

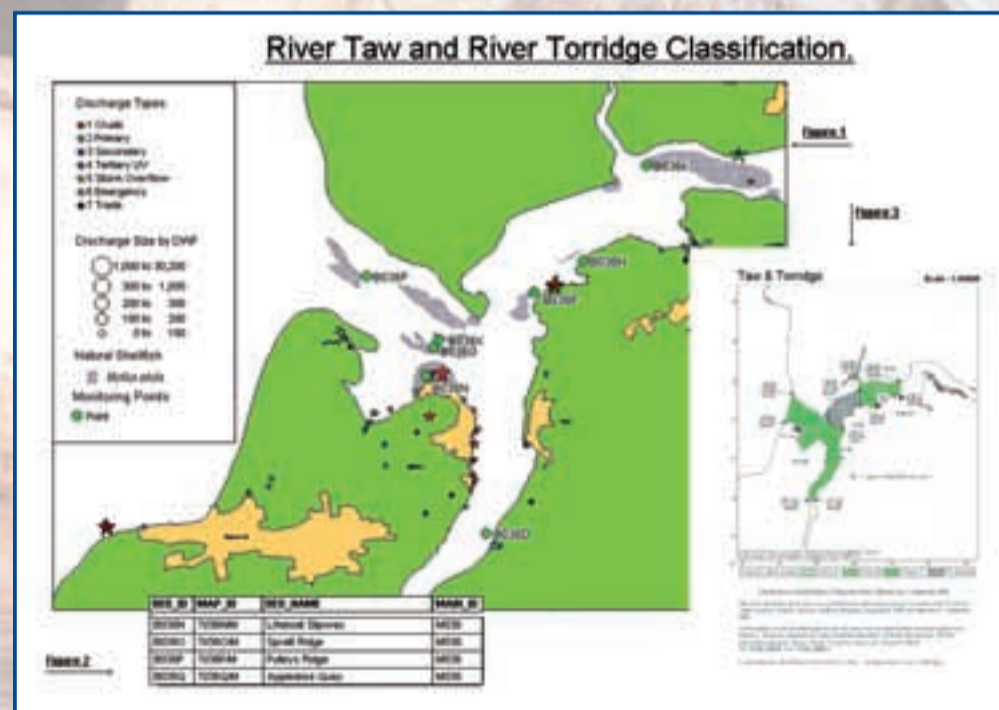
## Introduction

The use of a Geographical Information System (GIS) is integral to the statutory shellfish hygiene programmes undertaken at The Centre for the Environment, Fisheries and Aquaculture Science (CEFAS).

CEFAS manages the programmes for the microbiological and biotoxin monitoring of shellfish harvesting areas in England and Wales on behalf of the Food Standards Agency (FSA) and undertakes technical assessment of proposed new sewage discharges into tidal waters of England and Wales on behalf of the Department of Environment, Food and Rural Affairs (DEFRA). CEFAS Weymouth specifically assesses these applications with respect to the microbial impact on shellfish waters. Additionally, CEFAS undertakes research in these areas.

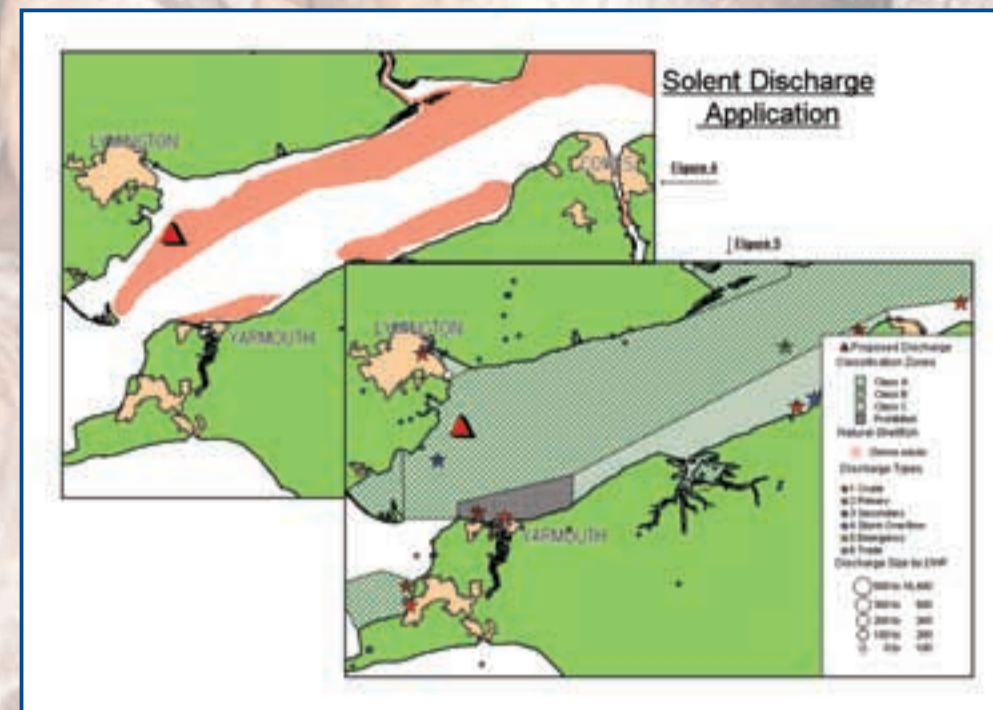
A number of the data sets that are used in such work have a geographical element and this makes the use of a GIS an efficient and beneficial tool in the visualising and integrating the data. These data sets include shellfish bed locations, shellfish monitoring points, point source discharges (marine and non-marine), classification zones, biotoxin monitoring zones and microbiological and biotoxin (or phytoplankton) concentrations in shellfish and water.

The data sets can be entered into the GIS in the form of separate layers which can be overlaid for viewing or interactively interrogated.



## Microbiological Monitoring of Shellfish Harvesting Areas

- A new shellfish bed is identified by the local authority on behalf of the local shellfishery interests.
- The shellfish bed is digitised and displayed over base information consisting of coastline, rivers, sewage discharges and existing monitoring points tables (Figure 1). The discharges can be 'thematically mapped' to show the level of treatment undergone by the effluent and the size of the discharge.
- Locations for new monitoring points are determined on the basis of the location of impacting discharges and the coastal topography, supplemented with information on the hydrodynamics of the area (Figure 2).
- Microbiological monitoring is then instituted and the data analysed
- An enforcement zone map is determined for the area based on the classifications determined according to the criteria in the Shellfish Hygiene Directive (Figure 3).

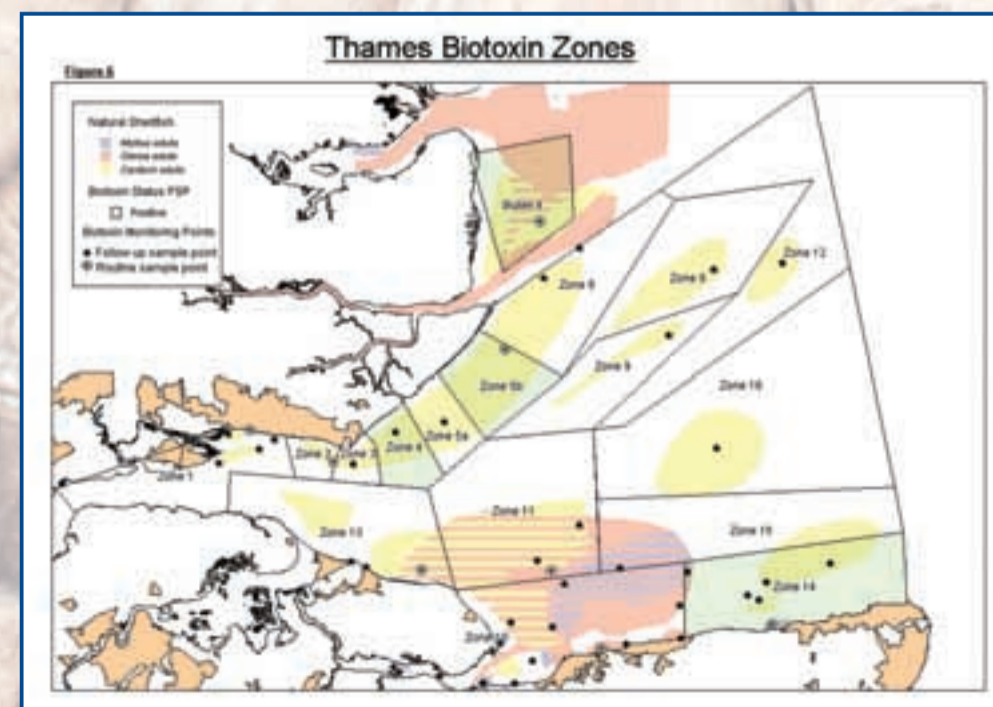


## Technical Assessment of Sewage Discharges Impacting on Shellfish Waters

- The location of a proposed new discharge, together with annotation of its characteristics, is displayed over the base information.
- The proximity to shellfish beds, other sewage discharges and current microbiological monitoring points can be ascertained (Figure 4).
- Shellfish classification zones can also be displayed (Figure 5). Microbiological monitoring data can also be interrogated via the GIS display.
- The GIS, together with other tools such as water quality models and tidal analysis software, is then used to assess the potential impact of the discharge and thus helps determine whether CEFAS deems the proposals to be acceptable or in need of modification.

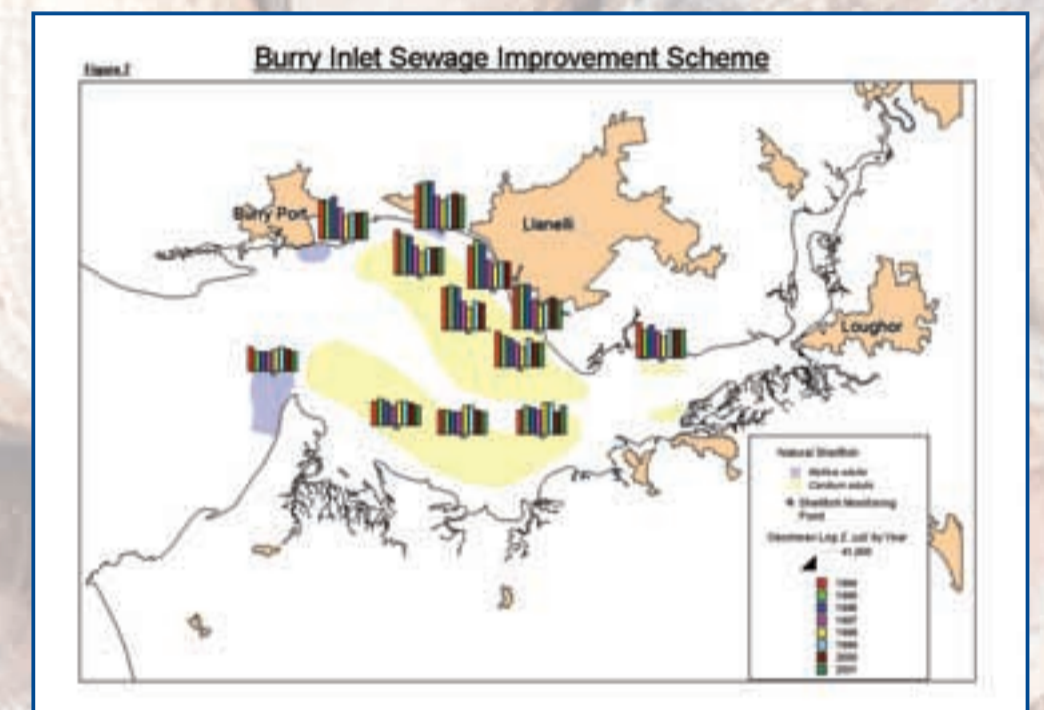
## Monitoring Programme for Algal Biotoxins in Water and Shellfish

- Sampling points for the biotoxin monitoring programme were selected from those currently used for microbiological monitoring using the GIS.
- Large areas subject to positive biotoxin episodes have been subdivided using the GIS, taking into account the location of positive results and enforcement considerations.
- The zones are then used to determine the monitoring strategy and for subsequent enforcement decisions.
- The GIS can also be determined to display the biotoxin data and status of zones (Figure 6).



## The use of GIS in Shellfish Water Quality Investigations

- The example given in Figure 7 shows the affect of the Burry Inlet Sewage Improvement Scheme on *E. coli* concentrations in shellfish.
- The map includes the base information with the geometric mean *E. coli* concentrations thematically displayed for each year from 1994 to 2001.
- In 1997 several large primary treated sewage discharges were moved from the northern side of the inlet to a new treatment works to the southeast of Llanelli. The new treatment works included tertiary UV treatment.
- The affect of the scheme can be seen in the geometric mean *E. coli* concentrations at the monitoring points. The monitoring points on the northern side of the estuary show a decrease in the levels of *E. coli*. However, the points on the southern side of the estuary appear to be unaffected by the sewage improvement scheme.
- The continuing lower level of contamination seen on the north side since the improvements, together with the maintained contamination on the south side, is considered to be due to sewage discharges (and possibly other sources) higher up the catchment.



Mussels (*Mytilus edulis*)



Oysters (*Crassostrea edulis*)

## Research

- The above investigations can be used as a basis of research.
- Examining different sewage improvement schemes and their affect on the microbial loads in shellfish and the water, the affect of new schemes can be anticipated.
- These assessments can be further improved by using more datasets such as meteorological data (temperature, rain and wind) hydrographic data (high/low and spring/neap tidal cycles) and bathymetry.

## Conclusions

- GIS enables data sets to be visually combined and allows interaction to be determined between such data sets.
- Datasets can efficiently be changed or updated using a GIS
- GIS is therefore an extremely useful tool in the management of monitoring programmes for shellfisheries.
- Its adaptability also makes it effective in water quality investigations and associated research.