

User's guide (version 1)

ST:REAM Model (SEPA version) and Datasets

A- What do we need?

- 1) To run the model: **Excel 2003 or later**.
- 2) If you are planning to use the pre-elaborated "Scotland Dataset" you will need **Excel 2007 or later**. (Previous versions are constrained to 65,000 rows).
- 3) If you are planning to work with Flow Duration Curves (FDC), you will need to have access to **Low Flow Enterprise (LFE)**.
- 4) **ArcGIS** will allow you to map the outcomes.

B- What is in the "STREAM model folder"?

- 1) STREAM model: **STREAMv7.0-SEPAvx.xls** (Excel file with macros).
- 2) **Scotland Dataset** (Excel 2007 or later). This worksheet contains all the required information by the model. Every 50 meters and for the whole river network (baseline rivers and tributaries), it contains the next information:
 - a. Catchment: catchment number.
 - b. Branch number: every river in every catchment has a branch number starting in 1. The branch number 1 must be the main stem.
 - c. Point: for every river (branch). The point number starts with 1 (upstream) and increases its value downstream.
 - d. D/S Branch: just for the last point of every river. It is the branch where the current river comes into. Branch number 1 comes into 0 (zero).
 - e. D/S Point: just for the last point of every river. It is the point number where the current river comes into. Branch number 1 comes into 0 (zero).
 - f. Q₂ (m³/s): Flood peak flow for 2 years return period. Q₂ is the median annual maximum flow, known as Q_{MED}. The flood peak estimates have been produced using the first version of a fully automated version of the 1999 FER statistical procedures. (See: Morris, D1G. 2003. Automation and appraisal of the FEH statistical procedures for flood frequency estimation. Report to Defra. CEH Wallingford.) The cell size of the Flow Grid is 50m. ([Further information](#)).
 - g. Slope (m/m):
 - i. Baseline Rivers: the slope of the search window for the sampling point (50 m). Note search window length is scaled by Strahler order encoded into the MM centreline.
 - ii. Tributaries: Based on the altitude every 50m. (Nextmap)
 - h. Width (m): Channel width.

- i. Baseline Rivers: OS Master Map. The width of the channel as calculated from the MM polygon. If the sampling point falls outside a MM polygon it is given a nominal 1m width. Channel width from Master Map corresponds to normal winter level instead of bank full level.
 - ii. Tributaries: Os Master Map.
 - i. X coordinate: British National Grid
 - j. Y coordinate: British National Grid
 - k. HA: Hydrometric Area for Scotland.
 - l. Tributary: a flag field of Y or N indicating if the point belongs to a tributary or not.
- 3) **Geodatabase**. This GeoDataBase (ArcGIS) contains different layers/datasets and toolboxes for managing data, showing outputs and extracting information.
 - 4) User's guide

C- What can we find in the model?

- 1) Open the file: STREAMv7.0-SEPAvx.xls
- 2) Click on the first Worksheet: "1.Model Input"



- 3) Have a look at the different control panels:

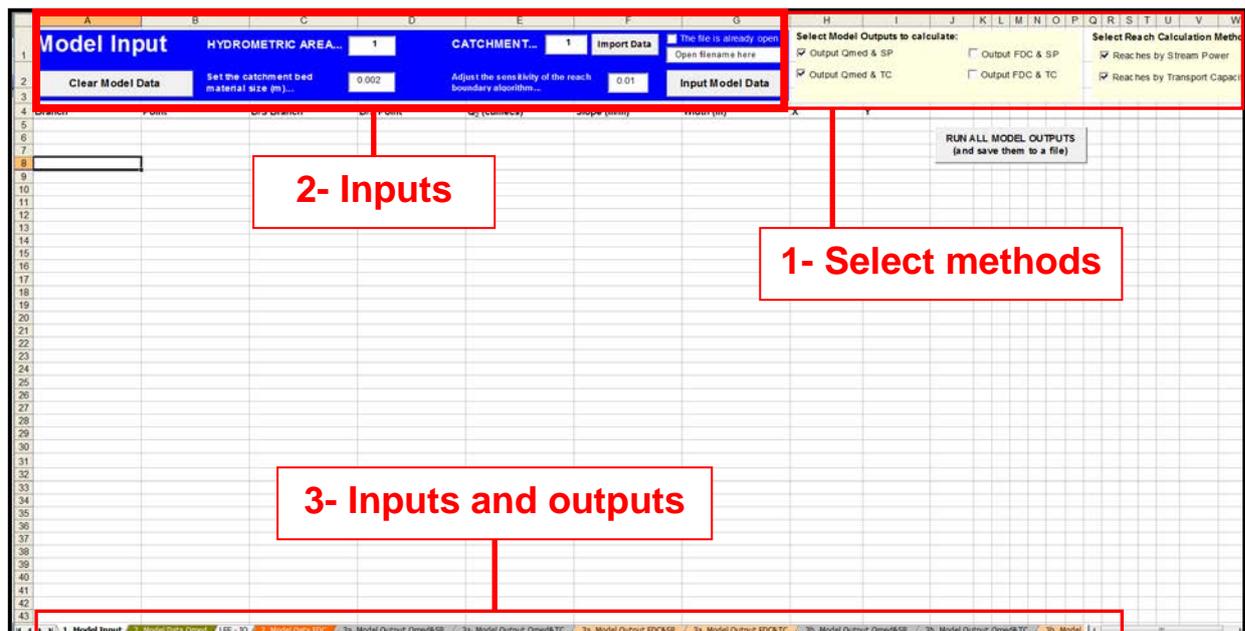


Figure 1 Control panels

D- How do we introduce data into the model?

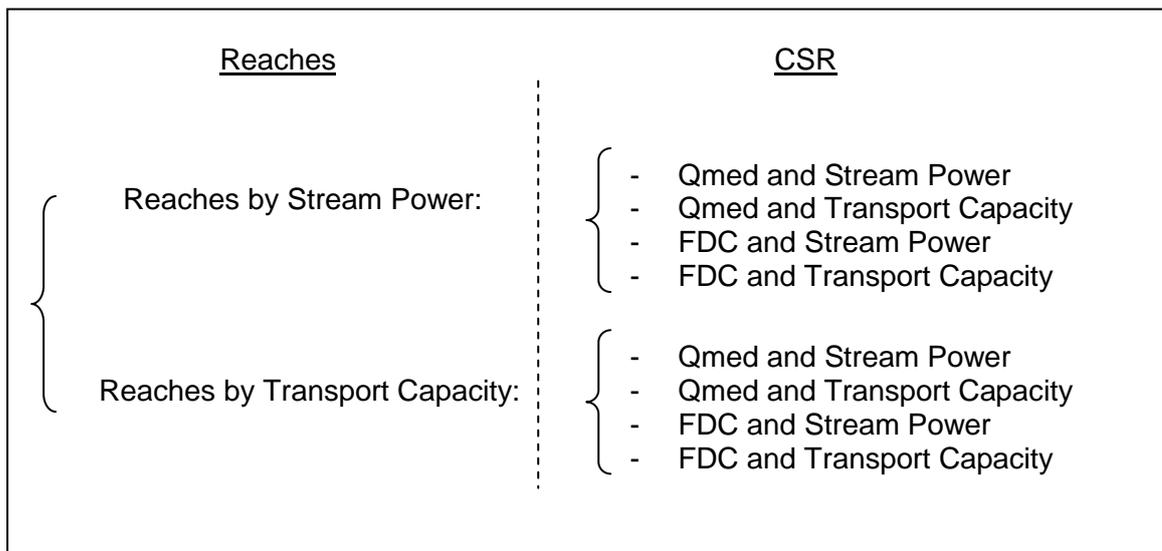
- 1) Click on Worksheet: "1.Model Input"
- 2) Go to control panel 1, **Select methods** (see figure 1). Select a method for generating the **reaches**: Stream Power (SP), Transport Capacity (TC) or both.

<p>Select Model Outputs to calculate:</p> <p><input checked="" type="checkbox"/> Output Qmed & SP <input checked="" type="checkbox"/> Output FDC & SP</p> <p><input checked="" type="checkbox"/> Output Qmed & TC <input checked="" type="checkbox"/> Output FDC & TC</p>	<p>Select Reach Calculation Method:</p> <p><input checked="" type="checkbox"/> Reaches by Stream Power</p> <p><input checked="" type="checkbox"/> Reaches by Transport Capacity</p>
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- 3) Select the **outcomes** you want to calculate. Go to control panel 1, *Select methods* (see figure 1).

<p>Select Model Outputs to calculate:</p> <p><input checked="" type="checkbox"/> Output Qmed & SP <input checked="" type="checkbox"/> Output FDC & SP</p> <p><input checked="" type="checkbox"/> Output Qmed & TC <input checked="" type="checkbox"/> Output FDC & TC</p>	<p>Select Reach Calculation Method:</p> <p><input checked="" type="checkbox"/> Reaches by Stream Power</p> <p><input checked="" type="checkbox"/> Reaches by Transport Capacity</p>
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Tree of outcomes: (you can produce up to 8 outcomes for the same set of data)



- 4) Go to control panel 2, **Inputs** (see figure 1). If you want to start a new model, click on “**Clear Model Data**”.

The screenshot shows the 'Model Input' control panel. The 'Clear Model Data' button is highlighted with a red box. The panel includes fields for 'HYDROMETRIC AREA...' (value 9), 'CATCHMENT...' (value 30), 'Import Data', a checkbox for 'The file is already open' (checked), and a file name 'Model_DATA_Trial.xls'. Below these are 'Set the catchment bed material size (m)...' (value 0.0177) and 'Adjust the sensitivity of the reach boundary algorithm...' (value 0.01), both with 'Input Model Data' buttons.

- 5) When working with FDC it is needed to introduce the **Hydrometric Area** in order to generate the export files for LFE. If you are working with the “Scotland Dataset”, this value will be introduced automatically.

The screenshot shows the 'Model Input' control panel. The 'HYDROMETRIC AREA...' field, containing the value 9, is highlighted with a red box. Other elements are the same as in the previous screenshot.

- 6) Set the **catchment bed material size** and **sensitivity of the reach boundary algorithm**.

The screenshot shows the 'Model Input' control panel. The 'Set the catchment bed material size (m)...' field (value 0.0177) and the 'Adjust the sensitivity of the reach boundary algorithm...' field (value 0.01) are highlighted with a red box. Other elements are the same as in the previous screenshot.

- 7) Set the **catchment number** you want to work on. And press “**Import Data**”. Browse to “Scotland Dataset.xls”. The current worksheet will be filled with the data from the selected catchment.

The screenshot shows the 'Model Input' control panel. The 'CATCHMENT...' field (value 30) and the 'Import Data' button are highlighted with a red box. Other elements are the same as in the previous screenshot.

- 8) Click on **Input Model Data** to start running the model.

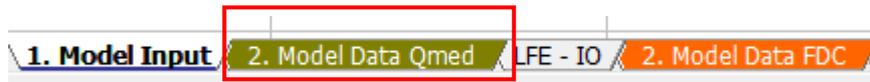
- 9) If any problem running the model, check:

- a. Your slope values are lower than 1 and different to 0.
- b. Your Qmed values are different to 0.
- c. Your width values are different to 0.

- d. The last point of your main stem connects to D/S Branch=0 and D/S Point=0.
- e. All the branches have a D/S branch/point.
- f. Your branches and points are ranked.
- g. There is not more than one branch coming into the same junction. If this happens, set one of the branches junctions 50m upstream of the original one.

E- How do we get the outcomes when CSR requires Qmed?

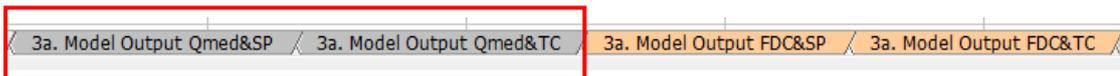
1) Click on Worksheet: “2.Model Data Qmed”



2) Check the data. You can plot the different branches.

3) Which are the outputs (worksheets) I have to look at?

a. If your reaches are based on Stream Power: 3a in grey background.



b. If your reaches are based on Transport Capacity: 3b in grey background.



4) For every output you will need to set the reaches with **non-erodible boundaries**. Click on every worksheet you are working on and flag “y” in them. Bear in mind that reaches based on SP or TC can be different. For helping determinate where the non-erodible boundaries are, a layer providing this information has been added into the GeoDatabase.

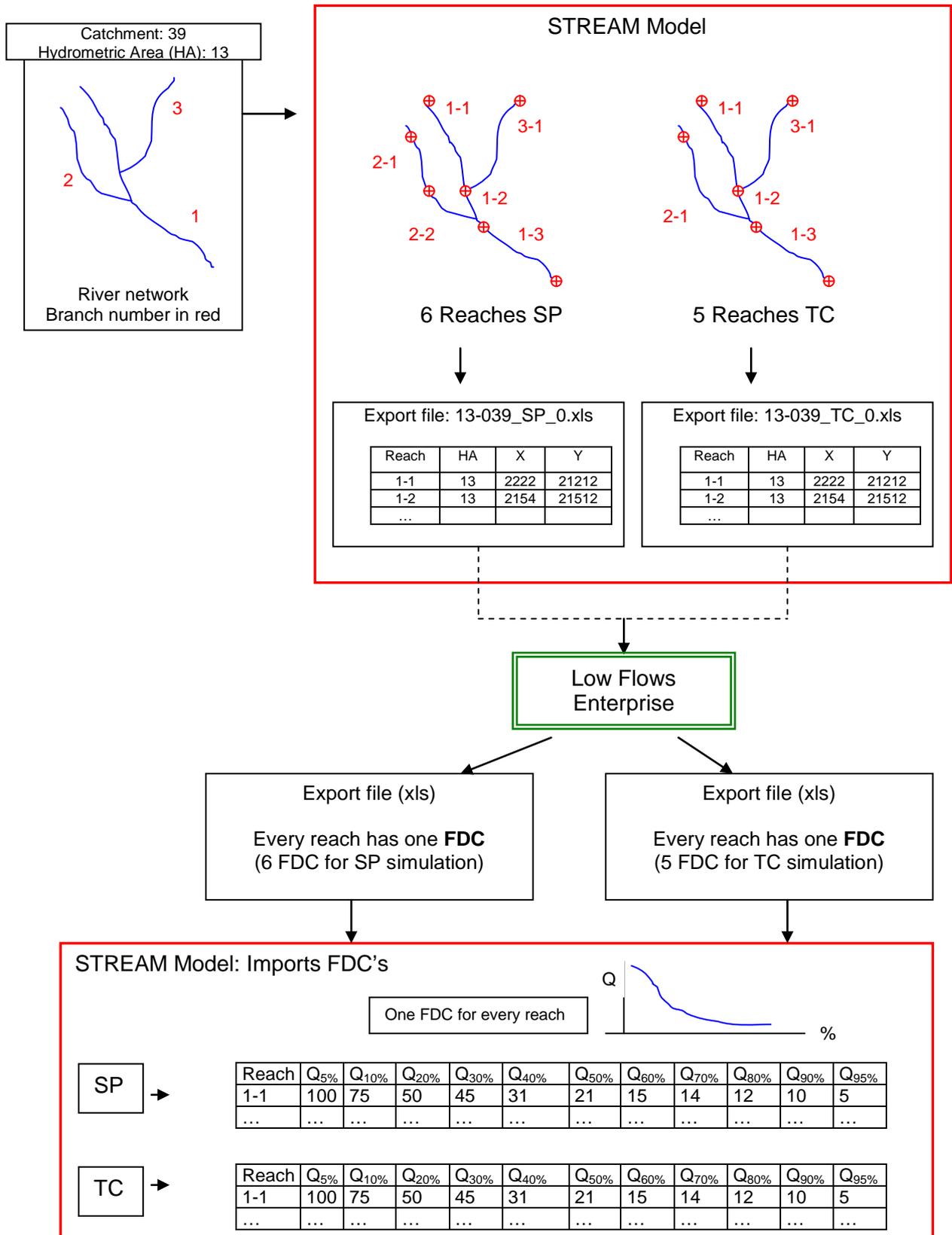
Branch	Reach	0. Distance upstream from catchment end (m)	1. Q ₂ (cumecs)	2. Slope	3. Width (m)	4. Q ₂ Stream power per unit bed area (W/m ²)	5. Elevation above catchment end (m)	6. Are reach boundaries non-erodible?	7. In Stre per area
1	1	32350	0.192723636	0.070529091	1	133.3436303	858.98	y	
1	1	31800	0.192723636	0.070529091	1	133.3436303	858.98	y	
1	2	31800	1.476620185	0.073286667	1	1061.604565	820.89	y	
1	2	29100	1.476620185	0.073286667	1	1061.604565	820.89	y	
1	3	29100	10.24753302	0.034068962	5.715700283	599.2082602	622.315		1
1	3	23800	10.24753302	0.034068962	5.715700283	599.2082602	622.315		1
1	4	23800	13.8807	0.0293044	5.9036496	675.9158588	441.7495		7
1	4	22550	13.8807	0.0293044	5.9036496	675.9158588	441.7495		7
1	5	22550	14.23479462	0.007310769	7.198673077	141.8178305	405.19		6
1	5	21900	14.23479462	0.007310769	7.198673077	141.8178305	405.19		6

- 5) Click on **Run Model** in every of the outputs you are interested in.
- 6) You can **run all the models at once** (including the ones calculated with FDC, if they were already processed) and save them to a file (.xx_ALL_Outpus.xls) in your desktop. Go to “1.Model Input”, and click on “**Run all model outputs**”.

<input checked="" type="checkbox"/> The file is already open Model_DATA_Trial.xls		Select Model Outputs to calculate: <input checked="" type="checkbox"/> Output Qmed & SP <input checked="" type="checkbox"/> Output FDC & SP <input checked="" type="checkbox"/> Output Qmed & TC <input checked="" type="checkbox"/> Output FDC & TC		Select Re <input checked="" type="checkbox"/> Reac t <input checked="" type="checkbox"/> Reac t	
Input Model Data					
Width (m)	X	Y	RUN ALL MODEL OUTPUTS (and save them to a file)		
24	1	335920.098			820475.149
196	1	335969.516			820480.169
179	1	336017.627			820467.824
174	1	336062.781			820475.445
118	1	336108.423			820495.321
101	1	336156.508			820496.399
159	1	336198.761			820506.223
58	1	336247.029			820514.750

F- How do we get the outcomes when CSR requires FDC?

Conceptual model when working with FDC: Next figure shows the process though and an example.



- 1) When you clicked in **Model Input Data** on the “1. Model Input worksheet”, one or two excel files were saved in your desktop. These files are going to be read by LFE. They contain the coordinates of the last but one point of every reach. We will have one export file for the reaches based on Stream Power and a different one for Transport Capacity.

The default name of these files is:
 “Hydrometric Area_Catchment Number_Method”;

I.e. “13-039_SP_0”, stands for HA=13, Catchment=39, Method=Stream Power.

The batch processing limit for LFE is 250 points, so if our catchment has more than 250 reaches, the export files will be split into more than one file. (I.e. 13-039_SP_1; 13-039_SP_2, etc).

LFE

- 2) Open **Low Flows Enterprise** (LFE). Click on Analysis → Launch Batch .
- 3) Set New **Batch Project**.
- 4) Browse to the export files from step 1. Click “Go”.
- 5) Set the **criteria** (parameters by default can be an appropriate choice).
- 6) **Run** impoundment pre-process.
- 7) LFE runs the project.

Possible crash: when a point has X, Y coordinates far away from the river it belongs to, you must modify manually the coordinates. (The river network used in LFE is slightly different from the one used to get the points).

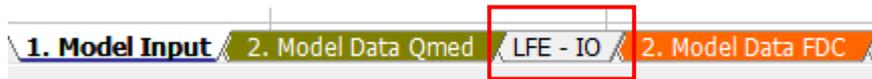
- 8) When finished, **check the outputs**.
- 9) Fill the check-box on the left in every row.

Point	Easting	Northing	ClimbS
<input type="checkbox"/> 001-000010	368598	785005	15
<input checked="" type="checkbox"/> 001-000064	370672	783942	1
<input checked="" type="checkbox"/> 001-000170	374470	781302	15

- 10) Click on : Options → Write results to XLS
- 11) Browse and save the file in one empty folder. This folder will contain nothing but the file or files generated by LFE. The export file/s based on SP will be saved in an empty folder, and the ones based on TC in another one. Don't mix them as the “Import Module” in STREAM won't work properly.

STREAM Model

- 12) Go to **STREAM Model**
- 13) Go to the worksheet: "**LFE-IO**"



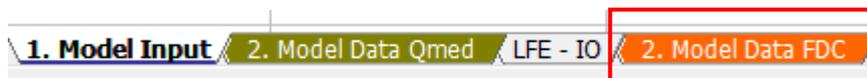
- 14) Click on **the FDC result** you want to import into the model: SP or TC

Reaches calculated by Stream Power					Reaches calculated by Transport Capacity				
Hydro	GridX	GridY	ExpArea	PointName	Hydro	GridX	GridY	ExpArea	PointName
13	368597.9	785005		001-000010	13	368641.3	785020		001-000011
13	370671.7	783942		001-000064	13	370671.7	783941.8		001-000064
13	374469.7	781302		001-000170	13	374469.7	781302.3		001-000170
13	375385.7	780712		001-000195	13	375893.1	780376.6		001-000208
13	375893.1	780377		001-000208	13	377878.6	780081.3		001-000259
13	377878.6	780081		001-000259	13	378273.9	779476.5		001-000274

Import LFE results (Stream Power)
Import LFE results (Transport Capacity)

- 15) **Browse** to the **folder** (folder, not file) where the files are contained. Click ok, after that, the data will have been added into the model.

- 16) Go to the worksheet: **Model Data FDC**.



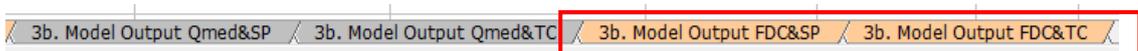
- 17) Check the data. You can plot the different branches.

- 18) Which are the outputs (worksheets) I have to look at?

- a. If your reaches are based on Stream Power: 3a in yellow background.



- b. If your reaches are based on Transport Capacity: 3b in yellow background.



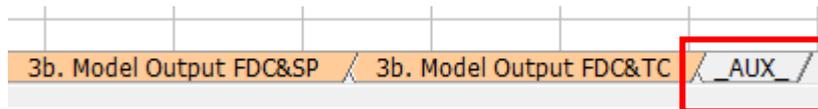
- 19) For every output you will need to set the reaches with **non-erodible boundaries**. Click on every of the worksheets you are working on and flag "y" in them. Bear in mind that reaches based on SP or TC can be different. For

helping determine where the non-erodible boundaries are, a layer providing this information has been added into the GeoDatabase.

	Q ₉₀	Q ₉₅	2. Slope	3. Width (m)	4. Transport Capacity (N/s)	5. Elevation above catchment end (m)	6. Are reach boundaries non-erodible?	7. Input Transp (N/s)
	0.006	0.004	0.004	0.071104	1	36528498.9	858.98 y	
	0.006	0.004	0.004	0.071104	1	36528498.9	858.98 y	
	0.029	0.019	0.015	0.073208	1	669989223.6	816.3175 y	
	0.029	0.019	0.015	0.073208	1	669989223.6	816.3175 y	
	0.195	0.141	0.116	0.034069	5.7157	492761721.6	622.315	29
	0.195	0.141	0.116	0.034069	5.7157	492761721.6	622.315	29

20) Click on **Run Model** in every of the outputs you are interested in.

21) You can have a look at all SP and TC values for every FDC by going to the worksheet: **_AUX_**.



7) You can **run all the models at once** (including the ones calculated with Qmed, if they were already processed) and save them to a file (xx_ALL_Outpus.xls) in your desktop. Go to **"1.Model Input"**, and click on **"Run all model outputs"**.

The file is already open
 Model_DATA_Trial.xls
Input Model Data

Select Model Outputs to calculate:
 Output Qmed & SP Output FDC & SP
 Output Qmed & TC Output FDC & TC

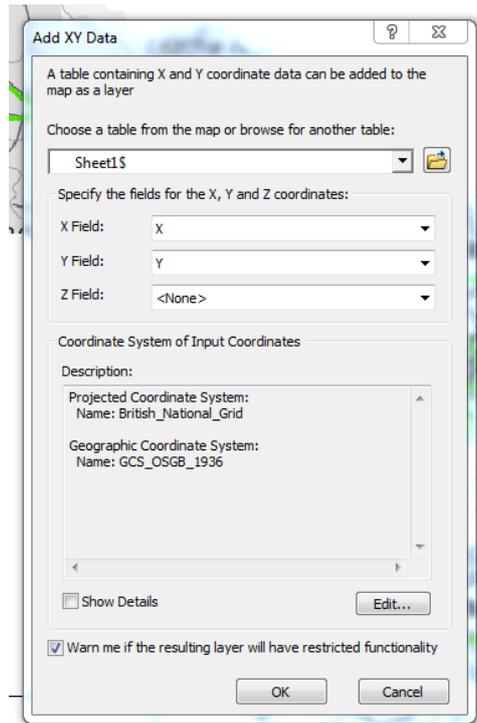
Select Re
 Reac t
 Reac t

Width (m)	X	Y
24	1	335920.098
196	1	335969.516
179	1	336017.627
174	1	336062.781
118	1	336108.423
101	1	336156.508
159	1	336198.761
58	1	336247.029

RUN ALL MODEL OUTPUTS
 (and save them to a file)

G- How do we map the outcomes?

- 1) Make sure you generated the “_ALL_outputs.xls” file.
- 2) Open **ArcGIS**
- 3) Click on File → Add data... → **Add X,Y data**
- 4) **Select your outcome file (sheet1\$)**



- 5) Click ok (ArcGIS will recognize the X and Y automatically)
- 6) All the points will be added in the ArcGIS view.
- 7) **Export the points to a feature dataset** (shapefile): right click on the layer → Data → Export Data
- 8) **Add the shapefile** to your current ArcGIS project.
- 9) Double click on the shapefile → Symbology → **Import**.
- 10) Browse to the “.lyr” file provided in the GeoDatabase.
- 11) **Select the outcome** you want to map.
- 12) Click Ok.
- 13) Every point will be shown following the pre-stated legend (you can produce your own legend).
- 14) Use the **GeoDatabe** for adding new features to your layout.

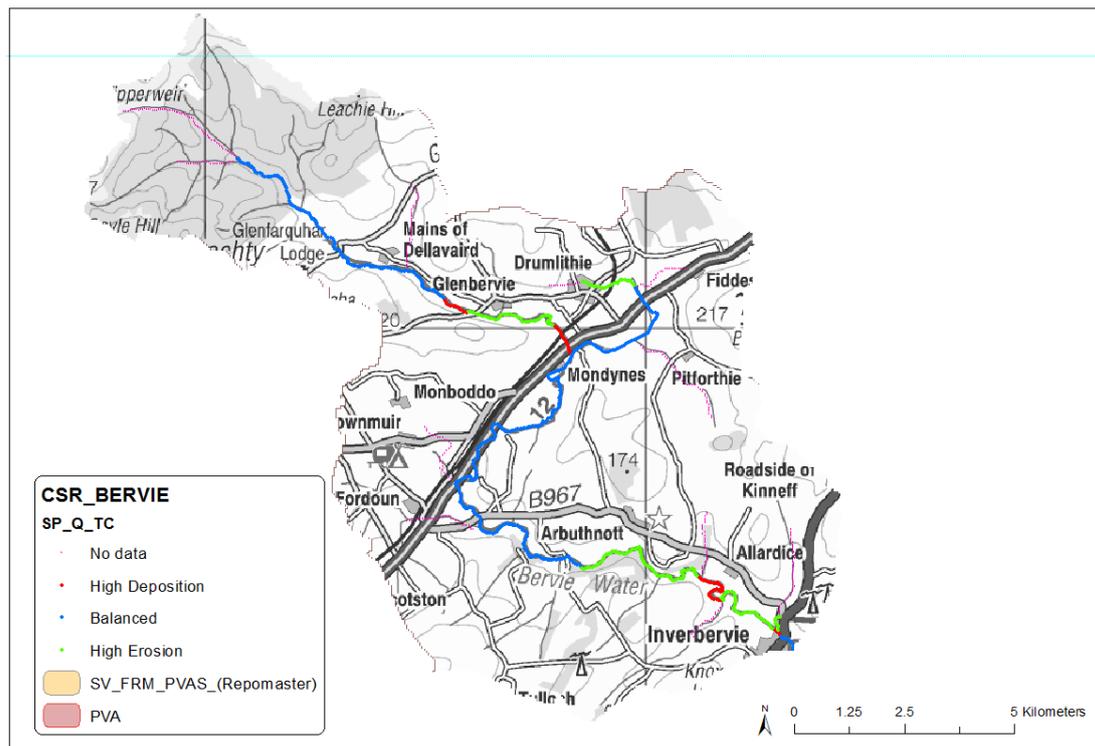


Figure 2 Example of mapping

H- What else can we do?

1) New Hydro-scheme alteration.

a. Toolbox....

2) Sinks and sources

I- You should know this:

1. Things that you must check if you are not using the "Scotland Dataset":
 - a. Branch numbers must be consecutive, starting with 1 (main stem) to the last value.
 - b. Last point of the branch 1 joins to D/S Branch=0 and D/S point=0.
 - c. Sort values by branch number and point number.
2. Baseline Rivers network comes from OS Master Map.
3. Tributaries network comes from CEH national fluvial.
4. Tributaries have a catchment area greater than 3 km²
5. There are different methodologies for getting the FDC in LFE (for further information, review the LFE manual):
 - a. Natural: the FDC without taking into consideration any human alteration.

- i. Lake adjustment
- ii. No lake adjustment
- b. Influenced: taking into consideration abstractions, water diversions, etc.
 - i. Lake adjustment (this one cannot be calculated in batch processing)
 - ii. No lake adjustment

The selected methodology employed in the mode by default is:
Influenced with no lake adjustment.

6. Most of the calculations are saved in memory, so: **Never close the Model (excel file) you are working on before getting the outcomes.** You will need to run the model again if so. This is especially important when you are dealing with river networks with long simulation times. Bear this in mind when working with FDC.

You will not be able to plot the outcomes once you close the excel file.