

Geographic information systems: a consistent approach to land use planning decisions around hazardous installations

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Abstract

The Health and Safety Executive (HSE) advises Local Planning Authorities about the siting of major hazard installations and pipelines and the control of housing and other developments nearby. HSE uses quantified risk assessment (QRA) to set a consultation distance around each of the major hazards and advises on possible risks to people within this distance so these risks can be considered in reaching planning decisions. The risks may be derived from dispersion models which estimate concentration levels and exposure times for a range of loss of containment accidents. The paper describes how HSE has piloted a Geographic Information System (GIS) to support the expert decision making process and to assist in ensuring consistent responses within statutory deadlines. It considers both the advantages and disadvantages of a GIS over more conventional methods as well as potential developments such as the use of population data in considering societal risks, biological constraints and 3D terrain mapping. Crown Copyright © 1998 Published by Elsevier Science B.V. All rights reserved.

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1. Introduction

HSEMAP is a tailor-made Geographic Information System (GIS) software package, developed for the Major Hazards Assessment Unit (MHAU) of the Health and Safety Executive's (HSE) Chemical and Hazardous Installations Division (CHID) under a research contract by consultants RSK Environment. HSEMAP is based on proprietary GIS software called MapInfo which is one of two market leaders in this field in the UK.

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MapInfo forms the basis of a number of GIS applications used by pipeline operators such as Shell and ICI, Local Authorities, Police and Emergency Services.

HSEMAP contains digital Ordnance Survey 1:50 000 and 1:10 000 scale map tiles used as the backdrop in the system, over which can be placed a number of separate layers, specific to the application required by MHAU, to show Notifiable Installation site locations and pipeline routes, their consultation zones and risk contours, together with locations of planning developments. The package has a number of additional features such as editing and annotating the displays, running a selection of simpler risk modelling tools, importing and displaying supporting documents and diagrams, measuring distances and areas, and displaying risk contours which have been generated by MHAU's principal decision tool 'RISKAT'.

The system runs at present on a conventional stand-alone PC, supported by a colour Paintjet printer, able to accept a variety of media and print out at up to A0 size.

2. Background

One of the main statutory functions carried out by MHAU is to advise Local Planning/Hazardous Substances Authorities (LPA/HSA) on risk levels generated by Notifiable Installation sites in relation to new developments in the vicinity, or to existing populations from a new or modified sites. Such sites may be either fixed installations, subject to the requirements of the Control of Industrial Major Accident Hazards (CIMAH) regulations and/or the Planning (Hazardous Substances) (P/HS) regulations, or hazardous transmission pipelines as defined by the Pipelines Safety Regulations (PSR).

Land-Use Planning (LUP) consultation is based on a pre-determined Consultation Distance being set for each site by HSE and communicated to the appropriate LPA. Subsequent planning applications submitted to the LPA which fall within this CD are then automatically referred to HSE for consultation. Similarly any new or modified hazardous activity at a fixed site or pipeline subject to P/HS or PSR is referred to HSE both for advice on the potential risks to the surrounding population and for revising or setting a Consultation Distance.

Until recently, all the information exchange involved in the above consultation process has been carried out by traditional means using paper-copy maps for passing details of CDs and hard copies of decision letters. Each case received by MHAU has also been assigned to a separate case file and stored in a conventional filing system. The project for exploring a GIS based electronic handling scheme was conceived on the basis of the potential efficiency gains that should accrue when compared with the existing method of carrying out consultation work.

3. Development

(a) Hardware: HSEMAP has been designed to operate on a conventional desktop PC with a 486 processor, 8 MB working memory, 1 GB hard disk capacity and CD-ROM

drive. The latter is used only when importing new or updated OS map tile data for the system backdrop.

(b) Software: An initial, very limited, trial was started in 1994 based on CARIS software and only incorporating three sites. This was later upgraded in mid-1995 when the main pilot phase was introduced, now using MapInfo as the basic software, and with about 70 sites included, selected from the busiest locations in the country. Evaluation showed an increased speed and flexibility of operation. A recent further extension has included additional pipeline route information and a supplementary software package to enable risk contours, generated by HSE’s RISKAT suite, to be imported directly and displayed against the existing map backdrop.

(c) Timing: Although the project has now been running for about 3 years in total, the actual time for development has amounted to 9 months.

(d) Cost: The total cost to date, including OS data and licence fees plus VAT, amounts to almost £50 k.

4. Application

HSE receives about 5000 planning consultations each year from LPAs. These are initially sent to one of 14 HSE CHID area offices where a preliminary screening process takes place. Responses to the more straightforward cases can be dealt with by reference

DECISION MATRIX

Category of Development	Development in Inner Zone	Development in Middle Zone	Development in Outer Zone
B (Workplaces, parking areas)	Area to reply no objection	Area to reply no objection	Area to reply no objection
C (Retail outlets, community & leisure facilities)	Refer to MHAU	Refer to MHAU	Area to reply no objection
A (Housing, hotel/holiday accommodation)	Area to reply strongly against	Refer to MHAU	Area to reply no objection
D (Educational establishments, institutional accommodation)	Area to reply strongly against	Refer to MHAU	Refer to MHAU



EXCEPTIONS:

- Cat.B carpark for >200 spaces
 - industrial >100 employees
 - Cat.C retail with >5000m² floorspace
- }
 } >Cat.C
 } >Cat.D

Fig. 1. Decision matrix.

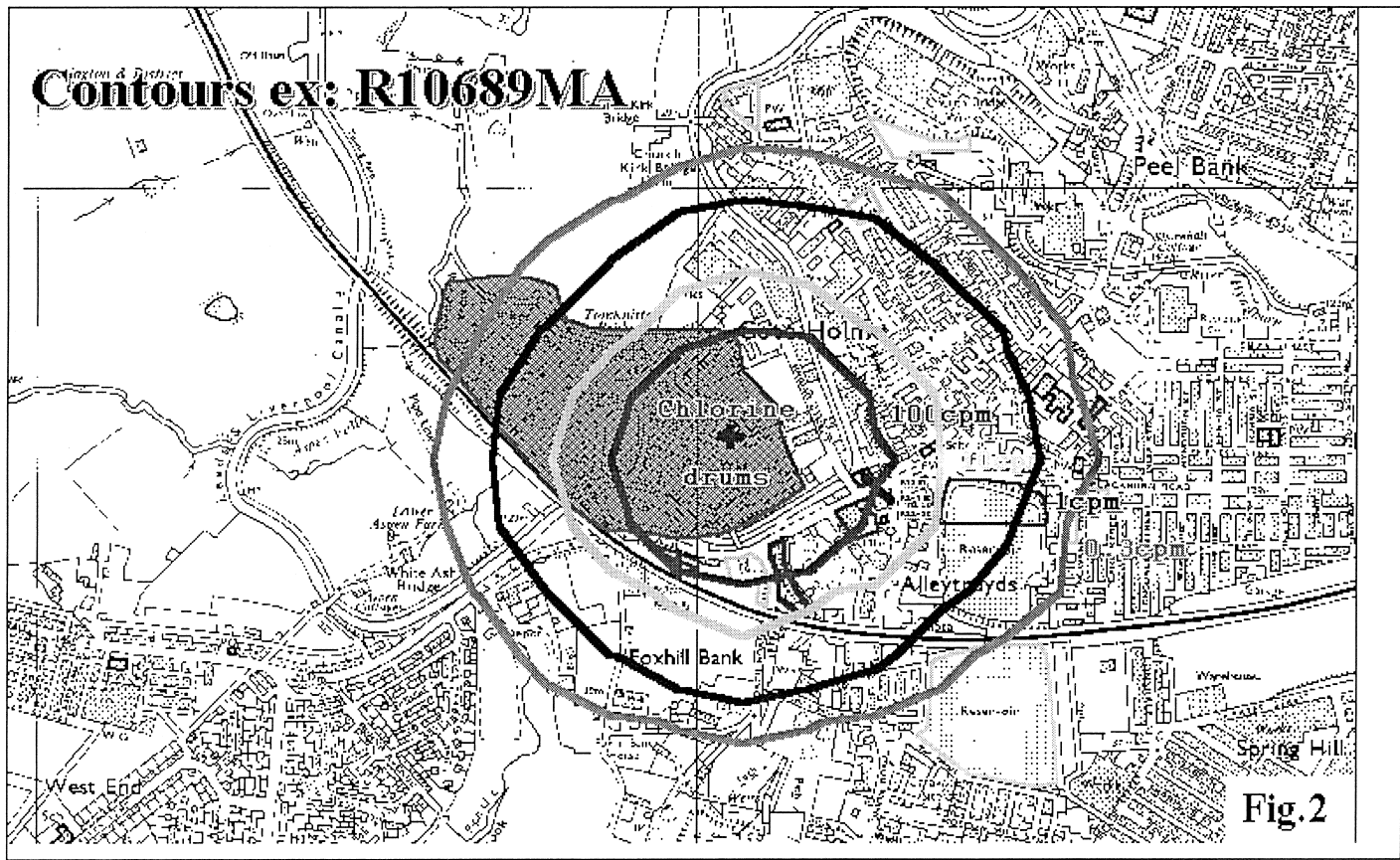


Fig. 2. Prepared from Ordnance Survey Mapping with permission of the Controller of HMSO (C) Crown copyright.

to a standard decision matrix (see Fig. 1) based on four categories of development and a three-zone consultation envelope for each site (or complexes in certain locations). More involved cases, requiring detailed technical or policy consideration, are referred to specialist inspectors at MHAU. MHAU handles some 750 such cases each year.

In order to preserve a consistent approach in HSE's advice to LPAs, not only nationally but in a local context, it is important to maintain a working knowledge of the development history in a given location. Hitherto this has depended not only on the experience and knowledge of individual inspectors but on the ability to cross-reference appropriate case files. With a conventional filing system this process has not always been infallible and can prove to be quite time consuming. HSEMAP has the facility to display all the relevant history on a VDU, providing links to the previous decision letters and where appropriate, displaying photographs and diagrams of developments or installations. Such an electronic system can therefore not only store readily all the required information but can also be updated easily. In this way much time, effort, space and paper can be saved.

A further use is found in the preparation of documents for internal discussion. When planning applications are received which involve particularly sensitive issues, borderline risk levels or unusual assessment methods where existing policy makes it difficult for an individual inspector to reach a decision, then the case is subjected to peer review at a panel meeting of the whole unit to produce a consensus view. This requires preparation of appropriate documentation. HSEMAP has the potential to assist in this process in producing better quality material faster and consuming less paper in the process.

Another area of LUP consultation work in which HSEMAP has the potential to assist is in the preparation of initial consultation zones when a site is first notified or when significant changes occur in the inventory of hazardous material handled. Here again HSEMAP can be used to advantage in the preparation of a high quality map for each installation on which the consultation zones can be overlaid and annotated. These zones may well be derived directly from imported RISKAT contours. The resultant map can already be sent by cc-Mail to HSE area offices and potentially thence to LPAs as Bitmap files. This facility will not only speed up communication but eliminate the use of paper-copy maps which have sometimes been of poor quality.

See Fig. 2 for an example of a typical site showing site boundary, risk contours and nearby planning application locations.

5. Benefits

Better and more consistent quality of advice information.

Significant reduction in paperwork and photocopying.

Quicker and more comprehensive communication.

Simple and effective means of keeping information up-to-date.

Map backdrops updated regularly via service level agreement.

Built-in facility for OS Grid referencing and distance/area measurement.

Easier identification of fixed sites and pipelines, especially when two or more are in close proximity.

Facility for carrying out ‘what if’ interrogations using built-in models.
Linking facility for displaying response letters, photographs, etc.
Improved QA processes.
Facilitating communication with site operators, especially pipelines where GIS is already well established.

6. Future extension

6.1. National coverage

Based on the experience achieved so far, MHAU has prepared a business case for extending HSEMAP to cover all the 1600 notifiable sites and 1500 pipelines in the UK. Several options have been studied in relation to accessibility to staff, both in MHAU and in the local HSE CHID offices. A logical further extension would be to enable electronic communication with LPAs, particularly as a recent survey has indicated that 80% of them already have their own GIS and only 2% have no plans to implement it.

6.2. 3D mapping applications

The Health and Safety Laboratory (HSL), HSE’s own research agency, has for some time been working on a project on behalf of MHAU for modelling gas dispersion more accurately over complex terrain. HSL has independently chosen to support this work using MapInfo software. A potential for integrating this work into the HSEMAP project at some stage has therefore been established.

6.3. Population data / societal risk

Much of the advice given by MHAU in response to LUP consultation has hitherto been supported by risk assessment methodology based on consequences of individual risk. For certain developments, particularly the increasing number of large supermarkets, sports centres, etc., whilst the individual risk may be quite low, there is now more concern about the level of societal or group risk. Although a number of simplistic approaches have been applied, the problems of obtaining suitable population data and the complexity in interpretation have so far inhibited this area of risk assessment. MHAU has commissioned an external research project to evaluate sources of suitable population data from the Geography Department at the University of Staffordshire. Once the project is complete it is intended to integrate the resultant data into the HSEMAP environment to enable societal risk assessments to be performed where appropriate.

7. Conclusions

HSEMAP has exploited the ‘small and easy’ approach to assessing the benefits of implementing GIS for supporting HSE’s land use planning consultation work in the

future. The pilot project has amply demonstrated the many benefits to be achieved as well as exposing a few minor pitfalls and teething problems. Quite apart from the internal efficiency gains, HSEMAP is seen as a means for promoting the quality and overall image of HSE in communication with its customers and maintaining its position alongside them in the technological advances leading into the 21st century.