Integrated Modelling of Geoscience Information to Support Sustainable Urban Planning, Greater Manchester Area, Northwest England

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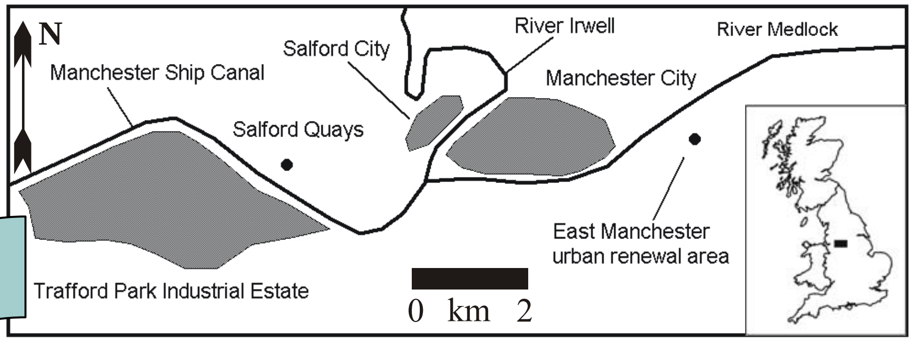
The provision of reliable and up-to-date geoscientific information for the urban environment has assumed increasing importance in recent years as legislative changes have forced developers, planning authorities and regulators to consider more fully the implications and impact on the environment of large-scale development initiatives. To comply with the principles of sustainable development, developers are increasingly required to demonstrate that proposals are based on the best possible scientific information and analysis of risk. Nowhere is this more relevant than in the context of urban regeneration, where planning policy guidance gives priority to re-use of previously developed (brownfield) land. In England, brownfield sites, suitable for re-development, cover an area equivalent to half the size of London.

To better understand the problems of bringing this land back into use, the quality of the land and any potential problems need to be investigated. Whilst site investigation studies may provide a local answer, there is generally little incentive for developers to integrate information and examine impacts beyond their own area of interest. By taking a more holistic view and combining knowledge of the near-surface geology with other geoscientific information, it is possible to predict geological scenarios that may better inform sustainable development objectives. Ongoing research in the conurbation of Greater Manchester, in northwest England (Figure 1), is working towards this objective through development of an integrated spatial model of the shallow subsurface.

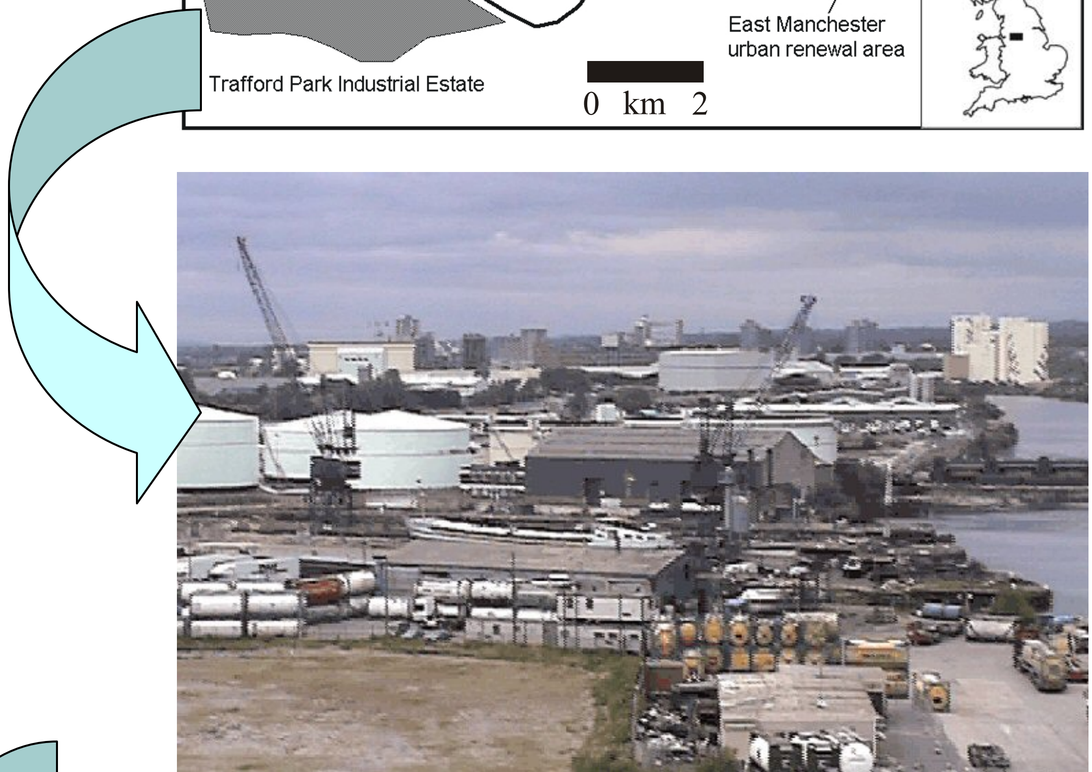
The Manchester three-dimensional (3-D) model (Figure 2) covers a geographical area of 100 km^2 and is built around a framework of 6,500 site investigation boreholes. The 3-D configuration of the geological units in the subsurface is built up from serial cross-sections, drawn interactively by combining map-face data with downhole information. Correlated surfaces are gridded, and stacked to produce the final geological model. Attribution of the model with a range of parameters (geotechnical, hydrogeological, geochemical) allows rapid generation of a range of derived products.

The model has the potential to deliver information in formats relevant to a wide range of planning issues (ground stability, contaminated land, groundwater management) (Figure 3). Currently, the model is being used to provide the Environment Agency of England and Wales with a framework for understanding groundwater resource and protection issues beneath one of Europe’s largest industrial parks.

The continued success of this approach will ultimately depend on engaging more fully with a range of users (consultants, planners) and demonstrating that there are real benefits (financial and environmental) in taking a more holistic approach to environmental assessment.



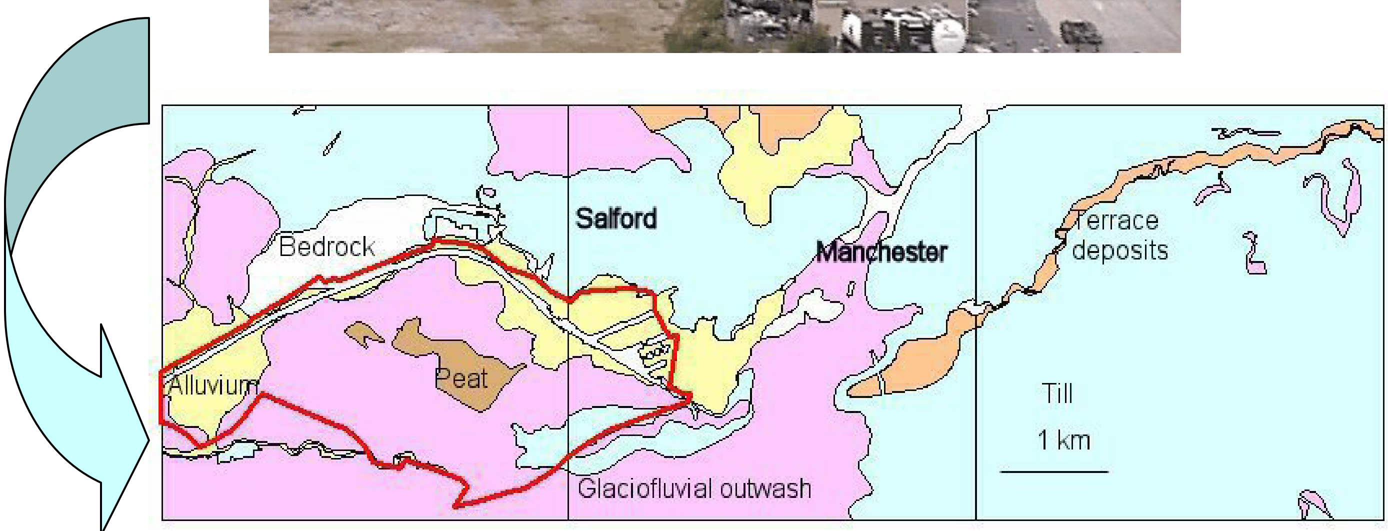
(a) Project area



(b) Trafford Park, Manchester

Issues:

- Groundwater management
- Aquifer protection



(c) 2-D map of superficial geology

Limitations:

- Difficult for the non-specialist to interpret
- Emphasis on top 2 m
- Difficult to produce derived (thematic) products

Figure 1. (a) Project area, (b) Trafford Park, Manchester issues, and (c) limitations of two-dimensional traditional geologic maps.

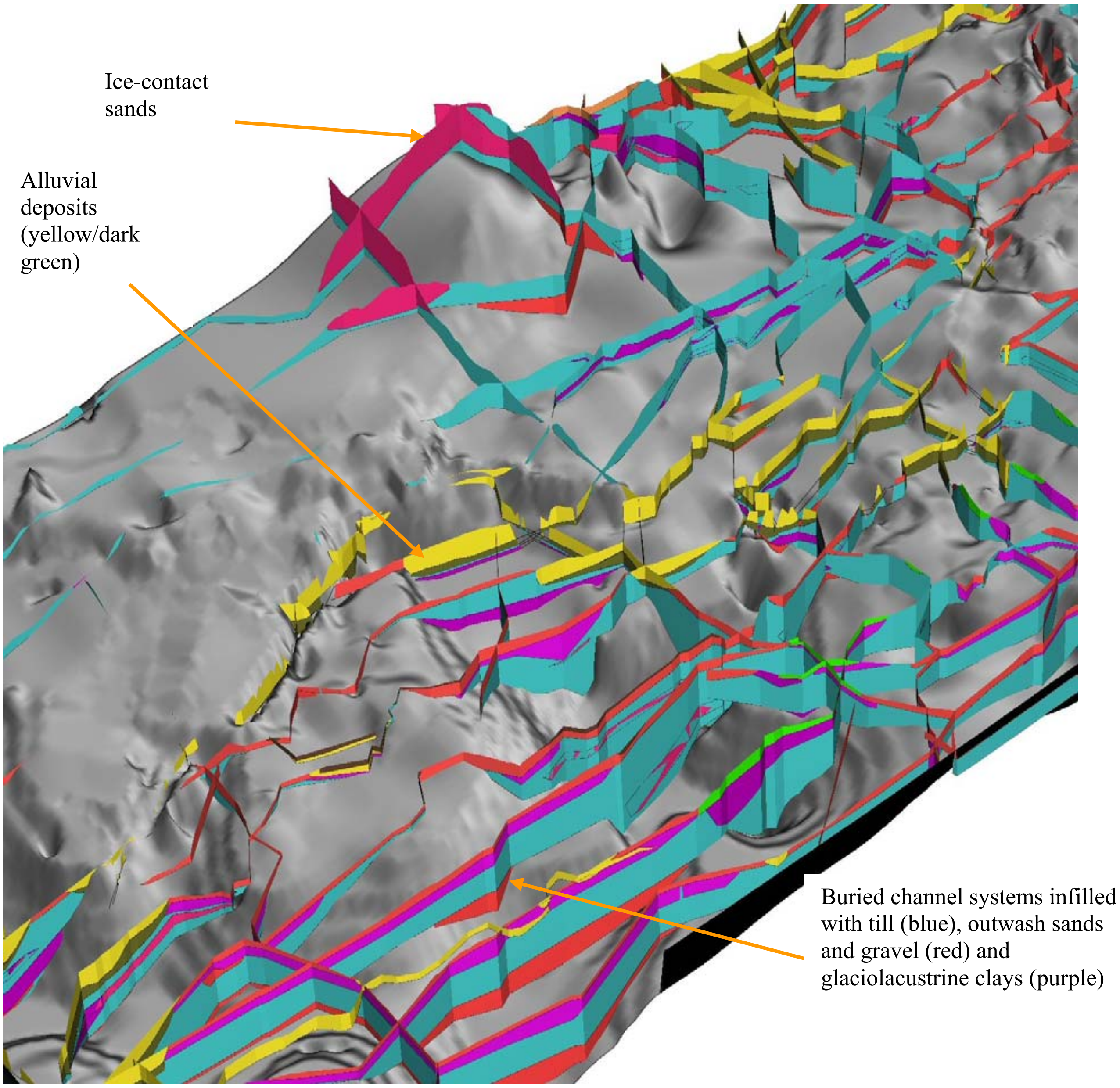
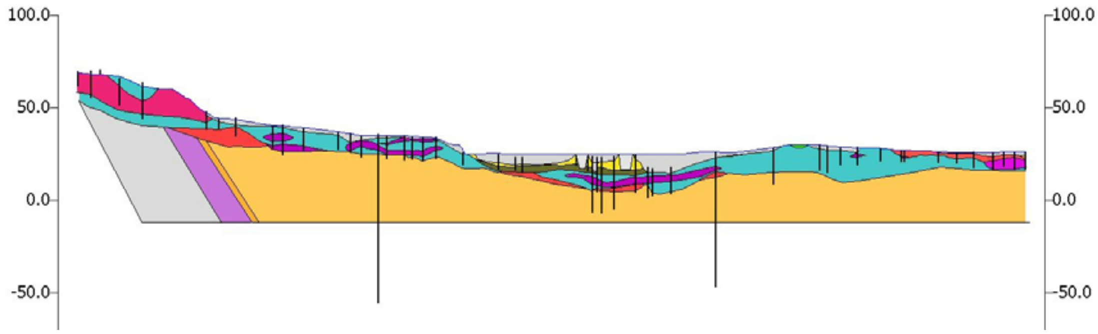
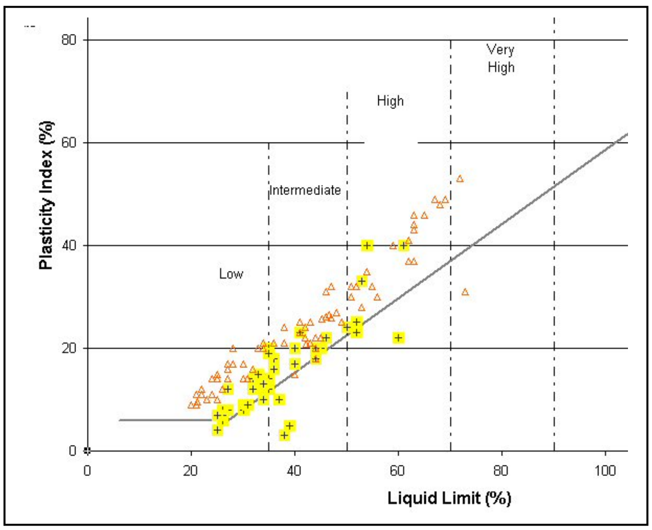


Figure 2. Three-dimensional model framework showing Quaternary deposits in multiple cross-sections lying on top of the Permo-Triassic sandstone aquifer (grey) in the Trafford Park area.

(a) Synthetic cross-sections along a user-defined transect (e.g., proposed pipeline route)



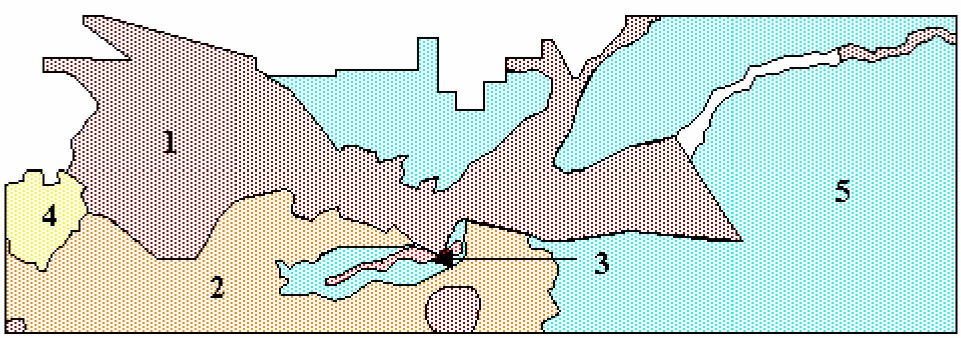
(b) Geotechnical properties of selected modelled units (e.g. for shrink-swell susceptibility)



Plasticity chart for alluvial silts (+) versus glaciolacustrine clays (Δ).

Under normal ground conditions, low and intermediate plasticity values generally indicate a low shrink-swell potential, whereas high and very high plasticity values indicate a high shrink-swell potential.

(c) Aquifer vulnerability



Hydrogeological domains map provides an assessment of recharge to the Permo-Triassic sandstone aquifer, and also an indication of groundwater vulnerability. (ranked 1-maximum recharge/vulnerability to 5 - minimum recharge/vulnerability)

Figure 3. Derivative products relevant to planning issues.