III. Program Input

Introduction

KINEROS2 processes input from two files as well as interactive input from the user. A parameter file describes the watershed geometric, hydraulic and infiltration characteristics. A rainfall file supplies breakpoint data from one or more rain gages.

A. Parameter File

1. Input Format

KINEROS2 input is tagged rather than formatted; parameters and data are identified by tags which can appear in any order. Tags are grouped into blocks, one block per model element (except compound channels), plus a *Global* block at the beginning. The order of blocks in the parameter file must follow the order in which the corresponding elements are to be processed and the name of each block identifies the type of element. A block has the following structure:

Begin Blockname

$\left\} \; \textit{Tags} \right.$

End

Within each block, tags are used in two types of constructs, *list* and *column*. These two types can be mixed within a block but not within a line.

A list is:

Tag = *value1*, *value2*

or simply,

Tag = *value*

where the list of values may continue over successive lines. There may be more than one list on a line.

The column type of construct uses tags as column headers:

Tag	Tag	Tag	...
value	*value*	*value*	...
value	*value*	*value*	...

Acceptable delimiters include blanks and commas, and additional blanks and blank lines can be used to make the file more readable. Numeric values can have a leading + or -, without intervening blanks. Comments, preceded by "!", can follow the data on the same line or be on a separate lines. Options are often inferred from the presence or absence of applicable parameters. For example, the absence of infiltration parameters implies the surface is impervious. ***KINEROS2 is not case sensitive***.

2. Input Parameters

The first block in the parameter file is the **Global** input block, with parameters common to all elements. The shortest permissible abbreviation of each tag is shown bold and underlined:

Tag	Description
Units	**M**etric or **E**nglish;
Clen	The "Characteristic Length" — generally equal to the longest single channel element or contiguous cascade of planes;

The following need only be specified when routing sediment:

Tag	Description
Temperature	degrees C or F;
Diameters	list of representative soil particle diameters (mm or inches) for up to 5 particle classes;
Densities	list of particle densities (g/cc) corresponding to the above classes;

Example:

```
Begin Global

        Clen = 423,  Units = Metric

        Diams = .005, .05, .25 ! mm

        Density = 2.65, 2.60, 2.60 ! g/cc

        Temp = 33 ! deg C
```

Following the Global input block are the element input blocks. There are two parameters which appear in every element input block:

Tag	Description	
Identifier	Element identification number (an integer from 1 - 999999);	
Print	= 0	no printout for current element (default),
	= 1	summary printout for current element,
	= 2	summary printout plus a listing of discharge and total sediment discharge at each time step,
	= 3	summary printout plus creation of a separate, comma-delimited file with a listing of discharge, total sediment discharge and discharge by particle class;
File	Name of file to create for Print = 3.	

2.a. Overland Flow Element (Plane)

Tag	Description
<u>Up</u>stream	Identifier of an upstream plane element, if applicable;
<u>Le</u>ngth	Length of plane in meters or feet;
<u>Wi</u>dth	Width of plane in meters or feet — alternatively, the program can compute the width based on the length and area, which can be entered in primary or secondary units:
	<u>Ar</u>ea — square meters or feet;
	<u>Ha</u> — hectares (metric units only);
	<u>Ac</u>res — acres (english units only);
<u>Sl</u>ope	Plane slope;
<u>Ma</u>nning	Manning roughness coefficient, or
<u>Ch</u>ezy	Chezy conveyance factor;
<u>X</u>	Representative x coordinate;
<u>Y</u>	Representative y coordinate;

Coordinates do not have to be specified if there is only one rain gage

<u>Re</u>lief	Average micro topographic relief in mm or inches;
<u>Spa</u>cing	Average micro topographic spacing in meters or feet;
<u>In</u>terception	Interception depth in mm or inches;
<u>Ca</u>nopy Cover	fraction of surface covered by intercepting cover — rainfall intensity is reduced by this fraction until the specified interception depth has accumulated;

If it is a pervious surface, the following parameters describe its infiltration characteristics:

Saturation	Initial degree of soil saturation, expressed as a fraction of the pore space filled;
CV	Coefficient of variation of Ks;

The following parameter is specified only for a 2-layer soil:

Thickness	Thickness of upper soil layer in mm or inches;

The following infiltration parameters can have two values, representing a two-layer soil, or single values representing a single, infinitely thick soil layer:

Ks	Saturated hydraulic conductivity, mm/hr or in/hr;
G	Mean capillary drive, mm or inches -- a zero value sets the infiltration to a constant rate equal to Ks;
Distribution	Pore size distribution index. This parameter is used for redistribution of soil moisture during unponded intervals;
Porosity	Porosity;
Rock	Volumetric rock fraction, if any. If Ks is estimated based on textural class, it should be multiplied by (1 - Rock) to reflect this rock volume;

If sediment is being routed, the following parameters are required:

Splash	Rain splash coefficient;
Cohesion	Soil cohesion coefficient;
Fractions	List of particle class fractions — must sum to one;

Example:

```
Begin Plane

        ID = 3,  Len = 1000,  Width = 2000,  Slope = .05,  Manning = .04

        CV = .8,  Thick = 2,  Sat = .2,  Print = 1

        Relief = .1,  Spacing = .8

        KS      G       Dist    Por     Rock
        0.4     20.     0.1     .35     0       ! upper layer
        2.0     10.     0.1     .40     0       ! lower layer

        Fract = 0.2, 0.6, 0.2    Splash = 50,  Coh = 0.5
```

This represents only one possible arrangement; another equivalent input block would be:

```
BEGIN PLANE

ID=3, PR=1

LE      WI      SL      MA      RE      SPA     SA      THI     CV
1000    2000    .05     .04     .1      .8      0.2     2       0.8

KS=0.4,2    G=20,10    DI=.1,.1    PO=.35,.4

FR=.2,.6,.2, SPL=50, CO=.5
```

Note that it in this case Rock was not specified making it zero for both layers.

2.b. Channel Element (Channel)

Tag	Description
<u>Up</u>stream	Identifier(s) of up to ten upstream contributing elements;
<u>La</u>teral	Identifier(s) of up to two plane elements contributing lateral inflow. For a compound channel, the second of two planes listed will be associated with the overbank section. Alternatively, this plane can be specified in the overbank input block;
<u>Le</u>ngth	Channel length in meters or feet;
<u>Ty</u>pe	Channel type = **<u>S</u>**imple or **<u>C</u>**ompound (default is simple);
<u>Qb</u>	Baseflow discharge at end of channel, if applicable, cu.m /s or cu.ft/s;

The following geometric parameters can have two values, representing its upstream and downstream sections, or a single value denoting the average:

<u>Wi</u>dth	Channel bottom width in meters or feet;
<u>Sl</u>ope	Channel slope;
<u>Ma</u>nning	Manning roughness coefficient, or
<u>Ch</u>ezy	Chezy conveyance factor;
<u>SS1</u>, **<u>SS2</u>**	Bank side slopes — right or left is immaterial to the routing equations, except for compound channels, in which case SS2 refers to the overbank side;
<u>Rw</u>idth	If it is desired to account for rainfall on the channel area, this parameter specifies a representative width;
<u>X</u>	Representative x coordinate;
<u>Y</u>	Representative y coordinate;

Coordinates are specified only if Rwidth is specified.
Coordinates do not have to be specified if there is only one raingage.

If it is a pervious channel, the following parameters describe its infiltration characteristics:

Wool — Wool = **Y**es turns on David Woolhiser's effective wetted perimeter function. During low flows, the wetted perimeter available for infiltration is reduced to account for channel micromorphology, according to the equation:

Pe = min (h / Wco * Sqrt (Width), 1.) * P

where Pe = effective wetted perimeter
P = wetted perimeter at depth h
Wco = 0.15 (see below) for Width in feet, but is automatically converted to an equivalent value if Width is in meters;

Wcoeff — Optional override of coefficient in the Woolhiser function;

Saturation — Initial degree of soil saturation, expressed as a fraction of of the pore space filled;

CV — Coefficient of variation of Ks;

The following parameter is specified only for a 2-layer channel bed:

Thickness — Thickness of the upper layer of bed material, mm or inches (the lower layer is assumed to have infinite thickness);

The following infiltration parameters can have two values, representing two layers of bed material, or single values representing a single, infinitely thick layer of bed material:

Ks — Saturated hydraulic conductivity, mm/hr or in/hr;

G — Mean capillary drive, mm or inches — a zero value sets the infiltration rate to a constant value of Ks;

Distribution — Pore size distribution index. This is a new parameter used for redistribution of soil moisture during intervals of no flow;

Porosity — Porosity;

Rock — Volumetric rock fraction, if any. If Ks is estimated based on textural class, it should be multiplied by (1 - Rock) to reflect this rock volume;

If sediment is being routed, the following parameters are required:

<u>Co</u>hesion — Cohesion coefficient of bed material;

<u>Fr</u>actions — List of particle class fractions — must sum to one;

A compound channel element has an additional input block for the ***Overbank*** *section, with the same geometric, infiltration and sediment parameters as above except Length, SS1 and SS2. Additional parameters are:*

<u>La</u>teral — Identifier of a plane element contributing lateral inflow (if not specified in the main channel input block);

The following geometric parameters can have two values, representing its upstream and downstream sections, or a single value denoting the average:

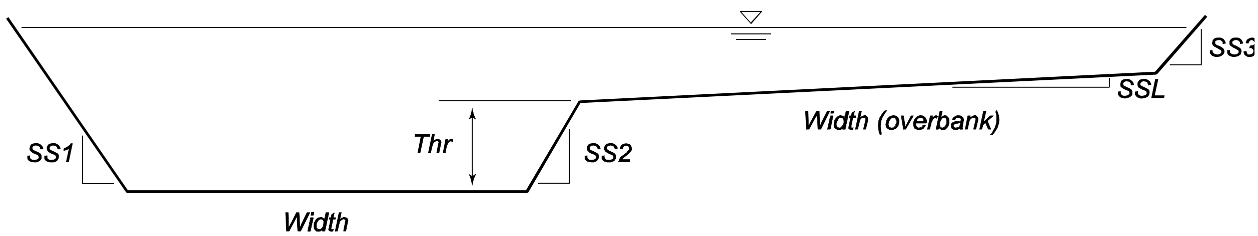
<u>Wi</u>dth — Overbank channel bottom width in meters or feet;
=

<u>SS3</u> — Bank slope;

<u>SSL</u> — Lateral bottom slope (towards main section);

<u>Thr</u>eshold — Threshold depth for spillover, m or ft;

<u>Rwi</u>dth — If it is desired to account for rainfall on the overbank area, this parameter specifies a representative width;



Example:

```
Begin Channel

        ID = 4,  Up = 1,  Lat = 2,  Pr = 1

        Len         Width       Slope       Manning     SS1    SS2
        114.9       6.2         .0077       .02         .38    .11

        Sat = .3

        Ks     G      Por    Rock   Dist
        21     4.6    .44    0      .7

        Coh = 0.1,  Fract = 0.2, 0.6, 0.2

        Type = Compound

End
```

```
Begin Overbank

        Lat = 3

        Width       Slope       Manning     SS3    SSL    Thresh
        22.8        .0077       .033        .013   .0077  .13

        Sat = .3

        Ks     G      Por    Rock   Dist
        3.2    6.3    .34    0      .7

        Coh = 0.1,  Fract = 0.5, 0.5
```

2.c. Pond Element (Pond)

Tag	Description
Upstream	Identifier(s) of up to ten upstream contributing elements;
Lateral	Identifier(s) of up to two plane elements contributing lateral inflow;
Storage	Initial storage volume in cu.m or cu.ft;
N	Number of [Volume, Discharge, Surface Area] entries in the rating table;
Volume	List or column of volume entries in the rating table in cu.m or cu.ft (volume must start at zero);
Discharge	Pond outflow discharge, cu.m/s or cu.ft/s, for the corresponding volume entry (there must be at least one zero value);
Surface	Surface area, sq.m or sq.ft, for the corresponding volume entry;
Ks	Constant (saturated) conductivity representing seepage, mm/hr or in/hr;

Example:

```
Begin Pond

          ID = 3,  UP = 2,  Print = 2

          Storage = 200 ! cu.ft

          N = 17

           Volume      Discharge          Surface Area
!           cu.ft        cu.ft/s                 sq.ft
!      --------------------------------------------------------------
                0              0                  1000
             2000              0                  1000
             2200         5.3665                  1000
             2400        15.1789                  1000
             2600        27.8854                  1000
             2800        42.9325                  1000
             3000        60.0000                  1000
             3200        78.8720                  1000
             3400        99.3900                  1000
             3600       121.4315                  1000
             3800       144.8972                  1000
             4000       169.7056                  1000
             4200       195.7876                  1000
             4400       223.0838                  1000
             4600       251.5424                  1000
             4800       281.1178                  1000
             5000       311.7691                  1000

 End
```

2.d. Injection (Inject)

Tag	Description
File	File with data to inject — a listing of time (min) and discharge (cu.m/s or cu.ft/s) pairs plus up to 5 columns of corresponding sediment concentrations by particle class (listed in the same order as in the Global parameter block);
Offset	An optional positive time offset in minutes;

Example:

```
Begin Inject

  ID = 18,  File = Ex1.inj, Print = 1
```

B. Rainfall File

Each set of rain gage data is entered in a separate input block; the block name can be any alphanumeric string.

Tag	Description
Number	Number of data pairs;
Time	Time in minutes (column or list);
Depth	Accumulated depth in mm or inches;
Intensity	Intensity in mm/hr or in/hr — input can be in either depth or intensity;
X	X coordinate (optional if there is only one gage);

Y Y coordinate (optional if there is only one gage);

Example:

```
Begin RG001

          N = 6

          Time          Depth
!        (min)           (in)

           0.0           0.00
          15.0           0.05
          35.0           2.40
         105.0           2.42
         115.0           3.02
         130.0           3.02
```

C. Run-Time Input

Upon execution, the following questions will be posed. Exactly how depends on the version (DOS, Windows, etc.):

Parameter file:
Rainfall file:
Output file:
Description:
Duration (min):
Time step (min):
Adjust (y/n):
Sediment (y/n):
Multipliers (y/n):

Under some conditions the rainfall file may be optional (for example, when using injected inflow exclusively).

If multipliers are being used, the corresponding parameters of each and all elements will be multiplied by the values specified. Multipliers are useful when calibrating parameters based on observed runoff or sediment.

The computational time step can be adjusted automatically by the program to maintain numerical accuracy as put forth by the Courant condition -- final output will still be at the user-specified time step. If this option is not chosen the program will still monitor the time step criteria and report a distribution based on three levels: 100, 75 and 50 percent, where the time step listed at the 50 percent level would be sufficient for accuracy 50 percent of the time, the 75 percent level would be sufficient 75 percent of the time, and the 100 percent level would be sufficient throughout the simulation.

The user time step is not completely arbitrary. If the time step is too large, even if the computational time step is adjusted, outflow hydrographs from individual elements may not be well represented, and the effect may be cumulative as water and sediment are routed through the system. If the automatic time step adjustment is in effect, the outflow volume of each element based on the computational time steps will be compared to the volume computed using the values stored at each user time step, and if the difference is greater than one percent for any element a warning will be printed in the event summary.

The rainfall rate printed out for PRINT = 2 or 3 will represent, for multiple rain gage inputs, the areal average intensity over each time step for the area contributing to, and including, the current element.