E+02
F	L 2	.530E-01	.610E-01	.156E-01	.424E-02	.591E-01	.480E+01	.265E+02	.265E+02
F	L 2	.818E-01	.941E-01	.241E-01	.654E-02	.912E-01	.740E+01	.409E+02	.409E+02
F	L 3	.172E-01	.197E-01	.506E-02	.137E-02	.191E-01	.155E+01	.858E+01	.858E+01
F	L 3	.292E-01	.336E-01	.861E-02	.234E-02	.326E-01	.264E+01	.146E+02	.146E+02

F	L 3	.494E-01	.568E-01	.146E-01	.395E-02	.551E-01	.447E+01	.247E+02	.247E+02
F	L 3	.580E-01	.667E-01	.171E-01	.464E-02	.647E-01	.525E+01	.290E+02	.290E+02
F	L 4	.546E-02	.628E-02	.161E-02	.437E-03	.609E-02	.494E+00	.273E+01	.273E+01
F	L 4	.776E-02	.892E-02	.229E-02	.621E-03	.865E-02	.702E+00	.388E+01	.388E+01
F	L 4	.131E-01	.151E-01	.388E-02	.105E-02	.147E-01	.119E+01	.657E+01	.657E+01
F	L 4	.127E-01	.146E-01	.373E-02	.101E-02	.141E-01	.115E+01	.633E+01	.633E+01
F	L 5	.972E-02	.112E-01	.287E-02	.778E-03	.108E-01	.880E+00	.486E+01	.486E+01
F	L 5	.216E-01	.248E-01	.637E-02	.173E-02	.241E-01	.195E+01	.108E+02	.108E+02
F	L 5	.310E-01	.356E-01	.915E-02	.248E-02	.346E-01	.281E+01	.155E+02	.155E+02
F	L 5	.322E-01	.370E-01	.950E-02	.258E-02	.359E-01	.291E+01	.161E+02	.161E+02
F	L 6	.129E-01	.149E-01	.381E-02	.103E-02	.144E-01	.117E+01	.646E+01	.646E+01
F	L 6	.218E-01	.251E-01	.643E-02	.174E-02	.243E-01	.197E+01	.109E+02	.109E+02
F	L 6	.248E-01	.285E-01	.732E-02	.198E-02	.277E-01	.224E+01	.124E+02	.124E+02
F	L 6	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	L 7	.125E-01	.144E-01	.369E-02	.100E-02	.140E-01	.113E+01	.626E+01	.626E+01
F	L 7	.125E-01	.144E-01	.369E-02	.100E-02	.140E-01	.113E+01	.626E+01	.626E+01
F	L 7	.250E-01	.287E-01	.738E-02	.200E-02	.279E-01	.226E+01	.125E+02	.125E+02
F	L 7	.500E-01	.575E-01	.148E-01	.400E-02	.558E-01	.453E+01	.250E+02	.250E+02
F	L 8	.136E-01	.157E-01	.402E-02	.109E-02	.152E-01	.123E+01	.681E+01	.681E+01
F	L 8	.136E-01	.157E-01	.402E-02	.109E-02	.152E-01	.123E+01	.681E+01	.681E+01
F	L 8	.272E-01	.313E-01	.802E-02	.218E-02	.303E-01	.246E+01	.136E+02	.136E+02
F	L 8	.546E-01	.628E-01	.161E-01	.437E-02	.609E-01	.494E+01	.273E+02	.273E+02
F	L 9	.133E-01	.153E-01	.392E-02	.106E-02	.148E-01	.120E+01	.665E+01	.665E+01
F	L 9	.248E-01	.285E-01	.732E-02	.198E-02	.277E-01	.224E+01	.124E+02	.124E+02
F	L 9	.344E-01	.396E-01	.101E-01	.275E-02	.384E-01	.311E+01	.172E+02	.172E+02
F	L 9	.378E-01	.435E-01	.112E-01	.302E-02	.421E-01	.342E+01	.189E+02	.189E+02
F	L 10	.980E-02	.113E-01	.289E-02	.784E-03	.109E-01	.887E+00	.490E+01	.490E+01
F	L 10	.175E-01	.201E-01	.516E-02	.140E-02	.195E-01	.158E+01	.874E+01	.874E+01
F	L 10	.258E-01	.297E-01	.761E-02	.206E-02	.288E-01	.233E+01	.129E+02	.129E+02
F	L 10	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	L 11	.926E-02	.106E-01	.273E-02	.741E-03	.103E-01	.838E+00	.463E+01	.463E+01

F	L 11	.165E-01	.190E-01	.487E-02	.132E-02	.184E-01	.150E+01	.826E+01	.826E+01
F	L 11	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	L 11	.167E-01	.192E-01	.491E-02	.133E-02	.186E-01	.151E+01	.833E+01	.833E+01
F	L 12	.658E-02	.757E-02	.194E-02	.526E-03	.734E-02	.595E+00	.329E+01	.329E+01
F	L 12	.658E-02	.757E-02	.194E-02	.526E-03	.734E-02	.595E+00	.329E+01	.329E+01
F	L 12	.131E-01	.151E-01	.388E-02	.105E-02	.147E-01	.119E+01	.657E+01	.657E+01
F	L 12	.262E-01	.301E-01	.773E-02	.210E-02	.292E-01	.237E+01	.131E+02	.131E+02
F	L 13	.568E-02	.653E-02	.168E-02	.454E-03	.633E-02	.514E+00	.284E+01	.284E+01
F	L 13	.568E-02	.653E-02	.168E-02	.454E-03	.633E-02	.514E+00	.284E+01	.284E+01
F	L 13	.114E-01	.131E-01	.335E-02	.909E-03	.127E-01	.103E+01	.568E+01	.568E+01
F	L 13	.228E-01	.262E-01	.673E-02	.182E-02	.254E-01	.206E+01	.114E+02	.114E+02
F	L 14	.500E-02	.575E-02	.148E-02	.400E-03	.558E-02	.453E+00	.250E+01	.250E+01
F	L 14	.500E-02	.575E-02	.148E-02	.400E-03	.558E-02	.453E+00	.250E+01	.250E+01
F	L 14	.998E-02	.115E-01	.294E-02	.798E-03	.111E-01	.903E+00	.499E+01	.499E+01
F	L 14	.200E-01	.230E-01	.589E-02	.160E-02	.223E-01	.181E+01	.998E+01	.998E+01
F	L 15	.464E-02	.534E-02	.137E-02	.371E-03	.517E-02	.420E+00	.232E+01	.232E+01
F	L 15	.464E-02	.534E-02	.137E-02	.371E-03	.517E-02	.420E+00	.232E+01	.232E+01
F	L 15	.926E-02	.106E-01	.273E-02	.741E-03	.103E-01	.838E+00	.463E+01	.463E+01
F	L 15	.185E-01	.213E-01	.546E-02	.148E-02	.206E-01	.168E+01	.926E+01	.926E+01
F	L 16	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	L 16	.446E-02	.513E-02	.132E-02	.357E-03	.497E-02	.404E+00	.223E+01	.223E+01
F	L 16	.892E-02	.103E-01	.263E-02	.714E-03	.995E-02	.807E+00	.446E+01	.446E+01
F	L 16	.178E-01	.205E-01	.526E-02	.143E-02	.199E-01	.161E+01	.892E+01	.892E+01
F	M 1	.942E-02	.108E-01	.278E-02	.754E-03	.105E-01	.853E+00	.471E+01	.471E+01
F	M 1	.176E-01	.203E-01	.520E-02	.141E-02	.196E-01	.159E+01	.881E+01	.881E+01
F	M 1	.214E-01	.246E-01	.631E-02	.171E-02	.239E-01	.194E+01	.107E+02	.107E+02
F	M 1	.442E-01	.508E-01	.130E-01	.354E-02	.493E-01	.400E+01	.221E+02	.221E+02
F	M 2	.135E-01	.155E-01	.397E-02	.108E-02	.150E-01	.122E+01	.673E+01	.673E+01
F	M 2	.516E-01	.593E-01	.152E-01	.413E-02	.575E-01	.467E+01	.258E+02	.258E+02
F	M 2	.922E-01	.106E+00	.272E-01	.738E-02	.103E+00	.834E+01	.461E+02	.461E+02
F	M 2	.151E+00	.174E+00	.445E-01	.121E-01	.168E+00	.137E+02	.755E+02	.755E+02

F	M 3	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	M 3	.406E-01	.467E-01	.120E-01	.325E-02	.453E-01	.367E+01	.203E+02	.203E+02
F	M 3	.718E-01	.826E-01	.212E-01	.574E-02	.801E-01	.650E+01	.359E+02	.359E+02
F	M 3	.736E-01	.846E-01	.217E-01	.589E-02	.821E-01	.666E+01	.368E+02	.368E+02
F	M 4	.230E-01	.264E-01	.679E-02	.184E-02	.256E-01	.208E+01	.115E+02	.115E+02
F	M 4	.424E-01	.488E-01	.125E-01	.339E-02	.473E-01	.384E+01	.212E+02	.212E+02
F	M 4	.600E-01	.690E-01	.177E-01	.480E-02	.669E-01	.543E+01	.300E+02	.300E+02
F	M 4	.634E-01	.729E-01	.187E-01	.507E-02	.707E-01	.574E+01	.317E+02	.317E+02
F	M 5	.684E-02	.787E-02	.202E-02	.547E-03	.763E-02	.619E+00	.342E+01	.342E+01
F	M 5	.122E-01	.140E-01	.360E-02	.976E-03	.136E-01	.110E+01	.610E+01	.610E+01
F	M 5	.124E-01	.143E-01	.366E-02	.994E-03	.138E-01	.112E+01	.621E+01	.621E+01
F	M 5	.760E-02	.874E-02	.224E-02	.608E-03	.847E-02	.688E+00	.380E+01	.380E+01
F	M 6	.164E-01	.189E-01	.484E-02	.131E-02	.183E-01	.149E+01	.821E+01	.821E+01
F	M 6	.164E-01	.189E-01	.484E-02	.131E-02	.183E-01	.149E+01	.821E+01	.821E+01
F	M 6	.328E-01	.377E-01	.968E-02	.262E-02	.366E-01	.297E+01	.164E+02	.164E+02
F	M 6	.656E-01	.754E-01	.194E-01	.525E-02	.731E-01	.594E+01	.328E+02	.328E+02
F	M 7	.212E-01	.244E-01	.625E-02	.170E-02	.236E-01	.192E+01	.106E+02	.106E+02
F	M 7	.364E-01	.419E-01	.107E-01	.291E-02	.406E-01	.329E+01	.182E+02	.182E+02
F	M 7	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	M 7	.404E-01	.465E-01	.119E-01	.323E-02	.450E-01	.366E+01	.202E+02	.202E+02
F	M 8	.150E-01	.172E-01	.442E-02	.120E-02	.167E-01	.136E+01	.749E+01	.749E+01
F	M 8	.272E-01	.313E-01	.802E-02	.218E-02	.303E-01	.246E+01	.136E+02	.136E+02
F	M 8	.362E-01	.416E-01	.107E-01	.290E-02	.404E-01	.328E+01	.181E+02	.181E+02
F	M 8	.300E-01	.345E-01	.885E-02	.240E-02	.334E-01	.272E+01	.150E+02	.150E+02
F	M 9	.123E-01	.142E-01	.363E-02	.986E-03	.137E-01	.111E+01	.616E+01	.616E+01
F	M 9	.258E-01	.297E-01	.761E-02	.206E-02	.288E-01	.233E+01	.129E+02	.129E+02
F	M 9	.340E-01	.391E-01	.100E-01	.272E-02	.379E-01	.308E+01	.170E+02	.170E+02
F	M 9	.274E-01	.315E-01	.808E-02	.219E-02	.306E-01	.248E+01	.137E+02	.137E+02
F	M 10	.112E-01	.128E-01	.329E-02	.893E-03	.124E-01	.101E+01	.558E+01	.558E+01
F	M 10	.112E-01	.128E-01	.329E-02	.893E-03	.124E-01	.101E+01	.558E+01	.558E+01
F	M 10	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02

F	M 10	.446E-01	.513E-01	.132E-01	.357E-02	.497E-01	.404E+01	.223E+02	.223E+02
F	M 11	.954E-02	.110E-01	.281E-02	.763E-03	.106E-01	.863E+00	.477E+01	.477E+01
F	M 11	.954E-02	.110E-01	.281E-02	.763E-03	.106E-01	.863E+00	.477E+01	.477E+01
F	M 11	.191E-01	.219E-01	.562E-02	.152E-02	.213E-01	.172E+01	.953E+01	.953E+01
F	M 11	.382E-01	.439E-01	.113E-01	.306E-02	.426E-01	.346E+01	.191E+02	.191E+02
F	M 12	.926E-02	.106E-01	.273E-02	.741E-03	.103E-01	.838E+00	.463E+01	.463E+01
F	M 12	.926E-02	.106E-01	.273E-02	.741E-03	.103E-01	.838E+00	.463E+01	.463E+01
F	M 12	.185E-01	.213E-01	.547E-02	.148E-02	.207E-01	.168E+01	.927E+01	.927E+01
F	M 12	.370E-01	.425E-01	.109E-01	.296E-02	.413E-01	.335E+01	.185E+02	.185E+02
F	M 13	.936E-02	.108E-01	.276E-02	.749E-03	.104E-01	.847E+00	.468E+01	.468E+01
F	M 13	.936E-02	.108E-01	.276E-02	.749E-03	.104E-01	.847E+00	.468E+01	.468E+01
F	M 13	.187E-01	.216E-01	.553E-02	.150E-02	.209E-01	.170E+01	.937E+01	.937E+01
F	M 13	.374E-01	.430E-01	.110E-01	.299E-02	.417E-01	.338E+01	.187E+02	.187E+02
F	M 14	.856E-02	.984E-02	.253E-02	.685E-03	.954E-02	.775E+00	.428E+01	.428E+01
F	M 14	.856E-02	.984E-02	.253E-02	.685E-03	.954E-02	.775E+00	.428E+01	.428E+01
F	M 14	.171E-01	.197E-01	.505E-02	.137E-02	.191E-01	.155E+01	.856E+01	.856E+01
F	M 14	.342E-01	.393E-01	.101E-01	.274E-02	.381E-01	.310E+01	.171E+02	.171E+02
F	M 15	.788E-02	.906E-02	.232E-02	.630E-03	.879E-02	.713E+00	.394E+01	.394E+01
F	M 15	.788E-02	.906E-02	.232E-02	.630E-03	.879E-02	.713E+00	.394E+01	.394E+01
F	M 15	.158E-01	.181E-01	.465E-02	.126E-02	.176E-01	.143E+01	.788E+01	.788E+01
F	M 15	.316E-01	.363E-01	.932E-02	.253E-02	.352E-01	.286E+01	.158E+02	.158E+02
F	M 16	.764E-02	.879E-02	.225E-02	.611E-03	.852E-02	.691E+00	.382E+01	.382E+01
F	M 16	.764E-02	.879E-02	.225E-02	.611E-03	.852E-02	.691E+00	.382E+01	.382E+01
F	M 16	.153E-01	.176E-01	.451E-02	.122E-02	.171E-01	.138E+01	.765E+01	.765E+01
F	M 16	.306E-01	.352E-01	.903E-02	.245E-02	.341E-01	.277E+01	.153E+02	.153E+02
F	N 1	.498E-02	.573E-02	.147E-02	.398E-03	.555E-02	.451E+00	.249E+01	.249E+01
F	N 1	.182E-01	.210E-01	.538E-02	.146E-02	.203E-01	.165E+01	.912E+01	.912E+01
F	N 1	.252E-01	.290E-01	.743E-02	.202E-02	.281E-01	.228E+01	.126E+02	.126E+02
F	N 1	.410E-01	.471E-01	.121E-01	.328E-02	.457E-01	.371E+01	.205E+02	.205E+02
F	N 2	.456E-01	.524E-01	.135E-01	.365E-02	.508E-01	.413E+01	.228E+02	.228E+02
F	N 2	.852E-01	.980E-01	.251E-01	.682E-02	.950E-01	.771E+01	.426E+02	.426E+02

F	N 2	.101E+00	.116E+00	.299E-01	.810E-02	.113E+00	.916E+01	.506E+02	.506E+02
F	N 2	.146E+00	.167E+00	.430E-01	.116E-01	.162E+00	.132E+02	.728E+02	.728E+02
F	N 3	.298E-01	.343E-01	.879E-02	.238E-02	.332E-01	.270E+01	.149E+02	.149E+02
F	N 3	.564E-01	.649E-01	.166E-01	.451E-02	.629E-01	.510E+01	.282E+02	.282E+02
F	N 3	.940E-01	.108E+00	.277E-01	.752E-02	.105E+00	.851E+01	.470E+02	.470E+02
F	N 3	.854E-01	.982E-01	.252E-01	.683E-02	.952E-01	.773E+01	.427E+02	.427E+02
F	N 4	.296E-01	.340E-01	.873E-02	.237E-02	.330E-01	.268E+01	.148E+02	.148E+02
F	N 4	.636E-01	.731E-01	.188E-01	.509E-02	.709E-01	.576E+01	.318E+02	.318E+02
F	N 4	.790E-01	.908E-01	.233E-01	.632E-02	.881E-01	.715E+01	.395E+02	.395E+02
F	N 4	.508E-01	.584E-01	.150E-01	.406E-02	.566E-01	.460E+01	.254E+02	.254E+02
F	N 5	.198E-01	.228E-01	.584E-02	.158E-02	.221E-01	.179E+01	.990E+01	.990E+01
F	N 5	.440E-01	.506E-01	.130E-01	.352E-02	.491E-01	.398E+01	.220E+02	.220E+02
F	N 5	.688E-01	.791E-01	.203E-01	.550E-02	.767E-01	.623E+01	.344E+02	.344E+02
F	N 5	.554E-01	.637E-01	.163E-01	.443E-02	.618E-01	.501E+01	.277E+02	.277E+02
F	N 6	.536E-02	.616E-02	.158E-02	.429E-03	.598E-02	.485E+00	.268E+01	.268E+01
F	N 6	.936E-02	.108E-01	.276E-02	.749E-03	.104E-01	.847E+00	.468E+01	.468E+01
F	N 6	.129E-01	.148E-01	.379E-02	.103E-02	.143E-01	.116E+01	.643E+01	.643E+01
F	N 6	.810E-02	.931E-02	.239E-02	.648E-03	.903E-02	.733E+00	.405E+01	.405E+01
F	N 7	.204E-01	.235E-01	.602E-02	.163E-02	.227E-01	.185E+01	.102E+02	.102E+02
F	N 7	.183E-01	.210E-01	.539E-02	.146E-02	.204E-01	.165E+01	.914E+01	.914E+01
F	N 7	.348E-01	.400E-01	.103E-01	.278E-02	.388E-01	.315E+01	.174E+02	.174E+02
F	N 7	.660E-01	.759E-01	.195E-01	.528E-02	.736E-01	.597E+01	.330E+02	.330E+02
F	N 8	.195E-01	.225E-01	.576E-02	.156E-02	.218E-01	.177E+01	.977E+01	.977E+01
F	N 8	.195E-01	.225E-01	.576E-02	.156E-02	.218E-01	.177E+01	.977E+01	.977E+01
F	N 8	.390E-01	.448E-01	.115E-01	.312E-02	.435E-01	.353E+01	.195E+02	.195E+02
F	N 8	.782E-01	.899E-01	.231E-01	.626E-02	.872E-01	.708E+01	.391E+02	.391E+02
F	N 9	.184E-01	.211E-01	.542E-02	.147E-02	.205E-01	.166E+01	.919E+01	.919E+01
F	N 9	.184E-01	.211E-01	.542E-02	.147E-02	.205E-01	.166E+01	.919E+01	.919E+01
F	N 9	.368E-01	.423E-01	.109E-01	.294E-02	.410E-01	.333E+01	.184E+02	.184E+02
F	N 9	.734E-01	.844E-01	.217E-01	.587E-02	.818E-01	.664E+01	.367E+02	.367E+02
F	N 10	.179E-01	.206E-01	.527E-02	.143E-02	.199E-01	.162E+01	.894E+01	.894E+01

F	N 10	.179E-01	.206E-01	.527E-02	.143E-02	.199E-01	.162E+01	.894E+01	.894E+01
F	N 10	.358E-01	.412E-01	.106E-01	.286E-02	.399E-01	.324E+01	.179E+02	.179E+02
F	N 10	.716E-01	.823E-01	.211E-01	.573E-02	.798E-01	.648E+01	.358E+02	.358E+02
F	N 11	.170E-01	.196E-01	.503E-02	.136E-02	.190E-01	.154E+01	.852E+01	.852E+01
F	N 11	.170E-01	.196E-01	.503E-02	.136E-02	.190E-01	.154E+01	.852E+01	.852E+01
F	N 11	.340E-01	.391E-01	.100E-01	.272E-02	.379E-01	.308E+01	.170E+02	.170E+02
F	N 11	.682E-01	.784E-01	.201E-01	.546E-02	.760E-01	.617E+01	.341E+02	.341E+02
F	N 12	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	N 12	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	N 12	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	N 12	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02
F	N 13	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	N 13	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	N 13	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	N 13	.412E-01	.474E-01	.122E-01	.330E-02	.459E-01	.373E+01	.206E+02	.206E+02
F	N 14	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	N 14	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	N 14	.187E-01	.215E-01	.550E-02	.149E-02	.208E-01	.169E+01	.933E+01	.933E+01
F	N 14	.374E-01	.430E-01	.110E-01	.299E-02	.417E-01	.338E+01	.187E+02	.187E+02
F	N 15	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01
F	N 15	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01
F	N 15	.173E-01	.199E-01	.510E-02	.138E-02	.193E-01	.157E+01	.865E+01	.865E+01
F	N 15	.346E-01	.398E-01	.102E-01	.277E-02	.386E-01	.313E+01	.173E+02	.173E+02
F	N 16	.822E-02	.945E-02	.242E-02	.658E-03	.917E-02	.744E+00	.411E+01	.411E+01
F	N 16	.822E-02	.945E-02	.242E-02	.658E-03	.917E-02	.744E+00	.411E+01	.411E+01
F	N 16	.164E-01	.189E-01	.485E-02	.132E-02	.183E-01	.149E+01	.822E+01	.822E+01
F	N 16	.328E-01	.377E-01	.968E-02	.262E-02	.366E-01	.297E+01	.164E+02	.164E+02
F	O 1	.175E-01	.201E-01	.517E-02	.140E-02	.195E-01	.159E+01	.876E+01	.876E+01
F	O 1	.200E-01	.230E-01	.590E-02	.160E-02	.223E-01	.181E+01	.100E+02	.100E+02
F	O 1	.220E-01	.253E-01	.649E-02	.176E-02	.245E-01	.199E+01	.110E+02	.110E+02
F	O 1	.344E-01	.396E-01	.101E-01	.275E-02	.384E-01	.311E+01	.172E+02	.172E+02

F	0 9	.286E-01	.329E-01	.844E-02	.229E-02	.319E-01	.259E+01	.143E+02	.143E+02
F	0 10	.210E-01	.242E-01	.620E-02	.168E-02	.234E-01	.190E+01	.105E+02	.105E+02
F	0 10	.216E-01	.248E-01	.637E-02	.173E-02	.241E-01	.195E+01	.108E+02	.108E+02
F	0 10	.264E-01	.304E-01	.779E-02	.211E-02	.294E-01	.239E+01	.132E+02	.132E+02
F	0 10	.232E-01	.267E-01	.684E-02	.186E-02	.259E-01	.210E+01	.116E+02	.116E+02
F	0 11	.159E-01	.182E-01	.468E-02	.127E-02	.177E-01	.144E+01	.793E+01	.793E+01
F	0 11	.170E-01	.195E-01	.501E-02	.136E-02	.189E-01	.154E+01	.849E+01	.849E+01
F	0 11	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	0 11	.208E-01	.239E-01	.614E-02	.166E-02	.232E-01	.188E+01	.104E+02	.104E+02
F	0 12	.142E-01	.163E-01	.418E-02	.113E-02	.158E-01	.128E+01	.709E+01	.709E+01
F	0 12	.159E-01	.183E-01	.469E-02	.127E-02	.177E-01	.144E+01	.795E+01	.795E+01
F	0 12	.191E-01	.219E-01	.563E-02	.153E-02	.213E-01	.173E+01	.954E+01	.954E+01
F	0 12	.165E-01	.190E-01	.486E-02	.132E-02	.184E-01	.149E+01	.824E+01	.824E+01
F	0 13	.114E-01	.131E-01	.335E-02	.909E-03	.127E-01	.103E+01	.568E+01	.568E+01
F	0 13	.127E-01	.147E-01	.376E-02	.102E-02	.142E-01	.115E+01	.637E+01	.637E+01
F	0 13	.159E-01	.183E-01	.470E-02	.128E-02	.178E-01	.144E+01	.797E+01	.797E+01
F	0 13	.144E-01	.166E-01	.425E-02	.115E-02	.161E-01	.131E+01	.721E+01	.721E+01
F	0 14	.952E-02	.109E-01	.281E-02	.762E-03	.106E-01	.862E+00	.476E+01	.476E+01
F	0 14	.102E-01	.118E-01	.301E-02	.818E-03	.114E-01	.925E+00	.511E+01	.511E+01
F	0 14	.132E-01	.151E-01	.388E-02	.105E-02	.147E-01	.119E+01	.658E+01	.658E+01
F	0 14	.116E-01	.134E-01	.343E-02	.931E-03	.130E-01	.105E+01	.582E+01	.582E+01
F	0 15	.832E-02	.957E-02	.245E-02	.666E-03	.928E-02	.753E+00	.416E+01	.416E+01
F	0 15	.878E-02	.101E-01	.259E-02	.702E-03	.979E-02	.795E+00	.439E+01	.439E+01
F	0 15	.113E-01	.130E-01	.334E-02	.906E-03	.126E-01	.102E+01	.566E+01	.566E+01
F	0 15	.103E-01	.118E-01	.303E-02	.821E-03	.114E-01	.929E+00	.513E+01	.513E+01
F	0 16	.812E-02	.934E-02	.240E-02	.650E-03	.905E-02	.735E+00	.406E+01	.406E+01
F	0 16	.812E-02	.934E-02	.240E-02	.650E-03	.905E-02	.735E+00	.406E+01	.406E+01
F	0 16	.105E-01	.120E-01	.309E-02	.837E-03	.117E-01	.947E+00	.523E+01	.523E+01
F	0 16	.101E-01	.116E-01	.298E-02	.808E-03	.113E-01	.914E+00	.505E+01	.505E+01
F	P 1	.218E-01	.251E-01	.643E-02	.174E-02	.243E-01	.197E+01	.109E+02	.109E+02
F	P 1	.198E-01	.228E-01	.584E-02	.158E-02	.221E-01	.179E+01	.990E+01	.990E+01

F	P	1	.274E-01	.315E-01	.808E-02	.219E-02	.306E-01	.248E+01	.137E+02	.137E+02
F	P	1	.348E-01	.400E-01	.103E-01	.278E-02	.388E-01	.315E+01	.174E+02	.174E+02
F	P	2	.510E-02	.587E-02	.150E-02	.408E-03	.569E-02	.462E+00	.255E+01	.255E+01
F	P	2	.184E-01	.212E-01	.543E-02	.147E-02	.205E-01	.167E+01	.920E+01	.920E+01
F	P	2	.165E-01	.190E-01	.486E-02	.132E-02	.184E-01	.149E+01	.824E+01	.824E+01
F	P	2	.125E-01	.143E-01	.368E-02	.997E-03	.139E-01	.113E+01	.623E+01	.623E+01
F	P	3	.738E-01	.849E-01	.218E-01	.590E-02	.823E-01	.668E+01	.369E+02	.369E+02
F	P	3	.556E-01	.639E-01	.164E-01	.445E-02	.620E-01	.503E+01	.278E+02	.278E+02
F	P	3	.103E+00	.118E+00	.303E-01	.821E-02	.114E+00	.929E+01	.513E+02	.513E+02
F	P	3	.576E-01	.662E-01	.170E-01	.461E-02	.642E-01	.521E+01	.288E+02	.288E+02
F	P	4	.836E-01	.961E-01	.247E-01	.669E-02	.932E-01	.757E+01	.418E+02	.418E+02
F	P	4	.842E-01	.968E-01	.248E-01	.674E-02	.939E-01	.762E+01	.421E+02	.421E+02
F	P	4	.938E-01	.108E+00	.277E-01	.750E-02	.105E+00	.849E+01	.469E+02	.469E+02
F	P	4	.838E-01	.964E-01	.247E-01	.670E-02	.934E-01	.758E+01	.419E+02	.419E+02
F	P	5	.320E-01	.368E-01	.944E-02	.256E-02	.357E-01	.290E+01	.160E+02	.160E+02
F	P	5	.320E-01	.368E-01	.944E-02	.256E-02	.357E-01	.290E+01	.160E+02	.160E+02
F	P	5	.642E-01	.738E-01	.189E-01	.514E-02	.716E-01	.581E+01	.321E+02	.321E+02
F	P	5	.128E+00	.148E+00	.379E-01	.103E-01	.143E+00	.116E+02	.642E+02	.642E+02
F	P	6	.404E-01	.465E-01	.119E-01	.323E-02	.450E-01	.366E+01	.202E+02	.202E+02
F	P	6	.404E-01	.465E-01	.119E-01	.323E-02	.450E-01	.366E+01	.202E+02	.202E+02
F	P	6	.810E-01	.932E-01	.239E-01	.648E-02	.903E-01	.733E+01	.405E+02	.405E+02
F	P	6	.162E+00	.186E+00	.477E-01	.129E-01	.180E+00	.146E+02	.809E+02	.809E+02
F	P	7	.326E-01	.375E-01	.962E-02	.261E-02	.363E-01	.295E+01	.163E+02	.163E+02
F	P	7	.326E-01	.375E-01	.962E-02	.261E-02	.363E-01	.295E+01	.163E+02	.163E+02
F	P	7	.652E-01	.750E-01	.192E-01	.522E-02	.727E-01	.590E+01	.326E+02	.326E+02
F	P	7	.130E+00	.150E+00	.385E-01	.104E-01	.145E+00	.118E+02	.652E+02	.652E+02
F	P	8	.282E-01	.324E-01	.832E-02	.226E-02	.314E-01	.255E+01	.141E+02	.141E+02
F	P	8	.282E-01	.324E-01	.832E-02	.226E-02	.314E-01	.255E+01	.141E+02	.141E+02
F	P	8	.566E-01	.651E-01	.167E-01	.453E-02	.631E-01	.512E+01	.283E+02	.283E+02
F	P	8	.113E+00	.130E+00	.334E-01	.906E-02	.126E+00	.102E+02	.566E+02	.566E+02
F	P	9	.444E-02	.511E-02	.131E-02	.355E-03	.495E-02	.402E+00	.222E+01	.222E+01

F	P 9	.890E-03	.102E-02	.263E-03	.712E-04	.992E-03	.805E-01	.445E+00	.445E+00
F	P 9	.107E-02	.123E-02	.314E-03	.853E-04	.119E-02	.965E-01	.533E+00	.533E+00
F	P 9	.128E-02	.147E-02	.378E-03	.102E-03	.143E-02	.116E+00	.640E+00	.640E+00
F	P 10	.988E-02	.114E-01	.291E-02	.790E-03	.110E-01	.894E+00	.494E+01	.494E+01
F	P 10	.494E-02	.568E-02	.146E-02	.395E-03	.551E-02	.447E+00	.247E+01	.247E+01
F	P 10	.740E-02	.851E-02	.218E-02	.592E-03	.825E-02	.670E+00	.370E+01	.370E+01
F	P 10	.111E-01	.128E-01	.327E-02	.888E-03	.124E-01	.100E+01	.555E+01	.555E+01
F	P 11	.128E-01	.147E-01	.377E-02	.102E-02	.142E-01	.116E+01	.639E+01	.639E+01
F	P 11	.960E-02	.110E-01	.283E-02	.768E-03	.107E-01	.869E+00	.480E+01	.480E+01
F	P 11	.168E-01	.193E-01	.495E-02	.134E-02	.187E-01	.152E+01	.839E+01	.839E+01
F	P 11	.294E-01	.338E-01	.867E-02	.235E-02	.328E-01	.266E+01	.147E+02	.147E+02
F	P 12	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	P 12	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	P 12	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	P 12	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02
F	P 13	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	P 13	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	P 13	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	P 13	.412E-01	.474E-01	.122E-01	.330E-02	.459E-01	.373E+01	.206E+02	.206E+02
F	P 14	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	P 14	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	P 14	.187E-01	.215E-01	.550E-02	.149E-02	.208E-01	.169E+01	.933E+01	.933E+01
F	P 14	.374E-01	.430E-01	.110E-01	.299E-02	.417E-01	.338E+01	.187E+02	.187E+02
F	P 15	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01
F	P 15	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01
F	P 15	.173E-01	.199E-01	.510E-02	.138E-02	.193E-01	.157E+01	.865E+01	.865E+01
F	P 15	.346E-01	.398E-01	.102E-01	.277E-02	.386E-01	.313E+01	.173E+02	.173E+02
F	P 16	.822E-02	.945E-02	.242E-02	.658E-03	.917E-02	.744E+00	.411E+01	.411E+01
F	P 16	.822E-02	.945E-02	.242E-02	.658E-03	.917E-02	.744E+00	.411E+01	.411E+01
F	P 16	.164E-01	.189E-01	.485E-02	.132E-02	.183E-01	.149E+01	.822E+01	.822E+01
F	P 16	.328E-01	.377E-01	.968E-02	.262E-02	.366E-01	.297E+01	.164E+02	.164E+02

F	Q	1	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	Q	1	.199E-01	.229E-01	.588E-02	.159E-02	.222E-01	.180E+01	.996E+01	.996E+01
F	Q	1	.374E-01	.430E-01	.110E-01	.299E-02	.417E-01	.338E+01	.187E+02	.187E+02
F	Q	1	.442E-01	.508E-01	.130E-01	.354E-02	.493E-01	.400E+01	.221E+02	.221E+02
F	Q	2	.210E-01	.242E-01	.620E-02	.168E-02	.234E-01	.190E+01	.105E+02	.105E+02
F	Q	2	.336E-01	.386E-01	.991E-02	.269E-02	.375E-01	.304E+01	.168E+02	.168E+02
F	Q	2	.290E-01	.333E-01	.856E-02	.232E-02	.323E-01	.262E+01	.145E+02	.145E+02
F	Q	2	.330E-01	.379E-01	.974E-02	.264E-02	.368E-01	.299E+01	.165E+02	.165E+02
F	Q	3	.604E-02	.695E-02	.178E-02	.483E-03	.673E-02	.547E+00	.302E+01	.302E+01
F	Q	3	.158E-01	.182E-01	.467E-02	.127E-02	.176E-01	.143E+01	.791E+01	.791E+01
F	Q	3	.220E-01	.253E-01	.649E-02	.176E-02	.245E-01	.199E+01	.110E+02	.110E+02
F	Q	3	.266E-01	.306E-01	.785E-02	.213E-02	.297E-01	.241E+01	.133E+02	.133E+02
F	Q	4	.540E-01	.621E-01	.159E-01	.432E-02	.602E-01	.489E+01	.270E+02	.270E+02
F	Q	4	.496E-01	.570E-01	.146E-01	.397E-02	.553E-01	.449E+01	.248E+02	.248E+02
F	Q	4	.118E+00	.135E+00	.348E-01	.942E-02	.131E+00	.107E+02	.589E+02	.589E+02
F	Q	4	.876E-01	.101E+00	.258E-01	.701E-02	.977E-01	.793E+01	.438E+02	.438E+02
F	Q	5	.588E-01	.676E-01	.173E-01	.470E-02	.656E-01	.532E+01	.294E+02	.294E+02
F	Q	5	.624E-01	.718E-01	.184E-01	.499E-02	.696E-01	.565E+01	.312E+02	.312E+02
F	Q	5	.708E-01	.814E-01	.209E-01	.566E-02	.789E-01	.641E+01	.354E+02	.354E+02
F	Q	5	.636E-01	.731E-01	.188E-01	.509E-02	.709E-01	.576E+01	.318E+02	.318E+02
F	Q	6	.458E-01	.527E-01	.135E-01	.366E-02	.511E-01	.414E+01	.229E+02	.229E+02
F	Q	6	.510E-01	.587E-01	.150E-01	.408E-02	.569E-01	.462E+01	.255E+02	.255E+02
F	Q	6	.558E-01	.642E-01	.165E-01	.446E-02	.622E-01	.505E+01	.279E+02	.279E+02
F	Q	6	.468E-01	.538E-01	.138E-01	.374E-02	.522E-01	.424E+01	.234E+02	.234E+02
F	Q	7	.442E-01	.508E-01	.130E-01	.354E-02	.493E-01	.400E+01	.221E+02	.221E+02
F	Q	7	.594E-01	.683E-01	.175E-01	.475E-02	.662E-01	.538E+01	.297E+02	.297E+02
F	Q	7	.740E-01	.851E-01	.218E-01	.592E-02	.825E-01	.670E+01	.370E+02	.370E+02
F	Q	7	.810E-01	.932E-01	.239E-01	.648E-02	.903E-01	.733E+01	.405E+02	.405E+02
F	Q	8	.336E-01	.386E-01	.991E-02	.269E-02	.375E-01	.304E+01	.168E+02	.168E+02
F	Q	8	.336E-01	.386E-01	.991E-02	.269E-02	.375E-01	.304E+01	.168E+02	.168E+02
F	Q	8	.674E-01	.775E-01	.199E-01	.539E-02	.752E-01	.610E+01	.337E+02	.337E+02

F	Q 8	.135E+00	.155E+00	.397E-01	.108E-01	.150E+00	.122E+02	.673E+02	.673E+02
F	Q 9	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	Q 9	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	Q 9	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	Q 9	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	Q 10	.198E-01	.228E-01	.585E-02	.159E-02	.221E-01	.179E+01	.991E+01	.991E+01
F	Q 10	.198E-01	.228E-01	.585E-02	.159E-02	.221E-01	.179E+01	.991E+01	.991E+01
F	Q 10	.396E-01	.455E-01	.117E-01	.317E-02	.442E-01	.358E+01	.198E+02	.198E+02
F	Q 10	.794E-01	.913E-01	.234E-01	.635E-02	.885E-01	.719E+01	.397E+02	.397E+02
F	Q 11	.170E-01	.195E-01	.500E-02	.136E-02	.189E-01	.153E+01	.848E+01	.848E+01
F	Q 11	.170E-01	.195E-01	.500E-02	.136E-02	.189E-01	.153E+01	.848E+01	.848E+01
F	Q 11	.340E-01	.391E-01	.100E-01	.272E-02	.379E-01	.308E+01	.170E+02	.170E+02
F	Q 11	.678E-01	.780E-01	.200E-01	.542E-02	.756E-01	.614E+01	.339E+02	.339E+02
F	Q 12	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	Q 12	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	Q 12	.252E-01	.290E-01	.743E-02	.202E-02	.281E-01	.228E+01	.126E+02	.126E+02
F	Q 12	.506E-01	.582E-01	.149E-01	.405E-02	.564E-01	.458E+01	.253E+02	.253E+02
F	Q 13	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	Q 13	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	Q 13	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	Q 13	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02
F	Q 14	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	Q 14	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	Q 14	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	Q 14	.412E-01	.474E-01	.122E-01	.330E-02	.459E-01	.373E+01	.206E+02	.206E+02
F	Q 15	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	Q 15	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	Q 15	.187E-01	.215E-01	.550E-02	.149E-02	.208E-01	.169E+01	.933E+01	.933E+01
F	Q 15	.374E-01	.430E-01	.110E-01	.299E-02	.417E-01	.338E+01	.187E+02	.187E+02
F	Q 16	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01
F	Q 16	.866E-02	.996E-02	.255E-02	.693E-03	.966E-02	.784E+00	.433E+01	.433E+01

F	Q 16	.173E-01	.199E-01	.510E-02	.138E-02	.193E-01	.157E+01	.865E+01	.865E+01
F	Q 16	.346E-01	.398E-01	.102E-01	.277E-02	.386E-01	.313E+01	.173E+02	.173E+02
F	R 1	.198E-01	.227E-01	.583E-02	.158E-02	.220E-01	.179E+01	.988E+01	.988E+01
F	R 1	.168E-01	.193E-01	.495E-02	.134E-02	.187E-01	.152E+01	.839E+01	.839E+01
F	R 1	.334E-01	.384E-01	.985E-02	.267E-02	.372E-01	.302E+01	.167E+02	.167E+02
F	R 1	.358E-01	.412E-01	.106E-01	.286E-02	.399E-01	.324E+01	.179E+02	.179E+02
F	R 2	.115E-01	.133E-01	.340E-02	.923E-03	.129E-01	.104E+01	.577E+01	.577E+01
F	R 2	.178E-01	.204E-01	.525E-02	.142E-02	.198E-01	.161E+01	.889E+01	.889E+01
F	R 2	.143E-01	.164E-01	.421E-02	.114E-02	.159E-01	.129E+01	.713E+01	.713E+01
F	R 2	.214E-01	.246E-01	.631E-02	.171E-02	.239E-01	.194E+01	.107E+02	.107E+02
F	R 3	.646E-02	.743E-02	.191E-02	.517E-03	.720E-02	.585E+00	.323E+01	.323E+01
F	R 3	.152E-01	.175E-01	.449E-02	.122E-02	.170E-01	.138E+01	.761E+01	.761E+01
F	R 3	.208E-01	.239E-01	.614E-02	.166E-02	.232E-01	.188E+01	.104E+02	.104E+02
F	R 3	.230E-01	.264E-01	.679E-02	.184E-02	.256E-01	.208E+01	.115E+02	.115E+02
F	R 4	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02
F	R 4	.548E-01	.630E-01	.162E-01	.438E-02	.611E-01	.496E+01	.274E+02	.274E+02
F	R 4	.970E-01	.112E+00	.286E-01	.776E-02	.108E+00	.878E+01	.485E+02	.485E+02
F	R 4	.103E+00	.119E+00	.305E-01	.827E-02	.115E+00	.936E+01	.517E+02	.517E+02
F	R 5	.350E-01	.402E-01	.103E-01	.280E-02	.390E-01	.317E+01	.175E+02	.175E+02
F	R 5	.342E-01	.393E-01	.101E-01	.274E-02	.381E-01	.310E+01	.171E+02	.171E+02
F	R 5	.648E-01	.745E-01	.191E-01	.518E-02	.723E-01	.586E+01	.324E+02	.324E+02
F	R 5	.498E-01	.573E-01	.147E-01	.398E-02	.555E-01	.451E+01	.249E+02	.249E+02
F	R 6	.432E-01	.497E-01	.127E-01	.346E-02	.482E-01	.391E+01	.216E+02	.216E+02
F	R 6	.432E-01	.497E-01	.127E-01	.346E-02	.482E-01	.391E+01	.216E+02	.216E+02
F	R 6	.864E-01	.994E-01	.255E-01	.691E-02	.963E-01	.782E+01	.432E+02	.432E+02
F	R 6	.173E+00	.199E+00	.510E-01	.138E-01	.193E+00	.157E+02	.865E+02	.865E+02
F	R 7	.324E-01	.373E-01	.956E-02	.259E-02	.361E-01	.293E+01	.162E+02	.162E+02
F	R 7	.444E-01	.511E-01	.131E-01	.355E-02	.495E-01	.402E+01	.222E+02	.222E+02
F	R 7	.558E-01	.642E-01	.165E-01	.446E-02	.622E-01	.505E+01	.279E+02	.279E+02
F	R 7	.614E-01	.706E-01	.181E-01	.491E-02	.685E-01	.556E+01	.307E+02	.307E+02
F	R 8	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02

F	R 8	.286E-01	.329E-01	.844E-02	.229E-02	.319E-01	.259E+01	.143E+02	.143E+02
F	R 8	.308E-01	.354E-01	.909E-02	.246E-02	.343E-01	.279E+01	.154E+02	.154E+02
F	R 8	.268E-01	.308E-01	.791E-02	.214E-02	.299E-01	.243E+01	.134E+02	.134E+02
F	R 9	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	R 9	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	R 9	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	R 9	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	R 10	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	R 10	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	R 10	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	R 10	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	R 11	.175E-01	.201E-01	.516E-02	.140E-02	.195E-01	.158E+01	.874E+01	.874E+01
F	R 11	.175E-01	.201E-01	.516E-02	.140E-02	.195E-01	.158E+01	.874E+01	.874E+01
F	R 11	.350E-01	.402E-01	.103E-01	.280E-02	.390E-01	.317E+01	.175E+02	.175E+02
F	R 11	.700E-01	.805E-01	.206E-01	.560E-02	.781E-01	.634E+01	.350E+02	.350E+02
F	R 12	.138E-01	.159E-01	.408E-02	.111E-02	.154E-01	.125E+01	.692E+01	.692E+01
F	R 12	.138E-01	.159E-01	.408E-02	.111E-02	.154E-01	.125E+01	.692E+01	.692E+01
F	R 12	.276E-01	.317E-01	.814E-02	.221E-02	.308E-01	.250E+01	.138E+02	.138E+02
F	R 12	.554E-01	.637E-01	.163E-01	.443E-02	.618E-01	.501E+01	.277E+02	.277E+02
F	R 13	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	R 13	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	R 13	.252E-01	.290E-01	.743E-02	.202E-02	.281E-01	.228E+01	.126E+02	.126E+02
F	R 13	.506E-01	.582E-01	.149E-01	.405E-02	.564E-01	.458E+01	.253E+02	.253E+02
F	R 14	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	R 14	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	R 14	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	R 14	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02
F	R 15	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	R 15	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	R 15	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	R 15	.412E-01	.474E-01	.122E-01	.330E-02	.459E-01	.373E+01	.206E+02	.206E+02

F	R 16	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	R 16	.932E-02	.107E-01	.275E-02	.746E-03	.104E-01	.843E+00	.466E+01	.466E+01
F	R 16	.187E-01	.215E-01	.550E-02	.149E-02	.208E-01	.169E+01	.933E+01	.933E+01
F	R 16	.374E-01	.430E-01	.110E-01	.299E-02	.417E-01	.338E+01	.187E+02	.187E+02
F	S 1	.844E-02	.971E-02	.249E-02	.675E-03	.941E-02	.764E+00	.422E+01	.422E+01
F	S 1	.125E-01	.143E-01	.368E-02	.997E-03	.139E-01	.113E+01	.623E+01	.623E+01
F	S 1	.294E-01	.338E-01	.867E-02	.235E-02	.328E-01	.266E+01	.147E+02	.147E+02
F	S 1	.252E-01	.290E-01	.743E-02	.202E-02	.281E-01	.228E+01	.126E+02	.126E+02
F	S 2	.530E-02	.609E-02	.156E-02	.424E-03	.591E-02	.480E+00	.265E+01	.265E+01
F	S 2	.926E-02	.106E-01	.273E-02	.741E-03	.103E-01	.838E+00	.463E+01	.463E+01
F	S 2	.105E-01	.121E-01	.310E-02	.842E-03	.117E-01	.952E+00	.526E+01	.526E+01
F	S 2	.158E-01	.181E-01	.466E-02	.126E-02	.176E-01	.143E+01	.789E+01	.789E+01
F	S 3	.424E-02	.488E-02	.125E-02	.339E-03	.473E-02	.384E+00	.212E+01	.212E+01
F	S 3	.123E-01	.141E-01	.362E-02	.981E-03	.137E-01	.111E+01	.613E+01	.613E+01
F	S 3	.184E-01	.211E-01	.542E-02	.147E-02	.205E-01	.166E+01	.918E+01	.918E+01
F	S 3	.242E-01	.278E-01	.714E-02	.194E-02	.270E-01	.219E+01	.121E+02	.121E+02
F	S 4	.170E-01	.195E-01	.500E-02	.136E-02	.189E-01	.153E+01	.848E+01	.848E+01
F	S 4	.170E-01	.195E-01	.500E-02	.136E-02	.189E-01	.153E+01	.848E+01	.848E+01
F	S 4	.340E-01	.391E-01	.100E-01	.272F-02	.379E-01	.308E+01	.170E+02	.170E+02
F	S 4	.678E-01	.780E-01	.200E-01	.542E-02	.756E-01	.614E+01	.339E+02	.339E+02
F	S 5	.170E-01	.195E-01	.500E-02	.136E-02	.189E-01	.153E+01	.848E+01	.848E+01
F	S 5	.170E-01	.195E-01	.500E-02	.136E-02	.189E-01	.153E+01	.848E+01	.848E+01
F	S 5	.340E-01	.391E-01	.100E-01	.272E-02	.379E-01	.308E+01	.170E+02	.170E+02
F	S 5	.678E-01	.780E-01	.200E-01	.542E-02	.756E-01	.614E+01	.339E+02	.339E+02
F	S 6	.336E-01	.386E-01	.991E-02	.269E-02	.375E-01	.304E+01	.168E+02	.168E+02
F	S 6	.336E-01	.386E-01	.991E-02	.269E-02	.375E-01	.304E+01	.168E+02	.168E+02
F	S 6	.674E-01	.775E-01	.199E-01	.539E-02	.752E-01	.610E+01	.337E+02	.337E+02
F	S 6	.135E+00	.155E+00	.398E-01	.108E-01	.150E+00	.122E+02	.674E+02	.674E+02
F	S 7	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	S 7	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	S 7	.568E-01	.653E-01	.168E-01	.454E-02	.633E-01	.514E+01	.284E+02	.284E+02

F	S 7	.114E+00	.131E+00	.335E-01	.909E-02	.127E+00	.103E+02	.568E+02	.568E+02
F	S 8	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	S 8	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	S 8	.568E-01	.653E-01	.168E-01	.454E-02	.633E-01	.514E+01	.284E+02	.284E+02
F	S 8	.114E+00	.131E+00	.335E-01	.909E-02	.127E+00	.103E+02	.568E+02	.568E+02
F	S 9	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	S 9	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	S 9	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	S 9	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	S 10	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	S 10	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	S 10	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	S 10	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	S 11	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	S 11	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	S 11	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	S 11	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	S 12	.156E-01	.180E-01	.461E-02	.125E-02	.174E-01	.141E+01	.781E+01	.781E+01
F	S 12	.156E-01	.180E-01	.461E-02	.125E-02	.174E-01	.141E+01	.781E+01	.781E+01
F	S 12	.312E-01	.359E-01	.920E-02	.250E-02	.348E-01	.282E+01	.156E+02	.156E+02
F	S 12	.626E-01	.720E-01	.185E-01	.501E-02	.698E-01	.567E+01	.313E+02	.313E+02
F	S 13	.138E-01	.159E-01	.408E-02	.111E-02	.154E-01	.125E+01	.692E+01	.692E+01
F	S 13	.138E-01	.159E-01	.408E-02	.111E-02	.154E-01	.125E+01	.692E+01	.692E+01
F	S 13	.276E-01	.317E-01	.814E-02	.221E-02	.308E-01	.250E+01	.138E+02	.138E+02
F	S 13	.554E-01	.637E-01	.163E-01	.443E-02	.618E-01	.501E+01	.277E+02	.277E+02
F	S 14	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	S 14	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	S 14	.252E-01	.290E-01	.743E-02	.202E-02	.281E-01	.228E+01	.126E+02	.126E+02
F	S 14	.506E-01	.582E-01	.149E-01	.405E-02	.564E-01	.458E+01	.253E+02	.253E+02
F	S 15	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	S 15	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01

F	S 15	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	S 15	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02
F	S 16	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	S 16	.103E-01	.118E-01	.304E-02	.824E-03	.115E-01	.932E+00	.515E+01	.515E+01
F	S 16	.206E-01	.237E-01	.608E-02	.165E-02	.230E-01	.186E+01	.103E+02	.103E+02
F	S 16	.412E-01	.474E-01	.122E-01	.330E-02	.459E-01	.373E+01	.206E+02	.206E+02
F	T 1	.686E-02	.789E-02	.202E-02	.549E-03	.765E-02	.621E+00	.343E+01	.343E+01
F	T 1	.686E-02	.789E-02	.202E-02	.549E-03	.765E-02	.621E+00	.343E+01	.343E+01
F	T 1	.137E-01	.158E-01	.405E-02	.110E-02	.153E-01	.124E+01	.687E+01	.687E+01
F	T 1	.274E-01	.315E-01	.808E-02	.219E-02	.306E-01	.248E+01	.137E+02	.137E+02
F	T 2	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 2	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 2	.120E-01	.138E-01	.353E-02	.958E-03	.134E-01	.108E+01	.599E+01	.599E+01
F	T 2	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	T 3	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 3	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 3	.120E-01	.138E-01	.353E-02	.958E-03	.134E-01	.108E+01	.599E+01	.599E+01
F	T 3	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	T 4	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 4	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 4	.120E-01	.138E-01	.353E-02	.958E-03	.134E-01	.108E+01	.599E+01	.599E+01
F	T 4	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	T 5	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 5	.600E-02	.690E-02	.177E-02	.480E-03	.669E-02	.543E+00	.300E+01	.300E+01
F	T 5	.120E-01	.138E-01	.353E-02	.958E-03	.134E-01	.108E+01	.599E+01	.599E+01
F	T 5	.240E-01	.276E-01	.708E-02	.192E-02	.268E-01	.217E+01	.120E+02	.120E+02
F	T 6	.342E-01	.393E-01	.101E-01	.274E-02	.381E-01	.310E+01	.171E+02	.171E+02
F	T 6	.342E-01	.393E-01	.101E-01	.274E-02	.381E-01	.310E+01	.171E+02	.171E+02
F	T 6	.684E-01	.787E-01	.202E-01	.547E-02	.763E-01	.619E+01	.342E+02	.342E+02
F	T 6	.137E+00	.157E+00	.403E-01	.109E-01	.152E+00	.124E+02	.683E+02	.683E+02
F	T 7	.306E-01	.352E-01	.903E-02	.245E-02	.341E-01	.277E+01	.153E+02	.153E+02

F	T 7	.306E-01	.352E-01	.903E-02	.245E-02	.341E-01	.277E+01	.153E+02	.153E+02
F	T 7	.612E-01	.704E-01	.181E-01	.490E-02	.682E-01	.554E+01	.306E+02	.306E+02
F	T 7	.122E+00	.141E+00	.361E-01	.979E-02	.136E+00	.111E+02	.612E+02	.612E+02
F	T 8	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	T 8	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	T 8	.568E-01	.653E-01	.168E-01	.454E-02	.633E-01	.514E+01	.284E+02	.284E+02
F	T 8	.114E+00	.131E+00	.335E-01	.909E-02	.127E+00	.103E+02	.568E+02	.568E+02
F	T 9	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	T 9	.284E-01	.327E-01	.838E-02	.227E-02	.317E-01	.257E+01	.142E+02	.142E+02
F	T 9	.568E-01	.653E-01	.168E-01	.454E-02	.633E-01	.514E+01	.284E+02	.284E+02
F	T 9	.114E+00	.131E+00	.335E-01	.909E-02	.127E+00	.103E+02	.568E+02	.568E+02
F	T 10	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	T 10	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	T 10	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	T 10	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	T 11	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	T 11	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	T 11	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	T 11	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	T 12	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	T 12	.244E-01	.281E-01	.720E-02	.195E-02	.272E-01	.221E+01	.122E+02	.122E+02
F	T 12	.486E-01	.559E-01	.143E-01	.389E-02	.542E-01	.440E+01	.243E+02	.243E+02
F	T 12	.974E-01	.112E+00	.287E-01	.779E-02	.109E+00	.881E+01	.487E+02	.487E+02
F	T 13	.156E-01	.180E-01	.461E-02	.125E-02	.174E-01	.141E+01	.781E+01	.781E+01
F	T 13	.156E-01	.180E-01	.461E-02	.125E-02	.174E-01	.141E+01	.781E+01	.781E+01
F	T 13	.312E-01	.359E-01	.920E-02	.250E-02	.348E-01	.282E+01	.156E+02	.156E+02
F	T 13	.626E-01	.720E-01	.185E-01	.501E-02	.698E-01	.567E+01	.313E+02	.313E+02
F	T 14	.138E-01	.159E-01	.408E-02	.111E-02	.154E-01	.125E+01	.692E+01	.692E+01
F	T 14	.138E-01	.159E-01	.408E-02	.111E-02	.154E-01	.125E+01	.692E+01	.692E+01
F	T 14	.276E-01	.317E-01	.814E-02	.221E-02	.308E-01	.250E+01	.138E+02	.138E+02
F	T 14	.554E-01	.637E-01	.163E-01	.443E-02	.618E-01	.501E+01	.277E+02	.277E+02

F	T 15	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	T 15	.126E-01	.145E-01	.373E-02	.101E-02	.141E-01	.114E+01	.632E+01	.632E+01
F	T 15	.252E-01	.290E-01	.743E-02	.202E-02	.281E-01	.228E+01	.126E+02	.126E+02
F	T 15	.506E-01	.582E-01	.149E-01	.405E-02	.564E-01	.458E+01	.253E+02	.253E+02
F	T 16	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	T 16	.112E-01	.129E-01	.331E-02	.898E-03	.125E-01	.102E+01	.561E+01	.561E+01
F	T 16	.224E-01	.258E-01	.661E-02	.179E-02	.250E-01	.203E+01	.112E+02	.112E+02
F	T 16	.450E-01	.518E-01	.133E-01	.360E-02	.502E-01	.407E+01	.225E+02	.225E+02

PRINTOUT SEGMENT IV

Echo of initial heavy metal concentrations in the surface crust.

ELEMENT	METAL 1	METAL 2	METAL 3	METAL 4	METAL 5	METAL 6	METAL 7	METAL 8
C A 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C A 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C A 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C A 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C A 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C A 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C A 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C B 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C C 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C D 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C D 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	D 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	D 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	E 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	F 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	F 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	G 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	H 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	H 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	I 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	J 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	J 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	K 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	L 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	L 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	M 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	N 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	N 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	O 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	P 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	P 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	Q 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	R 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	R 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	S 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

C	T 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
C	T 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

PRINTOUT SEGMENT V

Echo of initial heavy metal concentrations in the subsurface.

ELEMENT	METAL 1	METAL 2	METAL 3	METAL 4	METAL 5	METAL 6	METAL 7	METAL 8
S A 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S A 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S A 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S A 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S A 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S A 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S A 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S B 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S C 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S D 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S D 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	D 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	D 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	E 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	F 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	F 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	G 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	H 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	H 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	I 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	J 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	J 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	K 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	L 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	L 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	M 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	N 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	N 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	O 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	P 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	P 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	Q 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	R 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	R 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	S 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 1	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 2	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 3	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 4	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 5	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

S	T 6	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 7	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 8	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 9	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 10	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 11	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 12	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 13	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 14	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 15	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.
S	T 16	.295E+03	.750E+00	.167E+03	.265E+01	.526E+03	.147E+01	0.	0.

IHVM(1) = 1

IHVM(2) = 2

IHVM(3) = 3

IHVM(4) = 4

IHVM(5) = 5

IHVM(6) = 6

IHVM(7) = 7

IHVM(8) = 8

READ FILE FOR INITIAL HEAVY METAL RESIDUE (NR4)= 22

PRINTOUT SEGMENT VI

Sample model output for one year.

HYDROLOGIC SUB-BASIN	TOTAL SOIL AREA SQ.KM	TOTAL LAKE AREA SQ.KM
1	.605E+04	0.
2	.144E+04	0.
3	.978E+04	.320E+03
4	.560E+04	0.
5	.470E+04	0.

ACCUMULATED AND TOTAL YEARLY VALUES AND MONTHLY PRECIPITATION AND INFILTRATION BY HYDROLOGIC SUB-BASIN

** YEAR 1 **

ACCUMULATED FALLOUT IN KG

HYDROLOGIC SUB-BASIN	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.435E+03	.501E+03	.128E+03	.348E+02	.486E+03	.394E+05	.218E+06	.218E+06
2	.129E+03	.148E+03	.379E+02	.103E+02	.143E+03	.116E+05	.643E+05	.643E+05
3	.367E+04	.422E+04	.108E+04	.294E+03	.409E+04	.332E+06	.183E+07	.183E+07
4	.125E+04	.144E+04	.370E+03	.100E+03	.140E+04	.114E+06	.627E+06	.627E+06
5	.155E+04	.179E+04	.458E+03	.124E+03	.173E+04	.141E+06	.777E+06	.777E+06

ACCUMULATED FALLOUT DIRECTLY ON THE LAKE IN KG

HYDROLOGIC SUB-BASIN	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.
3	.188E+03	.216E+03	.553E+02	.150E+02	.209E+03	.170E+05	.938E+05	.938E+05
4	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.

ACCUMULATED HEAVY METALS ERODED TO THE LAKE IN KG

HYDROLOGIC SUB-BASIN	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.450E+05	.120E+03	.255E+05	.405E+03	.803E+05	.698E+03	.262E+04	.262E+04
2	.435E+05	.118E+03	.246E+05	.391E+03	.775E+05	.820E+03	.333E+04	.333E+04
3	.149E+06	.475E+03	.844E+05	.135E+04	.266E+06	.835E+04	.420E+05	.420E+05

4	.282E+05	.809E+02	.160E+05	.254E+03	.503E+05	.862E+03	.399E+04	.399E+04
5	.295E+05	.926E+02	.167E+05	.266E+03	.526E+05	.154E+04	.769E+04	.769E+04

ACCUMULATED HEAVY METALS LEFT IN THE SOIL CRUST IN KG

HYDROLOGIC SUB-BASIN	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.174E+07	.491E+04	.984E+06	.156E+05	.310E+07	.476E+05	.215E+06	.215E+06
2	.378E+06	.110E+04	.214E+06	.340E+04	.674E+06	.128E+05	.606E+05	.606E+05
3	.274E+07	.108E+05	.155E+07	.248E+05	.487E+07	.321E+06	.170E+07	.170E+07
4	.163E+07	.559E+04	.924E+06	.148E+05	.291E+07	.121E+06	.626E+06	.626E+06
5	.136E+07	.522E+04	.768E+06	.123E+05	.242E+07	.146E+06	.769E+06	.769E+06

ACCUMULATED HEAVY METALS LEFT IN THE SUBSOIL IN KG

HYDROLOGIC SUB-BASIN	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.178E+07	.453E+04	.101E+07	.160E+05	.318E+07	.889E+04	0.	0.
2	.425E+06	.108E+04	.240E+06	.382E+04	.757E+06	.212E+04	0.	0.
3	.289E+07	.734E+04	.163E+07	.259E+05	.514E+07	.144E+05	0.	0.
4	.165E+07	.420E+04	.935E+06	.148E+05	.295E+07	.823E+04	0.	0.
5	.139E+07	.353E+04	.785E+06	.125E+05	.247E+07	.691E+04	0.	0.

MONTHLY PRECIPITATION - 30 MINUTE INTENSITY IN CM

HYDROLOGIC SUB-BASIN	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.121E+03	.111E+03	.110E+03	.116E+03	.297E+02	.313E+02	.296E+02	.299E+02	.316E+02	.302E+02	.122E+03	.118E+03
2	.398E+02	.363E+02	.332E+02	.355E+02	.762E+01	.978E+01	.121E+02	.760E+01	.852E+01	.923E+01	.392E+02	.399E+02
3	.942E+02	.773E+02	.868E+02	.920E+02	.504E+02	.538E+02	.555E+02	.580E+02	.556E+02	.513E+02	.105E+03	.969E+02
4	.849E+02	.733E+02	.733E+02	.785E+02	.282E+02	.287E+02	.308E+02	.289E+02	.288E+02	.283E+02	.861E+02	.870E+02
5	.290E+02	.217E+02	.281E+02	.300E+02	.206E+02	.221E+02	.275E+02	.253E+02	.271E+02	.271E+02	.365E+02	.304E+02

MONTHLY INFILTRATION IN CM

HYDROLOGIC SUB-BASIN	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	.693E+03	.636E+03	.636E+03	.672E+03	.176E+03	.192E+03	.172E+03	.173E+03	.186E+03	.182E+03	.706E+03	.667E+03
2	.166E+03	.150E+03	.139E+03	.148E+03	.357E+02	.433E+02	.600E+02	.330E+02	.408E+02	.405E+02	.164E+03	.166E+03
3	.395E+03	.329E+03	.360E+03	.381E+03	.195E+03	.207E+03	.211E+03	.224E+03	.216E+03	.198E+03	.433E+03	.405E+03
4	.565E+03	.498E+03	.480E+03	.514E+03	.161E+03	.154E+03	.158E+03	.159E+03	.155E+03	.146E+03	.562E+03	.576E+03
5	.983E+02	.735E+02	.957E+02	.102E+03	.746E+02	.753E+02	.944E+02	.849E+02	.961E+02	.932E+02	.124E+03	.103E+03

ACCUMULATED SOIL ERODED TO THE LAKE IN KG

HYDROLOGIC SUB-BASIN	SOIL ERODED
1	.225E+10
2	.289E+10
3	.854E+10
4	.161E+10
5	.167E+10

TOTALS FOR YEAR 1 IN KG

	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
TOTAL FALLOUT	.704E+04	.810E+04	.208E+04	.563E+03	.785E+04	.637E+06	.352E+07	.352E+07
FALLOUT ON LAKE	.188E+03	.216E+03	.553E+02	.150E+02	.209E+03	.170E+05	.938E+05	.938E+05
ERODED TO LAKE	.295E+06	.888E+03	.167E+06	.266E+04	.526E+06	.123E+05	.596E+05	.596E+05
CHG. IN CRUST	.784E+07	.277E+05	.444E+07	.709E+05	.140E+08	.649E+06	.337E+07	.337E+07
CHG. IN								

SUBSOIL	.813E+07	.207E+05	.460E+07	.730E+05	.145E+08	.405E+05	0.	0.

THE TOTAL SOIL ERODED TO THE LAKE IN KG = .170E+11

YEARLY TOTALS SUMMARY

FALLOUT IN KG

YEAR	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.704E+04	.810E+04	.208E+04	.563E+03	.785E+04	.637E+06	.352E+07	.352E+07

FALLOUT DIRECTLY ON THE LAKE IN KG

YEAR	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.188E+03	.216E+03	.553E+02	.150E+02	.209E+03	.170E+05	.938E+05	.938E+05

HEAVY METALS ERODED TO THE LAKE IN KG

YEAR	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.295E+06	.888E+03	.167E+06	.266E+04	.526E+06	.123E+05	.596E+05	.596E+05

HEAVY METALS LEFT IN SOIL CRUST IN KG

YEAR	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.784E+07	.277E+05	.444E+07	.709E+05	.140E+08	.649E+06	.337E+07	.337E+07

HEAVY METALS LEFT IN SUB-SOIL IN KG

YEAR	HEAVY METAL 1	HEAVY METAL 2	HEAVY METAL 3	HEAVY METAL 4	HEAVY METAL 5	HEAVY METAL 6	HEAVY METAL 7	HEAVY METAL 8
1	.813E+07	.207E+05	.460E+07	.730E+05	.145E+08	.405E+05	0.	0.

SOIL ERODED TO THE LAKE IN KG

YEAR	
1	.170E+11

APPENDIX C

PROGRAM LISTING

```
C*
C*                    PROGRAM 10MM
C*
FILE  5=FILE5
FILE  6=FILE6
FILE  7=FILE7
FILE  11(KIND=DISK,FILETYPE=7,TITLE="DATA11")
FILE  12(KIND=DISK,FILETYPE=7,TITLE="DATA12")
FILE  13(KIND=DISK,FILETYPE=7,TITLE="DATA13")
FILE  14(KIND=DISK,FILETYPE=7,TITLE="DATA14")
FILE  15(KIND=DISK,FILETYPE=7,TITLE="DATA15")
FILE  20(KIND=DISK,MAXRECSIZE=22,BLOCKSIZE=220,AREAS=1000,AREASIZE=10
     *  ,SAVEFACTOR=99,TITLE="FODATA")
FILE  21(KIND=DISK,MAXRECSIZE=22,BLOCKSIZE=220,AREAS=1000 ,AREASIZE=10
     *  ,SAVEFACTOR=99,TITLE="READSX")
FILE  22(KIND=DISK,MAXRECSIZE=22,BLOCKSIZE=220,AREAS=1000 ,AREASIZE=10
     *  ,SAVEFACTOR=99,TITLE="RDINHX")
FILE  23(KIND=DISK,MAXRECSIZE=22,BLOCKSIZE=220,AREAS=1000 ,AREASIZE=10
     *  ,SAVEFACTOR=99,TITLE="RAIN")
FILE  24(KIND=DISK,MAXRECSIZE=22,BLOCKSIZE=220,AREAS=1000 ,AREASIZE=10
     *  ,SAVEFACTOR=99,TITLE="FOZERO")
FILE  25(KIND=DISK,MAXRECSIZE=22,BLOCKSIZE=220,AREAS=1000 ,AREASIZE=10
     *  ,SAVEFACTOR=99,TITLE="DATA25")
      NR1=5
      NW1=6
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,IEROW(300),IECOL(300),TTRAN(2,300),PTRAN(3,300),IHYDB(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZON(300),SADD(300),SLAXE(6)
      COMMON /PRECIP/ P(27),R(27)
      COMMON /EROS/ PINST(8),RKST(8),THATA(3),P30MIN,VC(10)
     *               ,EROSD(12,300)
      COMMON /CHEM/ FO(8,4,300),POR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      COMMON /CHEM2/ WT(8),XMO1(12)
      COMMON /PPTAD/ UPH(5),UCA(5),UNA(5),UMG(5),UK(5),USO4(5),UCL(5)
      COMMON /OUTPUT/ MONTH(12),IYEAR,PECHB(12,6),PINFHB(12,6),
     *                 PEC30(12,300)
      COMMON /TOTAL/ T1(8,6),T2(8,6),T3(8,6),T4(8,6),T5(8,6),SLAEPT(6)
      COMMON /STAT/ ACFOT(8,100),XLADT(8,100),XLAET(8,100),Y1T(8,100),
     *               Y2T(8,100),SLAXET(100),IYSTRT,NR
C*
C*                 DATA FOR PRECIPITATION SUBMODEL
C*
      DATA P/.0001,.0005,.0010,.0050,.0100,.0200,.0250,.0400,.0500,
     *.1000,.2000,.3000,.4000,.5000,.6000,.7000,.8000,.9000,.9500,.9600,
     *.9750,.9800,.9900,.9950,.9990,.9995,.9999/
      DATA R/3.71902,3.29053,3.09023,2.57583,2.32635,2.05375,1.95996,
     *1.75069,1.64485,1.28155,.84162,.52440,.25335,.00000,-.25335,-.524
     *40,-.84162,-1.28155,-1.64485,-1.75069,-1.95996,-2.05375,-2.32635,
     *-2.57583,-3.09023,-3.29053,-3.71902/
C*
C*                 DATA FOR EROSION SUBMODEL
C*
      DATA PINST / 0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.50 /
      DATA THATA /.174533,.436332,.872665/
      DATA P30MIN /0.0/
      DATA VC /.04,.06,.13,.15,.18,.3,.32,.35,0.0,0.0/
      DATA RKST /.6,.5,.45,.4,.3,.2,.1,0.0/
C*
```

```
C*                     DATA FOR SOIL CHEMISTRY SUBMODEL
      DATA OPH/2*8.04,3*7.94/
      DATA UCA/2*.01,3*.014/
      DATA UNA/2*.00224,3*.01024/
      DATA UMG/2*.00072,3*.00054/
      DATA UK/2*.00146,3*.0024/
      DATA USO4/2*.01112,3*.01992/
      DATA UCL/2*.00132,3*.00104/
      DATA WT/65.38,200.61,207.2,112.41,116.01,94.89,62.01,96.07/
      DATA XMOI/.13,.18,.19,.20,.22,.17,.12,.20,.18,.17,.13,.23/
C*
C*                     DATA FOR OUTPUT SUBROUTINES
      DATA MONTH/4HJAN.,4HFEB.,4HMAR.,4HAPR.,4HMAY ,4HJUNE,4HJULY,4HAUG.
     *                 ,4HSEP.,4HOCT.,4HNOV.,4HDEC./
C*                     CALL SUBROUTINES
C*
      READ(NR1,1000)NOP
 1000 FORMAT(I1)
      DO 50 N=1,NOP
      DO 20 J=1,6
      SLAEPT(J)=0.
      DO 10 I=1,8
      XLAXO(I,J)=0.
      XLAXE(I,J)=0.
      T1(I,J)=0.
      T2(I,J)=0.
      T3(I,J)=0.
      T4(I,J)=0.
      T5(I,J)=0.
   10 CONTINUE
   20 CONTINUE
      DO 40 J=1,100
      SLAXET(J)=0.
      DO 30 I=1,8
      ACFOT(I,J)=0.
      XLAOT(I,J)=0.
      XLAET(I,J)=0.
      Y1T(I,J)=0.
      Y2T(I,J)=0.
   30 CONTINUE
   40 CONTINUE
      DO 45 I=1,288
      DO 45 J=3,5
      X(J,1,I)=295.
      X(J,2,I)=0.75
      X(J,3,I)=167.
      X(J,4,I)=2.65
      X(J,5,I)=526.
      X(J,6,I)=1.47
      X(J,7,I)=145.
   45 CONTINUE
      CALL CONTRO(NR1,NW1)
      REWIND 20
      REWIND 21
      REWIND 22
      REWIND 23
      WRITE(NW1,1100)
 1100 FORMAT(1H1)
   50 CONTINUE
      LOCK 20
      LOCK 21
```

```
      LOCK 22
      LOCK 23
      LOCK 24
      STOP
      END


      SUBROUTINE CONTRO(NR1,NW1)
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDB(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOI(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZON(300),SADD(300),SLAXE(6)
      COMMON /EROS/ PINST(8),RKST(8),THATA(3),P30MIN,VC(10)
     *               ,EROSD(12,300)
      COMMON /CHEM/ FO(8,4,300),PCR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      COMMON /RAIN3/ CF(4,12),CF4(4,12),XBAR(5,7),SDX(5,7),PRO(5,7),
     *               RCF(9),PR(7),RCFCPT(9)
      COMMON /OUTPUT/ MONTH(12),IYEAR,PECHB(12,6),PINFHB(12,6),
     *                PEC30(12,300)
      COMMON /TOTAL/ T1(8,6),T2(8,6),T3(8,6),T4(8,6),T5(8,6),SLAEPT(6)
      COMMON /STAT/ ACFOT(8,100),XLADT(8,100),XLAET(8,100),Y1T(8,100),
     *              Y2T(8,100),SLAXET(100),IYSTRT,NR
      DIMENSION CRUST(300),XADD(8,300),AST(6),ALT(6),XSUB(8,300)
      NR=NR1
      CRUSTD=1.
      DELTAI=1.0
      MO=0
      KOUNT=0
      READ(NR1,502) (TITL(1,I),I=1,20),(TITL(2,I),I=1,20)
  502 FORMAT(20A4 / 20A4)
      WRITE(NW1,602)(TITL(1,I),I=1,20),(TITL(2,I),I=1,20)
  602 FORMAT( 1H0,20A4 / 1H ,20A4)
      READ(NR1,504) IOPRUN(1),NR5,NW5,IOPRUN(2),IOPRUN(3),IOPECH(1)
     *              ,IOPECH(2),IOPECH(3),(IOPWRT(I),I=1,5)
     *              ,NR1,NW1,NYEARS, IRADUM,NHYDB,IOPRUN(4),IOPRUN(6)
     *              ,IYSTRT,NR6
  504 FORMAT(    1X,I1,2(1X,I2),10(1X,I1),3(1X,I2),1X,I15,3(1X,I1),1X,I4,
     *       1X,I2)
      IF(IYSTRT.LT.1)IYSTRT=1
      WRITE(NW1,604)IOPRUN(1),NR5,NW5,IOPRUN(2),IOPRUN(3),IOPECH(1)
     *              ,IOPECH(2),IOPECH(3),(IOPWRT(I),I=1,5),NR1,NW1,NYEARS
     *              ,IRADUM,NHYDB,IOPRUN(4),IOPRUN(6),IYSTRT,NR6
  604 FORMAT(1H0,'IOPRUN(1)=',I2,3X,'NR5=',I3,3X,'NW5=',I3,3X
     *      ,'IOPRUN(2)=',I2,3X,'IOPRUN(3)=',I2,3X,'IOPECH(1)=',I2,3X
     *      ,'IOPECH(2)=',I2,3X,'IOPECH(3)=',I2 / 1H0
     *            ,'IOPWRT(1)=',I2,3X,'IOPWRT(2)='
     *      ,I2,3X,'IOPWRT(3)=',I2,3X,'IOPWRT(4)=',I2,3X,'IOPWRT(5)='
     *      ,I2,3X,'NR1=',I3,3X,'NW1=',I3,3X,'NYEARS=',I3
     *             ,//,1X,'IRADUM =',I15,3X,'NHYDB = ',I1,3X,'IOPRUN(4) =
     *              ,I1,3X,'IOPRUN(6) = ',I1,3X,'IYSTRT = ',I4,3X,'NR6 ='
     *              ,1X,I2)
      READ(NR1,506)  NR2,NW2,NELE,AREA,INXOPT
  506 FORMAT( 2(1X,I2),1X,I3,1X,F6.0,1X,I1)
      WRITE(NW1,606) NR2,NW2,NELE,AREA,INXOPT
  606 FORMAT(1H0,'NR2=',I3,3X,'NW2=',I3,3X,'NELE=',I4,3X'AREA=',F8.2,
     *       3X,'INXOPT = ',I1)
      ICHCK=IYSTRT-1
      DO 1 I=1,NELE
    1 CRUST(I)=0.
      WRITE(NW1,401)
  401 FORMAT(//,3X,'HEAVY METAL 1 = ZINC',/,3X,'HEAVY METAL 2 = MERCURY'
```

```
     *        ,/,3X,'HEAVY METAL 3 = LEAD',/,3X,'HEAVY METAL 4 = CADMIUM'
     *        ,/,3X,'HEAVY METAL 5 = CHROMATE',/,3X,'HEAVY METAL 6 ='
     *        ,' ORTHO PHOSPHATE',//)
      WRITE(NW1,402)
  402 FORMAT(3X,'HYDROLOGIC SUB-BASIN 1 = FREMONT',/,3X,'HYDROLOGIC SUB'
     *        '-BASIN 2 = DIRTY DEVIL',/,3X,'HYDROLOGIC SUB-BASIN 3 = '
     *        'COLORADO',/,3X,'HYDROLOGIC SUB-BASIN 4 = ESCALANTE',/,3X,
     *        'HYDROLOGIC SUB-BASIN 5 = SAN JUAN',//)
      CALL READSC(NR2,NW1,AREA)
      READ(NR1,508)  NR3,NHVM,(IHVM(I),I=1,8),NHVT,NR4,NW4
  508 FORMAT(1X,I2,10(1X,I1),2(1X,I2))
      WRITE(NW1,608) NR3,NHVM,NHVT
  608 FORMAT(1H0,'READ FILE (NR3) = ',I3,3X,'NUMBER OF HEAVY METALS THIS
     * RUN = ',I2,3X,'TOTAL HEAVY METALS = ',I2)
      CALL READDF(NR3,NW1)
      CALL RDINHT(NR4,NW1)
      DO 2 I=1,NHVM
      WRITE(NW1,609) I,IHVM(I)
  609 FORMAT(1H0,3X,'IHVM(',I1,') =',I2)
    2 CONTINUE
      WRITE(NW1,610) NR4
  610 FORMAT(1H0,'READ FILE FOR INITIAL HEAVY METAL RESIDUE (NR4)='
     *        ,I3)
      DO 100 IA=1,6
      AST(IA)=0.
      ALT(IA)=0.
  100 CONTINUE
      DO 101 IE=1,NELE
      IH=IHYDB(IE)
      AST(IH)=AST(IH)+AS(IE)
      ALT(IH)=ALT(IH)+AL(IE)
  101 CONTINUE
      WRITE(NW1,102)
  102 FORMAT(1H1,////,41X,'HYDROLOGIC      TOTAL SOIL AREA      TOTAL LAK'
     *        ,'E AREA',/,41X,'SUB-BASIN             SQ.KM              ',
     *        'SQ.KM')
      DO 103 IH=1,NHYDB
      WRITE(NW1,104)IH,AST(IH),ALT(IH)
  104 FORMAT(/,45X,I1,13X,E9.3,11X,E9.3)
  103 CONTINUE
      IF(IOPRUN(1).NE.1) GOTO 6
      IF(IOPWRT(3).EQ.1.OR.IOPWRT(3).EQ.2)
     *WRITE(NW1,611)
  611 FORMAT(1H1,'PRECIPITATION DATA FROM NR5' / 1H )
C*
C*                   PRECIPITATION/EROSION SUBMODELS
C*
      DO 8 IE=1,NELE
      READ(NR5,512) IDUM1,IDUM2,(F3CX(J),J=1,12),(PINF(J,IE),J=1,12)
  512 FORMAT(A1,I2,12E10.3 / 3X,12E10.3)
      IF(IOPWRT(3).EQ.1.OR.IOPWRT(3).EQ.2)
     *WRITE(NW1,612)IDUM1,IDUM2,(F3CX(J),J=1,12),(PINF(J,IE),J=1,12)
  612 FORMAT(1H ,A1,I2,3X,12F10.3/ 1H ,3X,12F10.3)
      IF(IDUM1.EQ.IEROW(IE).AND.IDUM2.EQ.IECOL(IE)) GOTO 10
      WRITE(NW1,614)IE,IEROW(IE),IECOL(IE)
  614 FORMAT(1H0,'ERROR IN PRECIP DATA READ FROM NR5, ELEMENT =',I4
     *        ,3X'ROW = ',A1,3X,'COLUMN = ',I2)
      WRITE(NW1,612)IDUM1,IDUM2,(P3CX(J),J=1,12),(PINF(J,IE),J=1,12)
      IOPRUN(5)=1
   10 DO 12 IMO=1,12
      CALL [illegible](NS1(IE),B1(1,IE),B1(2,IE),B1(3,IE),B1(4,IE))
```

```
     *          ,...ISO)...ZOM(...,IE)...EROSD(IMO,IE))
      IF(EROSD(IMO,IE).LT.CRUSTD)GO TO 12
      KOUNT=KOUNT+1
      IF(KOUNT.LT.10)
     *WRITE(NW1,750)IMO,IE,IEROW(IE),IECOL(IE),EROSD(IMO,IE)
  750 FORMAT(10X,'*** WARNING: EROSD(',I2,',',I3,') WHICH IS ELEMENT ',
     *        A1,I2,' IS EQUAL TO ',E10.3,' CM WHICH IS GREATER THAN ',
     *        'CRUSTD',/)
   12 CONTINUE
    8 CONTINUE
      IF(IOPWRT(4).NE.1) GOTO 6
      CALL WRTERO(NW1)
    6 CONTINUE
      IF(IOPRUN(1).EQ.1)GO TO 85
      DO 51 I=1,4
   51 READ(NR6,710)(CF(I,M),M=1,12)
      DO 52 I=1,4
   52 READ(NR6,710)(CF4(I,M),M=1,12)
  710 FORMAT(12F5.0)
      DO 53 I=1,5
   53 READ(NR6,720)(XBAR(I,M),M=1,7)
      DO 54 I=1,5
   54 READ(NR6,720)(SDX(I,M),M=1,7)
  720 FORMAT(7F10.0)
      READ(NR6,730)(RCF(I),I=1,9)
  730 FORMAT(9F5.0)
      READ(NR6,730)(RCFOPT(I),I=1,9)
   85 CONTINUE
      IF(INXOPT.NE.1)GO TO 74
      DO 71 IHB=1,NHYDB
      READ(NR1,740)(ACCFO(IHM,IHB),IHM=1,NHVM)
  740 FORMAT(8(E8.3,2X))
   71 CONTINUE
      DO 72 IHB=1,NHYDB
      READ(NR1,740)(XLAXD(IHM,IHB),IHM=1,NHVM)
   72 CONTINUE
      DO 73 IHB=1,NHYDB
      READ(NR1,740)(XLAXE(IHM,IHB),IHM=1,NHVM)
   73 CONTINUE
      IF(IOPRUN(6).NE.1)GO TO 74
      READ(NR1,760)(SLAXE(IH),IH=1,NHYDB)
  760 FORMAT(8(E8.3,2X))
   74 CONTINUE
      IF(IOPRUN(5).EQ.1) STOP
      DO 134 IE=1,NELE
      DO 134 IH=1,8
      DO 134 I=3,5
  134 X(I,IH,IE)=X(2,IH,IE)
      IF(IOPRUN(3).LT.2) GOTO 130
      DO 132 IE=1,NELE
      DO 132 IH=1,8
      DO 132 I=1,5
  132 X(I,IH,IE)=0.0
  130 CONTINUE
      NYEARS=NYEARS+IYSTRT-1
      DO 14 IYEAR=IYSTRT,NYEARS
      IF(IOPRUN(1).EQ.1) GOTO 30
      DO 18 IMO=1,12
      DO 55 L=1,5
   55 PRO(L,1)=0.
      DO 16 IE=1,NELE
```

```
      TAREA=AL(IE)+AS(IE)
      CALL RAIN3 (IMO,IRADUN,P30X(IMO),PINF(IMO,IE),MO,ALPHA(IE),CEF(IE)
     *           ,MAS(IE),IOZON(IE),IPZON(IE),IOPRUN(1),TAREA)
      PEC30(IMO,IE)=P30X(IMO)
   22 IF(IOPRUN(2).EQ.1) GOTO 16
      CALL EROS(NB1(IE),B1(1,IE),B1(2,IE),B1(3,IE),B1(4,IE)
     *          ,P30X(IMO),P30MIN,BD(IE),EROSD(IMO,IE))
      IF(EROSD(IMO,IE).LT.CRUSTC)GO TO 16
      KOUNT=KOUNT+1
      IF(KOUNT.LT.10)
     *WRITE(NW1,750)IMO,IE,IEROW(IE),IECOL(IE),EROSD(IMO,IE)
   16 CONTINUE
   15 CONTINUE
      IF(IOPWRT(3).NE.1) GO TO 24
      CALL WRTNW5(NW5)
   24 IF(IOPWRT(4).NE.1) GOTO 30
      CALL WRTERO(NW4)
C*
C*                    CHEMISTRY SUBMODEL
C*
   30 DO 60 IMO=1,12
      IS=1
      IF(IMO.GT.2)IS=2
      IF(IMO.GT.5)IS=3
      IF(IMO.GT.8)IS=4
      IF(IMO.EQ.12)IS=1
      IF(IOPRUN(3).GT.0) GOTO 32
      DO 34 IE=1,NELE
      DELTA=CRUST(IE)
      CALL CHEM(IE,IS,IMO)
   34 CONTINUE
C*
C*                    DISTRIBUTE MASS AMONG ELEMENTS
C*
   32 DO 36 IE=1,NELE
      DO 38 IH=1,8
      XSUB(IH,IE)=0.
   38 XADD(IH,IE)=0.
      SADD(IE)=0.
   36 CRUST(IE)=0.
      DO 40 IE=1,NELE
      ESV=EROSD(IMO,IE)*AS(IE)
      ESM=ESV*BD(IE)*1.0E7
      DO 112 I=1,2
      KE=ITRAN(I,IE)
      IF(KE.EQ.0) GOTO 112
      CRUST(KE)=CRUST(KE)+ESV*PTRAN(I,IE)
      CRUST(IE)=CRUST(IE)-ESV*PTRAN(I,IE)
      SADD(KE)=SADD(KE)+ESM*PTRAN(I,IE)
  112 CONTINUE
      CRUST(IE)=CRUST(IE)-ESV*PTRAN(3,IE)
   40 CONTINUE
      DO 114 IE=1,NELE
      IF(AS(IE).LT.1.0E-6) GOTO 116
      CRUST(IE)=CRUST(IE)/(AS(IE)+AL(IE))
      GOTO 118
  116 CRUST(IE)=0.0
  118 IHB=IHYDB(IE)
      SLAKE(IHB)=SLAKE(IHB)+PTRAN(3,IE)*EROSD(IMO,IE)*AS(IE)*BD(IE)
     *           *1.0E7
      SLAKE(IHB)=SLAKE(IHB)+SADD(IE)*AL(IE)/(AS(IE)+AL(IE))
```

```
114 CONTINUE
    DO 120 IE=1,NELE
    DO 122 IH=1,NHVM
    KH=IHVM(IH)
    DO 124 I=1,2
    KE=ITRAN(I,IE)
    IF(KE.EQ.0) GOTO 124
    Q=X(1,KH,IE)*EROSD(IMO,IE)*AS(IE)*PTRAN(I,IE)/(AS(KE)+AL(KE))
    XADD(KH,KE)=XADD(KH,KE)+Q
    XSUB(KH,IE)=XSUB(KH,IE)+Q
124 CONTINUE
122 CONTINUE
120 CONTINUE
    DO 126 IE=1,NELE
    IHB=IHYDB(IE)
    DO 128 IH=1,NHVM
    KH=IHVM(IH)
    XEROD=X(1,KH,IE)*EROSD(IMO,IE)*PTRAN(3,IE)*AS(IE)
    XSUB(KH,IE)=XSUB(KH,IE)+XEROD/(AS(IE)+AL(IE))
    XLAXE(KH,IHB)=XLAXE(KH,IHB)+XEROD+XADD(KH,IE)*AL(IE)
    XLAXD(KH,IHB)=XLAXD(KH,IHB)+AL(IE)*FO(KH,IS,IE)*DELTAT
    ACCFO(KH,IHB)=ACCFO(KH,IHB)+FO(KH,IS,IE)*(AS(IE)+AL(IE))*DELTAT
    IF(ABS(CRUST(IE)).GT.CRUSTD)
   *  WRITE(6,772) CRUSTD,IYEAR,IMO,IE,CRUST(IE),EROSD(IMO,IE)

772 FORMAT(1H0,'EROSION OR DOPOSITION EXCEEDS CRUST DEPTH OF',F8.3,
   *  '    YEAR =',I4,'    MONTH =',I3,'     IE =',I4,'     CRUST =',
   *  F8.3,'     EROSD =',F8.3)
    IF(IOPRUN(3).EQ.3) GOTO 150
    IF(CRUST(IE)) 140,142,142
140 Q=-CRUST(IE)
    X(1,KH,IE)=X(1,KH,IE)+(Q*X(2,KH,IE)+XADD(KH,IE)-XSUB(KH,IE)
   *               +FO(KH,IS,IE)*DELTAT)/CRUSTD
    X(2,KH,IE)=X(2,KH,IE)+(X(3,KH,IE)-X(2,KH,IE))*Q/CRUSTD
    X(3,KH,IE)=X(3,KH,IE)+(X(4,KH,IE)-X(3,KH,IE))*Q/(2.*CRUSTD)
    X(4,KH,IE)=X(4,KH,IE)+(X(5,KH,IE)-X(4,KH,IE))*Q/(2.*CRUSTD)
    GOTO 128
142 Q=CRUST(IE)
    X(4,KH,IE)=X(4,KH,IE)+(X(3,KH,IE)-X(4,KH,IE))*Q/(2.*CRUSTD)
    X(3,KH,IE)=X(3,KH,IE)+(X(2,KH,IE)-X(3,KH,IE))*Q/(2.*CRUSTD)
    X(2,KH,IE)=X(2,KH,IE)+(X(1,KH,IE)-X(2,KH,IE))*Q/CRUSTD
    X(1,KH,IE)=X(1,KH,IE)+(XADD(KH,IE)-XSUB(KH,IE)-Q*X(1,KH,IE)
   *               +FO(KH,IS,IE)*DELTAT)/CRUSTD
    GO TO 128
150 X(1,KH,IE)=X(1,KH,IE)+(XADD(KH,IE)-XSUB(KH,IE)
   *               +FO(KH,IS,IE)*DELTAT)/CRUSTD
128 CONTINUE
126 CONTINUE
 60 CONTINUE
    CALL OUTPUT(NW1,NHYDB,ICHCK,NYEARS)
 14 CONTINUE
    IF(IOPRUN(4).EQ.1) CALL RERUN(NW1,7,IRADUM,NHYDB)
    RETURN
    END
```

```
      SUBROUTINE READOF(NR3,NW1)
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDR(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IOZON(300),SADU(300),SLAXE(6)
      COMMON /CHEM/ FO(8,4,300),POR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      IF(IOPECH(2).GT.0)GO TO 30
      WRITE(NW1,200)NELE,NHVM
  200 FORMAT(1H1,5X,"NO. OF ELEMENTS="I3/1H
     *          ,5X,"NO. OF HEAVY METALS TO BE RUN IN THIS RUN=",I2)
      WRITE(NW1,230)
  230 FORMAT(1H ,///,7X,"ELEMENT"7X,"METAL 1",7X,"METAL 2",7X,"METAL 3",
     *7X,"METAL 4",7X,"METAL 5",7X,"METAL 6",7X,"METAL 7",7X,"METAL 8")
   30 CONTINUE
      DO 10 I=1,NELE
      DO 10 J=1,4
      READ(NR3,100)IDUM,IDUM1,IDUM2,(FO(K,J,I),K=1,8)
  100 FORMAT(A1,1X,A1,I2,8E9.3)
      IF(IOPECH(2) .GT. 0) GO TO 20
      WRITE(NW1,210)IDUM,IDUM1,IDUM2,(FO(K,J,I),K=1,8)
  210 FORMAT(1H0,5X,A1,3X,A2,I2,8(5X,E9.3))
   20 IF(IDUM .EQ. "F" .AND. IDUM1 .EQ. IEROW(I) .AND. IDUM2 .EQ.
     *IECOL(I)) GO TO 10
      WRITE(NW1,220)
  220 FORMAT(1H0,"ERROR IN FALLOUT DATA FROM NR3")
      WRITE(NW1,210)IDUM,IDUM1,IDUM2,(FO(K,J,I),K=1,8)
      IOPRUN(5)=1
   10 CONTINUE
      RETURN
      END

      SUBROUTINE RDINHT(NR4,NW1)
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDR(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IOZON(300),SADU(300),SLAXE(6)
      COMMON /CHEM/ FO(8,4,300),POR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      IF(IOPECH(3).GT.0)GO TO 80
      WRITE(NW1,250)
  250 FORMAT(1H1,///,7X,"ELEMENT"7X,"METAL 1",7X,"METAL 2",7X,"METAL 3",
     *7X,"METAL 4",7X,"METAL 5",7X,"METAL 6",7X,"METAL 7",7X,"METAL 8")
   80 CONTINUE
      DO 50 I=1,NELE
```

```
      READ(NR4,110)IDUM,IDUM1,IDUM2,(X(1,J,I),J=1,8)
  110 FORMAT(A1,1X,A1,I2,1X,8E9.3)
      IF(IOPECH(3).GT.0)GO TO 40
      WRITE(NW1,260)IDUM,IDUM1,IDUM2,(X(1,J,I),J=1,8)
  260 FORMAT(1H0,5X,A1,3X,A2,I2,8(5X,E9.3))
   40 IF(IDUM .EQ. "C" .AND. IDUM1 .EQ. IEROW(I) .AND. IDUM2 .EQ.
     *IECOL(I)) GO TO 50
      WRITE(NW1,270)
  270 FORMAT(1H0,"ERROR IN INITIAL HEAVY METAL DATA FROM NR4 (IN THE
     *CRUST)")
      WRITE(NW1,260)IDUM,IDUM1,IDUM2,(X(1,J,I),J=1,8)
      IOPRUN(5)=1
   50 CONTINUE
      IF(IOPECH(3).GT.0)GO TO 90
      WRITE(NW1,280)
  280 FORMAT(1H1,///,7X,"ELEMENT"7X,"METAL 1",7X,"METAL 2",7X,"METAL 3",
     *7X,"METAL 4",7X,"METAL 5",7X,"METAL 6",7X,"METAL 7",7X,"METAL 8")
   90 CONTINUE
      DO 60 I=1,NELE
      READ(NR4,120)IDUM,IDUM1,IDUM2,(X(2,J,I),J=1,8)
  120 FORMAT(A1,1X,A1,I2,1X,8E9.3)
      IF(IOPECH(3).GT.0)GO TO 70
      WRITE(NW1,290)IDUM,IDUM1,IDUM2,(X(2,J,I),J=1,8)
  290 FORMAT(1H0,5X,A1,3X,A2,I2,8(5X,E9.3))
   70 IF(IDUM .EQ. "S" .AND. IDUM1 .EQ. IEROW(I) .AND. IDUM2 .EQ.
     * IECOL(I)) GO TO 60
      WRITE(NW1,300)
  300 FORMAT(1H0,"ERROR IN INITIAL HEAVY METAL DATA FROM NR4
     * (BENITH CRUST)")
      WRITE(NW1,290)IDUM,IDUM1,IDUM2,(X(2,J,I),J=1,8)
      IOPRUN(5)=1
   60 CONTINUE
      RETURN
      END


      SUBROUTINE READSC(NR2,NW1,AREA)
      COMMON  NR1(300) ,ITTL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDB(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZON(300),SADU(300),SLAXE(6)
      COMMON /EROS/ PINST(8),RKST(8),THATA(3),P30MIN,VC(10)
     *              ,EROSD(12,300)
      COMMON /CHEM/ FO(8,4,300),POR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      DIMENSION ISLOP(4),IVEG(4),PA(4),ITROW(2),ITCOL(2)
      DO 2 IE=1,NELE
      READ(NR2,502) IEROW(IE),IECOL(IE),(ISOT(I,IE),ISLOP(I)
     *               ,IVEG(I),PA(I),I=1,4),(FO(1,I,IE)
     *              ,ITRAN(I,IE),PTRAN(I,IE),I=1,2),PTRAN(3,IE),IDZON(IE)
     *       ,IPZON(IE),IHYDB(IE),POR(IE),BD(IE),CEE(IE),ALPHA(IE),ELAR
     *       ,MAR(IE)
  502 FORMAT(A1,I2,4(1X,I1,A1,I1,F3.2),2(1X,A1,I2
     *      ,F3.2),F3.2,3(1X,I2),F3.2,2(1X,F3.2),F3.2,F6.0,2X,I1)
      IF(ELAR.LT.0.000001)ELAR=AREA
      IF(IOPECH(1).NE.1)
     *WRITE(NW1,608)IE,IEROW(IE),IECOL(IE),(ISOT(I,IE),ISLOP(I)
     *               ,IVEG(I),PA(I),I=1,4),(FO(1,I,IE)
     *              ,ITRAN(I,IE),PTRAN(I,IE),I=1,2),PTRAN(3,IE),IDZON(IE)
     *       ,IPZON(IE),IHYDB(IE),POR(IE),BD(IE),CEE(IE),ALPHA(IE),ELAR
     *       ,MAR(IE)
  608 FORMAT(1H0,I3,1X,A1,I2,2X,4(1X,I1,1X,A1,1X,I1,1X,F5.2)
```

```
     *        ,2X,2(2X,A1,I2,1X,F4.2),1X,F4.2,1X,3(1X,I2),4F5.2,F8.2
     *        ,2X,I1)
C*
C*                   CHECK FOR ERRORS AND DISTINGUISH SLOPES
C*
      DO 62 I=1,4
      IF(ISOT(I,IE).EQ.0) GOTO 62
      IF(ISOT(I,IE).GT.0.AND.ISOT(I,IE).LT.9) GO TO 24
      WRITE(NW1,606)IE,IEROW(IE),IECOL(IE)
  606 FORMAT(1H0,"ERROR, SOIL TYPE CODE DOES NOT FALL IN THE RANGE 1-8!"
     *       ,"IE = ",I4,3X,"ROW = ",A1,3X,"COLUMN = ",I3)
      IOPRUN(5)=1
   24 IF(ISOT(I,IE).EQ.8) GOTO 62
      IF(ISLOP(I).NE."F") GO TO 12
      ISLOP(I)=1
      GOTO 62
   12 IF(ISLOP(I).NE."M") GO TO 16
      ISLOP(I)=2
      GOTO 62
   16 IF(ISLOP(I).NE."S") GO TO 18
      ISLOP(I)=3
      GOTO 62
   18 WRITE(NW1,602)ISLOP(I),IE,IEROW(IE),IECOL(IE)
  602 FORMAT(1H0,"ERROR IN SLOPE IDENTIFICATION = ",A1,3X."IE =",I3
     *       ,3X,"ROW = ",A1,3X,"COLUMN = ",I3)
      IOPRUN(5)=1
   62 CONTINUE
      IF(ABS(PA(1)+PA(2)+PA(3)+PA(4)-1.00).LT.0.02) GO TO 64
      WRITE(NW1,604)IE,IEROW(IE),IECOL(IE)
  604 FORMAT(1H0,"ERROR, SUM OF SUBELEMENT AREAS IS LESS THAN 100%
     *       , IE =",I4,3X,"ROW = ",A1,"COLUMN = ",I3)
      IOPRUN(5)=1
C*
C*
C*                   CALCULATE AREAS
   64 AL(IE)=0.0
      AS(IE)=0.0
      DO 50 I=1,4
      IF(ISOT(I,IE).EQ.0) GOTO 50
      IF(ISOT(I,IE).EQ.8) GOTO 52
      AS(IE)=AS(IE)+ELAR*PA(I)
      GOTO 50
   52 AL(IE)=AL(IE)+ELAR*PA(I)
   50 CONTINUE
      IF(ABS((AL(IE)+AS(IE))/ELAR-1.0).GT.0.02)
     *WRITE(NW1,604)IE,IEROW(IE),IECOL(IE)
C*
C*                   CALCULATE B1 FOR THE EROSION MODEL
C*
      NB1(IE)=0
      DO 6 I=1,4
      IF(ISOT(I,IE).EQ.0) GOTO 6
      NB1(IE)=NB1(IE)+1
      K1=ISOT(I,IE)
      IF(AS(IE).LT.1.0E-6) GOTO 102
      IF(K1.NE.8) GO TO 8
  102 B1(I,IE)=0.0
      GO TO 6
      CONTINUE
      K2=ISLOP(I)
      K3=IV[illegible](I)
```

```
      Z1=TAN(THATA(K2))
      Z2=Z1**.[illegible]
      Z2=10.0*SIN(THATA(K2))/Z1
      B1(I,IE)=Z2*VC(K2)*RKST(K1)
      B1(I,IE)=B1(I,IE)*(AS(IE)+AL(IE))*PA(I)/AS(IE)
    6 CONTINUE
   10 CONTINUE
    2 CONTINUE
C*
C*                     IDENTIFY TRANSPORT ELEMENTS
C*
      DO 40 IE=1,NELE
      DO 42 I=1,2
      IF(ITRAN(I,IE).EQ.0) GOTO 42
      DO 44 IEC=1,NELE
      IF(FO(1,I,IE).NE.IEROW(IEC).OR.ITRAN(I,IE).NE.IECOL(IEC)) GOTO 44
      ITRAN(I,IE)=IEC
      GOTO 42
   44 CONTINUE
      WRITE(NW1,630)FO(1,I,IE),ITRAN(I,IE),IE,IEROW(IE),IECOL(IE)
  630 FORMAT(1H0,'ERROR, TRANSFER ELEMENT ',A1,I2,'  NOT FOUND FOR IE ='
     *       ,I3,'  ELEMENT ',A1,I2)
      IOPRUN(5)=1
   42 CONTINUE
   40 CONTINUE
      IF(IOPECH(1))66,66,68
   66 CONTINUE
      DO 70 IE=1,NELE
      WRITE(NW1,610)IE,IEROW(IE),IECOL(IE),(ITRAN(I,IE),PTRAN(I,IE),I=1,
     *                2),PTRAN(3,IE),AL(IE),AS(IE),NB1(IE),
     *                (B1(I,IE),I=1,4)
  610 FORMAT(1H0,I3,2X,A1,2X,I3,2(3X,I5,1X,F4.2),3X,F4.2,2(2X,E8.2),3X,
     *          I5,4(3X,E8.2))
   70 CONTINUE
   68 RETURN
      END


      SUBROUTINE EROS(N,B1,B2,B3,B4,P30,P30MIN,BD,D)
      DIMENSION B(4)
      IF(N.NE.0) GOTO 6
      D=0.0
      RETURN
    6 IF(P30.GT.P30MIN) GOTO 4
      D=0.0
      RETURN
C*
C*    CHANGE P30 TO INCHES PER HOUR
C*
    4 P=P30*2./2.54
      E=210.3+89.0*ALOG10(P)
      P=P*E/100.0
      W=0.0
      B(1)=B1
      B(2)=B2
      B(3)=B3
      B(4)=B4
      DO 2 I=1,N
      W=B(I)*R+W
    2 CONTINUE
```

```
C*
C*     CHANGE W TO KG/SQ.CM
C*
       W=W*2.2437E-5
C*
C*     BD IN GM/CU.CM
C*
       D=W/(BD/1000.)
C*
C*     D IN CM
C*
       RETURN
       END

      SUBROUTINE WRTNW5(NW)
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDB(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZON(300),SADD(300),SLAXE(6)
      COMMON /CHEM/ FO(8,4,300),POR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      COMMON /OUTPUT/ MONTH(12),IYEAR,PECHB(12,6),PINFHB(12,6),
     *                 PEC30(12,300)
      WRITE(NW,1000)
 1000 FORMAT(1H1,///,45X,42HPRECIPITATION - 30 MINUTE INTENSITY IN CM.
     *       ,/,45X,42(1H_),//)
      WRITE(NW,1050)IYEAR
 1050 FORMAT(59X,8H** YEAR ,I2,3H **,/)
      WRITE(NW,1100)(MONTH(I),I=1,12)
 1100 FORMAT(1X,7HELEMENT,6X,11(A4,6X),A4,/)
      DO 100 IE=1,NELE
  100 WRITE(NW,1200)IE,(PEC30(IMO,IE),IMO=1,12)
 1200 FORMAT(3X,I3,4X,12E10.3,/)
      WRITE(NW,2000)
 2000 FORMAT(1H1,///,56X,19HINFILTRATION IN CM. ,/,56X,19(1H_),//)
      WRITE(NW,1050)IYEAR
      WRITE(NW,1100)(MONTH(I),I=1,12)
      DO 200 IE=1,NELE
  200 WRITE(NW,1200)IE,(PINF(IMO,IE),IMO=1,12)
      RETURN
      END

      SUBROUTINE WRTERO(NW)
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDB(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZON(300),SADD(300),SLAXE(6)
      COMMON /EROS/ PINST(8),RKST(8),THATA(3),P30MIN,VC(10)
     *               ,EROSD(12,300)
      COMMON /OUTPUT/ MONTH(12),IYEAR,PECHB(12,6),PINFHB(12,6),
     *                 PEC30(12,300)
      WRITE(NW,1000)
 1000 FORMAT(1H1,///,56X,20HEROSION DEPTH IN CM. ,/,56X,20(1H_),//)
      WRITE(NW,1050)IYEAR
 1050 FORMAT(59X,8H** YEAR ,I2,3H **,/)
      WRITE(NW,1100)(MONTH(I),I=1,12)
 1100 FORMAT(1X,7HELEMENT,6X,11(A4,6X),A4,/)
      DO 100 IE=1,NELE
  100 WRITE(NW,1200)IE,(EROSD(IMO,IE),IMO=1,12)
 1200 FORMAT(3X,I3,4X,12E10.3,/)
      RETURN
```

```
      SUBROUTINE OUTPUT(NW,NHYB,IC,IYEARS)
      COMMON ENI(300),TITL(2,20),IOPRON(6),IOPRCH(5),IOPART(6)
     *,IEROS(300),IECOL(300),ITRAN(2,300),FTRAN(3,300),IHYDB(300)
     *,NHVM,IHVM(8),ACCFO(8,6),XLAXD(5,6),XLAXE(8,6),CHUSTD,AS(300)
     *,AL(300),NELE,H1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZOM(300),SADD(300),SLAXE(6)
      COMMON /CHEM/ FO(8,4,300),POW(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
      COMMON /OUTPUT/ MONTH(12),IYEAR,PECHB(12,6),PINFHB(12,6),
     *                 PEC30(12,300)
      COMMON /TOTAL/ T1(8,6),T2(8,6),T3(8,6),T4(8,6),T5(8,6),SLAEPT(6)
      COMMON /STAT/ ACFOT(8,100),XLADT(8,100),XLAET(8,100),Y1T(8,100),
     *               Y2T(8,100),SLAXET(100),IYSTRT,NR
      INTEGER H
      DIMENSION H(8,6),X1(8,6),X2(8,6)
      DIMENSION ACFO(8,6),XLAD(8,6),XLAE(8,6),Y1(8,6),Y2(8,6)
      DATA (H(I,1),I=1,8) /8*4HHEAV/
      DATA (H(I,2),I=1,8) /8*4HY ME/
      DATA (H(I,3),I=1,8) /8*4HTAL /
      IC=IC+1
      DO 1 I=1,12
      DO 1 J=1,6
      PECHB(I,J)=0.
      PINFHB(I,J)=0.0
    1 CONTINUE
      DO 5 I=1,8
      DO 5 J=1,6
      X1(I,J)=0.0
      X2(I,J)=0.0
    5 CONTINUE
      IF(IC.GT.IYSTRT)GO TO 10
      WRITE(NW,1000)
 1000 FORMAT(1H1,///,16X,43HACCUMULATED AND TOTAL YEARLY VALUES AND MON,
     *       57HTHLY PRECIPATION AND INFILTRATION BY HYDROLOGIC SUB-BASI
     *N      ,/,16X,100(1H_),///)
      GO TO 20
   10 WRITE(NW,1100)
 1100 FORMAT(1H1,///)
   20 WRITE(NW,1200)IYEAR
 1200 FORMAT(59X,8H** YEAR ,I2,3H **,//)
      WRITE(NW,1300)
 1300 FORMAT(53X,25HACCUMULATED FALLOUT IN KG,/,53X,25(1H_),/)
      WRITE(NW,1400)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,NHVM)
 1400 FORMAT(1X,10HHYDROLOGIC,1X,7(A4,A4,A4,I1,2X),3A4,I1)
      WRITE(NW,1500)
 1500 FORMAT(1X,9HSUB-BASIN,/)
      CALL SETUP (ACCFO,ACFO,NHVM,IHVM,NHYB)
      DO 30 J=1,NHYB
   30 WRITE(NW,1600)J,( ACFO(I,J),I=1,NHVM)
 1600 FORMAT(/,5X,I1,7X,7(E9.3,6X),E9.3)
      WRITE(NW,1700)
 1700 FORMAT(///,43X,46HACCUMULATED FALLOUT DIRECTLY ON THE LAKE IN KG,/
     *,      43X,46(1H_),/)
      WRITE(NW,1400)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,NHVM)
      WRITE(NW,1500)
      CALL SETUP (XLAXD,XLAD,NHVM,IHVM,NHYB)
      DO 40 J=1,NHYB
   40 WRITE(NW,1600)J,( XLAD(I,J),I=1,NHVM)
      WRITE(NW,1800)
 1800 FORMAT(///,41X,49HACCUMULATED HEAVY METALS ERODED TO THE LAKE IN K
```

```
     *G      ,/,41X,49(1H_),/)
      WRITE(NW,1400)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,NHVM)
      WRITE(NW,1500)
      CALL SETUP (XLAXE,XLAE,NHVM,IHVM,NHYB)
      DO 50 J=1,NHYB
   50 WRITE(NW,1600)J,( XLAE(I,J),I=1,NHVM)
      DO 70 IE=1,NELE
      IHB=IHYDB(IE)
      DO 60 KH=1,8
      X1(KH,IHB)=X1(KH,IHB)+X(1,KH,IE)*AS(IE)
      X2(KH,IHB)=X2(KH,IHB)+X(2,KH,IE)*AS(IE)
   60 CONTINUE
   70 CONTINUE
      WRITE(NW,1900)
 1900 FORMAT(///,39X,47HACCUMULATED HEAVY METALS LEFT IN THE SOIL CRUST,
     *        6H IN KG,/,39X,53(1H_),/)
      WRITE(NW,1400)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,NHVM)
      WRITE(NW,1500)
      CALL SETUP (X1,Y1,NHVM,IHVM,NHYB)
      DO 80 J=1,NHYB
   80 WRITE(NW,1600)J,(Y1(I,J),I=1,NHVM)
      WRITE(NW,2000)
 2000 FORMAT(///,41X,44HACCUMULATED HEAVY METALS LEFT IN THE SUBSOIL,
     *        6H IN KG,/,41X,50(1H_),/)
      WRITE(NW,1400)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,NHVM)
      WRITE(NW,1500)
      CALL SETUP (X2,Y2,NHVM,IHVM,NHYB)
      DO 90 J=1,NHYB
   90 WRITE(NW,1600)J,(Y2(I,J),I=1,NHVM)
      DO 110 IE=1,NELE
      IHB=IHYDB(IE)
      DO 100 IMO=1,12
      PECHB(IMO,IHB)=PECHB(IMO,IHB)+PEC30(IMO,IE)
      PINFHB(IMO,IHB)=PINFHB(IMO,IHB)+PINF(IMO,IE)
  100 CONTINUE
  110 CONTINUE
      WRITE(NW,2100)
 2100 FORMAT(///,41X,49HMONTHLY PRECIPITATION - 30 MINUTE INTENSITY IN C
     *M      ,/,41X,49(1H_),/)
      WRITE(NW,2200)(MONTH(I),I=1,12)
 2200 FORMAT(1X,10HHYDROLOGIC,3X,11(A4,6X),A4,/,1X,9HSUB-BASIN,//)
      DO 120 J=1,NHYB
  120 WRITE(NW,2300)J,(PECHB(IMO,J),IMO=1,12)
 2300 FORMAT(5X,I1,4X,12E10.3,/)
      WRITE(NW,2400)
 2400 FORMAT(///,53X,26HMONTHLY INFILTRATION IN CM,/,53X,26(1H_),/)
      WRITE(NW,2200)(MONTH(I),I=1,12)
      DO 130 J=1,NHYB
  130 WRITE(NW,2300)J,(PINFHB(IMO,J),IMO=1,12)
      IF(IOPRUN(6).NE.1) GO TO 150
      WRITE(NW,2500)
 2500 FORMAT(///,46X,41HACCUMULATED SOIL ERODED TO THE LAKE IN KG,/,
     *        46X,41(1H_),/)
      WRITE(NW,2600)
 2600 FORMAT(46X,41HHYDROLOGIC SUB-BASIN          SOIL ERODED,/)
      DO 140 J=1,NHYB
  140 WRITE(NW,2700)J,SLAXE(J)
 2700 FORMAT(/,56X,I1,21X,E9.3)
  150 CONTINUE
      DO 170 J=1,NHYB
      DO 160 I=1,NHVM
```

```
      ACFOT(I,IC)=ACFOT(I,IC)+ACFO(I,J)-T1(I,J)
      XLADT(I,IC)=XLADT(I,IC)+XLAD(I,J)-T2(I,J)
      XLAET(I,IC)=XLAET(I,IC)+XLAE(I,J)-T3(I,J)
      Y1T(I,IC)=Y1T(I,IC)+Y1(I,J)-T4(I,J)
      Y2T(I,IC)=Y2T(I,IC)+Y2(I,J)-T5(I,J)
  160 CONTINUE
      SLAXET(IC)=SLAXET(IC)+SLAXE(J)-SLAEPT(J)
  170 CONTINUE
      WRITE(NW,2800)IYEAR
 2800 FORMAT(///,54X,16HTOTALS FOR YEAR ,I2,6H IN KG,/,54X,24(1H_))
      WRITE(NW,2900)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,NHVM)
 2900 FORMAT(//,12X,7(A4,A4,A4,I1,2X),3A4,I1)
      WRITE(NW,3000)(ACFOT(I,IC),I=1,NHVM)
 3000 FORMAT( /,2X,7H TOTAL ,/,2X,7HFALLOUT,4X,7(E9.3,6X),E9.3)
      WRITE(NW,3100)(XLADT(I,IC),I=1,NHVM)
 3100 FORMAT(/ ,2X,7HFALLOUT,/,2X,7HON LAKE,4X,7(E9.3,6X),E9.3)
      WRITE(NW,3200)(XLAET(I,IC),I=1,NHVM)
 3200 FORMAT(/ ,2X,7H ERODED,/,2X,7HTO LAKE,4X,7(E9.3,6X),E9.3)
      WRITE(NW,3300)(Y1T  (I,IC),I=1,NHVM)
 3300 FORMAT(/ ,2X,7HCHG. IN,/,2X,7H CRUST ,4X,7(E9.3,6X),E9.3)
      WRITE(NW,3400)(Y2T  (I,IC),I=1,NHVM)
 3400 FORMAT(/ ,2X,7HCHG. IN,/,2X,7HSUBSOIL,4X,7(E9.3,6X),E9.3)
      IF(IOPRUN(6).NE.1)GO TO 180
      WRITE(NW,3500)SLAXET(IC)
 3500 FORMAT( /,2X,42HTHE TOTAL SOIL ERODED TO THE LAKE IN KG = ,E10.3)
  180 CONTINUE
      DO 200 J=1,NHYB
      DO 190 I=1,NHVM
      T1(I,J)=ACFO(I,J)
      T2(I,J)=XLAD(I,J)
      T3(I,J)=XLAE(I,J)
      T4(I,J)=Y1(I,J)
      T5(I,J)=Y2(I,J)
  190 CONTINUE
      SLAEPT(J)=SLAXE(J)
  200 CONTINUE
      IF(IC.NE.NYEARS) RETURN
      WRITE(NW,3600)
 3600 FORMAT(1H1)
      CALL LASTOP(NYEARS,IOPRUN(6),NHVM,H,IHVM)
      RETURN
      END

      SUBROUTINE SETUP (XX,X,NHVM,IHVM,NHYB)
      DIMENSION XX(8,6),X(8,6),IHVM(8)
      DO 20 I=1,NHVM
      II=IHVM(I)
      DO 10 J=1,NHYB
      X(I,J)=XX(II,J)
   10 CONTINUE
   20 CONTINUE
      RETURN
      END

      SUBROUTINE LASTOP(NYEARS,IOPRN6,NHVM,H,IHVM)
      COMMON /STAT/ ACFOT(8,100),XLADT(8,100),XLAET(8,100),Y1T(8,100),
     *              Y2T(8,100),SLAXET(100),IYSTRT,NR
      INTEGER H
      DIMENSION H(8,6),IHVM(8),XC(8)
      IY=IYSTRT
      READ(NR ,1000)IOP,NHM,NW,NP,(XC(I),I=1,8)
 1000 FORMAT(I1,I1,2(I2,1X),8(E8.3,1X))
      IF(IOP.NE.1)GO TO 60
```

```
      DO 20 J=IY,NYEARS
      DO 10 I=2,NHH
      ACFOT(I,J)=ACFOT(1,J)
      XLADT(I,J)=XLADT(1,J)
      XLAET(I,J)=XLAET(1,J)
      Y1T(I,J)=Y1T(1,J)
      Y2T(I,J)=Y2T(1,J)
   10 CONTINUE
   20 CONTINUE
   30 CONTINUE
      DO 50 J=IY,NYEARS
      DO 40 I=1,NHM
      ACFOT(I,J)=ACFOT(I,J)*XC(I)
      XLADT(I,J)=XLADT(I,J)*XC(I)
      XLAET(I,J)=XLAET(I,J)*XC(I)
      Y1T(I,J)=Y1T(I,J)*XC(I)
      Y2T(I,J)=Y2T(I,J)*XC(I)
      IHVM(I)=I
   40 CONTINUE
   50 CONTINUE
      N=NHH
      GO TO 70
   60 N=NHVM
   70 CONTINUE
      WRITE(NW,1100)
 1100 FORMAT(1H1,/,56X,21HYEARLY TOTALS SUMMARY,/,56X,21(1H_))
      WRITE(NW,1200)
 1200 FORMAT(//,60X,13HFALLOUT IN KG,/,60X,13(1H_),/)
      WRITE(NW,1300)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,N)
 1300 FORMAT(4X,4HYEAR,4X,7(A4,A4,A4,I1,2X),3A4,I1)
      WRITE(NP,1400)
 1400 FORMAT(5HACFOT)
      DO 80 J=IY,NYEARS
      WRITE(NW,1500)J,(ACFOT(I,J),I=1,N)
      WRITE(NP,1600)J,(ACFOT(I,J),I=1,N)
 1500 FORMAT(/,5X,I2,6X,7(E9.3,6X),E9.3)
 1600 FORMAT(I2,6X,8(E9.3))
   80 CONTINUE
      WRITE(NW,1700)
 1700 FORMAT(1H1,////,49X,34HFALLOUT DIRECTLY ON THE LAKE IN KG,/,49X,
     *          34(1H_),/)
      WRITE(NW,1300)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,N)
      WRITE(NP,1800)
 1800 FORMAT(5HXLADT)
      DO 90 J=IY,NYEARS
      WRITE(NW,1500)J,(XLADT(I,J),I=1,N)
      WRITE(NP,1600)J,(XLADT(I,J),I=1,N)
   90 CONTINUE
      WRITE(NW,1900)
 1900 FORMAT(1H1,////,47X,37HHEAVY METALS ERODED TO THE LAKE IN KG,/,47X
     *          ,37(1H_),/)
      WRITE(NW,1300)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,N)
      WRITE(NP,2000)
 2000 FORMAT(5HXLAET)
      DO 100 J=IY,NYEARS
      WRITE(NW,1500)J,(XLAET(I,J),I=1,N)
      WRITE(NP,1600)J,(XLAET(I,J),I=1,N)
  100 CONTINUE
      WRITE(NW,2100)
 2100 FORMAT(1H1,////,47X,37HHEAVY METALS LEFT IN SOIL CRUST IN KG,/,47X
     *          ,37(1H_),/)
```

```
      WRITE(NW,1300)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,N)
      WRITE(NP,2200)
 2200 FORMAT(3HY1T)
      DO 110 J=IY,NYEARS
      WRITE(NW,1500)J,(Y1T(I,J),I=1,N)
      WRITE(NP,1600)J,(Y1T(I,J),I=1,N)
  110 CONTINUE
      WRITE(NW,2300)
 2300 FORMAT(1H1,////,48X,35HHEAVY METALS LEFT IN SUB=SOIL IN KG,/,48X,
     *          35(1H_),/)
      WRITE(NW,1300)(H(I,1),H(I,2),H(I,3),IHVM(I),I=1,N)
      WRITE(NP,2400)
 2400 FORMAT(3HY2T)
      DO 120 J=IY,NYEARS
      WRITE(NW,1500)J,(Y2T(I,J),I=1,N)
      WRITE(NP,1600)J,(Y2T(I,J),I=1,N)
  120 CONTINUE
      IF(IOPRN6.NE.1)GO TO 140
      WRITE(NW,2500)
 2500 FORMAT(1H1,50X,29HSOIL ERODED TO THE LAKE IN KG,/,51X,29(1H_),///,
     *          51X,4HYEAR)
      WRITE(NP,2600)
 2600 FORMAT(6HSLAXET)
      DO 130 J=IY,NYEARS
      WRITE(NW,2700)J,SLAXET(J)
      WRITE(NP,2800)J,SLAXET(J)
 2700 FORMAT(/,52X,I2,16X,E9.3)
 2800 FORMAT(I2,6X,E9.3)
  130 CONTINUE
  140 CONTINUE
      RETURN
      END

      SUBROUTINE RERUN(NW,NP,IRADUM,NHYDB)
      COMMON  NB1(300) ,TITL(2,20),IOPRUN(6),IOPECH(5),IOPWRT(6)
     *,IEROW(300),IECOL(300),ITRAN(2,300),PTRAN(3,300),IHYDB(300)
     *,NHVM,IHVM(6),ACCFO(8,6),XLAXD(8,6),XLAXE(8,6),CRUSTD,AS(300)
     *,AL(300),NELE,B1(4,300),ISOT(4,300),P30X(12),MAR(300)
     *,IPZON(300),IDZON(300),SADD(300),SLAXE(6)
      COMMON /EROS/ PINST(8),RKST(8),THATA(3),P30MIN,VC(10)
     *                 ,EROSD(12,300)
      COMMON /CHEM/ FO(8,4,300),POR(300),BD(300),PINF(12,300),X(5,8,300)
     *,DELTA,ALPHA(300),CEE(300),Y(8)
C*
C*    THIS SUBROUTINE WILL PROVIDE DATA NECESSARY FOR A PROGRAM RESTART
C*    THE LAST RANDOM NUMBER WILL BE PRINTED AND A PUNCHED DECK WILL BE
C*    MADE IN THE CORRECT INPUT FORMAT OF THE FOLLOWING
C*             ((X(1,KH,IE),KH=1,NHVM),IE=1,NELE)
C*             ((X(2,KH,IE),KH=1,NHVM),IE=1,NELE)
C*             ((ACCFO(IHM,IHB),IHM=1,NHVM),IHB=1,NHYDB)
C*             ((XLAXD(IHM,IHB),IHM=1,NHVM),IHB=1,NHYDB)
C*             ((XLAXE(IHM,IHB),IHM=1,NHVM),IHB=1,NHYDB)
C*             (SLAXE(IHB),IHB=1,NHYDB)
C*
      WRITE(NW,1000)IRADUM
 1000 FORMAT(1H1,///,10X,'THE LAST RANDOM NUMBER WAS = ',I15)
      DO 10 I=1,NELE
   10 WRITE(NP,1100)IEROW(I),IECOL(I),(X(1,J,I),J=1,8)
 1100 FORMAT(1HC,1X,A1,I2,1X,8E9.3)
      IF(IOPRUN(3).EQ.1)GO TO 30
      DO 20 I=1,NELE
   20 WRITE(NP,1200)IEROW(I),IECOL(I),(X(2,J,I),J=1,8)
```

```
1200 FORMAT(1HS,1X,A1,I2,1X,8E9.3)
  30 CONTINUE
     DO 40 IHB=1,NHYDB
     WRITE(NP,1300)(ACCFQ(IHM,IHB),IHM=1,NHVM)
1300 FORMAT(8(E8.3,2X))
  40 CONTINUE
     DO 50 IHB=1,NHYDB
     WRITE(NP,1300)(XLAXD(IHM,IHB),IHM=1,NHVM)
  50 CONTINUE
     DO 60 IHB=1,NHYDB
     WRITE(NP,1300)(XLAXE(IHM,IHB),IHM=1,NHVM)
  60 CONTINUE
     WRITE(NP,1300)(SLAXE(IHB),IHB=1,NHYDB)
     RETURN
     END
```

```
      SUBROUTINE RAINS(MON,IDUM,P30,TOTFIL,MO,ALFA,CP,MAR,IDZ,IPZ,IOPT,
     *                 AREA)
C***  NECESSARY INPUTS TO THIS SUBROUTINE ARE--MON,IDUM,ALFA,CP,MAR,IDZ,
C***  IPZ, AND MO.  (MO SHOULD BE INITIALLY SET AT 0)
C**   OUTPUTS ARE P30 AND TOTFIL WHICH ARE THE 30 MINUTE INTENSITY AND T
C**   INFILTRATION FOR THE MONTH RESPECTIVELY.
      COMMON /PRECIP/ P(27),R(27)
      COMMON /RAIN3/ CF(4,12),CF4(4,12),XBAR(5,7),SDX(5,7),PRO(5,7),
     *               RCF(9),PR(7),RCFOPT(9)
      DIMENSION TFIL(7),PRECI(7),FIL(7),PRE(7)
C**   ALL INFILTRATION CAPACITIES ARE DERIVED FROM THE 170 MINUTE RATE.
C**   CALCULATE INFILTRATION CAPACITY.  FIL(1) THRU FIL(7) ARE INFILTRAT
C**   CAPACITIES IN THE FIRST 30 MINUTES, SECOND 30 MINUTES, SECOND HOUR
C**   THIRD HOUR, 4TH THRU 6TH HOUR, 7TH THRU 12TH HOUR, AND 13TH THRU
C**   THE 24TH HOUR TIME PERIODS RESPECTIVELY.
      IF(IOPT.EQ.3)GO TO 401
      FILRAT=CP*ALFA*(170**(ALFA-1.))
      FIL(1)=30.*FILRAT
      FIL(2)=FIL(1)
      FIL(3)=FIL(2)*2.
      FIL(4)=FIL(3)
      FIL(5)=3.*FIL(4)
      FIL(6)=FIL(5)*2.
      FIL(7)=2.*FIL(6)
C**   CHECK TO SEE IF NEW PROBABILITIES SHOULD BE GENERATED.  (IE.1)SUMM
C**   MONTH, OR 2) WINTER MONTH WITH NO PREVIOUSLY GENERATED PROBABILITI
  401 IF(MON.GE.5.AND.MON.LE.10) GO TO 5
      IF(MON.NE.MO)GO TO 5
      IF(PRO(IPZ,1).GT.0.0) GO TO 16
C**   RANDOM(IDUM) IS THE BURROUGHS ROUTINE FOR GENERATING RANDOM NUMBER
      DO 15 J=1,7
      IF(IOPT.EQ.3) GO TO 16
   15 PRO(IPZ,J)=RANDOM(IDUM)
   16 DO 30 J=1,7
C**   PR(J) IS THE PROBABILITY.
      PR(J)=PRO(IPZ,J)
      GO TO 9
C*    GENERATE RANDOM PROBABILITY(PR)
    5 DO 31 J=1,7
      IF(J.EQ.2) PR(J)=PR(1)
      IF(J.EQ.2) GO TO 98
      PR(J)=RANDOM(IDUM)
    9 IF(PR(J).LE..0001) PR(J)=.0001
   98 PRO(IPZ,J)=PR(J)
      IF(PR(1).GE..98) GO TO 93
C**   APPLY CF(IDZ,MON) IF PR(1) IS LESS THAN .55 OR CF4(IDZ,MON) IF PR(
C**   IS GREATER THAN .55.
    6 PRE001=10.**(ALOG10(XBAR(IPZ,J))+3.09023*SDX(IPZ,J))
      IF(PR(J).GT..55) GO TO 1
      PRONEW=.001*CF(IDZ,MON)
      GO TO 2
    1 PRONEW=.001*CF4(IDZ,MON)
    2 CONTINUE
      XNEW=RLANGR(PRONEW,P,R)
      XBARR=10.**(ALOG10(PRE001)-XNEW*SDX(IPZ,J))
C**   COMPUTE DEPTHS
      X=RLANGR(PR(J),P,R)
      IF(J.EQ.1)AREDFA=2.7183**(-.00340*AREA)+2.7183**(-450.0/AREA)
      IF(J.EQ.2)AREDFA=2.7183**(-.00180*AREA)+2.7183**(-650.0/AREA)
      IF(J.EQ.3)AREDFA=2.7183**(-.00120*AREA)+2.7183**(-780.0/AREA)
```

```
      IF(J.EQ.4)AREDFA=2.7183**(-.00081*AREA)+2.7183**(-1000./AREA)
      IF(J.EQ.5)AREDFA=2.7183**(-.00060*AREA)+2.7183**(-1100./AREA)
      IF(J.EQ.6)AREDFA=2.7183**(-.00045*AREA)+2.7183**(-1140./AREA)
      IF(J.EQ.7)AREDFA=2.7183**(-.00032*AREA)+2.7183**(-1180./AREA)
      PRE(J)=(10.**(ALOG10(XBARR)+X*SDX(IPZ,J)))*AREDFA
      IF(IOPT.EQ.3) GO TO 402
      IF(MON.LT.5.OR.MON.GT.10) GO TO 35
      GO TO 31
   35 IF(MON.EQ.MO) GO TO 30
   31 CONTINUE
      GO TO 33
   30 CONTINUE
      GO TO 33
  402 TOTFIL=PRE(1)*RCFOPT(MAR)
      P30=PRE(1)
      GO TO 101
C**   FIND ACTUAL INFILTRATION
   33 PRECI(1)=PRE(1)
      IF(FIL(1).GT.PRECI(1)) GO TO 172
      TFIL(1)=FIL(1)
      GO TO 17
  172 TFIL(1)=PRECI(1)
   17 DO 62 J=2,7
      PRECI(J)=PRE(J)-PRE(J-1)
      IF(PRECI(J).GT.0.0) GO TO 12
      PRE(J)=PRE(J-1)
      TFIL(J)=0.0
      GO TO 62
   12 IF(FIL(J).GT.PRECI(J)) GO TO 13
      TFIL(J)=FIL(J)
      GO TO 62
   13 TFIL(J)=PRECI(J)
   62 CONTINUE
      TOTFIL=0.0
      DO 100 J=1,7
  100 TOTFIL=TFIL(J)+TOTFIL
      P30=PRE(1)
      GO TO 109
   93 TOTFIL=0.0
      P30=0.0
      GO TO 101
C***  CALCULATE RUNOFF
  109 TOTFIL=RCF(MAR)*TOTFIL
  101 MO=MON
      RETURN
      END
C*    FUNCTION TO DO A 3 POINT LAGRANGIAN INTERPOLATION.
      FUNCTION PLANGR(P0,P,R)
C*    P0 IS ACTUAL VALUE, P1 IS VALUE CLOSEST OR BELOW P0, P2 AND P3
C*    ARE THE NEXT TWO VALUES ABOVE P0, R1, R2, AND R3 ARE THE THREE
C*    TABLE VALUES ASSOCIATED WITH P1,P2, AND P3.
      DIMENSION P(27),R(27)
      DO 100 I=1,25
      IF(P(I)-P0)100,100,200
  100 CONTINUE
  200 P1=P(I-1)
      P2=P(I)
      P3=P(I+1)
      R1=R(I-1)
      R2=R(I)
```

```
R3=R(I+1)
A1=(P0-P2)*(P0-P3)*R1/((P1-P2)*(P1-P3))
A2=(P0-P1)*(P0-P3)*R2/((P2-P1)*(P2-P3))
A3=(P0-P1)*(P0-P2)*R3/((P3-P1)*(P3-P2))
RLAGR=A1+A2+A3
RETURN
END
```