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**PC-Proute User's Manual
DRAFT**

Prepared for:

Office of Science and Technology
Standards and Applied Science Division
U. S. Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460

Prepared by:

General Sciences Corporation
6100 Chevy Chase Drive
Laurel, MD 20707

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TABLE OF CONTENTS

1.	INTRODUCTION.....	1
2.	COMPUTATIONAL METHODS.....	3
2.1	Basic Modeling Equations.....	3
2.2	Non-Point Source Equations.....	4
2.3	Divergent Streams.....	6
2.4	Special Flow Situations.....	6
2.5	Flow Velocities.....	6
2.5.1	Mean Flow.....	6
2.5.2	7Q10 Flow.....	7
2.6	Withdrawal Calculations.....	8
2.7	WSM Model Input.....	8
3.	MINIMUM SYSTEM REQUIREMENTS AND SYSTEM LOADING.....	9
3.1	Minimum System Requirements.....	9
3.2	Loading the system.....	9
4.	USING THE PC-PROUTE INTERFACE.....	11
4.1	Accessing an Existing File or Opening a New File.....	11
4.2	Files Generated or Required by PC-Proute and File Naming Conventions.....	12
4.3	Saving Input Files.....	14
4.4	Setting Up a Default Editor for Viewing Output Files.....	14
4.5	Running the PC-Proute Model.....	15
4.6	PROUTE Output Graphics.....	15
4.7	PC-Proute Commands and Function Keys.....	16
5.	DESCRIPTIONS OF THE SCREENS IN PC-PROUTE.....	19
6.	EXAMPLE RUNS.....	21
	APPENDIX A: DESCRIPTION OF THE PC-PROUTE DATASETS.....	27

1. INTRODUCTION1. INTRODUCTION

The PC - Pollutant Routing Model (PC-Proute) is a simple first order decay routing model that estimates aqueous pollutant concentrations on a reach by reach stream flow basis. PC-Proute is similar to the RGDS model; however it utilizes an improved method of estimating average reach concentration of a pollutant. The Office of Science and Technology in the Office of Water as part of their TMDL program has a need for a simple pollutant routing model which can estimate point source and non-point source pollutant concentrations.

The basic functions include the following:

- Downstream concentration modeling of point and non-point source pollutants. Stream segments of interest may be identified as:
 - a. all reaches a specified number of miles downstream of a specified upstream reach or reaches;
 - b. all reaches a specified number of miles upstream of a downstream reach or reaches;
 - c. all reaches within a specified USGS stream cataloging unit.
- For each reach retrieval method described above, discharge facilities can be identified by reach for all modeled reaches. It is possible to associate one or more point source discharges with each modeled reach.
- For each reach, it is possible to identify points for water sampling or withdrawal. The model calculates final concentrations for each of these points.
- It is possible to associate a non-point source load with each modeled reach.
- Pollutant chemical data supported includes: name, CAS, first order decay rate for a single chemical and growth of a daughter chemical.
- The system supports transport and decay for two flow regimes: 7Q10 low flow and mean flow.
- Model output includes:
 - a. A summary of the input data,
 - b. A table of reaches, length, average concentration, final concentration, and final concentration for a child decay product,
 - c. A table describing sampling or withdrawal sites; data includes site information, reach, mile point, pollutant final concentration and child final concentration.

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2. COMPUTATIONAL METHODS2. COMPUTATIONAL METHODS

2.1 Basic Modeling Equations.1 Basic Modeling Equations

The modeling equations used in PC-Proute are detailed below:

Upstream Load (mg/s)

$$UL = FRC(U) * Q(U)$$

where $FRC(U) =$ Final Upstream Reach Concentration in milligrams per liter (mg/l)
 $Q(U) =$ Flow in the upstream reach in liters per second (l/s)

Final Reach Load

$$FLD = RLD * \exp(-kT)$$

where $RLD =$ Sum of the loads (UL above) from all upstream reaches in milligram per second (mg/s)

$k =$ Chemical decay rate per second ($0.693/t(1/2)$)

$t(1/2) =$ Half-Life

$T =$ Reach length (m) / average velocity in the reach (m/s)

Reach Load of the Chemical due to Facility(i) after decay and transport

$$RMF(i) = RM(i) * \exp(-kT(i))$$

where $RM(i) =$ Reach load of the chemical due to facility (i)

$T(i) =$ Distance of facility from downstream end of reach in meters (L(i)) / average velocity in the reach in meters per second. (Reach miles are designated beginning with zero at the downstream end of a reach)

Final Reach Concentration for this reach (µg/l)

$$FRC = SLD / Q$$

where $SLD =$ Sum of all final reach loads (FLD + RMF)

$Q =$ stream flow for this reach (l/s)

Average Reach Load for Each Discharger

$$ARLD(i) = (RMF(i) / k) * (1 - \exp(-kT(i))) * (V / L)$$

where

RMF(i)	=	Reach load of the chemical due to the facility i after decay and transport
k	=	Chemical decay rate per second
T(i)	=	Distance of facility from downstream end of reach in meters (L(i)) / average velocity in the reach in meters per second. (Reach miles are designated beginning with zero at the downstream end of a reach)
V	=	Average velocity in the reach
L	=	Reach length

Average reach concentration (µg/l)

ARC	=	$(ARLU + \text{sum}(ARLD(i))) / Q$
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where

ARLU	=	Average reach load for upstream loads
ARLD(I)	=	Average reach load for each discharger
Q	=	Stream flow for this reach (l/s)

2.2 Non-Point Source Equations.2 Non-Point Source Equations

For each calculation segment of a reach, the following equations are used to estimate the non-point source contributions to the reach concentrations.

End Point Load from a non-point source discharge

NFL	=	$((W * V) / k) * (1 - \exp(-(k * L / V)))$
-----	---	--

where

W	=	Non-point source load (µg/m*s)
V	=	Stream velocity (m/s)
k	=	Decay rate (1/s)
L	=	Distance from beginning of release (or reach) to the calculation point (m)

Average load in the calculation segment due to the non-point source load

NAL	=	$((W * V) / k) * (1 - \exp(-(k * L / (2 * V))))$
-----	---	--

where

W	=	Non-point source load
V	=	Stream velocity (m/s)
k	=	Decay rate (1/s)
L	=	Distance from beginning of release (or reach) to the calculation point (m)

Final reach concentration ($\mu\text{g/l}$)

$$\text{FRC} = (\text{Sum}(\text{NFL})/\text{Q})$$

where NFL = End point load from a non-point source discharge

Q = Stream flow (l/s)

Average Reach Concentration ($\mu\text{g/l}$)

$$\text{ARC} = (\text{SUM}(\text{NAL}) / \text{Q})$$

where NAL = Average load in the calculation segment due to the non-point source load

Q = Stream flow (l/s)

2.3 Divergent Streams

If a stream divergence occurs, both of the down stream reach flows are read and the flow values are summed. The downstream load is adjusted by the ratio of the flow in the reach that is divided by the sum flow for the divergent pair. If the sum is zero, downstream load is adjusted by .5 for each downstream reach.

2.4 Special Flow Situations

Since some reaches in the data file do not have a value for stream flow, it was necessary to implement special handling for zero flow and zero length reaches. For the purposes of modeling, reaches with zero flow or zero length are treated like a pipe with zero dilution and zero decay of the pollutant. Pollutant concentration at the end of one of these reaches is indeterminate.

2.5 Flow Velocities

Since the original reach data did not contain flow velocities for all reaches, it was necessary to modify the reach data with estimated reach velocities. The following equations were used to update the reach data when velocity information was not available from the GAGE file data. These values were obtained by fitting the GAGE file data for each hydrologic region to the equation: $\text{Ln}(\text{velocity}) = \text{Ln}(a) + b \cdot \text{Ln}(\text{flow})$. This is a standard form of the velocity vs. flow equation used in water quality models such as QUAL2E.

2.5.1 Mean Flow

$$\text{Velocity} = a \cdot \text{Q}^b$$

The values of a and b for each region are provided below:

region 01:	a = 0.221851;	b = 0.288407
region 02:	a = 0.233650;	b = 0.282880
region 03:	a = 0.218364;	b = 0.290477
region 04:	a = 0.225745;	b = 0.295071
region 05:	a = 0.240088;	b = 0.269413
region 06:	a = 0.229519;	b = 0.285150
region 07:	a = 0.223242;	b = 0.277959
region 08:	a = 0.283932;	b = 0.257095

region 09:	a = 0.188010;	b = 0.300053
region 10:	a = 0.226498;	b = 0.230375
region 11:	a = 0.217178;	b = 0.272341
region 12:	a = 0.211976;	b = 0.273694
region 13:	a = 0.209989;	b = 0.275491
region 14:	a = 0.244285;	b = 0.240884
region 15:	a = 0.263912;	b = 0.171967
region 16:	a = 0.211509;	b = 0.265071
region 17:	a = 0.205749;	b = 0.281236
region 18:	a = 0.194999;	b = 0.309036

2.5.2 7Q10 Flow.5.2 7Q10 Flow

For cases where the reach data has 7Q10 flow data but a zero low flow velocity, the following equations are used to estimate low flow velocity.

$$\text{Velocity} = a * Q^{**}b$$

The values of a and b for each region are provided below:

region 01:	a = 0.229	b = 0.216
region 02:	a = 0.244	b = 0.190
region 03:	a = 0.255	b = 0.192
region 04:	a = 0.239	b = 0.215
region 05:	a = 0.298	b = 0.145
region 06:	a = 0.227	b = 0.240
region 07:	a = 0.277	b = 0.190
region 08:	a = 0.263	b = 0.219
region 09:	a = 0.301	b = 0.073
region 10:	a = 0.334	b = 0.121
region 11:	a = 0.336	b = 0.094
region 12:	a = 0.324	b = 0.091
region 13:	a = 0.347	b = 0.071
region 14:	a = 0.298	b = 0.133
region 15:	a = 0.359	b = 0.082
region 16:	a = 0.293	b = 0.053
region 17:	a = 0.277	b = 0.179
region 18:	a = 0.315	b = 0.118

2.6 Withdrawal Calculations

Sampling locations and withdrawals are handled by treating withdrawal sites as if they were at a reach termination. As each reach is modeled, it is first inspected to determine if a withdrawal is present. For each withdrawal found, the final reach calculations are performed as if the withdrawal site was at the end of a reach. After calculations have been performed for all withdrawal sites, the normal reach calculations are performed.

2.7 WSM Model Input

PC-Proute also allows data input from the Watershed Screening Model (WSM) and allocates a specific screen for this non-point source (NPS) loading input. Application of WSM predicts the pollutant load for each cataloging unit modeled. PC-Proute takes the NPS pollution loading that you enter from the WSM model for the entire cataloging unit and divides it by total number of miles for all the reaches in the cataloging unit. Each reach in the cataloging unit receives a non-point source loading input based on the number of miles in that reach.

3. MINIMUM SYSTEM REQUIREMENTS AND SYSTEM LOADING3. MINIMUM SYSTEM REQUIREMENTS AND SYSTEM LOADING

3.1 Minimum System Requirements3.1 Minimum System Requirements

The system runs under Microsoft Windows®. The minimum system requirements are provided below:

- Windows Version 3.0
- 80386 Processor
- 4 Megabytes RAM
- 17 Megabytes of free hard disk space

NOTE: A math co-processor is recommended but not required.

3.2 Loading the system3.2 Loading the system

STEP 1. Go to DOS and create a directory on the hard disk: **MD\PROUTE**.

NOTE: You must have 17 Megabytes of space on the hard disk drive on which you are installing PC-Proute.

STEP 2. Place the disk marked **PC-Proute Disk #1** in either drive A: or drive B:. Go to the directory that you created (**CD\PROUTE**) and enter the following command from that directory:

A:INSTALL A:

or

B:INSTALL B:(if the disk is in drive B:)

STEP 3: Follow the instructions for copying.

STEP 4: Once you have finished copying the files, create an icon in the Windows Screen using the **NEW** option in the **FILE** menu under the program manager. You may choose to have PC-Proute be a separate group under the Program, have it as one of the items in the **STARTUP** menu so that it is available whenever you log into **WINDOWS** or make it an item under the **MAIN MENU** so that you can access it when you wish to use. Refer to your Windows Manual for information on creating an icon for PC-Proute. You are now ready to use PC-Proute.

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4. USING THE PC-PROUTE INTERFACE4. USING THE PC-PROUTE INTERFACE

Once you have finished loading the software, you will be ready to access the PC-Proute Build File Interface. This section details how to use the PC-Proute interface.

This section will describe the following:

- How to access an existing file or opening a new file
- Files Generated or Required by PC-Proute and File-Naming Conventions
- Saving Input Files
- Setting Up a Default Editor for Viewing Output Files
- Running the PC-Proute Model
- PC-Proute output graphics
- PC-Proute commands and function keys
- Restoring the values in an existing file

4.1 Accessing an Existing File or Opening a New File4.1 Accessing an Existing File or Opening a New File

When you first enter the PC-Proute Interface, you will be automatically assigned a new file. The new file name and number will appear at the top of the screen in parentheses.

To **access an existing file**, click on the **FILE** option on the very top line, select the **OPEN** option and select the file that you want from the list that appears. When you click on the **FILE** option, you will be asked to verify that you actually wish to open a new file. This is to remind you that calling a new file will overwrite all the values contained in the file that you are in presently.

NOTE: The input files must be in the same location as the *.BIN files (the PC-Proute database files). If you elect to read in an existing file from a different directory, the directory that the file is in becomes the default directory for PC-Proute. All the data files for PC-Proute must exist in the default directory. So we strongly recommend that you do not save input files in any location other than the PC-Proute directory.

If you have selected an existing file to edit, when you choose to save the file, the existing file will be rewritten with the new values unless you choose the SAVE AS option and assign a new file name. Please remember, if you are assigning a new name to a file, to follow the naming conventions followed by PC-Proute explained in the next subsection.

4.2 Files Generated or Required by PC-Proute and File Naming Conventions4.2 Files Generated or Required by PC-Proute and File Naming Conventions

All files created by PC-Proute in Windows have a file naming convention as explained below:

- They will have the word "PROUT" in the beginning of the file name, followed a three-digit number that is sequentially assigned depending on the number of the input files that reside in your direction

(N + 1).

Three different types of files are generated by the system: (1) Input Files, (2) System files, and (3) Output Files. Each is explained separately below:

Input Files

These files have the .INP file extension and contain all the selections and entries you make in the Input File Interface.

System Files

The following files are used to transfer information from one section of the program to other:

- *.CUR
- *.RIN
- *.CHM
- *.RLS
- *.PLS
- *.RO
- *.WDL
- *.OUT

The asterisk (*) is replaced by the run name given by the user on the first screen.

NOTE: These files are generated by PC-Proute and are provided only as a source of information on the files in your directory. We recommend that you do not tamper with these files. However, you may choose to delete them at any time. As long as you have an existing input file, the system files can be generated by PC-Proute.

The *.CUR files are used to pass the information from the WSM screen input to the retrieval section. There is one line for each cataloging unit and each line contains:

Cataloging Unit Number	Average Non-Point Source Load
------------------------	-------------------------------

This file is read by the reach retrieval portion of the program.

The *.RIN file is a list of the reaches as entered on screen two. The format is as follows and is repeated for each line of screen two:

Reach Number or Cataloging Unit Number	Distance Up or Down Stream
--	----------------------------

This file is read by the reach retrieval portion of the program.

The *.CHM file contains the chemical information provided on the first screen. The format is as follows:

Chemical Name					
CAS Number	Half-Life	Flow Type	Parent MW	Child MW	Threshold Value

This file is read by the model portion of the program.

The *.RLS file contains the reach information just as it is seen on screen four except in this order:

Reach Number	Description	Length	Non-Point Source Load
--------------	-------------	--------	-----------------------

This file is read by the discharge list creation and model portion of the program.

The *.PLS file contains the discharger information as seen on screen five except in this order:

Reach Number	Mile Point	NPDES Number	Description	Type	Point Source Load
--------------	------------	--------------	-------------	------	-------------------

This file is read by the model portion of the program.

Output Files

The following output files are created from the model portion of the program:

- *.RO Reach information portion of the *.out file
- *.WDL Withdrawal information portion of the *.out file
- *.OUT Model output file

The *.RO and *.WDL file are used to create the *.OUT file. The *.OUT file is used by the Graphics program to draw the reaches.

Also necessary for the operation of PC-Proute are the REG*.BIN, REG*.IDX, I'D*.BIN and REG*.LEAN files. The REG*.BIN files are the routing files and contain the information about the reaches which does not change. The REG*.IDX files are index files used by the program to quickly locate a reach in the reg*.bin file. The I'D*.BIN files are the discharger information files which contains the information about the dischargers which does not change. And the REG*.LEAN files are used by the WSM portion of the program file to average the non-point source load across the entire reach. It contains the total length of each cataloging unit.

4.3 Saving Input Files.3 Saving Input Files

PC-Proute will ask you whether you wish to save the input file when you exit the program or when you reach the last file. However, if you have accessed an existing file and made all the changes before reaching the last screen, you may save the input file by proceeding to the FILE option and selecting the SAVE option. Once you have completed an input file, you may submit it to the PC-Proute model for execution. When you submit the input file to the model, the input file will be validated by the PC-Proute interface. If any errors are detected during the validation, you will be informed of them and brought to the incorrect entry so that you might effect the change immediately.

4.4 Setting Up a Default Editor for Viewing Output Files4.4 Setting Up a Default Editor for Viewing Output Files

The default editor for viewing and editing PC-Proute output files is the NOTEPAD program in Windows. You may choose any other editor for viewing the output by selecting the UTILITIES option on the second line of the screen. Click on **SETUP OUTPUT FILE VIEWER**. You will then be required to enter the location and name of the output file editor.

4.5 Running the PC-Proute Model Running the PC-Proute Model

When you have completed the input file, select the RUN button to run the model with the input file you created. When you select the RUN option, all the entries in the file will be validated. If any errors are detected during the validation, PC-Proute will put up a message informing you of the type of error detected and will then take you to the prompt that is incorrect. Once all the values are valid, the file is submitted to the PC-Proute model for execution. When the processing of the input file is complete and the output results, PC-Proute will ask whether you wish to view them. If you indicated that you did wish to view the output file, PC-Proute will show them using a data editor allowing you to annotate the results if you so choose. To exit from the Data File Editor, press the ALT and F4 function keys simultaneously.

The model output consists of the following:

- A summary of the input data
- A table of reaches, length, average concentration, final concentration, and final concentration for a child decay product (the daughter pollutant)
- A table describing sampling or withdrawal sites: data includes site information, reach mile point, pollutant final concentration and child final concentration.

4.6 PROUTE Output Graphics PROUTE Output Graphics

Output graphics are provided in PC-Proute to allow you to visually represent the stream location and modeling results. The reaches are drawn using the start and end latitude/longitude pairs. The modeling concentration in the reaches are represent by color: blue represents zero concentration; red represents concentration at or above a user-supplied threshold value, and green represent an in-between value. Flows in the reach are represented by varying the width of the reach. The width is based on the percentage of flow relative to the largest flow being drawn.

To select the graphics option, click on the Utilities option at the top of the screen. Click on the Graphics option. A separate window will appear titled PROUTE Draw. If you have an existing output file with the same number as the input file that you are currently in, the PROUTE will draw the graphics file. Select the File option and use Open to draw a graph from an existing file.

To print the graph, select the Print option. The graph will be printed. The default output format is in Portrait, which will provide you with a graph that takes up half the screen. If you wish to change the format to print in landscape mode, proceed to the Printer Setup option under the File Menu and change it there.

To export the graph, select the Edit option and then the Copy option. This will copy the graph to the clipboard. You may then use the PASTE option in any Windows software package that accepts clipboard files (e.g., Paintbrush, Word for Windows, WordPerfect for Windows, etc.).

4.7 PC-Proute Commands and Function Keys PC-Proute Commands and Function Keys

PC-Proute has a series of "buttons" designed to make using the system as easy as possible. These buttons and the commands they represent are accessible in three ways: (1) click on the button with the mouse key to access the function that button represents, (2) press the ALT along with the underlined letter in the button title (e.g. ALT/H for Help), or (3) select the TOOL option and select the option under there from the list presented.

The buttons and the commands they represent are explained below:

The NEXT Button

This option allows you to move to the next screen in PC-Proute. If there are incorrect values on the screen that you are in currently and you attempt to move to another screen, PC-Proute will inform you of the error and allow you the option of going back (and correcting the error at a later time) or correcting the error. The cursor will blink at the prompt with the incorrect entry, if you elect to correct the error before moving on.

The BACK button

This button allows you to move back one screen. If there are incorrect values on the screen that you are in currently and you attempt to move to another screen, PC-Proute will inform you of the error and allow you the option of going back (and correcting the error at a later time) or correcting the error. The cursor will blink at the prompt with the incorrect entry, if you elect to correct the error before moving on.

The INDEX Function

There are five screens in the Build PC-Proute input file portion. Instead of moving backwards and forwards through the screens, you may use the INDEX feature to hop back and forth between screens. To access this feature, move your cursor over the INDEX button and click with the mouse button, or enter ALT, N. All the screens available in this option will be displayed with the screen title and the screen numbers. **Certain screens will be grayed out. This indicates that these screens are not accessible due to selections made on other screens. The screen that you were in when you selected the INDEX button will be highlighted in blue text**

If you wish to see the prompts that appear on each screen, press the EXPAND button at the bottom of the INDEX screen. The screen names and numbers will then include all the prompts contained in the screens. You may contract the screen again to the normal display of just the screen names and number by clicking on the CONTRACT button.

To move to the screen that you want, move your cursor over the screen number of any non-gray screen and click the left mouse button. You are taken immediately to that screen. To exit the INDEX screen and return to the previous screen, click on the CANCEL button.

The HELP Button

This option allows you access help information on PC-Proute. You have two different types of help: **Prompt-Level Help** which contains information on the specific prompt that your cursor is on or on which you are entering data and **General Help** which contains a general description of the PC-Proute system.

To access the **General Help**, move your cursor over to the tool bar and the select the HELP option, or enter ALT, H from the keyboard. A menu will appear showing the various types of help. Select the HELP INDEX option or enter I from the key board.

To access **Prompt-Level Help**, move your cursor over to the prompt on which you would like information and press either the **F1** function key or move your cursor over to the HELP button and click.

A window will appear in either case displaying broad help or prompt-specific help. If you are accessing prompt-specific help, you may browse through the helps for all the additional prompts that are related to the prompt you are on by accessing the forward and backward BROWSE keys.

If you are accessing **General Help**, all sentences that are in green and underlined have further information on them. Move your cursor over the phrase you would like further information and click. You will be taken to that option.

There is a search function within the HELP functions that allows you to type in a word and find all the help available on the word that you typed. To access this, select the SEARCH key in the HELP window and follow instructions.

When you are through viewing help, exit the help window by either entering ALT, F4 from the keyboard or by moving the cursor over to the icon on the top left corner of the window and double clicking the left mouse button. You will be returned to the screen that you were in previously.

- The CALC Button** This option allows you to access the Calculator Function within Windows, should you require the use of a calculator at any screen in PC-Proute.
- The TOP Button** This option allows you to move to the first screen in PC-Proute from any screen without having to use the INDEX function.
- The RUN Button** This option allows you to submit an input file that you have created to the PC-Proute model for execution. If you have incorrect entries in the file when you click on this button, PC-Proute will inform you that you have incorrect values and take you to the appropriate prompt so that you may correct the value and resubmit the file.
- The RESTORE Button** This option allows you to restore the default values that were in the file before you started making changes for this screen. This is an option that allows you to start again without having to exit the system or go back to every variable that you changed.

5. DESCRIPTIONS OF THE SCREENS IN PC-PROUTE5. DESCRIPTIONS OF THE SCREENS IN PC-PROUTE

PC-Proute has five screens. Each screen and a brief description of the input required for each screen is provided below.

Screen 1: This screen contains control information, chemical information, and type of reach selection. The user must identify the reaches of interest for the model run. This is done by selecting the type of reach identification (retrieval) approach to use. The options available for retrieval approach are (1) downstream from a list of upstream points (2) upstream from a list of downstream points; (3) from a list of cataloging units. Also, the user must enter the chemical name, CAS number, decay half life, the relative molecular weights of the parent and daughter compounds, and the threshold value used in the graphics output (for the color coding of the graphs). Additional selections on this screen that the user should be aware of are the selection of the WSM option

Screen 2: This screen requires the reach retrieval input information. This user input is used in the program to build the initial reach list of reaches of interest to the user. Reach retrieval is either a list of starting reaches and distances or a list of cataloging units of interest.

NOTE: If you elect to go downstream, the starting point for the distance downstream will be the upstream end of the reach. Similarly, if you elect to go upstream, the starting point for the distance upstream will be the downstream end of the reach.

Screen 3: This screen is a catalog unit list for user input of Non-Point Source (NPS) sources loads from the WSM model. This list is used to calculate non-point source loads by cataloging units. These loads are available for editing in the final reach list produced by the reach retrieval program.

Screen 4: This screen presents a list of the reaches of interest to the user. This list is produced by the reach retrieval program and can be edited by the user. This list includes a field for input of non-point source loads by reached. Any unwanted reaches may be deleted.

Screen 5: This screen presents a list of the points sources of interest. This list is initially created by the program from the final reach list in Screen 4. This list can be edited to specify point source loads and add point discharger or point withdrawals.

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6. EXAMPLE RUNS. EXAMPLE RUNS

Two example runs will be presented in this section. The example runs will be in the following format:

1. A list of the important inputs will be provided.
2. The output will be provided showing the results.

NOTE: These example runs illustrate hypothetical scenarios and should not be construed in any way to represent actual releases from the dischargers mentioned. The dischargers are mentioned only to represent the capabilities of these models in these example runs, and have been randomly chosen. They are there only because the database cannot be changed to create hypothetical dischargers. The selection of these dischargers do not in any way imply any undue conditions on the part of the dischargers mentioned.

6.1 Example 1: Discharge of the chemical EDC Downstream from a Specified Reach

In this example scenario, we will select a reach in Delaware (02040207007) and follow it downstream for 22 miles. We will presume that there is a single discharger at mile 6 on the reach. EDC is used as the chemical of release in this example since it has a relatively short half-life in surface waters. For chemicals with a short half-life, significant decay can occur within a reach. There will be no non-point source loading and the direct discharge amount will be kept nominal. You should notice therefore a significant difference between the final concentration and the average concentration, and a quick degradation of the chemical before the end of the distance downstream. This input file for this scenario is called PROUT001.INP. Retrieve this file using the File/Open command. The important input options are summarized below.

INPUT SCENARIO

Run Name: Leave at default
Run Description: Example Scenario at Murderkill River in Delaware
Chemical of Choice: ECD
CAS:
Half-Life: 5.561E03
Parent Molecular weight: 1
Child Molecular Weight: 1
Flow Regime: Mean Flow
Reach Selection: Reach Selection by Distance Downstream
Input from WSM: None

(Make sure that you have selected the Recreate Lists options since otherwise PROUTE will not generate a new list of reaches or dischargers)

Conc. Threshold Value: Leave blank
Reach Number: 02040207007
Distance: 22 miles
NPS Load: 0
Direct Discharger: Kent County Levy Court - WWTR TR
Load: 1 kg/day

OUTPUT RESULTS

CHEMICAL NAME: EDC

CAS NUMBER	A/L	Parent MW	Child MW	Threshold			
	AVG	1.000	1.000	0.000			
DECAY = 0.000124618 (SEC-1)							
REACH	NAME	LENGTH Miles	# (MLD)	FLOW (ug/l)	AVG CONC (ug/l)	FIN CONC	CHILD F CONC
02040204016	DELAWARE BAY	0.800	0	50852.437	0.000	0.000	0.020
02040204066	DELAWARE BAY	10.400	0	504.210	0.003	0.000	1.983
02040207007	MURDERKILL R	10.800	1	366.941	0.331	0.025	2.700

Example 2: Acrylonitrile Release

For this example, we will use Acrylonitrile, which is a slow-decaying chemical. We will follow this chemical by catalog unit, through four cataloging units that start in New Jersey and proceed down to Delaware. There will be a non-point threshold load that is estimated, and a direct discharge load that comes from the Toxic Release Inventory (TRI) database. The input file for this scenario is called PROUT002.INP and can be accessed using the File/Open command. The important inputs are summarized below. The concentration threshold value shown will be the chronic level of concern for freshwater fish. The input file and the output results will be shown for this input scenario.

INPUT SCENARIO

Run Name: Leave at default
Run Description: Acrylonitrile Study
Chemical of Choice: Acrylonitrile
CAS: 107131
Half-Life: 1.987E06
Parent Molecular weight: 1
Child Molecular Weight: 1
Flow Regime: Mean Flow
Reach Selection: Catalog Unit
Input from WSM: None

(Make sure that you have selected the Recreate Lists options since otherwise PROUTE will not generate a new list of reaches or dischargers)

Conc. Threshold Value: 0.0075
Catalog Unit Numbers: 02040207, 02040204, 02040202, 02040201
Reach for NPS Load: 02040201001, Delaware River
NPS Load: 100 kg/day/mile
Direct Discharger: Kent County Levy Court - WWTR TR
Load: 66.71 kg/day

Output Results

CHEMICAL NAME:

CAS NUMBER A/L Parent MW Child MW Threshold

10713 AVG 1.000 1.000 0.007

DECAY = 3.48767e-007 (SEC-1)

REACH	NAME	LENGTH (Miles)	# (MLD)	FLOW (ug/l)	AVG CONC (ug/l)	FIN CONC	CHILD F CONC
02040201001	DELAWARE R	2.200	0	33966.608	1.133	2.266	0.001
02040201002	DELAWARE R	3.200	0	33018.484	0.000	0.000	0.000
02040201003	ASSISCUNK CR	15.500	0	203.924	0.000	0.000	0.000
02040201004	DELAWARE R	11.300	0	32772.468	0.000	0.000	0.000
02040201005	*A	4.600	0	693.711	0.000	0.000	0.000
02040201006	CROSSWICKS CR	11.100	0	417.428	0.000	0.000	0.000
02040201007	*B	8.000	0	130.018	0.000	0.000	0.000
02040201008	*C	7.800	0	126.768	0.000	0.000	0.000
02040201009	DOCTORS CR	16.400	0	215.764	0.000	0.000	0.000
02040201010	DELAWARE R	5.300	0	31930.095	0.000	0.000	0.000
02040201011	NESHAMINY R	49.700	0	919.196	0.000	0.000	0.000
02040202001	DELAWARE R	1.700	0	45273.254	1.668	1.667	0.033
02040202004	DELAWARE R	2.300	0	178.071	0.000	0.000	0.000
02040202005	REPAUPO CR	11.600	0	148.606	0.000	0.000	0.000
02040202006	DELAWARE R	2.700	0	45073.414	1.677	1.676	0.032
02040202009	DELAWARE R	1.000	0	44765.144	1.691	1.690	0.030
02040202012	DELAWARE R	1.000	0	44569.472	1.699	1.698	0.029
02040202014	DELAWARE R	0.600	0	44299.173	1.710	1.710	0.029
02040202017	DELAWARE R	4.700	0	44040.054	1.722	1.720	0.028
02040202020	DELAWARE R	2.700	0	198.709	0.000	0.000	0.000
02040202021	MANTUA CR	11.400	0	164.119	0.000	0.000	0.000
02040202022	DELAWARE R	2.400	0	43781.143	1.736	1.735	0.024
02040202025	DELAWARE R	3.200	0	36082.873	2.109	2.107	0.027
02040202028	DELAWARE R	5.900	0	297.569	0.000	0.000	0.000
02040202029	BIG TIMBER CR	4.800	0	221.985	0.000	0.000	0.000
02040202030	DELAWARE R	6.500	0	35744.317	2.135	2.131	0.023
02040202033	DELAWARE R	4.200	0	254.068	0.000	0.000	0.000
02040202034	COOPER R	16.300	0	200.262	0.000	0.000	0.000
02040202035	DELAWARE R	4.000	0	35406.987	2.161	2.159	0.016
02040202038	DELAWARE R	0.700	0	115.256	0.000	0.000	0.000
02040202039	PENNSAUKEN CR	12.400	0	106.288	0.000	0.000	0.000
02040202040	DELAWARE R	0.600	0	35240.492	2.174	2.174	0.011
02040202043	DELAWARE R	4.000	0	35050.895	2.189	2.186	0.010
02040202046	DELAWARE R	1.000	0	34999.655	2.195	2.195	0.006
02040202049	DELAWARE R	2.200	0	989.501	0.000	0.000	0.000
02040202050	RANCOCAS CR	8.100	0	961.317	0.000	0.000	0.000
02040202051	RANCOCAS CR, S BR	26.200	0	294.796	0.000	0.000	0.000
02040202052	RANCOCAS CR, N BR	20.500	0	562.754	0.000	0.000	0.000
02040202053	DELAWARE R	2.400	0	33997.352	2.262	2.260	0.004
02040202066	DELAWARE R	0.000	0	0.000	0.000	0.000	0.000
02040202067	PENNY PACK CR	0.000	0	0.000	0.000	0.000	0.000
02040202068	DELAWARE R	0.300	0	181.915	0.000	0.000	0.000
02040202069	*A	13.900	0	178.071	0.000	0.000	0.000
02040202070	DELAWARE R	0.500	0	7667.539	0.000	0.000	0.000
02040202071	DELAWARE R	0.800	0	251.441	0.000	0.000	0.000
02040202072	DELAWARE R	0.600	0	257.499	0.000	0.000	0.000
02040202073	DELAWARE R	0.700	0	182.868	0.000	0.000	0.000
02040202074	DELAWARE R	0.700	0	273.685	0.000	0.000	0.000
02040202075	DARBY CR	24.000	0	241.192	0.000	0.000	0.000
02040202076	CRUM CR	9.400	0	249.812	0.000	0.000	0.000
02040202077	SPRINGTON RES	2.200	0	129.390	0.000	0.000	0.000

PC-Proute User's Guide

02040202080 CRUM CR	7.900	0	101.206	0.000	0.000	0.000
02040202081 RIDLEY CR	21.500	0	173.900	0.000	0.000	0.000
02040202082 CHESTER CR	21.000	0	264.717	0.000	0.000	0.000
02040202083 BIG TIMBER CR, S FK	8.200	0	90.032	0.000	0.000	0.000
02040202084 BIG TIMBER CR, N FK	5.500	0	70.460	0.000	0.000	0.000
02040204002 DELAWARE R	4.600	0	54094.522	2.524	2.521	0.135
02040204005 DELAWARE BAY	7.900	0	53670.384	2.552	2.547	0.131
02040204008 DELAWARE BAY	1.500	0	53099.798	2.585	2.584	0.122
02040204011 DELAWARE BAY	16.600	0	484.460	0.000	0.000	0.000
02040204012 DELAWARE BAY	5.800	0	52595.552	2.615	2.611	0.121
02040204015 DELAWARE BAY	11.500	0	1666.566	0.000	0.000	0.000
02040204016 DELAWARE BAY	2.300	0	50852.437	2.710	2.708	0.118
02040204019 DELAWARE BAY	1.600	0	50317.875	1.456	1.456	0.075
02040204022 DELAWARE R	9.700	0	49943.990	1.471	1.468	0.074
02040204025 DELAWARE R	5.600	0	49551.642	1.489	1.486	0.067
02040204028 DELAWARE R	4.500	0	554.418	0.000	0.000	0.000
02040204029 DELAWARE R	4.600	0	48923.320	1.511	1.510	0.064
02040204032 DELAWARE R	0.000	0	0.000	0.000	0.000	0.000
02040204033 DELAWARE R	2.500	0	48862.607	1.516	1.515	0.061
02040204036 DELAWARE R	6.100	0	48601.193	1.527	1.525	0.059
02040204039 DELAWARE R	0.800	0	48520.690	1.533	1.532	0.055
02040204042 DELAWARE R	4.100	0	48349.159	1.540	1.538	0.054
02040204045 DELAWARE R	0.000	0	0.000	0.000	0.000	0.000
02040204046 DELAWARE R	4.200	0	48295.046	1.545	1.543	0.051
02040204049 DELAWARE R	9.600	0	548.345	0.000	0.000	0.000
02040204050 DELAWARE R	12.700	0	47691.277	1.571	1.566	0.048
02040204053 DELAWARE R	6.300	0	45384.122	1.659	1.656	0.040
02040204056 DELAWARE R	0.000	0	0.000	0.000	0.000	0.000
02040204057 DELAWARE R	2.100	0	45300.967	1.666	1.665	0.035
02040204060 DELAWARE R	0.900	0	2139.541	0.000	0.000	0.000
02040204061 DELAWARE R	1.500	0	160.987	0.000	0.000	0.000
02040204062 DELAWARE R	0.000	0	0.000	0.000	0.000	0.000
02040204063 DELAWARE R	2.800	0	228.429	0.000	0.000	0.000
02040204064 DELAWARE R	3.800	0	264.329	0.000	0.000	0.000
02040204065 DELAWARE R	10.500	0	352.776	0.000	0.000	0.000
02040204066 DELAWARE BAY	10.400	0	504.210	129.372	128.161	4.149
02040204067 DELAWARE BAY	9.700	0	466.336	0.000	0.000	0.000
02040204068 DELAWARE BAY	8.400	0	363.426	0.000	0.000	0.000
02040207001 BROADKILL R	3.200	0	252.555	0.000	0.000	0.000
02040207002 *A	10.900	0	128.039	0.000	0.000	0.000
02040207003 BROADKILL R	7.400	0	86.926	0.000	0.000	0.000
02040207004 MISPILLION R	0.300	0	338.306	0.000	0.000	0.000
02040207005 MISPILLION R	15.700	0	184.424	0.000	0.000	0.000
02040207006 CEDAR CR	12.800	0	150.358	0.000	0.000	0.000
02040207007 MURDERKILL R	10.800	1	366.941	103.356	179.443	2.363
02040207008 MURDERKILL R	9.800	0	119.085	0.000	0.000	0.000
02040207009 *B	10.300	0	120.991	0.000	0.000	0.000
02040207010 JONES R	24.400	0	214.186	0.000	0.000	0.000
02040207011 LEIPSIC R	18.900	0	214.173	0.000	0.000	0.000
02040207012 SMYRNA R	16.300	0	191.472	0.000	0.000	0.000

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APPENDIX A: DESCRIPTION OF THE PC-PROUTE DATASETS

The REG*.BIN file is a binary file that is in the following format:

Reach Number	Character*11
Type	Integer*2
Upstream 1 Reach Number	Character*11
Upstream 1 Flag	Integer*2
Upstream 1 Record Number	Integer*2
Upstream 2 Reach Number	Character*11
Upstream 2 Flag	Integer*2
Upstream 2 Record Number	Integer*2
Downstream 1 Reach Number	Character*11
Downstream 1 Flag	Integer*2
Downstream 1 Record Number	Integer*2
Downstream 2 Reach Number	Character*11
Downstream 2 Flag	Integer*2
Downstream 2 Record Number	Integer*2
Reach Length	Real*8
Upstream Latitude	Real*8
Upstream Longitude	Real*8
Downstream Latitude	Real*8
Downstream Longitude	Real*8
Mean Flow	Real*8
7Q10 Flow	Real*8
Mean Flow Velocity	Real*8
7Q10 Flow Velocity	Real*8
Reach Name	Character*28
Buffer	Character

The Type Variable refers to the type of reach. The types are split into reach types and non-reach types. We are not concerned with the non-reach types at the moment since they cannot be modeled in PC-Proute. The reach types used by PC-Proute are:

1	Artificial Lake Region
3	Entry Reach
8	Isolated Reach
9	Regular Reach
10	Start Reach
11	Terminal Reach
12	Terminal Entry Reach
14	Terminal Start Reach
17	Artificial Open Water Reach

The flag fields are -1 meaning that direction is to be routed and 1 meaning that direction is not to be routed. In addition to the flags, the downstream record numbers must also be non-zero. Buffer is used to finish on a word (2 byte) boundary.

The REG*.IDX files are binary files with the following format:

Reach Number	Character*11
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Record Number	Integer*2
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The IFD*.BIN files are binary files with the following format:

Reach Number	Character*11
Discharge Mile Point	Real*4
NPDES	Character*9
Facility Name	Character*30

The REG*.LEN files are binary files with the following format:

Catalog Unit Number	Character*8
Total Length	Real*8
Number of Reaches	Integer*2