



A Review of the MarGIS Modeling System and Its Use by the English Environment Agency in the Assessment of the Potential Impact of Discharge Consent in Coastal Zone



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MARCON COMPUTATIONS INTERNATIONAL

**Advanced Solutions to
Engineering & Environmental Problems**



Introduction

- The Environment Agency is the "competent authority" in England and Wales to implement the EU Birds and Habitats Directives (79/409/EEC and 92/43/EEC) in planning and carrying out all of its regulatory and operational activities.
- These Regulations place a statutory duty on the Agency to protect sites designated as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).
- The regulations place two specific duties on the Agency:
 - to review all existing relevant consents to discharge.
 - to assess all relevant new applications.
- The Agency must ensure that designated sites achieve or remain in a favourable condition and meet the conservation objectives.
- In order to review existing discharge **consents** and assess the impact of new proposed discharges, both alone and in-combination, a bespoke estuarine model was required.

Solution

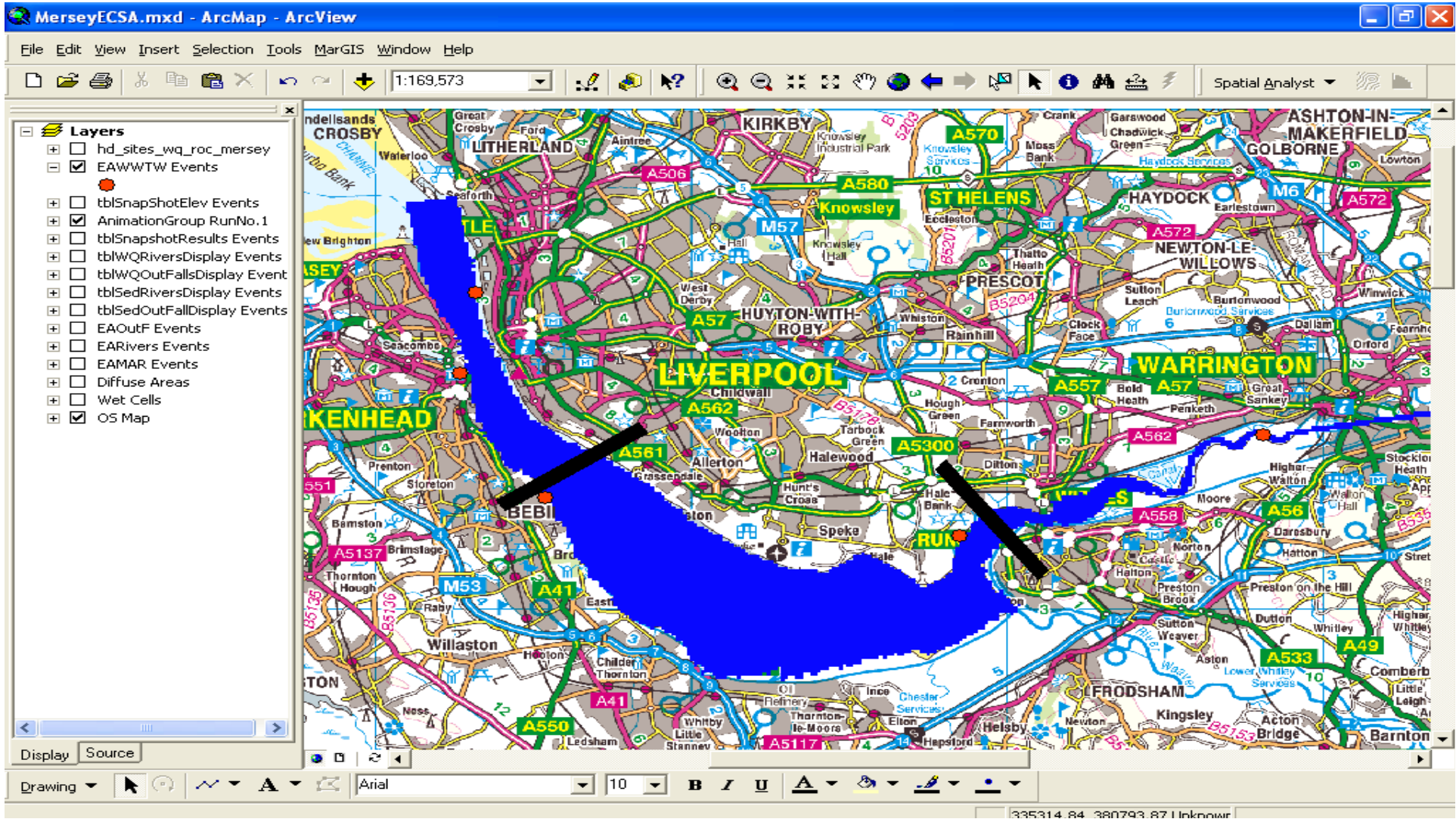
Build a Hydrodynamical Numerical Model

- A DIVAST (Depth Integrated Velocity And Solute Transport) model was developed
- A regular grid defined on two orthogonal axes on a horizontal plane
- Grid spacing was set a 100m
- Model size is 215 x 308 grid squares, or 66,220 computational grid points

And “Embed” the Model in to ArcMap (GIS from ESRI)

- Build a system with ArcMAP such that the user can access the model without leaving their ArcMAP desktop workspace

Mersey Estuary Properties



Model Requirements

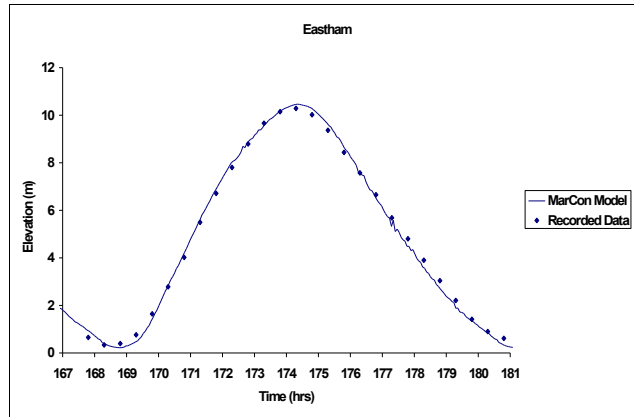
The modelling system had to be able to simulate concentrations of:

- Salinity;
- Temperature;
- Biochemical Oxygen Demand;
- Dissolved Oxygen;
- Ammoniacal Nitrogen;
- Oxides of Nitrogen;
- Orthophosphate;
- Chlorophyll;
- Silicate;
- Faecal Coliform
- Total Coliform
- Faecal Streptococci
- Suspended Solids;
- Heavy metals (Hg, Cd, Cu, Zn, Cr, Ni, Pb, As)
- Persistent organics (tributyltin, nonyl phenol)

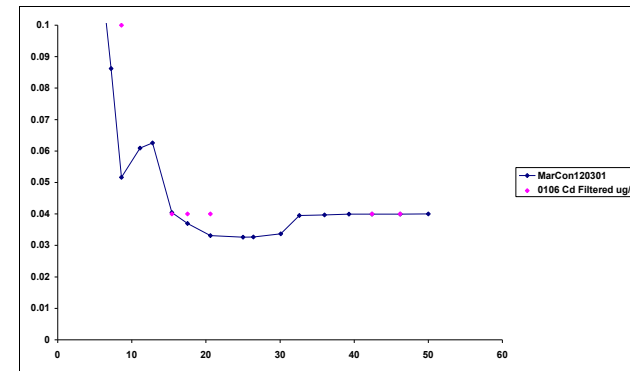
Model System Requirements

- **Horizontal position**
 - The modelling system had to be able to describe the horizontal position of an output from the model, in terms of Ordnance Survey (OS) co-ordinates.
- **Vertical position**
 - The modelling system had to be able to describe the vertical position of output (where vertical dimensionality is provided) with respect either to Ordnance Datum or to local chart datum.
- **Geographical Information Systems (GIS)**
 - The provision of a facility to exchange data in an industry standard format with a Geographical Information System (GIS) had to be supplied. In this way the Agency were able to present results of the modelling operations in the context of maps of their own making, such as:
 - maps of sewerage systems and treatment facilities;
 - maps of catchment water quality; and
 - maps of air quality relating to the location of incineration facilities.

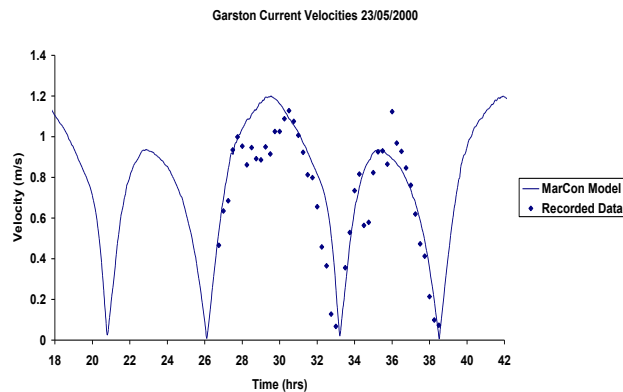
Model Calibration



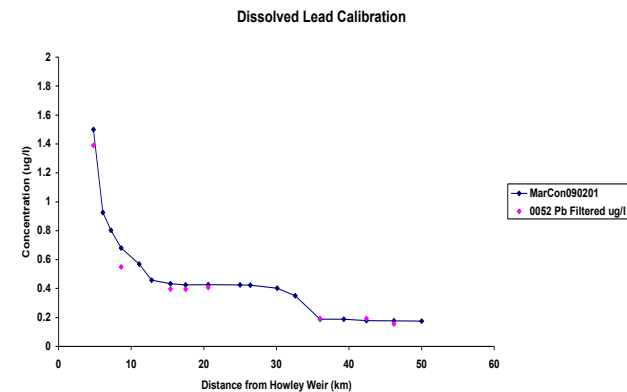
Water surface elevation



Cadmium Calibration



Current Velocity



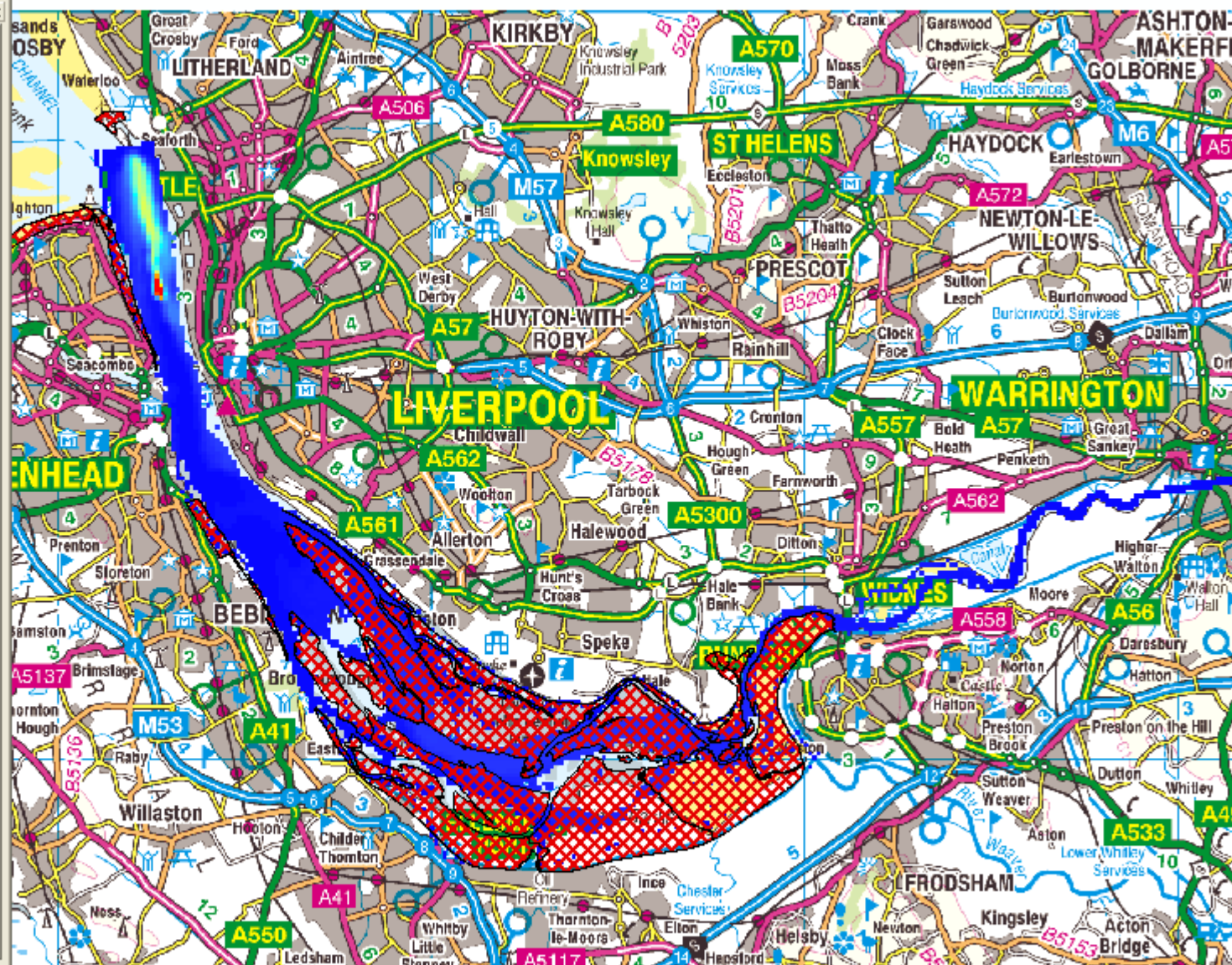
Lead Calibration

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Layers

- ☒ hd_sites_wq_roc_mersey
- ☒ RunNo.1 General
- ☐ tblSnapShotElev Events
- ☐ tblSnapshotResults Events
- ☐ tblWQRiversDisplay Events
- ☐ tblWQOutFallsDisplay Events
- ☐ tblSedRiversDisplay Events
- ☐ tblSedOutFallDisplay Events
- ☐ EAWWTW Events
- ☐ EAOutF Events
- ☐ EARivers Events
- ☐ EAMAR Events
- ☐ Diffuse Areas
- ☐ Wet Cells
- ☒ OS Map

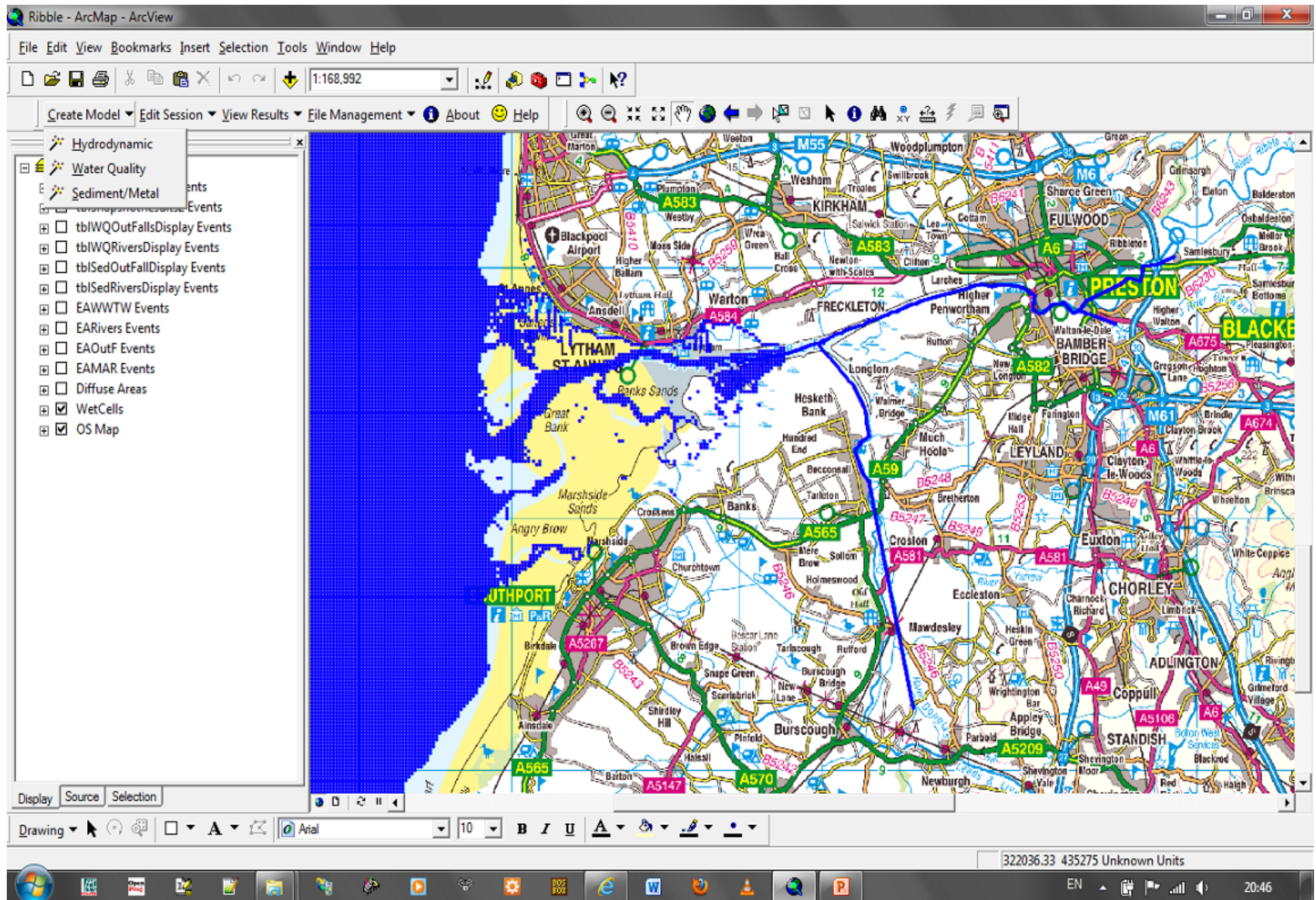


lay Source

Application by Environment Agency

- Used operationally in the assessment of over 900 discharge consents for Stage 3 Review of Consents as part of Habitats Directive.
- Deemed “Best Practice” in implementing the Habitats Directive.
- Currently **MarGIS** is also operational for the
 - Ribble Estuary
 - Mersey Estuary
 - Severn Estuaries (two versions)
 - Morecambe bay
- The EA are now using MarGIS as a tool to deal with the requirements of:
 - Habitats Directive
 - Shellfish Waters Directive
 - Bathing Waters Directive
 - Water Framework Directive
 - Marine Strategy Framework Directive





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Ribble Estuary

Complex Mixed Use Estuary:

- Contains 10 beaches designated as bathing waters (BWD 1995)
- Mouth of the estuary designated as shellfish waters (SWD 1999)
- Sensitive Area (Shellfish Waters) in 2003
- Estuary is a important area for wintering birds and waders and is designated a Special Protection Area (SPA) under the Wild Bird Directive (1995)

Ribble Planning Case

For the Ribble Estuary, the EA needs to ensure compliance with relevant legislative requirements:

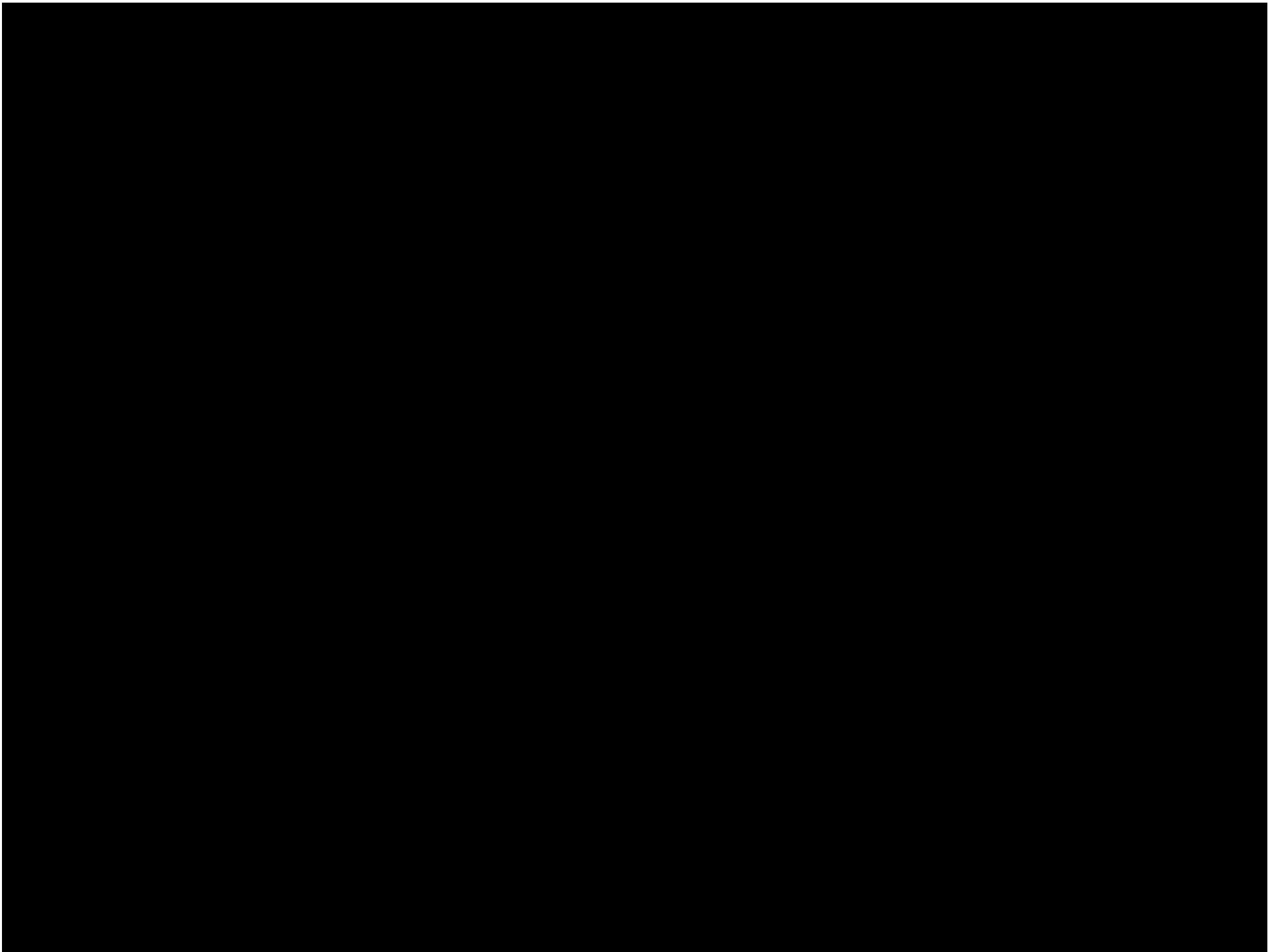
- EC Directives on Urban Waste Water Treatment (UWWTD)
- EC Bathing Waters Directive
- EC Shellfish Waters Directive
- EC Regulation on the hygiene of foodstuffs

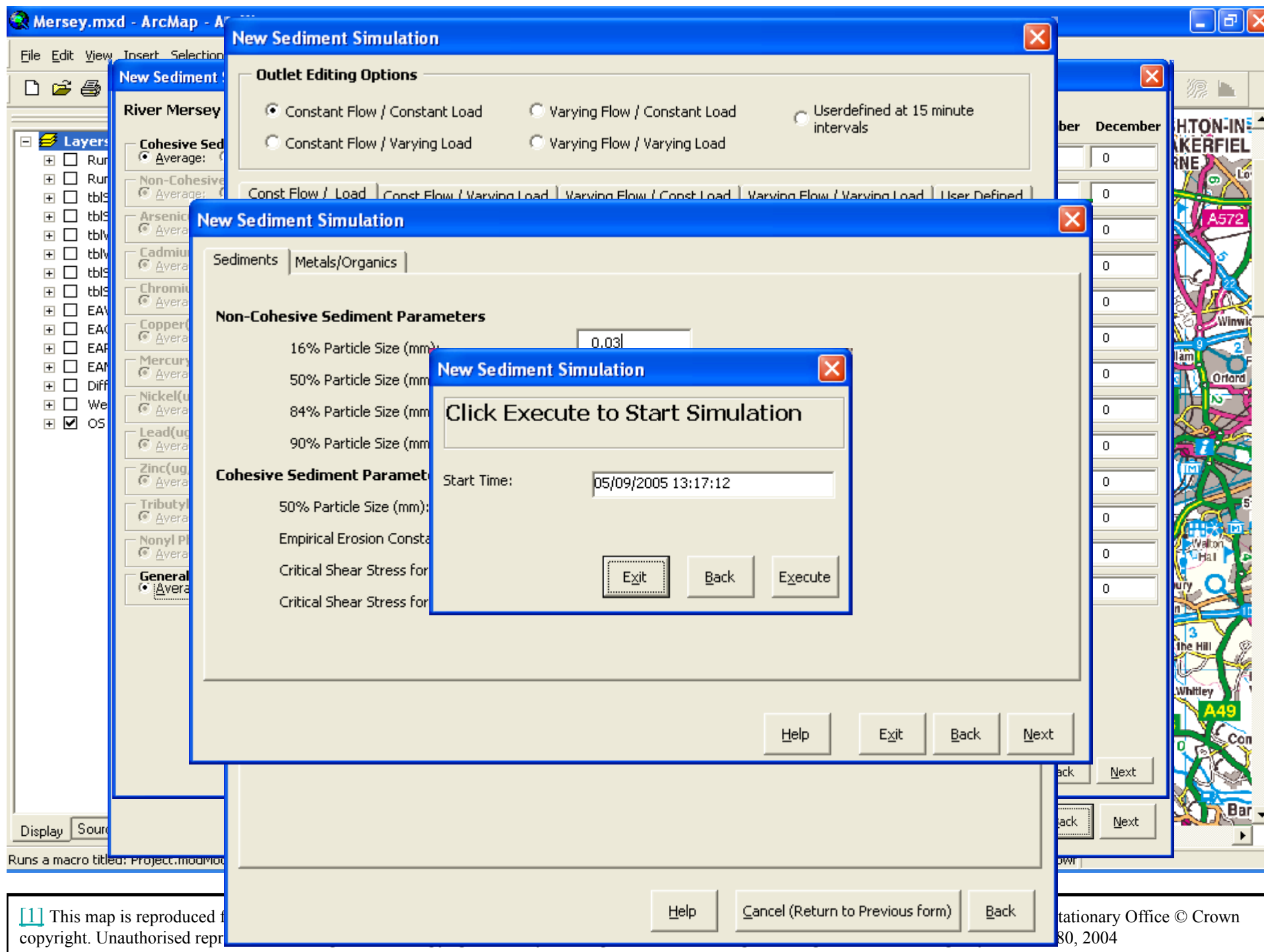
Ribble Planning Case

- In 2005 the EU started infraction proceedings against the UK for not meeting the guideline values in the SWD relating to Faecal coliforms
- In response, the EA submitted Pollution Reduction Plans
- The Waste Water Treatment Works (WWTW) at Preston (operated by United Utilities (UU)) was identified as having a significant impact on the levels of Faecal coliforms

Ribble Planning Case

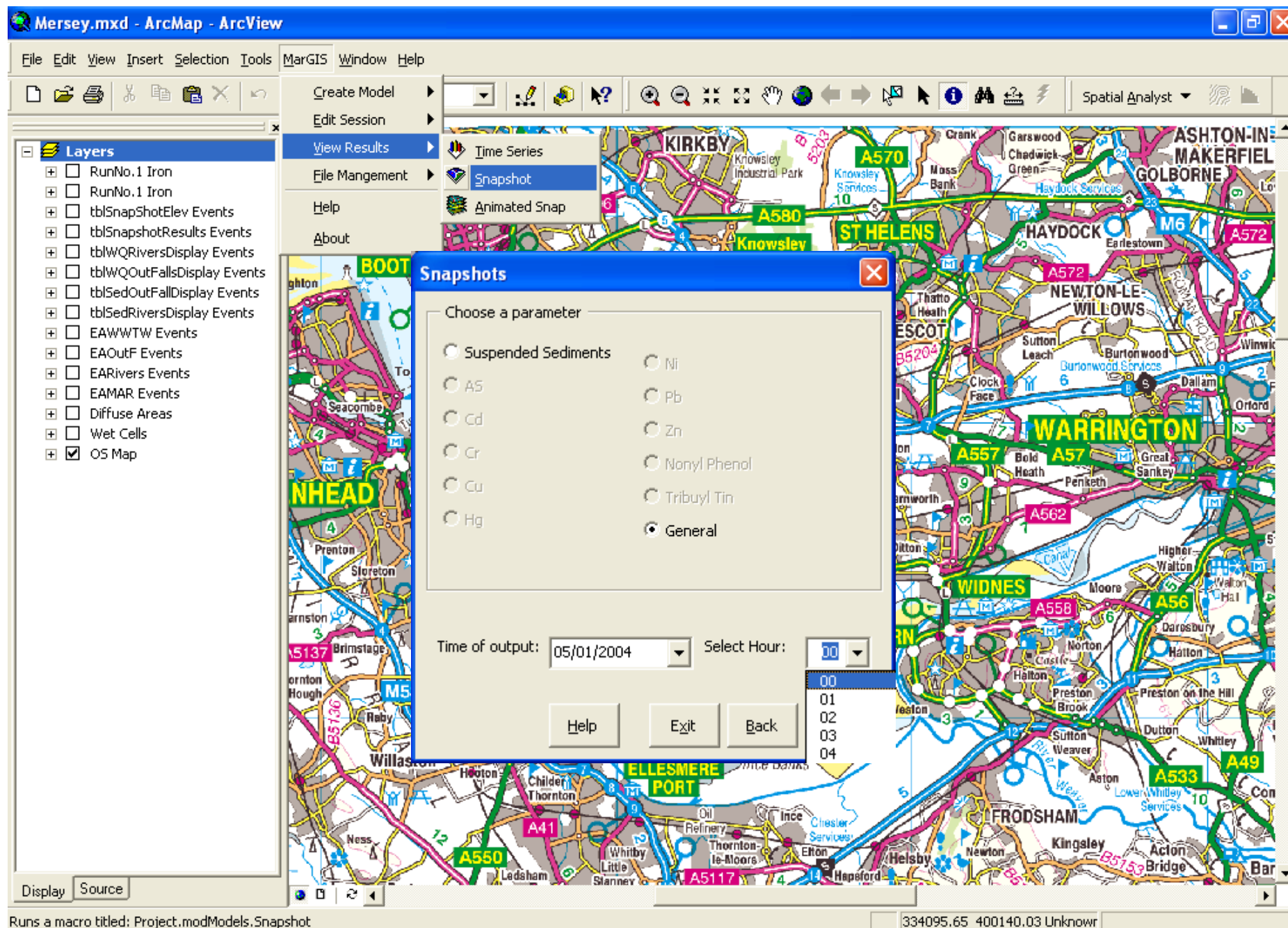
- New tougher Consents (discharge licences) were imposed on the Preston WWTW
- Old ones had been issued in 1987
- UU appealed
- The Planning Inspectorate reviewed the appeal (2008) and refused it.
- UU had to build new facilities (~£90 million)
- MarGIS was central to this whole process and was identified as a useful tool by the Planning Inspectorate



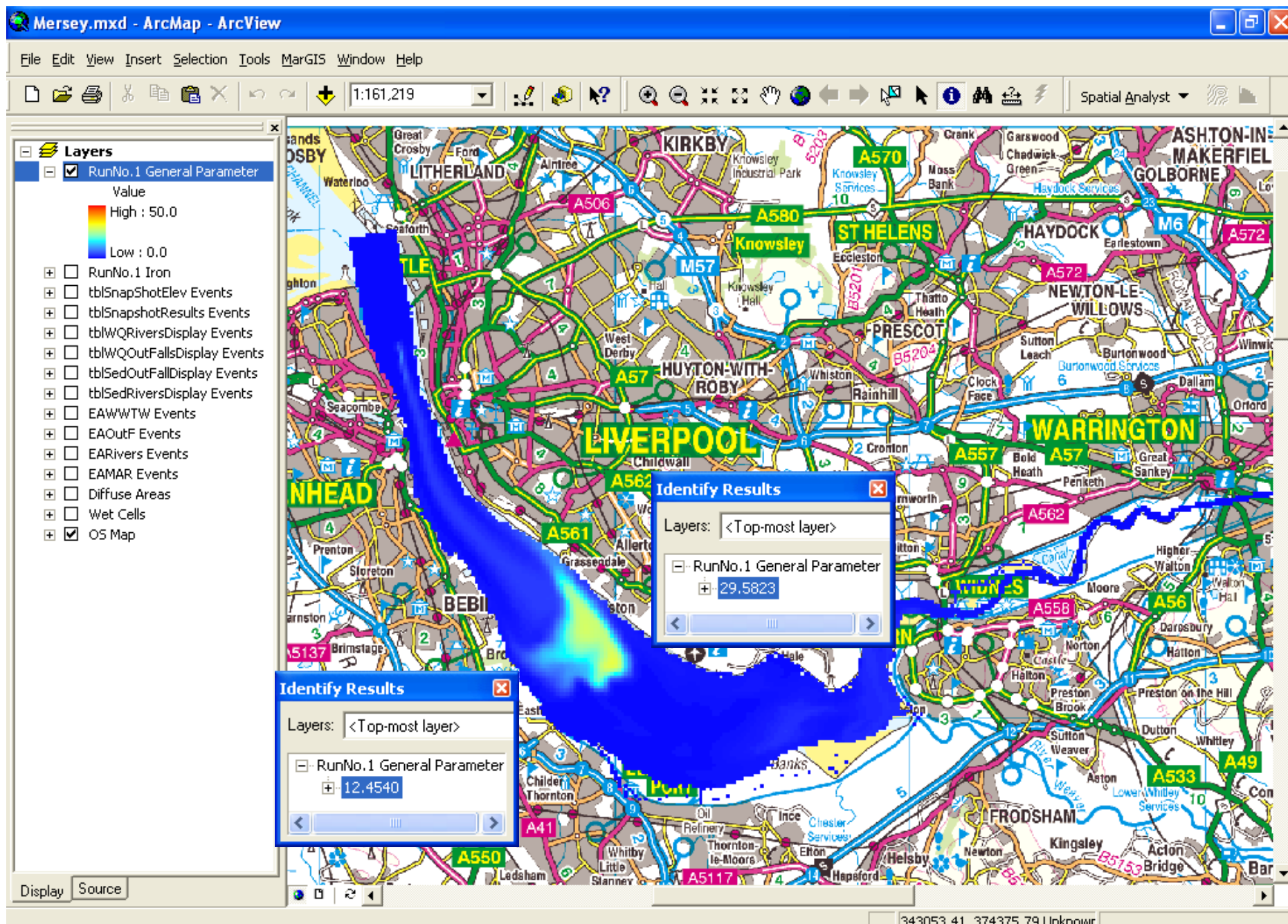


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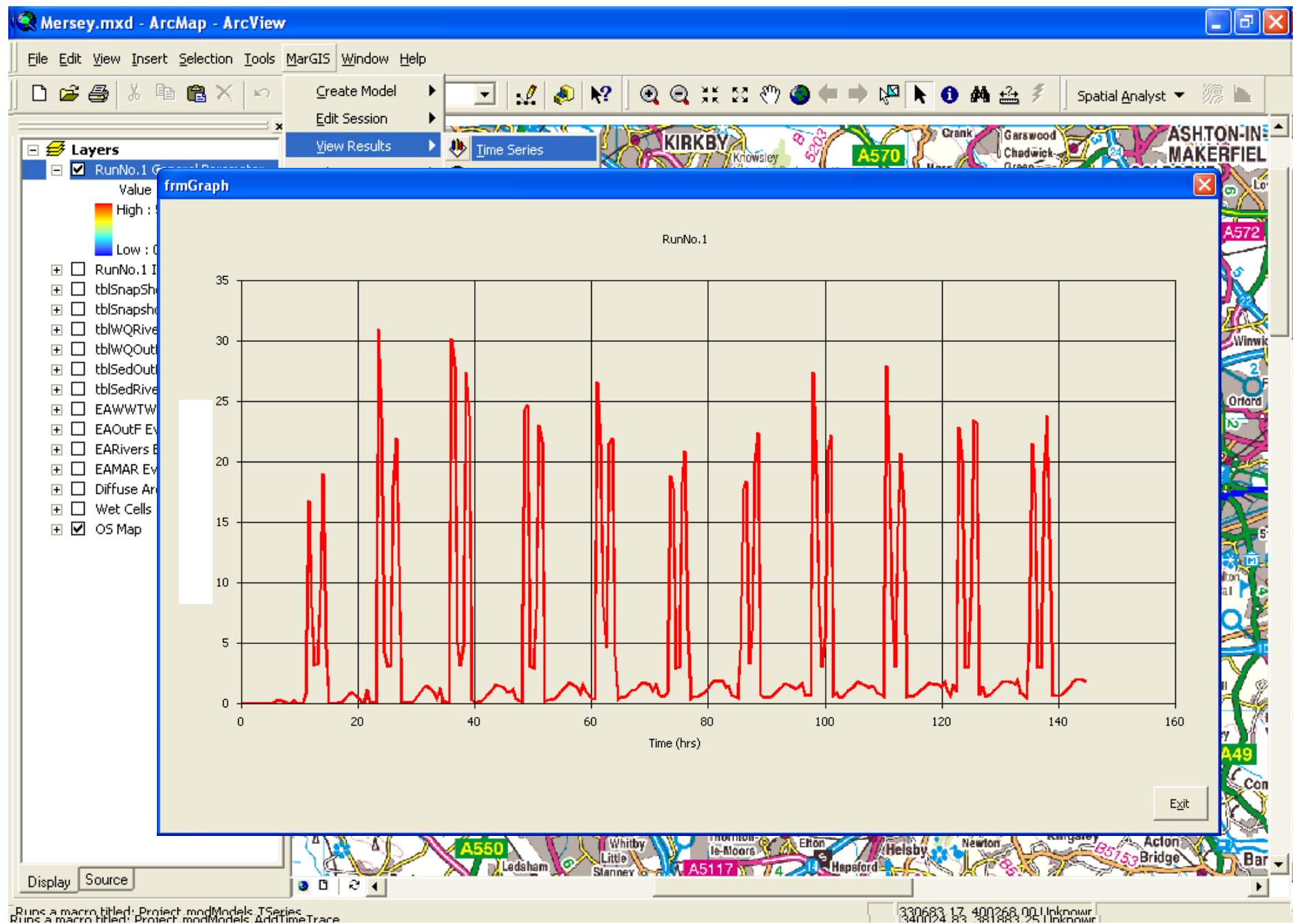
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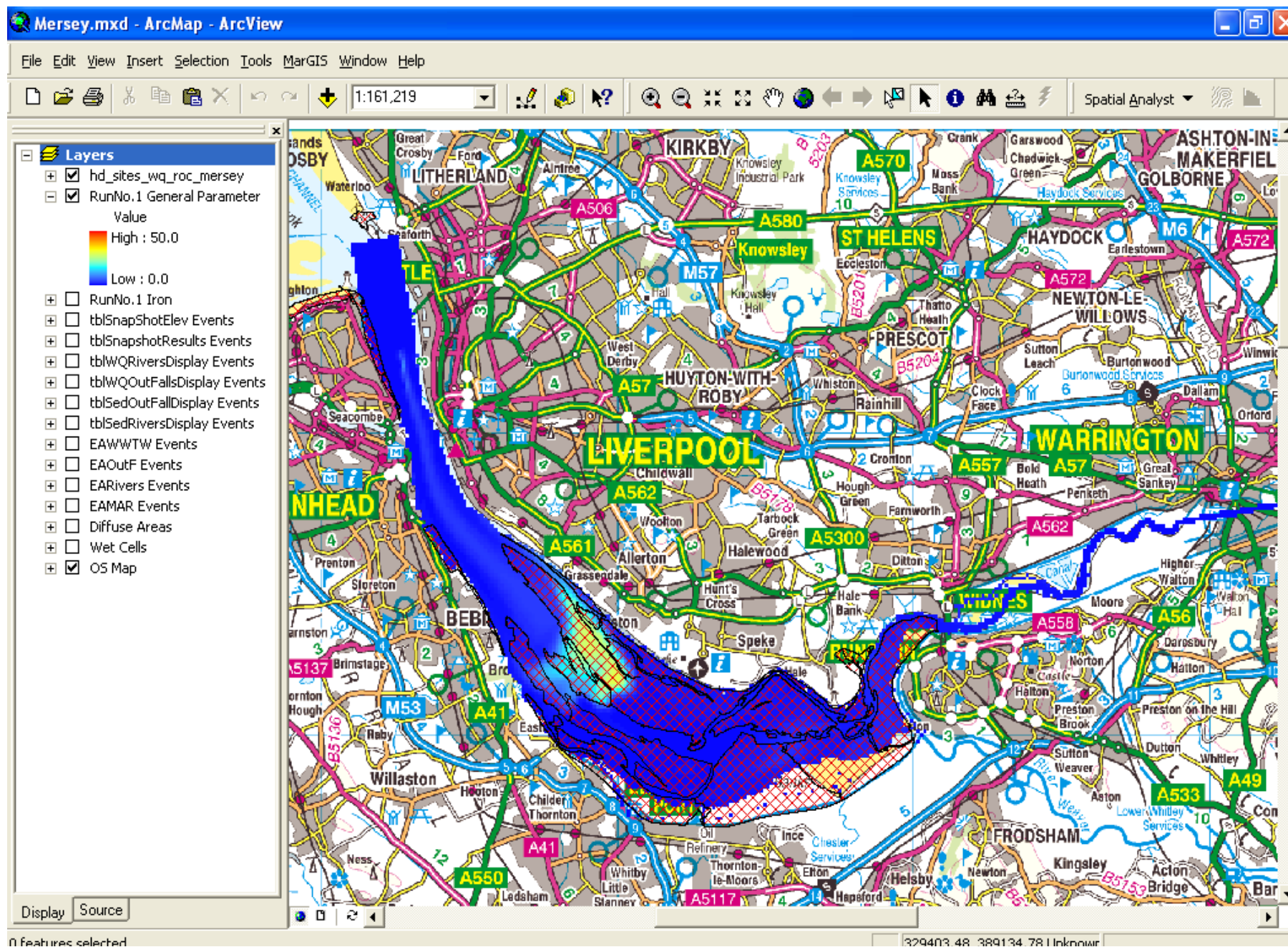
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