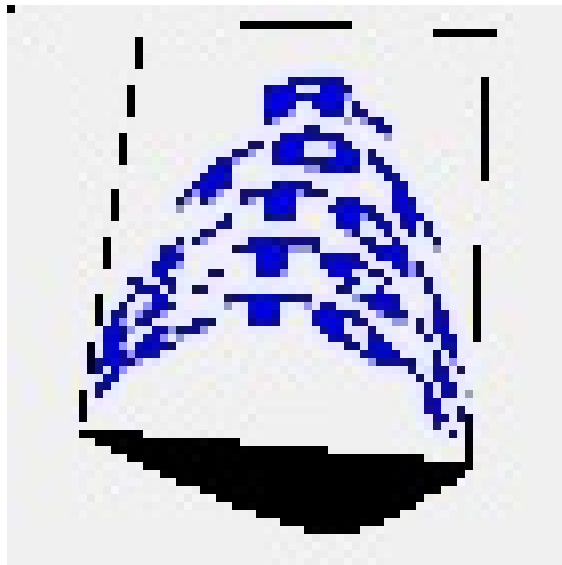


**R-TOT 6**  
River Time-of-Travel  
Computer Programmer's Manual



Michael Gene Waldon, Ph.D., P.E.  
Center for Louisiana Inland Water Studies  
Department of Civil Engineering  
University of Southwestern Louisiana  
Lafayette, Louisiana

June 1999



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## **Overview**

R-TOT, the River Time of Travel Model, is a model for prediction of time of travel of a solute or entrained material. The current version of R-TOT is implemented and programmed in Microsoft Visual Basic 6.0. The model provides a convenient user interface for input and output form to display results (Waldon 1999). The model also provides easy user access to various special features available within Visual Basic..

## **Theoretical background and calculations**

R-TOT calculates time-of-travel and peak concentration using a formulation termed the Modified Plug Flow (MPF) model (Waldon 1998). This model assumes that the leading edge, peak, and trailing edge of a spill travel at constant velocities dependent on stream discharge and parameters specific to stream location. The peak concentration, in this model, is assumed to fall in inverse proportion to spill duration.

Most calculations are performed in the module RTOTCalcModule. Some of the variables used in the calculations are described in the following table.

<b>Variable name</b>	<b>Description</b>
Rivermile	Location for calculations on this row starting at the most upstream rivermile and continuing by steps of DeltaMile to the most downstream rivermile
Discharge	Value of discharge is either single valued or is calculated from lookup table by rivermile from Discharge Values worksheet.
a-Lead	Parameter a for leading edge
b-Lead	Parameter b for leading edge
Area-Lead	Leading edge area in square feet
v-Lead fps	Velocity of leading edge in feet per second
v-Lead mph	Velocity of leading edge in miles per hour
TOT-Lead	Time of travel of the leading edge from the most upstream rivermile to the current rivermile in hours



a-Peak	Parameter a for peak
b-Peak	Parameter b for peak
Area-Peak	Peak area in square feet
v-Peak fps	Velocity of peak in feet per second
v-Peak mph	Velocity of peak in miles per hour
TOT-Peak	Time of travel of the peak from the most upstream rivermile to the current rivermile in hours
a-Trail	Parameter a for trailing edge
b-Trail	Parameter b for trailing edge
Area-Trail	Trailing edge area in square feet
v-Trail fps	Velocity of trailing edge in feet per second
v-Trail mph	Velocity of trailing edge in miles per hour
TOT-Trail	Time of travel of the trailing edge from the most upstream rivermile to the current rivermile in hours
Mass (Rel)	Initially 1.00 at the most upstream rivermile, this relative mass is reduced when discharge reduces (i.e. is diverted).
Peak Conc	
ug/L	Peak concentration as the spill passes the current rivermile
Rivermile	Rivermile value of this row if rivermile is between the user specified starting and ending rivermiles. Otherwise, a value of #N/A (in Excel this means no value is available) is assigned
Travel time from start	
Lead	Leading edge time-of-travel in hours from starting mile. If rivermile is outside the starting-ending rivermile reach a #N/A value is assigned



Peak	Peak time of travel as described above
Trail	Trailing edge time-of-travel as described above



## Description of forms

Form Name: **DataInput**

Description:

The "Option Explicit" statement included at the top of this module sheet means that all user defined variables must be explicitly declared, typically in a Dim statement. This option forces more complete documentation and reduces potential errors caused by misspelled variable names within the program.

This is the main user input interface. It allows the user to enter required information so as to get the desired results. Datainput form provides user with options for help. The help can be obtained by clicking the RTOTHLP submenu of the HELP menu. The user can give a title to the model.

The user is provided with two options of the date and time which are **KNOWN and UNKNOWN**. The KNOWN option allows the user to choose the month, day, year, hour and minute when the spill has occurred. The Datainput form has input for the discharge in cubic feet per second.

The other inputs in the datainput form are **LOCATIONS** where the spill has occurred which allows the user to select the location (upstream or down stream rivermile along with its distribution number) from the dropdown menu which comes up, the spill amount in either in pounds, kilograms, gallons or barrels. If the user selects the spill amount to be in either gallons or barrels he has to enter the specific gravity of the material too. Once all the requested data is filled the click of OK (**RUN TOT**) displays the results form which is the **OUTPUT** form.

Associated modules:

**ErrorChecker, RTOTCalcModule.**

Associated Files:

ParamVal.txt, ErrorDef.txt, rivermile.txt, SpGravity.txt.

Associated Menu:

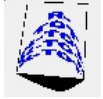
File, Edit and Help.

Form Name: **Output**

Description:

Used for Displaying the Results of the user input. This displays the banner of the R-TOT where the **current date** is displayed.

The various outputs in this form are the TITLE for the model chosen, the upstream river mile and down stream river mile with their distribution numbers, spill date



and time, spill amount and its units chosen, discharge in cfs.

The output form displays the calculations of the Travel Times of Leading Edge, Peak, Trailing Edge, Duration as total hours and also as number of days, hours and minutes. Their corresponding Arrival Dates and times with Velocity in Miles/Hr unit and Feet/sec unit. The specific gravity of the material chosen and the Peak concentration at the ending mile is also displayed along with its units.

The Model Does not allow the user to manipulate the Output data in any way for security purposes.

Associated Menu:

File, Back.



## Description of Modules

### **ErrorChecker:**

This Module displays the warnings and the error messages occurring in the application. Warnings are given when the entered Discharge is too low or too high when compared to the standard input. Error messages are displayed when the Down stream river mile is higher than the Upstream river mile.

Error messages are Displayed if important data is not entered. Provision has been made so that the User can re-enter the missed input. Care has been taken to avoid entering a character instead of a number. Error message is displayed when the value for the spill amount is either zero or smaller.

### **RTOTCalcModule:**

This is the place where all the calculations are Performed. It has all the functions and subroutines which perform the calculations for Travel time totalhours, (Days, hrs and min), Arrival date and time, Velocity in Miles/hr and Feet/sec for Leading Edge, Peak and Trailing Edge respectively. It also calculates the Peak concentration at the ending mile based on the Spill amount units.

## Description of the Menus

Datainput form:

### FILE

Print: Prints the Datainput form to the default Printer.

Calc: Pops the Calculator on to the Screen.

Exit: Exits RTOT.

### EDIT

Clear all: Clears All the data entered.

### HELP

RTOTHLP: Displays the RTOT6 help file

OUTPUT form:

### FILE

Print: Prints both Datainput and Output forms

Exit: Exits RTOT.

### Back

This allows the user to go to the Datainput form and allows the user to re-post the inputs or modify the input. On the Run click, it displays the recently calculated values on the Output form.

## Modification for simulation of a new stream





Simulating a new stream is relatively straightforward. An objective of this version of R-TOT was to keep all stream-specific values in data files. Thus, no knowledge of Visual Basic programming should be required by the user simply updating a current stream's parameters or seeking to simulate a new stream.

### **Description of Data Input Files**

#### ParamVal.txt:

File contains lookup table of parameter values. That is, a, b, and c values for the leading edge, peak, and trailing edge areas. Rivermile values must be in ascending numerical order. Values are assumed to be piecewise constant over the rivermile interval from the value on the current row to the value on the next row down. Commas are used as delimiters where multiple values are on a single line. Strings which include spaces on comma delimited lines must be enclosed in quotation marks.

#### Stream specific features:

Rivermile and parameter values must be entered for a new stream. Range name "Parameters" must be given to this lookup table, and must be redefined if the number of rows in the table is changed.

#### Format:

Line 1: name of river

Line 2: nRM – number of parameter reach values,  
Qtypical – typical discharge used to scale "a" values

Line 3: Comment line, description of parameters

Lines 4-end: nRM lines of parameter values seperated by commas  
Lead a, Peak a, Trailing a, Lead b, Peak b, Trailing b

#### ErrorDef.txt:

This file defines conditions and messages for Warnings and Errors depending on value of discharge, locations of the river mile and spill amount inputs.

#### Format:

Lines beginning with an apostrophe (') are comments

Errors are defined by input of 4 lines each

Line 1 is "E" or "W" for error or warning

Line 2 is name of variable to compare (Q, Amt, RMUp, RMDown)

Line 3 comparison operator ("<", "=", ">"), comparison value

Line 4 error message string

These records are repeated until all error and warnings are defined.



rivermile.txt:

This file lists rivermile locations for a number of predefined sites. These values are used in the dialog drop down boxes of the Datainput form. Values are selected from the drop down menu. Format is rivermile, followed by a comma and a space, then the location description. Entries should be sorted from upstream to downstream, that is, ascending rivermile, order. All locations are stream specific.

Format:

Lines beginning with an apostrophe (') are comments

Each line includes rivermile value, a comma, and location description

SpGravity.txt:

This file lists specific gravity values for a number of predefined materials. These values are used in the drop down box in the Datainput form. Values are picked from the dropdown menu. Format is specific gravity value, followed by a comma and a space, then the material description. Values in this table may be typical values and only represent an approximation.

Format:

Lines beginning with an apostrophe (') are comments

Each line includes specific gravity value, a comma, and description

## **Bibliography**

Waldon, M. G. (1998). "Time-of-travel in the Lower Mississippi River: Model Development, Calibration, and Application." *Water Environment Research*, 70(6), 1132-1141.

Waldon, M. G. (1999). "R-TOT 6, River Time-of-Travel Computer User's Manual." , USL, Center for Louisiana Inland Water Studies.