Healthy Estuaries 2020: Towards Addressing Coastal Squeeze in Estuaries

Appendix B: Technical User Guide

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Enhancing Society Together

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1 REQUIREMENTS

1.1 Software

1.1.1 ESRI ArcMap

The Healthy Estuaries 2020 Toolbox (HET) has been developed using ESRI ArcMap software and will work with version 10.1 and later.

http://www.esri.com/software/arcgis/arcgis10

The toolbox requires extensions:

- 3D Analyst
- Spatial Analyst

1.1.2 Microsoft Excel

The tool links to data stored within an Excel file. The tool requires Microsoft Excel 2010 or later.

1.1.3 Third Party Tools

The toolbox uses the ET Geo Wizard application to perform a number of the geoprocessing tasks.

The tool is designed to work with version 10.2 of ET Geowizards and can be bought from http://www.ian-ko.com/. Follow installation instructions from the supplier.

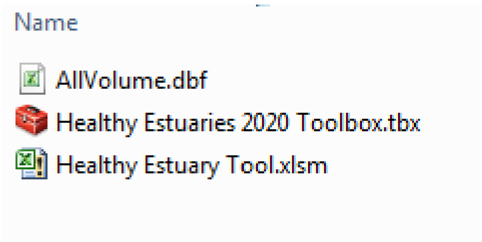
1.2 Data

Name	Description	Format
AIMS (Asset Information Management System)	Man Made Defences	ESRI Shapefile
Bathymetry	Topology of the estuary floor – best resolution available	ESRI Grid or ASCI
LiDAR	Topology of the terrain	ESRI Grid or ASCI
Saltmarsh	Spatial Location of Saltmarsh	ESRI Shapefile
Geology	Layers of geology for analysis. (http://www.bgs.ac.uk/data/services/wms.html)	WMS (web mapping Service) / ESRI Shapefile
Tidal Datum's	Location and level of tidal ranges (Mean High Water Spring tide, Mean High water Neap Tide and mean Low Water Spring Tide.	ESRI Point and Text

2 INSTALLATION

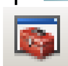
2.1 Files

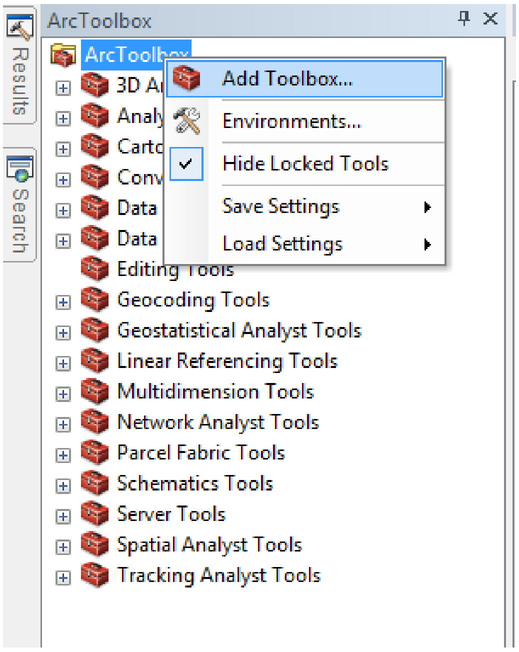
Make a copy of the file below to a folder on your network or local computer e.g. ‘E:\Healthy Estuaries 2020\Humber Estuary’.



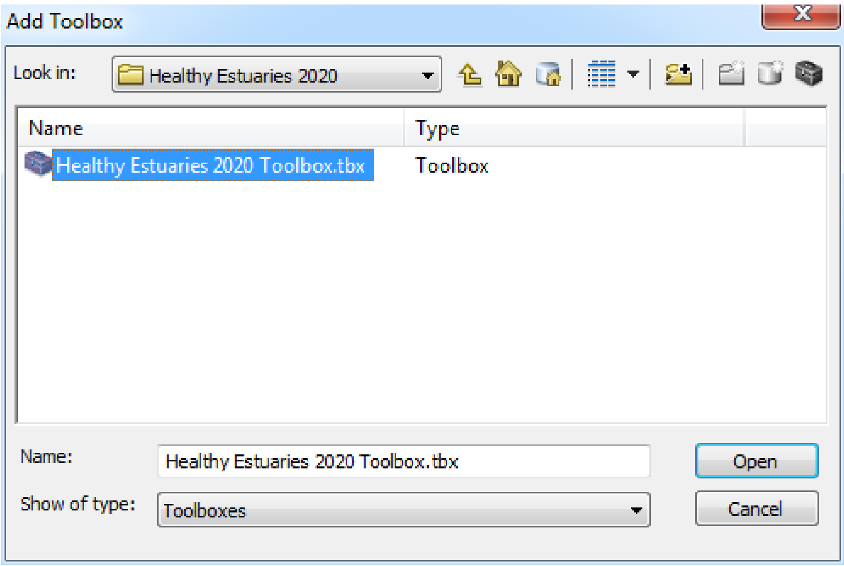
2.2 Toolbox

The HET tool has been developed as an ESRI ArcMap Toolbox to add the HET toolbox to your existing toolboxes

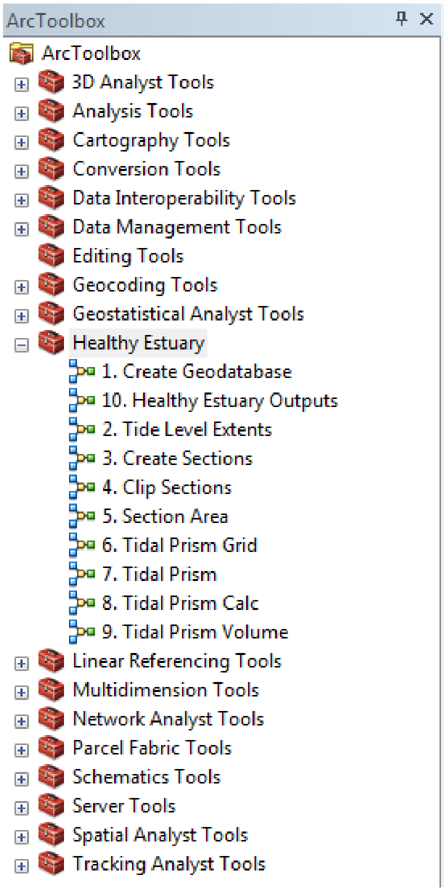
1. Opening ArcMap. 
2. Open Toolbox 
3. Add Toolbox by right clicking on ArcToolbox and selecting Add Toolbox…



4. Navigate to the toolbox location and open.



5. The toolbox should be displayed in the ArcToolbox Directory as Healthy Estuary



3 DATA PREPARATION

3.1 Bathymetry and LiDAR

To undertake the analysis the HET tool requires a topographic surface which incorporates the bathymetric data along with terrain, so those areas with a tidal range that is larger than the bathymetric datasets. The tool does not combine these two datasets so this needs to be undertaken before running the toolbox.

The HET toolbox requires the combined bathymetry and terrain data to be in either an ASCII grid or an ESRI grid format. Bathymetric points can be converted into a grid using ESRI 3D Analyst to create a TIN (Triangulated Irregular Network) and then converted from a TIN to a Grid. See ESRI.com for further help.

The data needs to be to Ordnance Datum and in metres.

4 RUNNING THE TOOLBOX

4.1 Toolbox Usage

The HET toolbox is made up of 10 models; each model requires a user input / data and will output into a central file store and needs to be run in order.

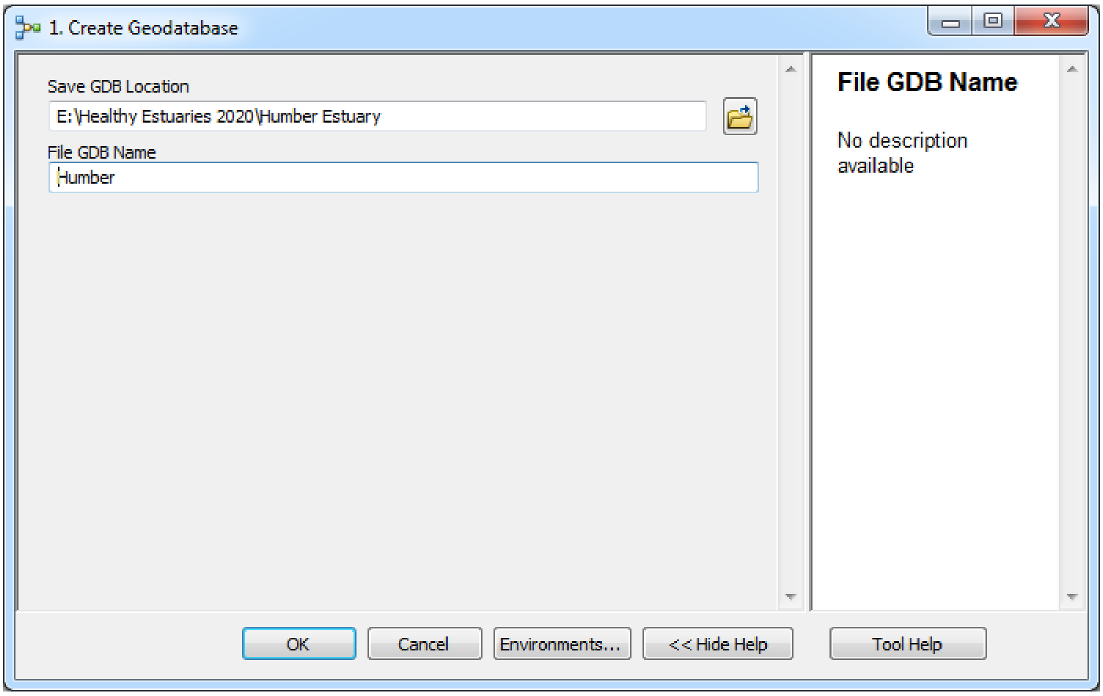
To run the toolbox, double-click the tool within ArcToolbox and select the model which needs to be run.

4.2 Model 1 – Create Geodatabase

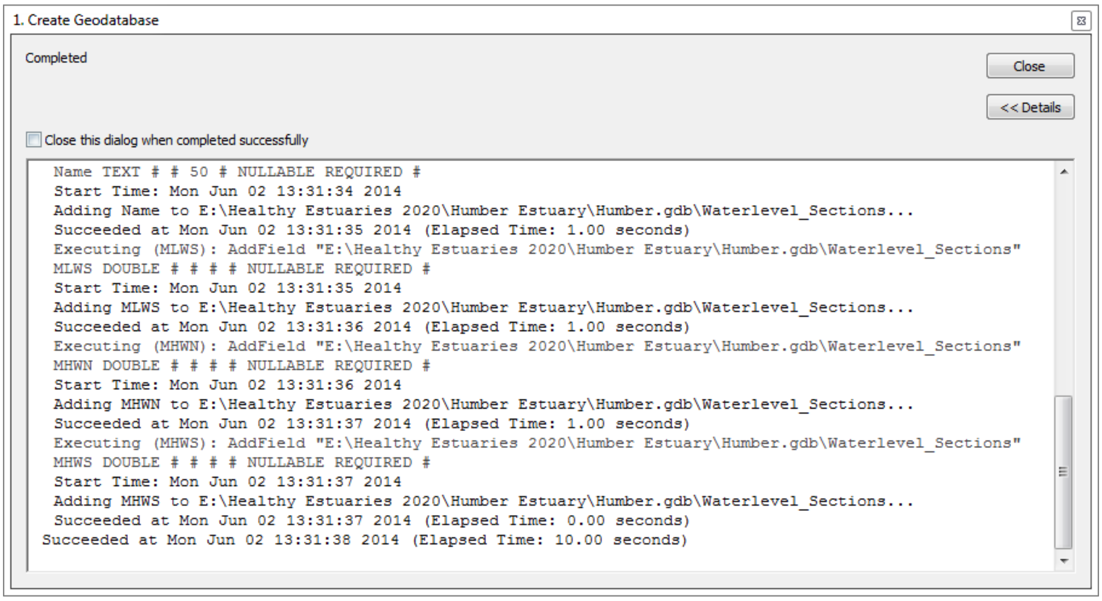
This tool creates a blank ESRI geodatabase in a user selected directory with predefined tables to be used in future models. Use the same directory you stored the toolbox, Excel file and dbf file in. (Section 2.1)

The geodatabase will act as the central storage location for the temporary and final files of the process.

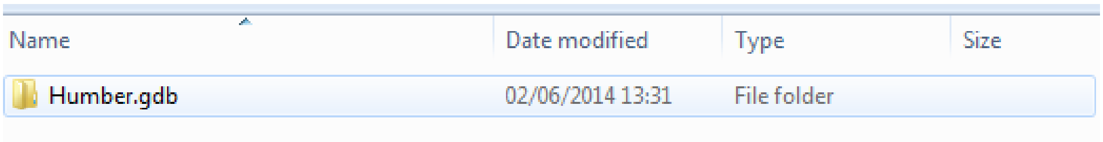
1. Double-click the '1. Create Geodatabase' model.

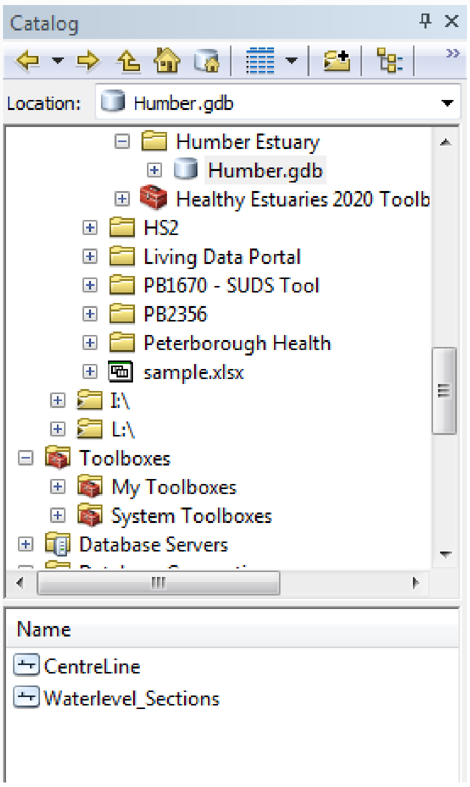


2. Under 'Save GDB Location', enter your selected storage location, e.g. E:\Healthy Estuaries 2020\Humber Estuary.
3. Under 'File GDB Name', enter the name of the geodatabase, e.g. for the Humber Estuary enter Humber.
4. Click OK to run the model.



5. A geodatabase will have been created in the folder selected.
6. To check the tables have been created view the geodatabase in your ArcCatalog window





4.3 Model 2 – Tidal Level Extents

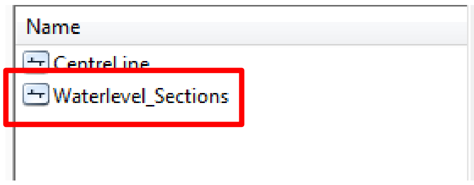
Model 2 creates tidal water level grids of the estuary for:

- Mean High Water Spring Tide;
- Mean High Water Neap Tide; and
- Mean Low Water Spring Tide.

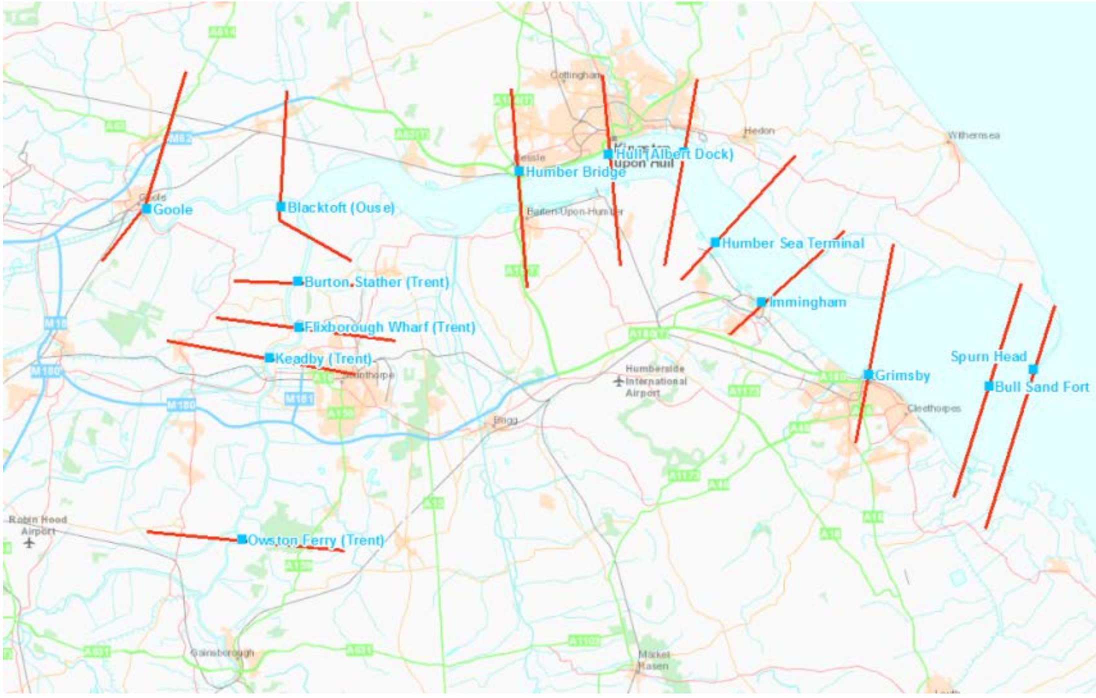
The water level surface grids are used to determine the model extents.

1. Identify the location of the tide gauges within the study area.
2. If required add the locations to the map.

3. Add the Waterlevel_Sections file created from Model 1 into the workspace and start editing.



4. Create lines perpendicular to the watercourse at each of the tidal datum locations (red lines). Note that as locations of convergence the lines need to cross both watercourse (See Blacktoft)
5. Add additional perpendicular lines to the end of the model extent if these extents are not the same as your tidal datum. These lines will be used to produce a TIN of the water levels; as such the arrangements and extents of the lines should cover the entire model.

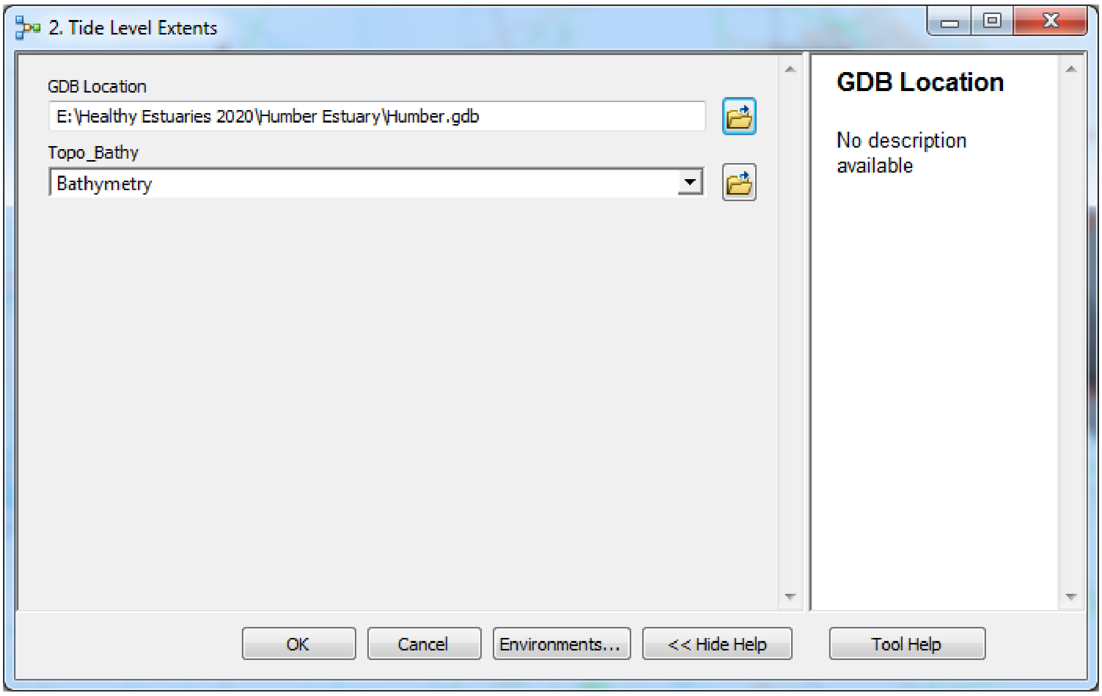


6. Open the attributes of the lines and populate the Name (optional), MLWS, MHWN and MHWS data to mOAD.

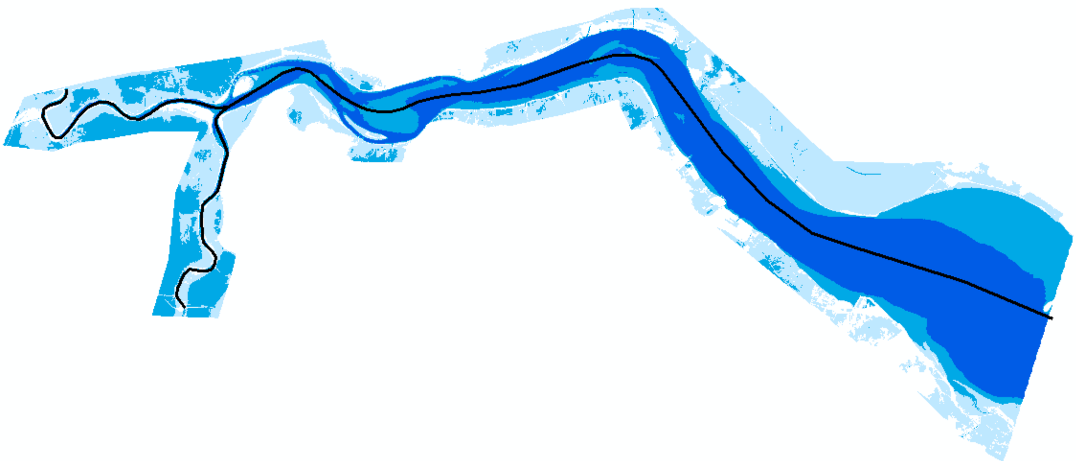
Waterlevel_Sections

OBJECTID *	Shape *	Shape_Length	Name	MLWS	MHWN	MHWS
1	Polyline	17184.178476	Spurn Head	-2.7	1.6	3
2	Polyline	16569.221467	Bull Sand Fort	-2.8	1.6	3
3	Polyline	14903.456902	Grimsby	-2.7	1.7	3.1
4	Polyline	12481.930369	Humber Sea Terminal	-2.8	1.8	3.3
5	Polyline	11430.916378	Immingham	-3	1.9	3.4
6	Polyline	14005.584701	Hull (King George Dock)	-3.2	2.1	3.7
7	Polyline	14128.697357	Hull (Albert Dock)	-3.2	2	3.7
8	Polyline	14698.978958	Humber Bridge	-3	2.1	3.9
9	Polyline	11093.507876	Burton Stather (Trent)	0.7	2.4	4.1
10	Polyline	13268.898392	Flixborough Wharf (Trent)	-0.9	2.3	4.1
11	Polyline	14091.608084	Keadby (Trent)	-0.4	2.6	4.4
12	Polyline	14651.143851	Owston Ferry (Trent)	<Null>	2.4	4.3
13	Polyline	15636.233887	Blacktoft (Ouse)	-1.7	2.5	4.2
14	Polyline	15543.965797	Goole	-1.1	2.3	4.3

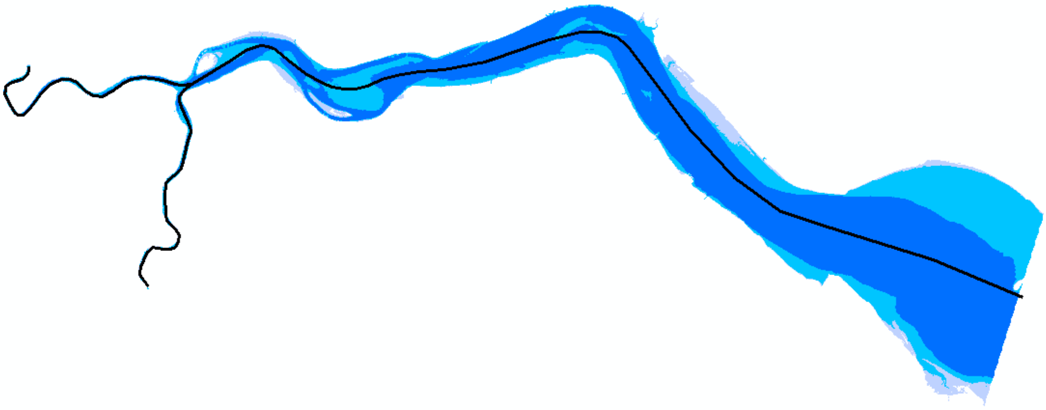
7. Stop editing
8. Double Click ‘2 – Tide Level Extents’ within the toolbox.
9. Add the Geodatabase Location (same as before)
10. Add the Location of your bathymetry grid.
11. Click Ok.



12. The below represents the extents created in the geodatabase as;
- MLWS
- MHWN
- MHWS



13. The tidal extents are typically larger than required, with low lying land from the bathymetry and LiDAR being included. To limit the analysis, the AIMS defence data can be used to clip the polygons.

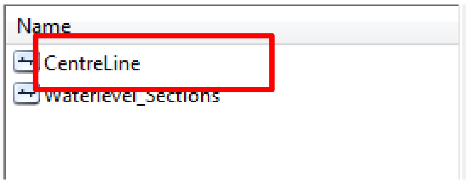


4.4 Model 3 – Create Sections

This stage of the model creates the section lines which are used as part of the tidal prism calculations and the profiles of the estuary.

The automatic process does require user verification as described in Section 4.3 of the main report.

1. Add the Centreline file generated from Model 1 into the map and start editing.

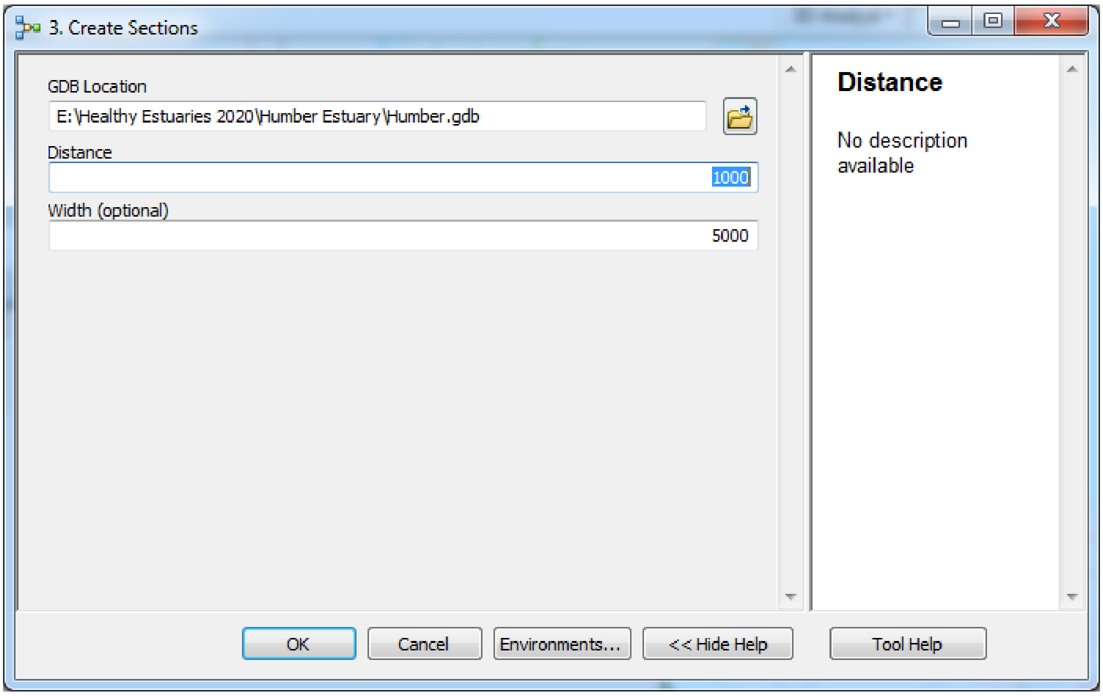


2. Draw the approximate centrelines of the river, starting from the Upstream Extent / Tidal limit down to each confluence.
3. At each confluence draw another centreline down the river to the confluence point and meet the previous line.
4. Do this for all centrelines required for the estuary
5. Attribute up the centrelines in order as in the example below using the Centreline Reference field.

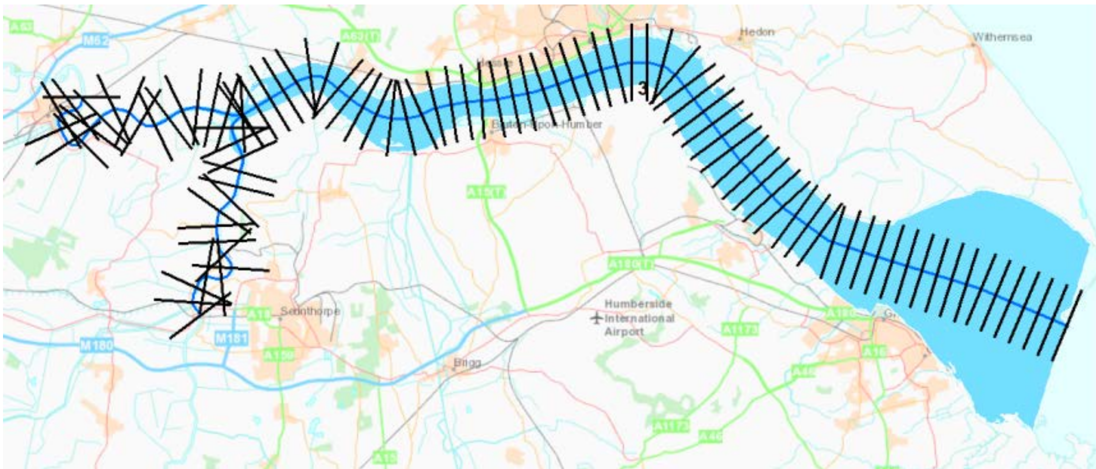
CentreLine

	OBJECTID *	Shape *	Centreline Reference	Shape_Length
▸	1	Polyline	1	17059.489933
	2	Polyline	2	16164.190269
	3	Polyline	3	61170.058734

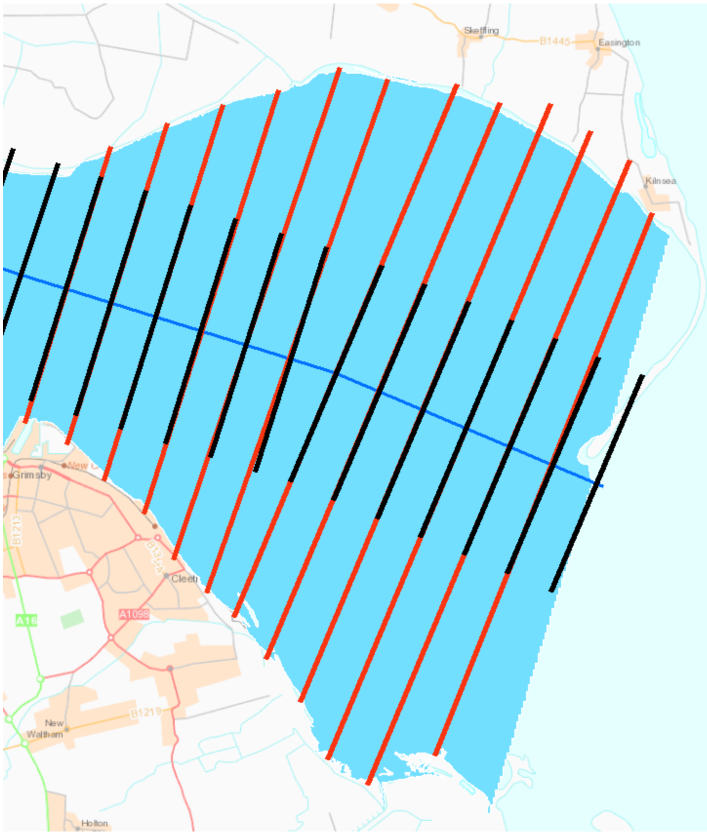
6. Open ‘3 – Create Sections’ and add in the geodatabase location.
7. The tool defaults the distance to 200m and a width of 1000m. These values are for a typical estuary, for the Humber these numbers had to be increased to a distance of 1000m and a width of 5000m. The distance field needs to be a multiple of 100m.



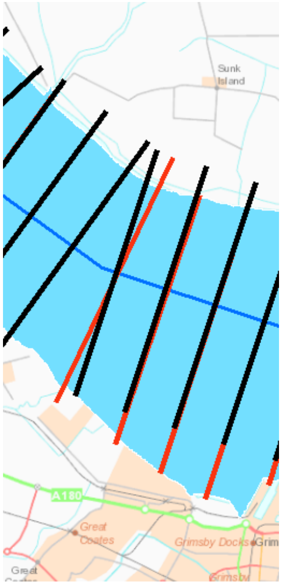
8. Add the resulting ‘Section’ file from the geodatabase to the map and the MHWS polygon.



9. The section lines need to meet a number of criteria. To meet these criteria the section line may require editing. Start editing the ‘Sections’ file.
10. Extend the sections to the width of the MHWS file, ensuring the centre point is not moved. In the example below the black line is the ordinal section line, which has been extended to the make the red line.

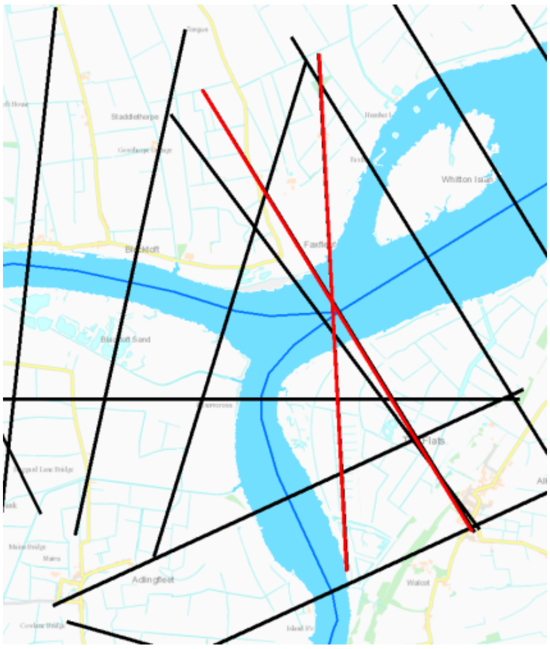


11. Rotate the lines to follow the course of the estuary.

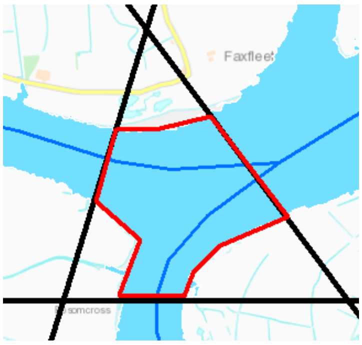


12. Shorten the section lines which cross back onto the estuary; section lines can cross outside the MHWS location

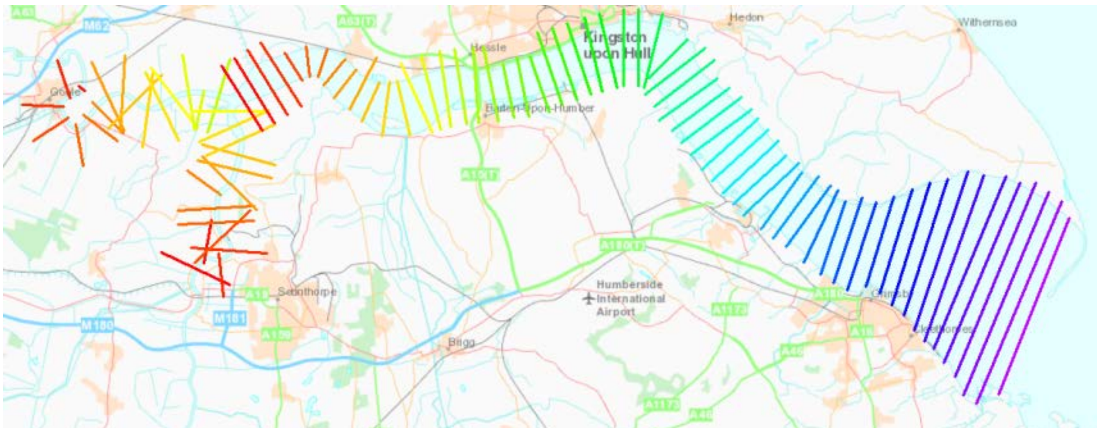
13. Remove all redundant sections or duplicates (red lines).



14. For each confluence a confluence extent will need to be created, this is achieved by removing sections to form an extent similar to the one shown below.



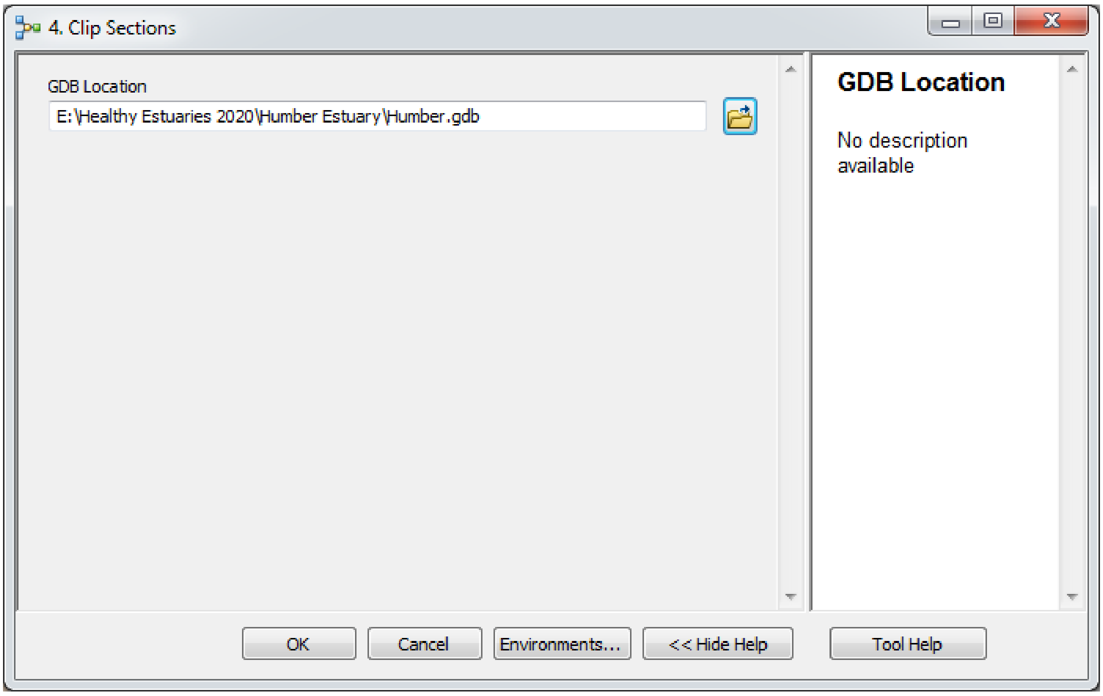
15. Once all edits have been made, review the ‘Number’ field to ensure the order is correct.



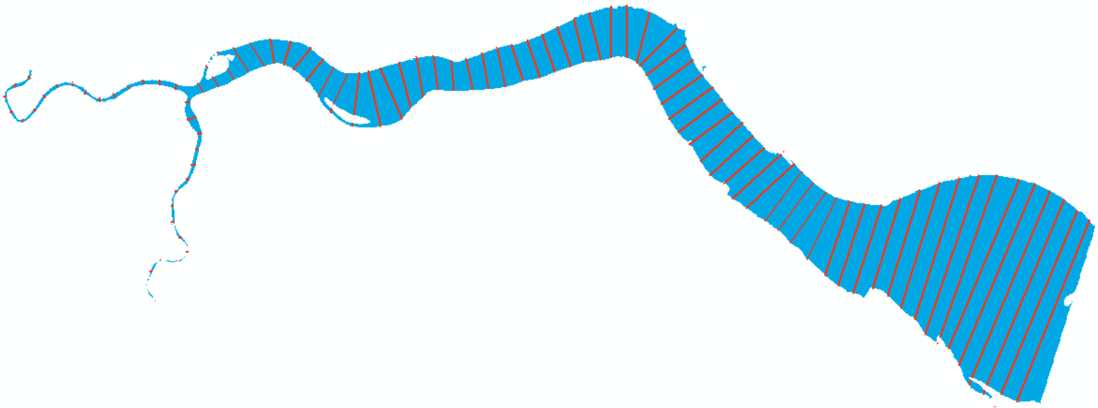
4.5 Model 4 – Clip Sections

This section of the model uses the Sections created from Model 3 and then clips them based on the tidal water levels from model 2. The resulting files are then used to generate the direction of the section, length of the section and the centre point of the section, x and y.

1. Open '4. Clip Section' model from the toolbox and add the geodatabase.
2. Click 'OK'



3. The resulting files are loaded into the geodatabase and the output files are created in the same directory as the geodatabase.



4. The resulting files will be stored in the geodatabase and dbf files stored in the root directory called Section_Widths.dbf, Section_Direction.dbf and Section_Centre_Points.dbf.

Section_Centre_Points

OID	FID_Sectio	REF	Number	Name	Mid_X	Mid_Y
0	7	1	10	1-10	476418.84085	424276.0669
1	8	1	20	1-20	475583.663	423796.6356
2	9	1	30	1-30	474995.5	423109.53255
3	10	1	40	1-40	475355	422201.72505
4	11	1	50	1-50	476060.57715	421646.6356
5	12	1	60	1-60	476775.4315	422313.5156
6	13	1	70	1-70	477356.5	423126.26535
7	14	1	80	1-80	478131.28085	423751.1356
8	15	1	90	1-90	479084.272045	423869.963
9	16	1	100	1-100	479891.5	423386.2367

Section_Direction

OID	CompassA	Name
0	309.225677	1-10
1	225	1-100
2	187.125419	1-110
3	154.334337	1-120
4	142.623157	1-130
5	170.535481	1-140
6	192.057871	1-150
7	197.10174	1-160
8	341.38835	1-20
9	271.909512	1-30
10	237.308388	1-40
11	170.056239	1-50
12	126.359978	1-60
13	135.012253	1-70
14	154.722203	1-80
15	183.012967	1-90

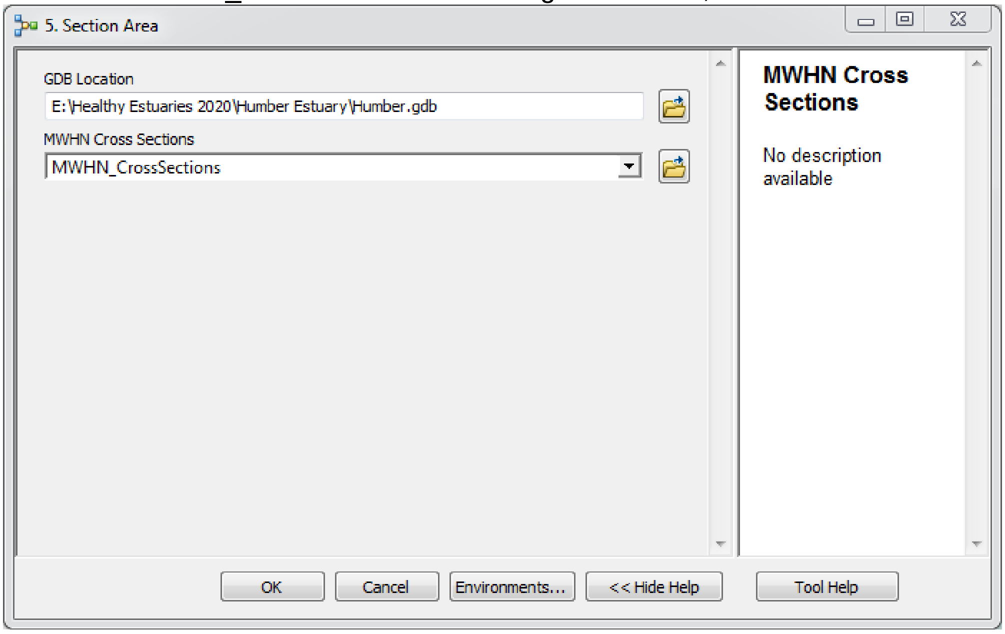
Section_Widths

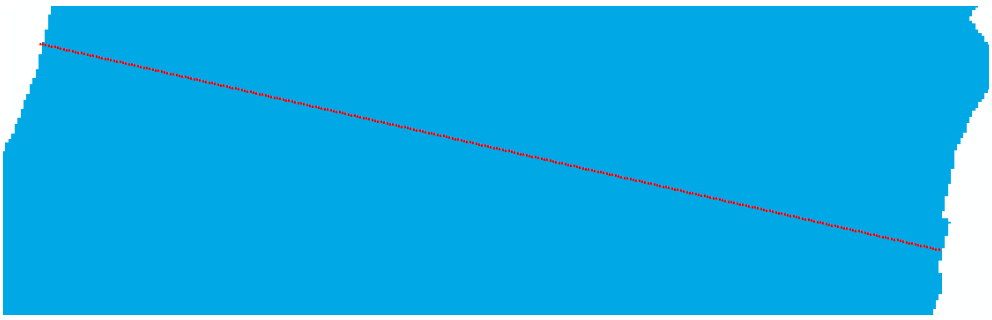
OID	Name	FREQUENCY	SUM_X_Widt
0	1-10	1	212.11635
1	1-100	1	255.972655
2	1-110	1	253.961342
3	1-120	1	367.232336
4	1-130	1	288.046195
5	1-140	1	317.319473
6	1-150	1	320.061483
7	1-160	1	377.700367
8	1-20	1	260.630029
9	1-30	1	207.115011
10	1-40	1	216.257357
11	1-50	1	202.035026
12	1-60	1	234.862901
13	1-70	1	239.053221
14	1-80	1	283.108147
15	1-90	2	248.343293

4.6 Model 5 – Section Area

Model 5 calculates the depth at every metre along the sections using the bathymetry grid. The resulting files are then used to create area sections.

1. Open '5. Section Area' model from the toolbox and add the geodatabase location.
2. Select the MWHN_CrossSections from the geodatabase, click 'Ok'.





Point at every metre along the MHWS Cross Section Line

3. The resulting files will be stored in the geodatabase and a dbf file called Section_Values.dbf will be created in the root directory.

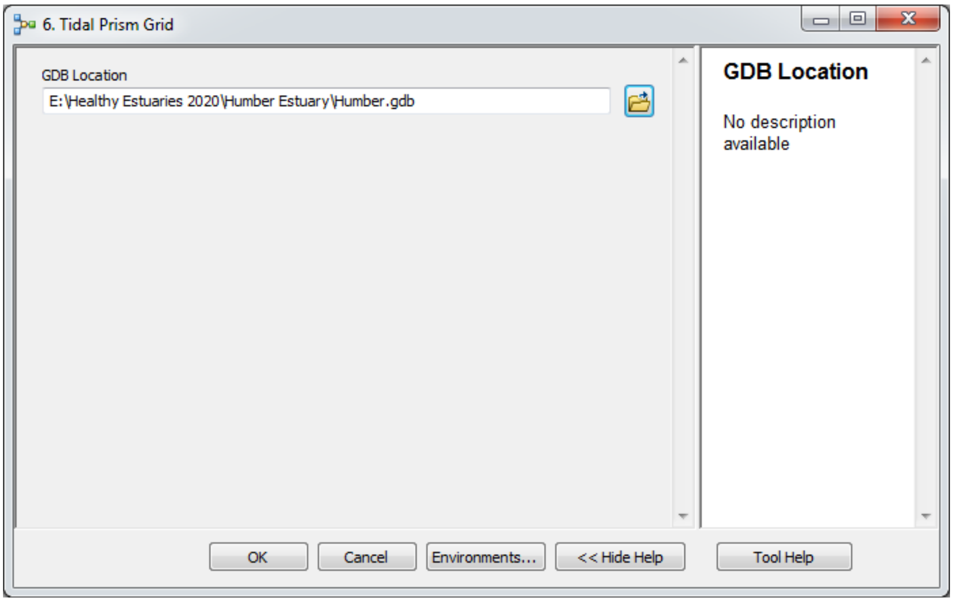
Section_Values

OID	Unique_Ref	FREQUENCY	FIRST_Star	FIRST_St_1	FIRST_End_	FIRST_End1	MEAN_Calc_	SUM_Calc_D	COUNT_Uniq
0	1-10	212	476501	424208.9982	476336.6817	424343.1356	3.977774	843.288064	212
1	1-100	255	479982	423476.7367	479801	423295.7367	3.187193	812.734208	255
2	1-110	254	480752.4314	423024.1356	480720.9296	422772.1356	4.86773	1236.403302	254
3	1-120	368	481570.5191	423320.1356	481729.5744	422989.1356	3.388725	1247.050808	368
4	1-130	288	482393	423802.0344	482567.8598	423573.1356	3.91977	1128.893715	288
5	1-140	318	483398.6567	424142.1356	483450.8357	423829.1356	5.281639	1679.561277	318
6	1-150	320	484428.8562	424122.1356	484361.9955	423809.1356	5.245123	1678.439445	320
7	1-160	378	485431.9665	423920.1356	485320.8964	423559.1356	5.06864	1915.94595	378
8	1-20	260	475625.2533	423673.1356	475542.0727	423920.1356	3.084237	801.901722	260
9	1-30	207	475099	423106.0819	474892	423112.9832	4.619624	956.262176	207
10	1-40	216	475446	422260.1272	475264	422143.3229	4.249562	917.905297	216
11	1-50	202	476043.1333	421746.1356	476078.021	421547.1356	5.660237	1143.367955	202
12	1-60	235	476680.863	422383.1356	476870	422243.8956	4.394911	1032.803995	235
13	1-70	230	477272	423210.8015	477441	423041.7292	3.539535	814.092988	230
14	1-80	284	478070.8362	423879.1356	478191.7255	423623.1356	4.996001	1418.86415	284
15	1-90	250	479091.7026	424011.1356	479088.0708	423942.1356	4.02438	1006.094998	250

4.7 Model 6 – Tidal Prism Grid

Model 6 generates the tidal prism grid; this is a merge between MLWS and the bathymetric data.

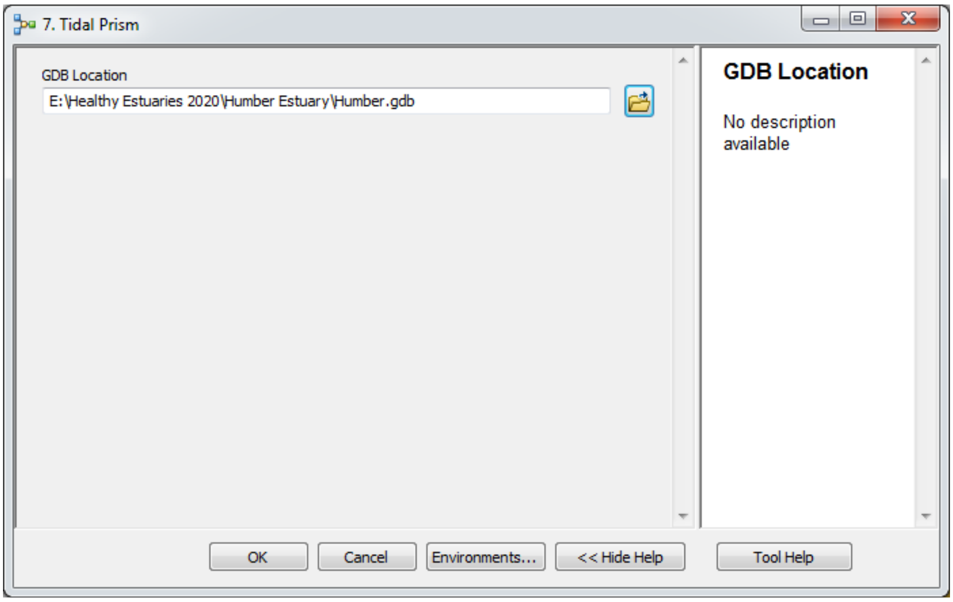
1. Open Model '6. Tidal Prism Grid' from the toolbox.
2. Add the geodatabase name, the rest of the files required will be generated from the previous model outputs.



4.8 Model 7 – Tidal Prism

This stage of the model uses the tidal prism grid created in Model 6 and the section lines produced as part of Model 4 to create the tidal prism polygons.

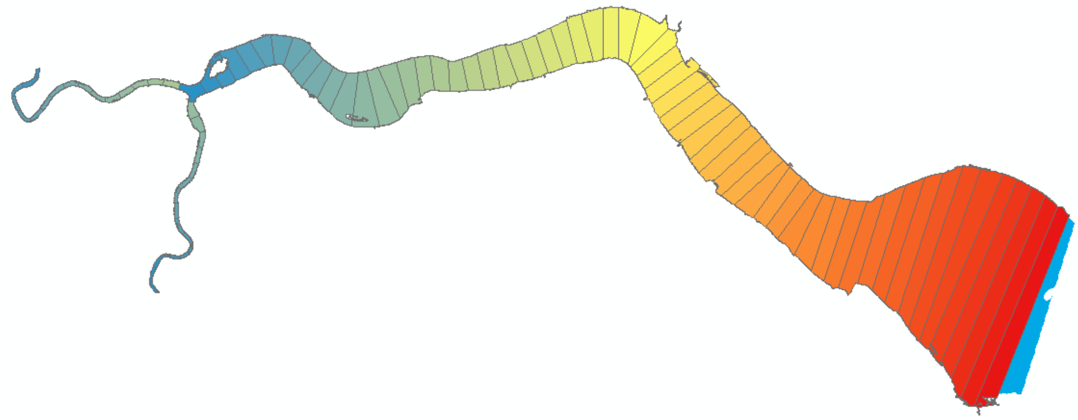
1. Open Model 7 from the toolbox and add the geodatabase path. All other files will be used from previous model outputs.



4.9 Model 8 – Tidal Prism Calc

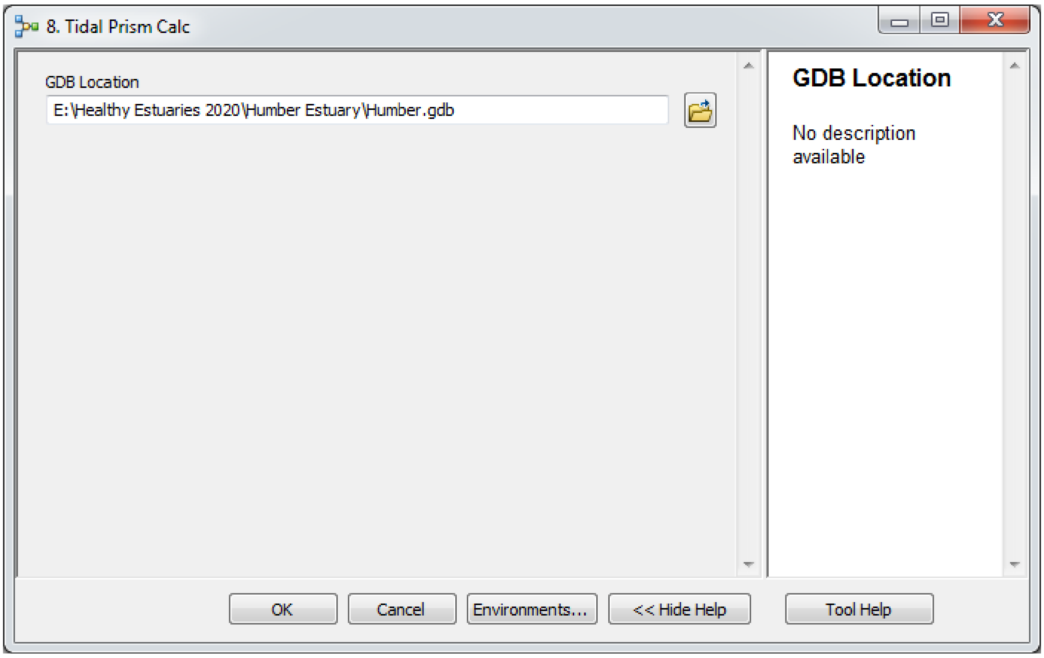
Model ‘ 8. Tidal Prism Calc’ uses the MHWS and the section lines to produce polygons to clip the tidal grid into individual files for each section extent.

1. Open Model 8 from the toolbox and add the geodatabase path. All other files will be used from previous model outputs.



Tidal_Polygon layer coloured on the Section Number.

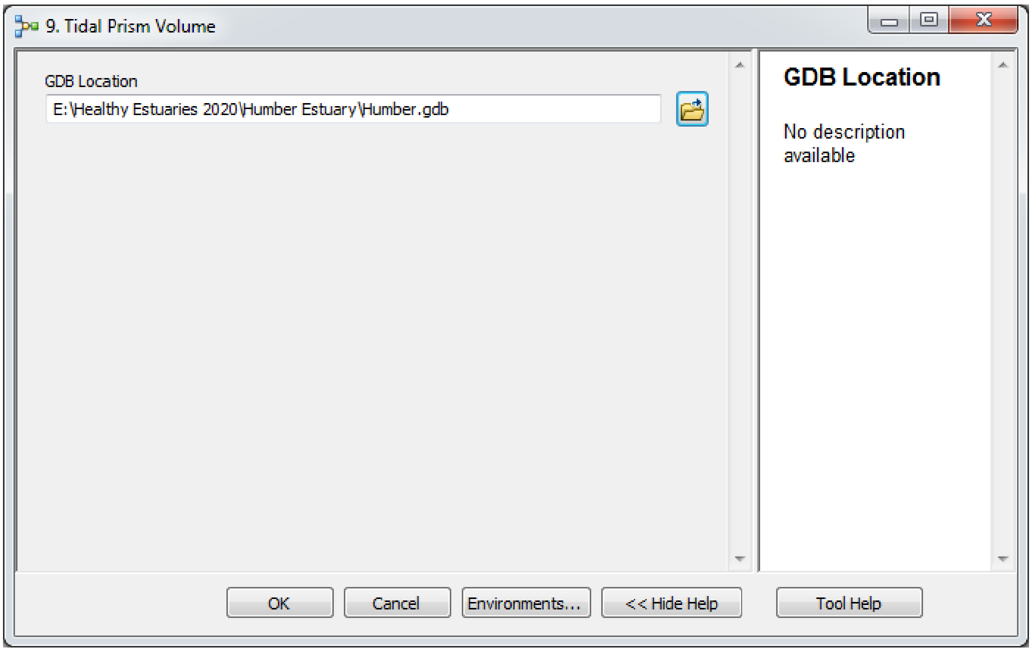
2. Use ‘Tidal_polygon’ file to review that each section has created a unique polygon for each location. If required clip and rename the appropriate polygons to the downstream section.



4.10 Model 9 – Tidal Prism Volume

Model 9 uses the individual grids produced from Model 8 to calculate the tidal prism volume. The results are added to the AllVolumes.dbf file located in the route directory.

1. Check that template AllVolumes.dbf file is empty by reviewing the file in ArcCatalog.
2. Open Model '9. Tidal Prism Volume' in the toolbox and add the geodatabase location. All additional files have already been created.



Example of AllVolumes.dbf

AllVolume

OID	FREQUENCY	SUM_VOLUME	D_Name
0	4	-527502.839661	tp_1_10
1	4	-1193108.50229	tp_1_100
2	4	-1080793.8946	tp_1_110
3	16	-1324779.42827	tp_1_120
4	3	-1502652.74727	tp_1_130
5	2	-1645953.67644	tp_1_140
6	9	-1733022.52639	tp_1_150
7	3	-2073272.34863	tp_1_160
8	2	-1224998.4056	tp_1_20
9	3	-1034419.12971	tp_1_30
10	3	-1015143.81567	tp_1_40
11	1	-962738.25	tp_1_50
12	1	-1052659.125	tp_1_60
13	3	-1246210.14956	tp_1_70
14	18	-1388718.87422	tp_1_80
15	7	-1272586.87871	tp_1_90
16	15	-398917.134086	tp_2_0
17	18	-561350.16225	tp_2_10
18	2	-1411871.58771	tp_2_100
19	9	-1517986.85406	tp_2_110
20	12	-2594762.05375	tp_2_120
21	1	-2818057.75	tp_2_130

5 RUNNING THE EXCEL TOOL

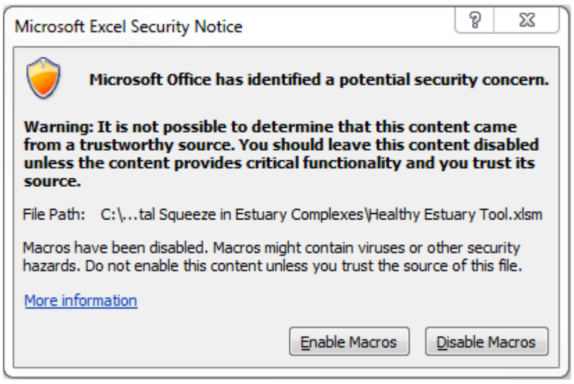
5.1 Excel Tool Usage

The Excel Tool is a Microsoft Excel 2010 macro-enabled workbook that uses the output files from the HET tool to calculate the predicted equilibrium depths and widths for each section within the estuary.

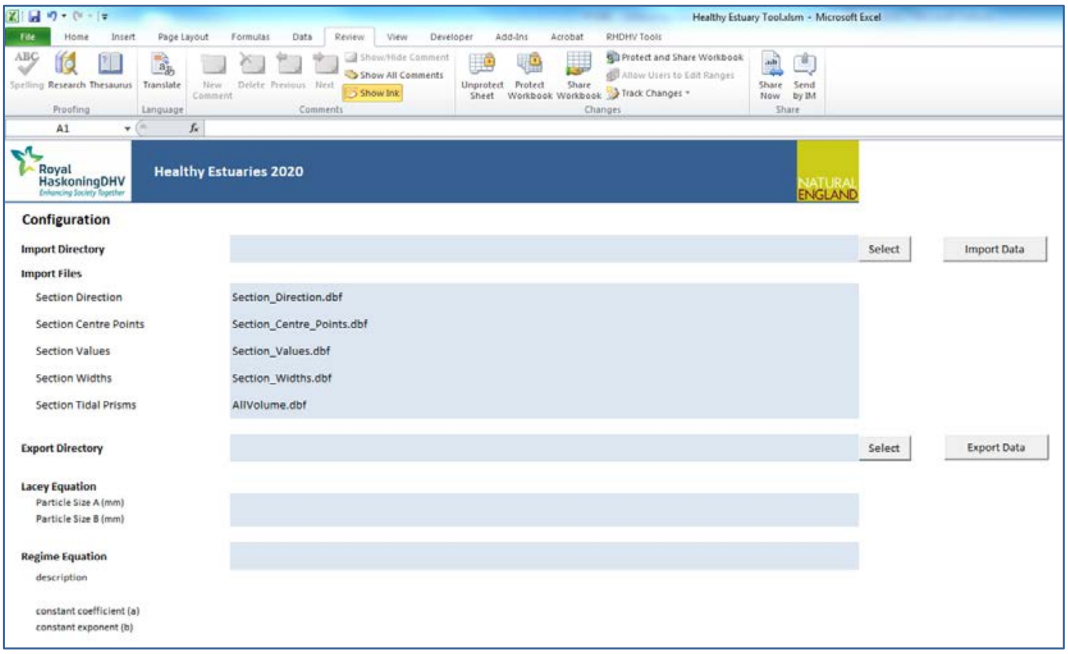
The Excel tool outputs this data as text files which are then visualised within ArcMAP.

To run the toolbox, double-click the tool, 'Healthy Estuary Tool.xlsm' located in the directory created in Section 2.1 (e.g., 'E:\Healthy Estuaries 2020\Humber Estuary'), from within Windows Explorer.

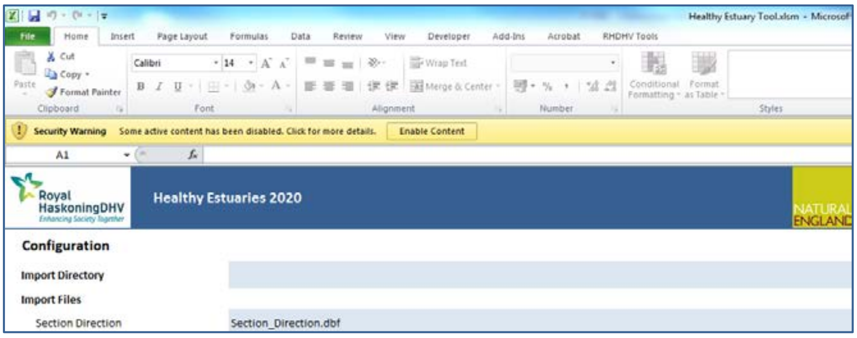
When opening the Excel tool for the first time the following message may appear.



This is normal for Excel workbooks containing macros, so click 'Enable Macros' and the tool will open to display the configuration page.



When the Excel tool is opened on subsequent occasions a yellow 'Security Warning' bar may appear at the top of the screen.



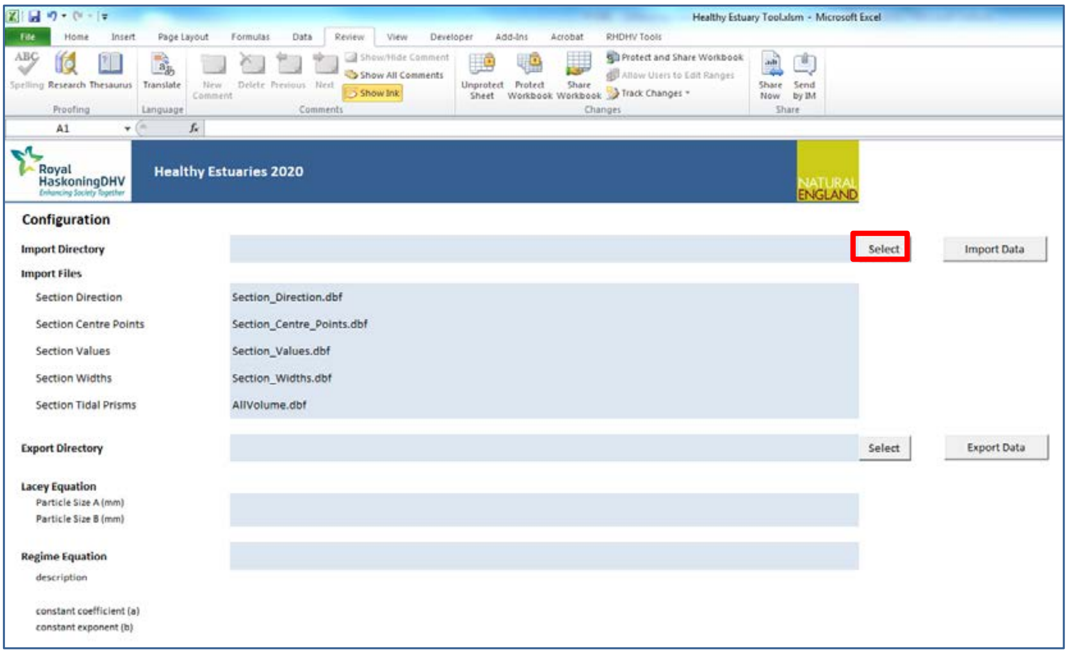
Again, this is normal for Excel workbooks containing macros, so click 'Enable Content'.

5.2 Configuration Tab

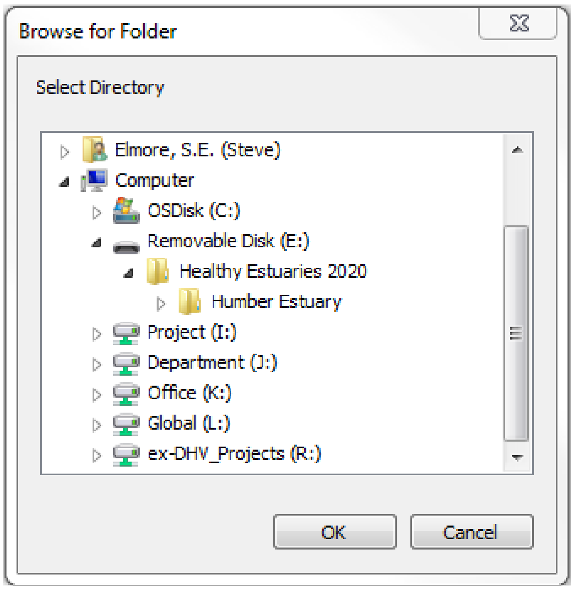
The Excel tool needs to be configured before being used so that it knows the locations to use for the import and export files and also what parameters to use in the Lacey and Regime equations.

5.2.1 Import Directory

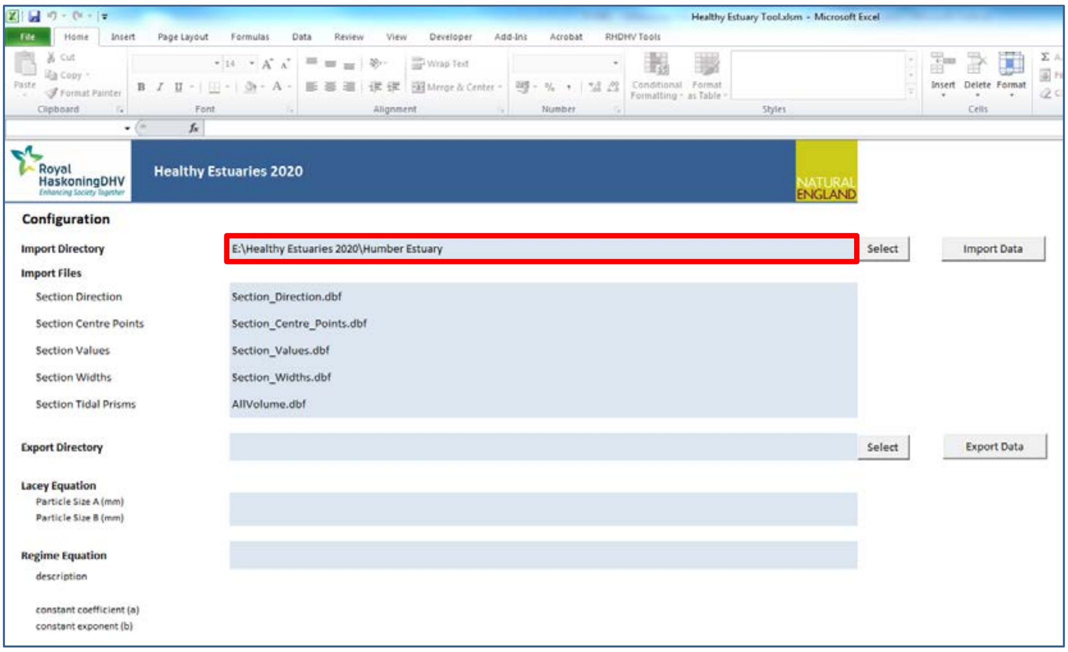
The import directory is the location of the output files from the HET tool. To add the location click the 'Select' button next to the Import Directory field on the configuration tab.



The following 'Browse for Folder' window will appear. Navigate to the required directory, click on it and then click 'OK'.



The path to the selected directory will appear in the Import directory field.

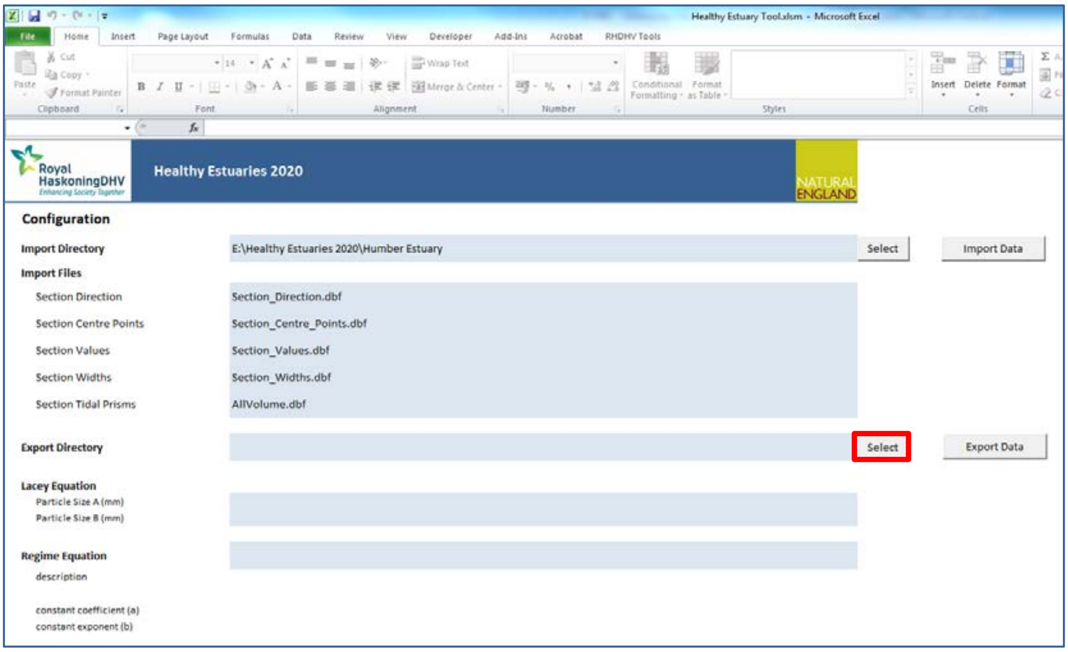


5.2.2 Import Files

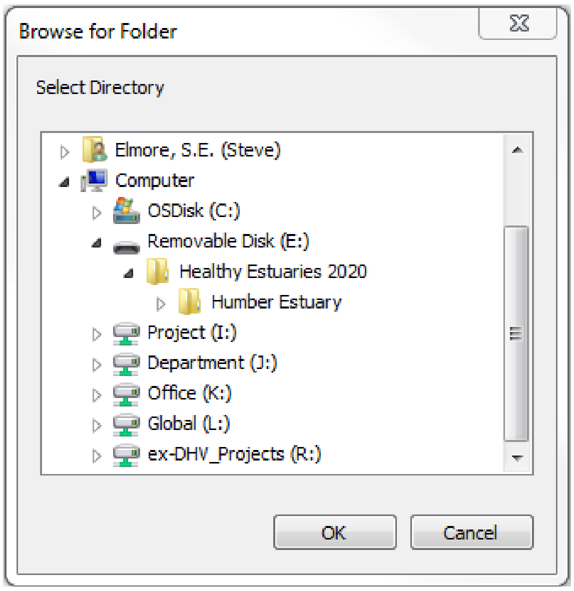
The import Files section is pre-populated with the default filenames created by the HET tool. These will only need to be modified if the output files from the HET tool change.

5.2.3 Export Directory

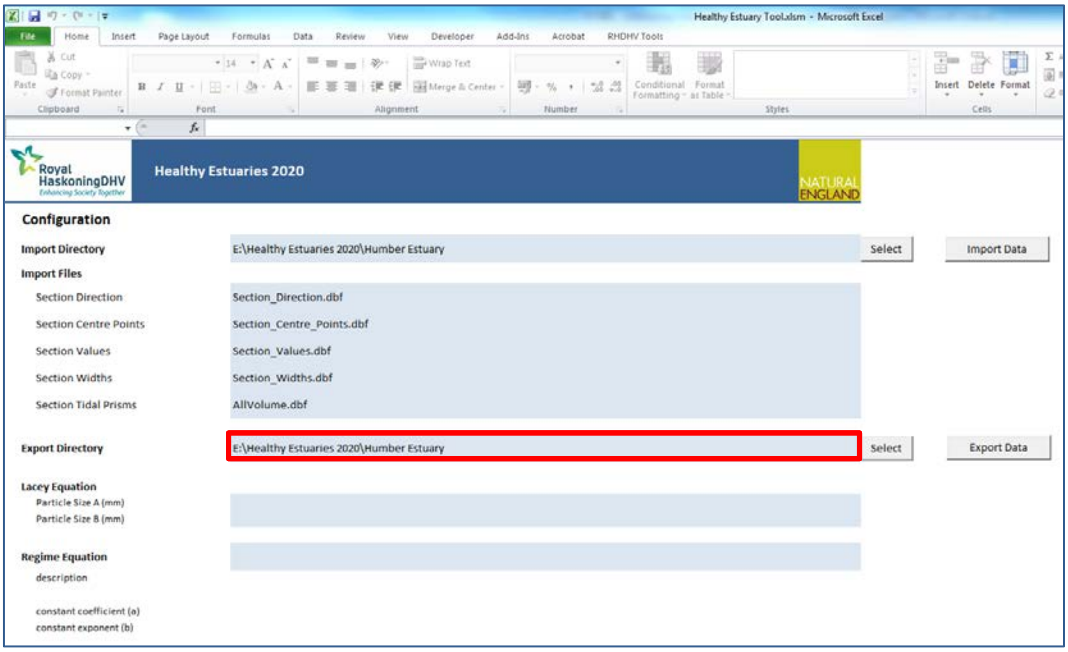
The export directory is the location for the output files from the Excel tool. To add the location click the ‘Select’ button next to the Export Directory field on the configuration tab.



The following ‘Browse for Folder’ window will appear. Navigate to the required directory, click on it and then click ‘OK’.



The path to the selected directory will appear in the Export directory field.



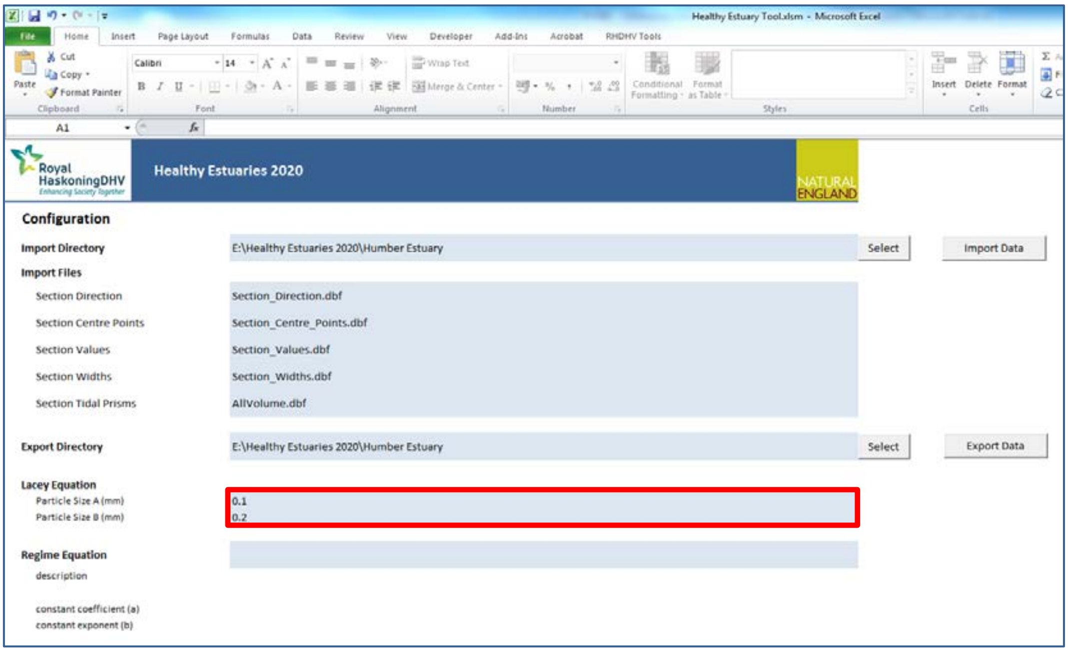
5.2.4 Lacey Equation

The Excel tool calculates three different predicted equilibrium channels. Two are based on the Lacey equation and one is based on the ‘Constant Evolution’ relationship.

This section of the Configuration tab allows two sediment particle sizes to be entered that are then used to calculate the two predicted equilibrium channels based on the Lacey equation.

The two values should be at either end of the expected particle size distribution for the estuary so that when visualised within ArcMAP the channels will show the expected range in channel width dependent of the particle size.

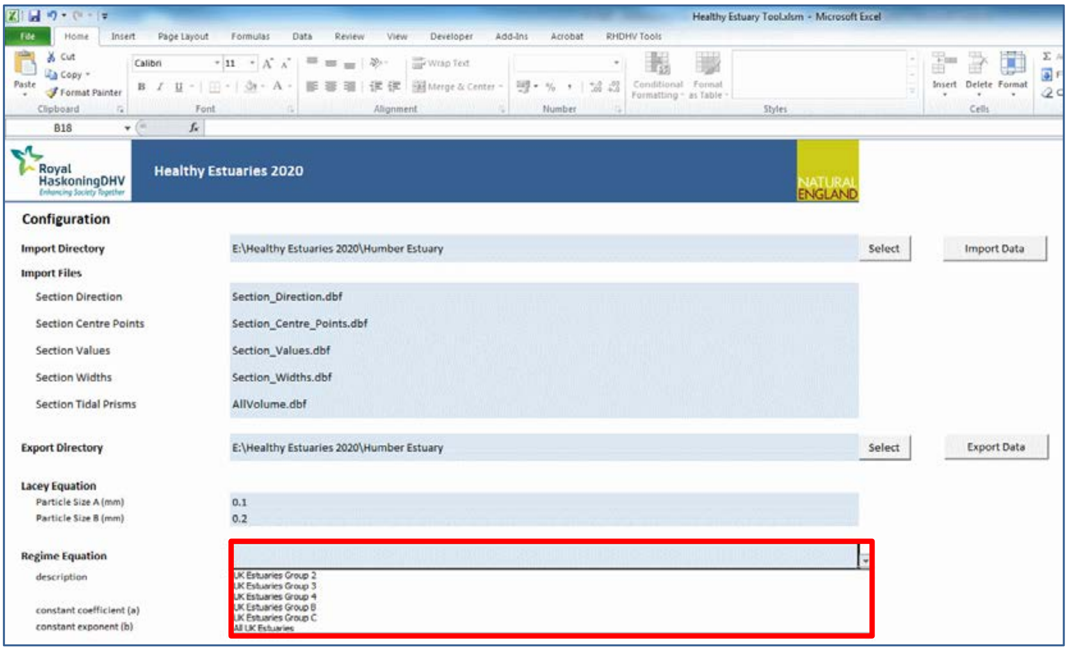
To enter a particle size, type the value in millimetres into the relevant particle size field.



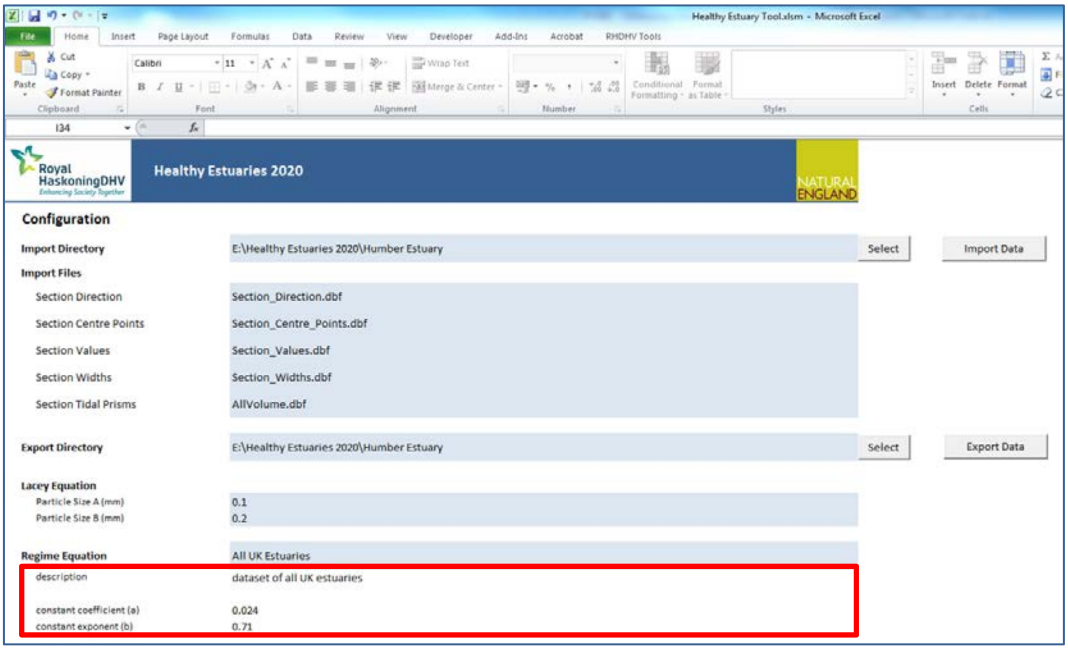
5.2.5 Regime Equation

The Regime equation is used within the Excel tool to calculate the cross-sectional area of the channels at each section. The parameters used in this equation vary depending on which estuary type, or estuary group, the estuary being looked at is put into.

To select the type of estuary, or estuary group, click the drop-down arrow at the right of the Regime Equation field.



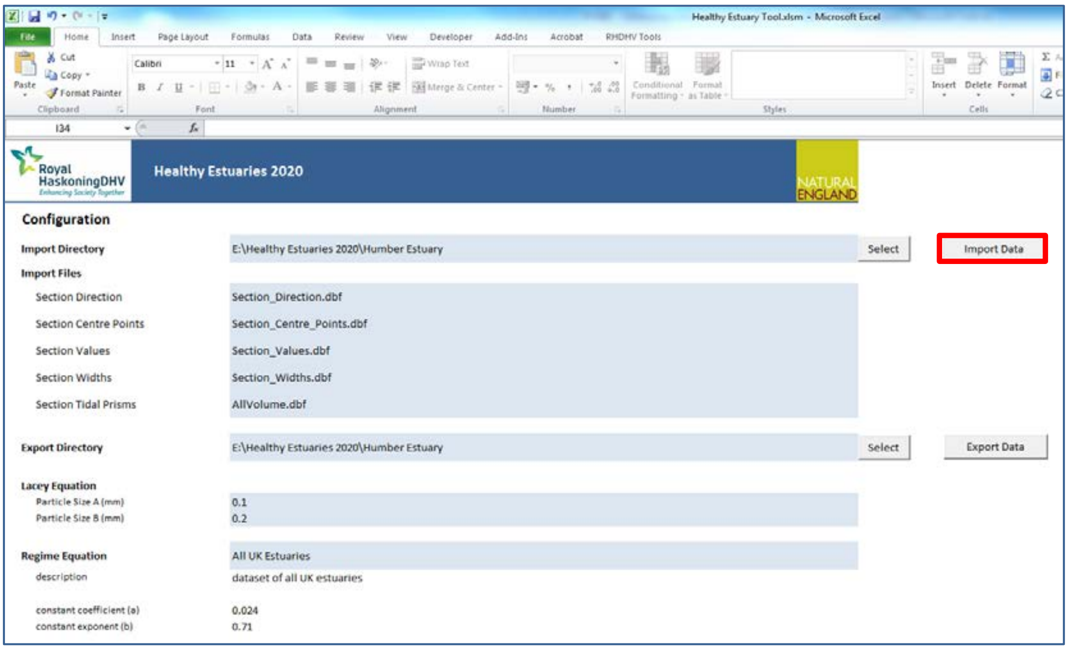
Once a selection has been made the parameters that will be used within the Regime Equation are displayed below the field.



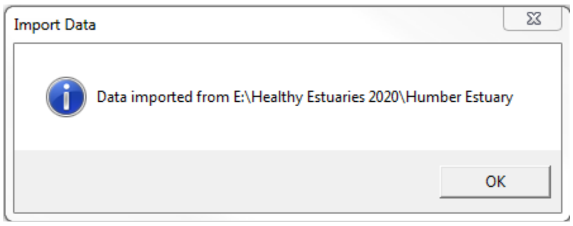
5.3 Import HET Tool Outputs

Once the configuration information has been entered the outputs from the HET tool can be imported.

To start the import process click the ‘Import Data’ button to the right of the ‘Import Directory’ field.



A window will appear once the import process has completed.

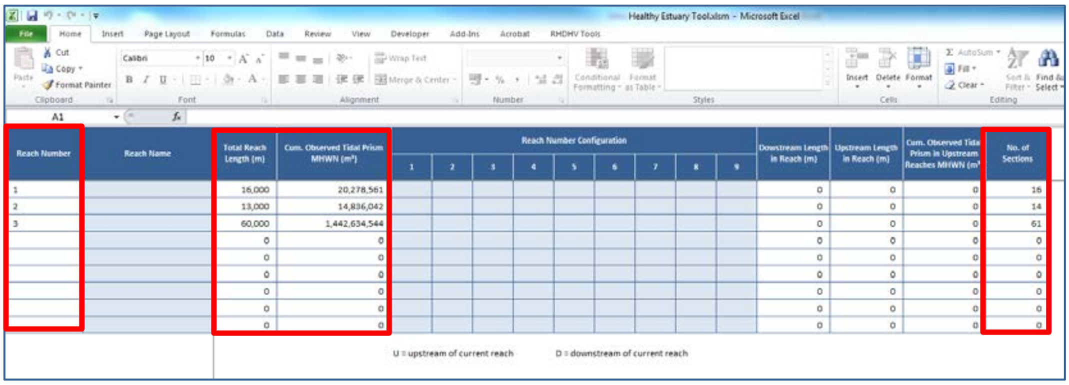


Click ‘OK’.

5.4 Reaches Tab

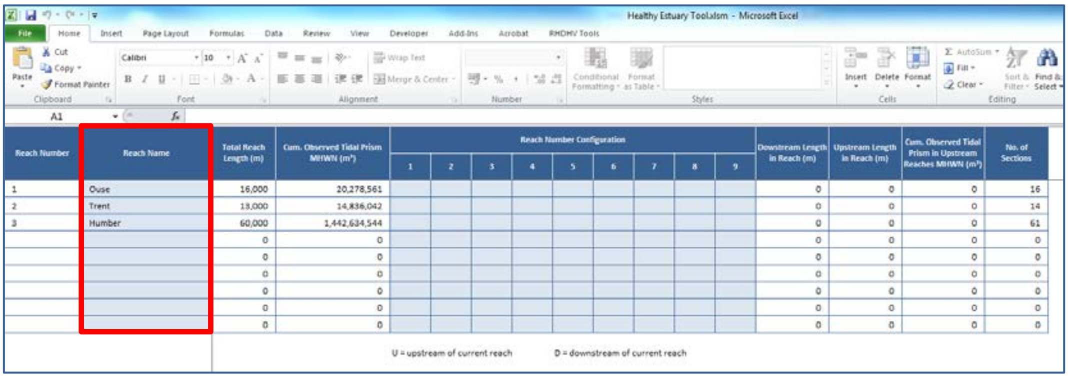
The Reaches tab displays each reach along with some summary information. This tab is locked and read only apart from the user input cells highlighted in light blue.

The reach numbers are automatically populated during the import process which enables the total reach length, cumulative observed tidal prism at MHWN and number of sections to be looked up from the imported data.



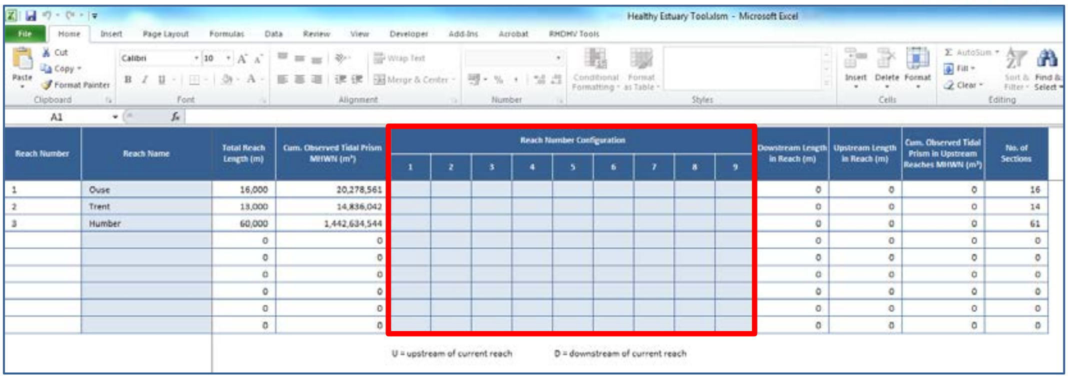
5.4.1 Reach Name

The reach name should be entered so the separate reaches can be easily identified.



5.4.2 Reach Number Configuration

The reach number configuration information should also be entered. This is used within the Excel tool to relate the reaches to each other. Once this information has been entered for each reach the tool knows which other reaches are upstream of downstream of it.



Reach Number	Reach Name	Total Reach Length (m)	Cum. Observed Tidal Prism MHWN (m³)	Reach Number Configuration 1	2	3	4	5	6	7	8	9	Downstream Length in Reach (m)	Upstream Length in Reach (m)	Cum. Observed Tidal Prism in Upstream Reaches MHWN (m³)	No. of Sections
1	Ouse	16,000	20,278,561										0	0	0	16
2	Trent	13,000	14,836,042										0	0	0	14
3	Humber	60,000	1,442,634,544										0	0	0	61
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0

U = upstream of current reach   D = downstream of current reach

This section is configured by entering D (downstream of the current reach) or U (upstream of the current reach) into the relevant fields.

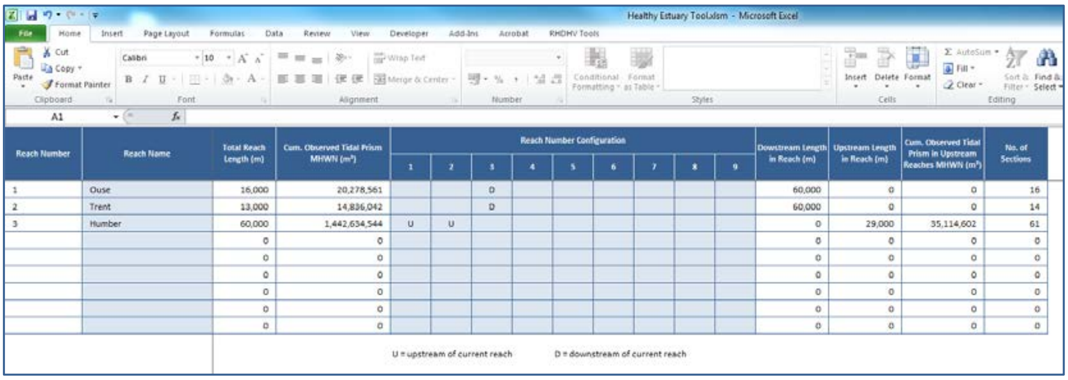
Reach Number	Reach Name	Total Reach Length (m)	Cum. Observed Tidal Prism MHWN (m³)	1	2	3
1	Ouse	16,000	20,278,561			D
2	Trent	13,000	14,836,042			D
3	Humber	60,000	1,442,634,544	U	U	
		0	0			
		0	0			
		0	0			
		0	0			
		0	0			
		0	0			

3 is downstream of 1

3 is downstream of 2

1 & 2 are upstream of 3

Once this section has been configured the downstream length, upstream length and cumulative observed tidal prism in upstream reaches is automatically populated.



Reach Number	Reach Name	Total Reach Length (m)	Cum. Observed Tidal Prism MHWN (m³)	Reach Number Configuration 1	2	3	4	5	6	7	8	9	Downstream Length in Reach (m)	Upstream Length in Reach (m)	Cum. Observed Tidal Prism in Upstream Reaches MHWN (m³)	No. of Sections
1	Ouse	16,000	20,278,561			D							60,000	0	0	16
2	Trent	13,000	14,836,042			D							60,000	0	0	14
3	Humber	60,000	1,442,634,544	U	U								0	29,000	35,114,602	61
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0
		0	0										0	0	0	0

U = upstream of current reach   D = downstream of current reach

5.5 Sections Tab

The Sections tab displays the details of each section. This tab is locked and read only.

The section references are automatically populated by the import process.

Section Reference	Reach Number	Section Number	Reach Name	Total Reach Length (m)	Upstream Length in Reach (m)	Downstream Length in Reach (m)	Section Angle to RB	Section Centre Point (X)	Section Centre Point (Y)
1-10	1	10	Ouse	16,000	1,000	15,000	309	476418.84085	424276.06690
1-20	1	20	Ouse	16,000	2,000	14,000	341	475583.66300	423796.63560
1-30	1	30	Ouse	16,000	3,000	13,000	272	474995.50000	423109.53255
1-40	1	40	Ouse	16,000	4,000	12,000	237	475355.00000	422201.72505
1-50	1	50	Ouse	16,000	5,000	11,000	170	476060.57715	421646.63560
1-60	1	60	Ouse	16,000	6,000	10,000	126	476775.43150	422313.51560
1-70	1	70	Ouse	16,000	7,000	9,000	135	477356.50000	423126.26535
1-80	1	80	Ouse	16,000	8,000	8,000	155	478131.28085	423751.13560
1-90	1	90	Ouse	16,000	9,000	7,000	183	479084.27205	423869.96300
1-100	1	100	Ouse	16,000	10,000	6,000	225	479891.50000	423386.23670
1-110	1	110	Ouse	16,000	11,000	5,000	187	480736.68050	422898.13560
1-120	1	120	Ouse	16,000	12,000	4,000	154	481650.04675	423154.63560

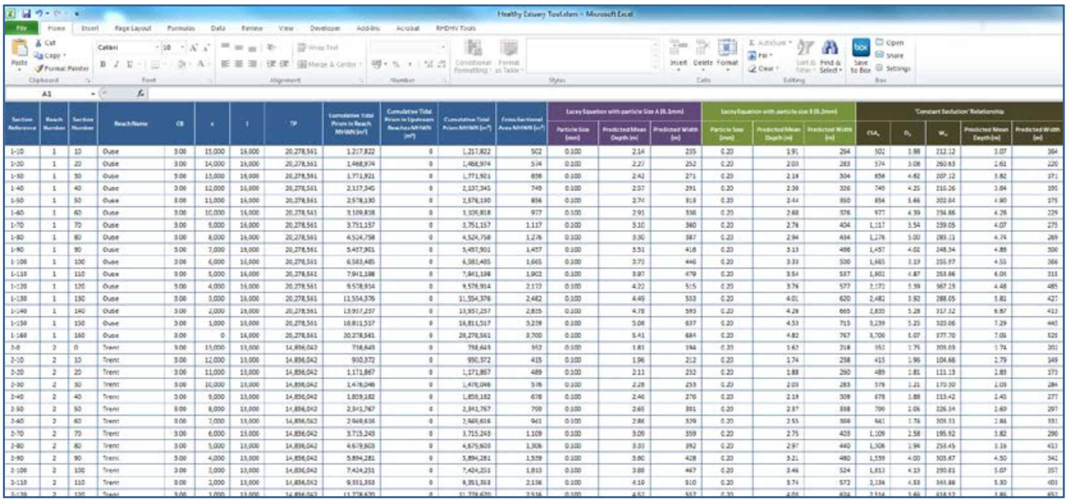
5.6 Observed Tab

The Observed tab displays each section along with the observed data. This tab is locked and read only.

Section Reference	Reach Number	Section Number	Reach Name	Observed Tidal Prism at Section MHWN (m³)	Cum. Observed Upstream Tidal Prism in Reach MHWN (m³)	Cum. Observed Tidal Prism in Upstream Reaches MHWN (m³)	Cum. Observed Tidal Prism MHWN (m³)	Observed Cross-Sectional Area MHWN (m²)	Observed Width MHWN (m)	Observed Mean Depth MHWN (m)	Observed Mean Depth to Width Ratio MHWN
1-10	1	10	Ouse	527,503	0	0	527,503	843	212	3.98	53.33
1-20	1	20	Ouse	1,224,998	527,503	0	1,752,501	802	261	3.08	84.50
1-30	1	30	Ouse	1,034,419	1,752,501	0	2,786,920	956	207	4.62	44.83
1-40	1	40	Ouse	1,015,144	2,786,920	0	3,802,064	918	216	4.25	50.89
1-50	1	50	Ouse	962,738	3,802,064	0	4,764,802	1,143	202	5.66	35.69
1-60	1	60	Ouse	1,052,659	4,764,802	0	5,817,462	1,033	235	4.39	53.44
1-70	1	70	Ouse	1,246,210	5,817,462	0	7,063,672	814	239	3.54	67.54
1-80	1	80	Ouse	1,388,719	7,063,672	0	8,452,391	1,419	283	5.00	56.67
1-90	1	90	Ouse	1,272,587	8,452,391	0	9,724,977	1,006	248	4.02	61.71
1-100	1	100	Ouse	1,193,109	9,724,977	0	10,918,086	813	256	3.19	80.31
1-110	1	110	Ouse	1,080,794	10,918,086	0	11,998,880	1,236	254	4.87	52.17
1-120	1	120	Ouse	1,324,779	11,998,880	0	13,323,659	1,247	367	3.39	108.37
1-130	1	130	Ouse	1,502,653	13,323,659	0	14,826,312	1,129	288	3.92	73.49
1-140	1	140	Ouse	1,645,954	14,826,312	0	16,472,266	1,680	317	5.28	60.08

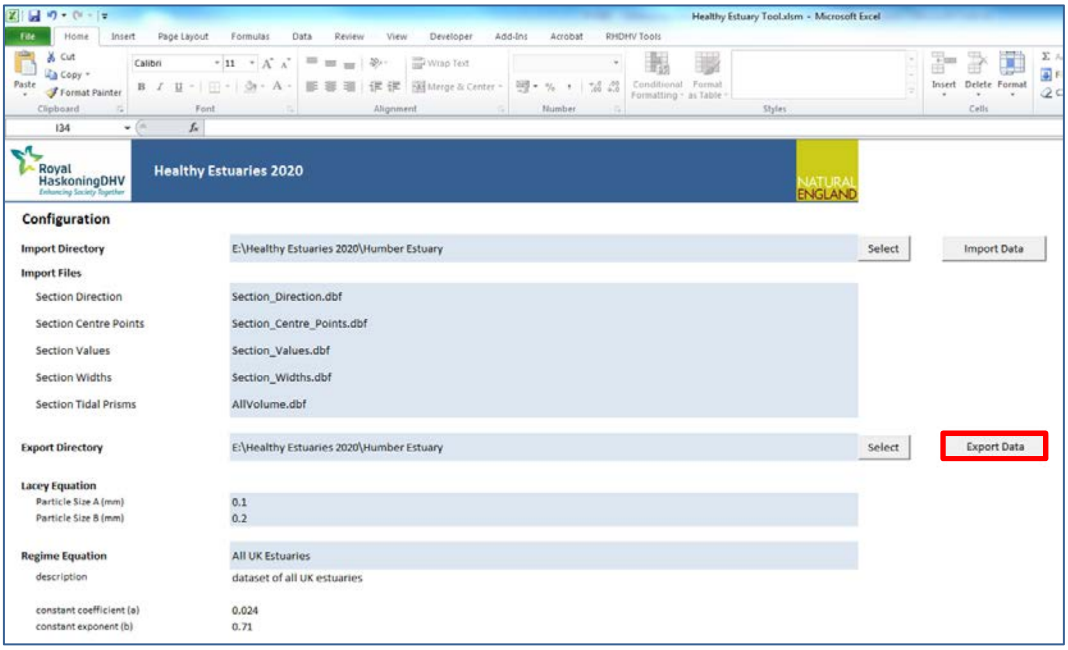
5.7 Predicted Tab

The Predicted tab displays each section along with the automatically calculated predicted data. This tab is locked and read only.

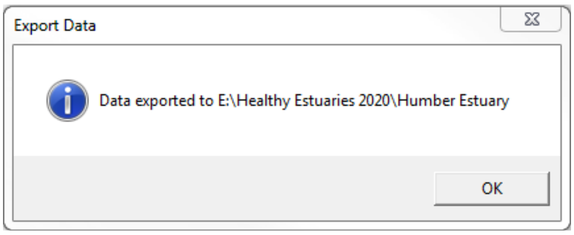


5.8 Export Excel Tool Output Files

To start the export process click the ‘Export Data’ button to the right of the ‘Export Directory’ field.



A window will appear once the export process has completed.



Click ‘OK’.

The Excel tool creates four output files which are used in the visualisation of the predicted equilibrium channels within ArcMAP. These file name will vary depending on the inputs but will always start with ‘A_’, ‘B_’ and ‘C_’

A_All UK Estuaries - Lacey (Particle Size 0.1mm).txt
B_All UK Estuaries - Lacey (Particle Size 0.2mm).txt
C_All UK Estuaries - Constant Evolution.txt

5.8.1 A_All UK Estuaries - Lacey (Particle Size 0.1mm).txt

This file contains the predicted channel data relating to the Lacey equation with particle size A.

Section_Ref	Reach	Section	Width	LB_X	LB_Y	RB_X	RB_Y
1-10	1	10	235	476509.8782	424201.7507	476327.8035	424350.3831
1-20	1	20	252	475623.9392	423677.0376	475543.3868	423916.2336
1-30	1	30	271	475130.9421	423105.017	474860.0579	423114.0481
1-40	1	40	291	475477.4726	422280.3257	475232.5274	422123.1244
1-50	1	50	313	476033.5918	421800.5603	476087.5625	421492.7109
1-60	1	60	336	476640.2904	422413.0046	476910.5726	422214.0266
1-70	1	70	360	477229.1025	423253.7173	477483.8975	422998.8134
1-80	1	80	387	478048.649	423926.1202	478213.9128	423576.151
1-90	1	90	416	479095.1947	424077.4806	479073.3494	423662.4454
1-100	1	100	446	480049.2917	423544.0284	479733.7083	423228.445
1-110	1	110	479	480766.4047	423135.9158	480706.9563	422660.3554
1-120	1	120	515	481538.5933	423386.5743	481761.5002	422922.6969
1-130	1	130	553	482312.6818	423907.1742	482648.178	423467.9958
1-140	1	140	593	483375.9516	424278.3343	483473.5409	423692.9369
1-150	1	150	637	484461.9921	424277.2572	484328.8596	423654.014
1-160	1	160	684	485477.0574	424066.6899	485275.8055	423412.5813

5.8.2 B_All UK Estuaries - Lacey (Particle Size 0.2mm).txt

This file contains the predicted channel data relating to the Lacey equation with particle size B.

Section_Ref	Reach	Section	Width	LB_X	LB_Y	RB_X	RB_Y
1-10	1	10	264	476520.9	424192.7	476316.8	424359.4
1-20	1	20	283	475628.8	423662.5	475538.5	423930.7
1-30	1	30	304	475147.4	423104.5	474843.6	423114.6
1-40	1	40	326	475492.3	422289.8	475217.7	422113.6
1-50	1	50	350	476030.3	421819.2	476090.8	421474.1
1-60	1	60	376	476623.9	422425.1	476926.9	422202
1-70	1	70	404	477213.7	423269.2	477499.3	422983.4
1-80	1	80	434	478038.6	423947.3	478223.9	423554.9
1-90	1	90	466	479096.5	424102.6	479072	423637.3
1-100	1	100	500	480068.4	423563.1	479714.6	423209.3
1-110	1	110	537	480770	423164.7	480703.4	422631.5
1-120	1	120	577	481525.1	423414.7	481775	422894.6
1-130	1	130	620	482292.4	423933.8	482668.5	423441.4
1-140	1	140	665	483370	424313.8	483479.5	423657.5
1-150	1	150	715	484470.1	424315	484320.8	423616.3

5.8.3 C_All UK Estuaries - Constant Evolution.txt

This file contains the predicted channel data relating to the 'Constant Evolution' relationship.

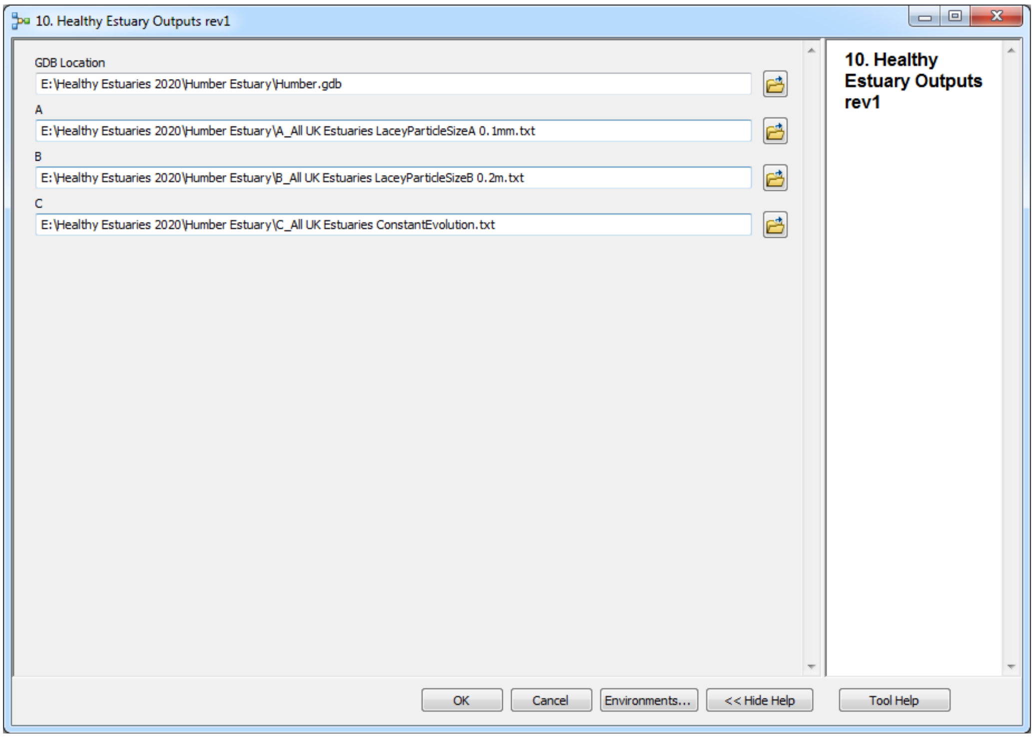
Section_Ref	Reach	Section	Width	LB_X	LB_Y	RB_X	RB_Y
1-10	1	10	164	476482.2	424224.3	476355.4	424327.8
1-20	1	20	220	475618.8	423692.3	475548.5	423901
1-30	1	30	171	475081.2	423106.7	474909.8	423112.4
1-40	1	40	195	475437.1	422254.4	475272.9	422149
1-50	1	50	175	476045.5	421732.7	476075.7	421560.6
1-60	1	60	229	476683.4	422381.3	476867.5	422245.8
1-70	1	70	275	477259.4	423223.4	477453.6	423029.2
1-80	1	80	269	478073.9	423872.7	478188.7	423629.6
1-90	1	90	300	479092.2	424019.7	479076.4	423720.2
1-100	1	100	366	480020.8	423515.5	479762.2	423257
1-110	1	110	315	480756.2	423054.4	480717.1	422741.9
1-120	1	120	485	481545	423373.3	481755.1	422936
1-130	1	130	427	482350.8	423857.3	482610.1	423517.9
1-140	1	140	413	483390.8	424189.2	483458.7	423782.1
1-150	1	150	445	484441.9	424183	484349	423748.3

6 VISUALISAING THE OUTPUTS

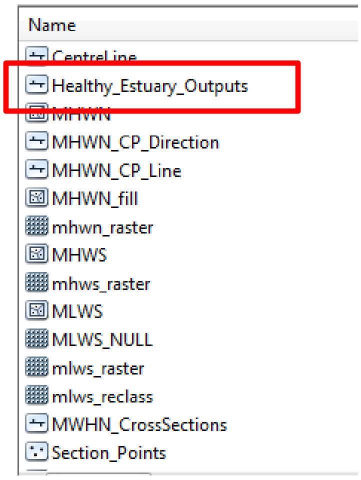
6.1 Model 10 – Healthy Estuary Outputs

The final toolbox model produces the outlines of the healthy estuary tool. The tool uses a centre point within the estuary and uses the distance and angle from the excel tool for each section line.

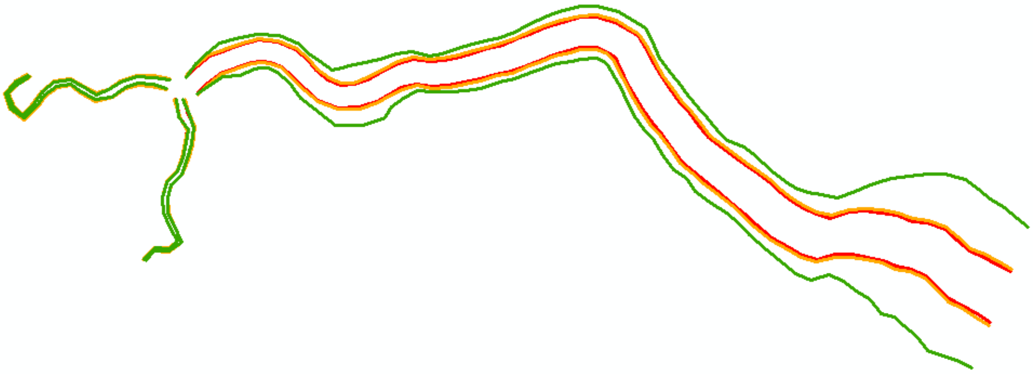
1. Open the toolbox and run Model 10.
2. Input the location of the geodatabase and the text files, with the proceeding values A, B and C into the A, B and C input boxes.



3. The model exports the Healthy_Estuarty_ouputs to the Geodatabase.

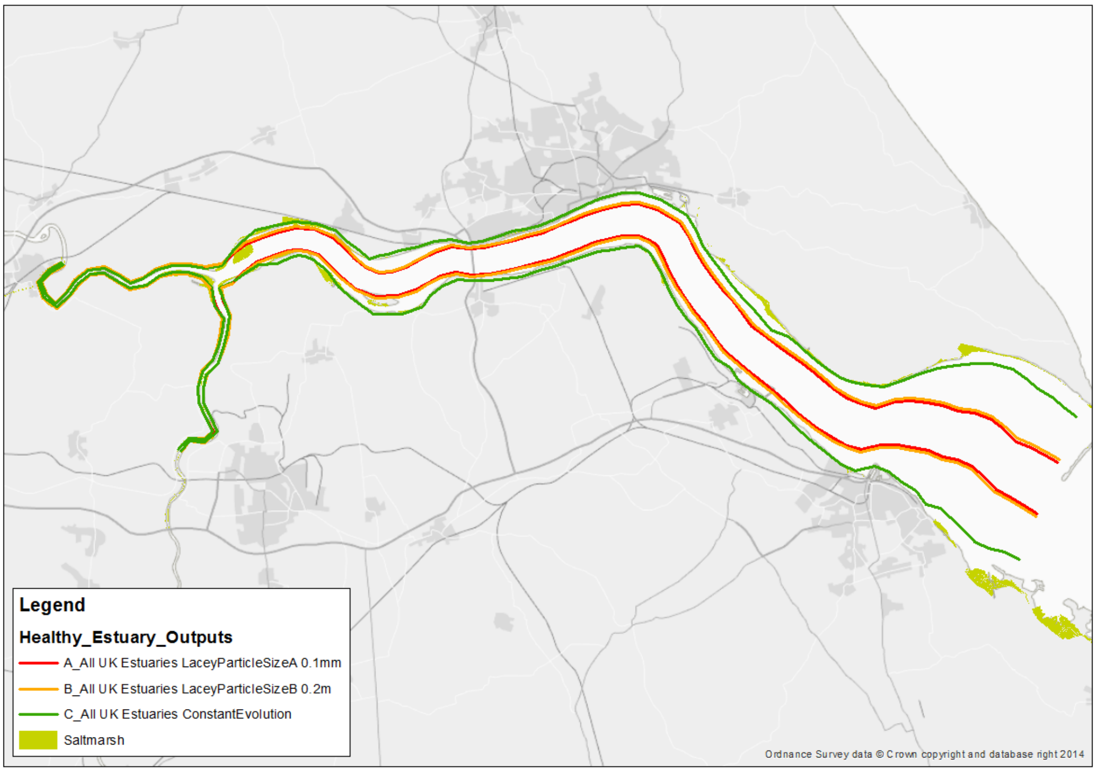


4. Load the Healthy_Estuary_ouputs inot ArcMAP and Symbalise on the Name Field.

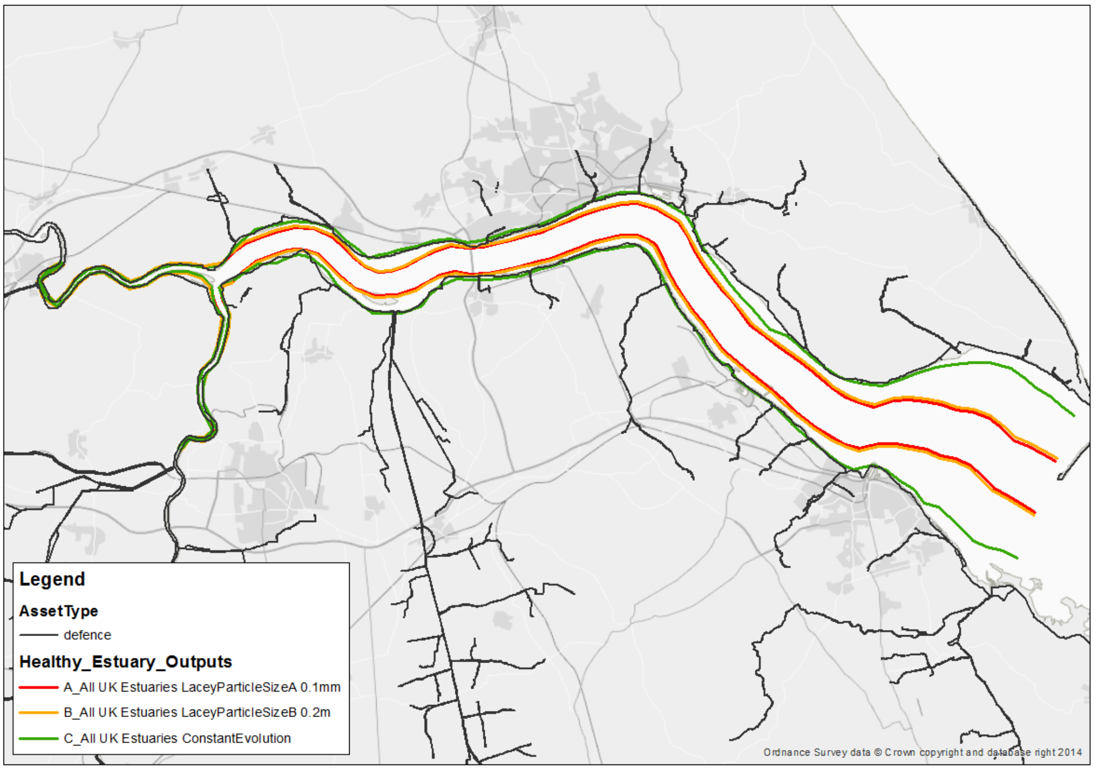


5. The Model cannot interpolate between the reaches so this will require a manual intervention. See before and after below.

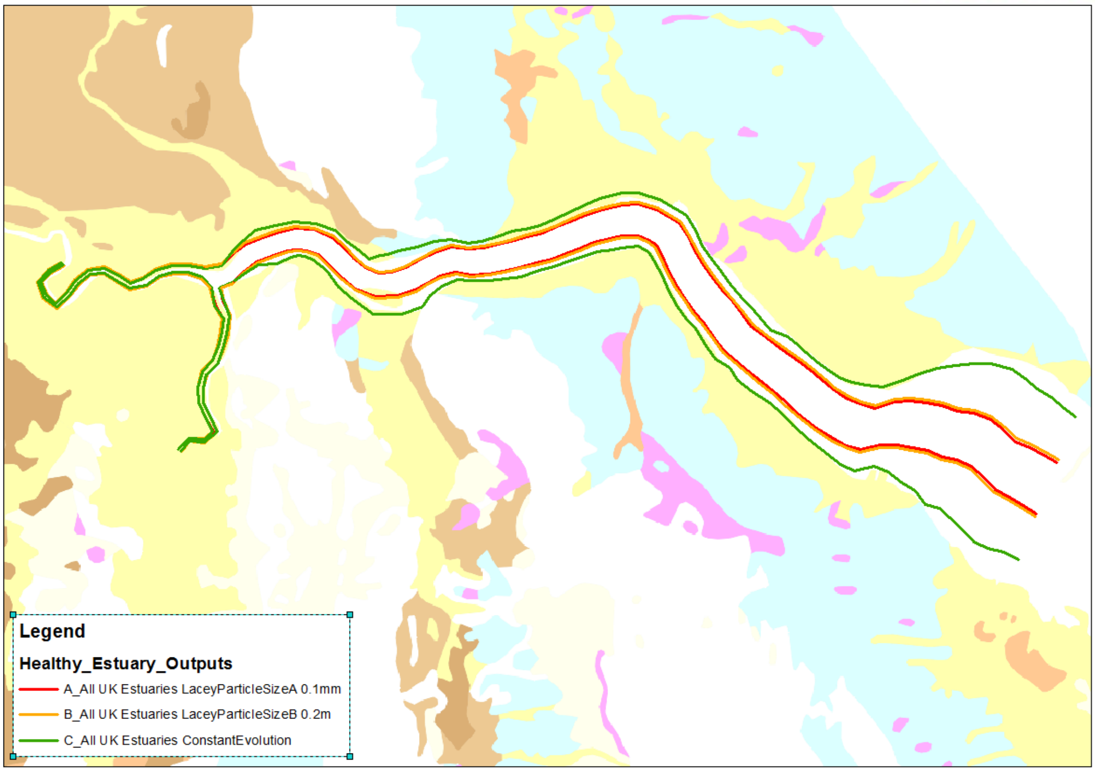
6. The Healthy Estuary outputs can be used alongside other data such as the BGS geology, Saltmarsh extent and Aims Data to make comparisons.



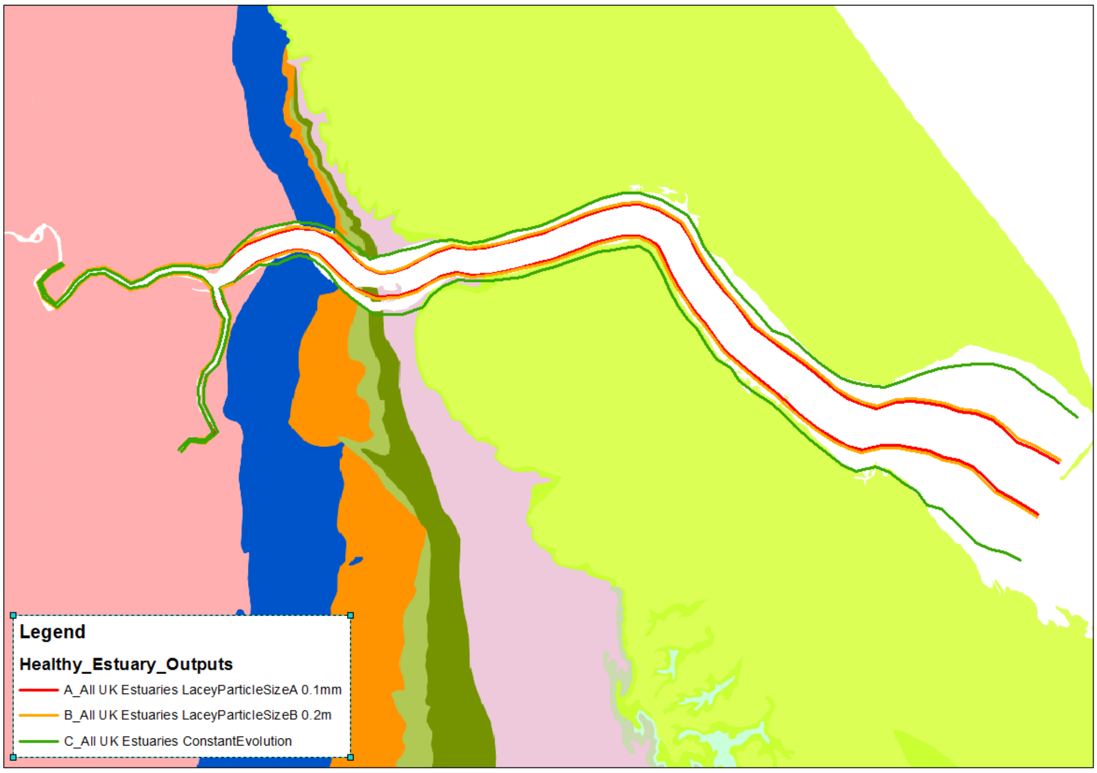
Outputs with Slatmarsh



Output with Environment Agency AIMS data



GBR BGS 1:625k scale Superficial Deposits Lithostratigraphy (including Lithomorphogenetic units)



GBR BGS 1:625k scale Bedrock Lithostratigraphy (including Lithogenic units)