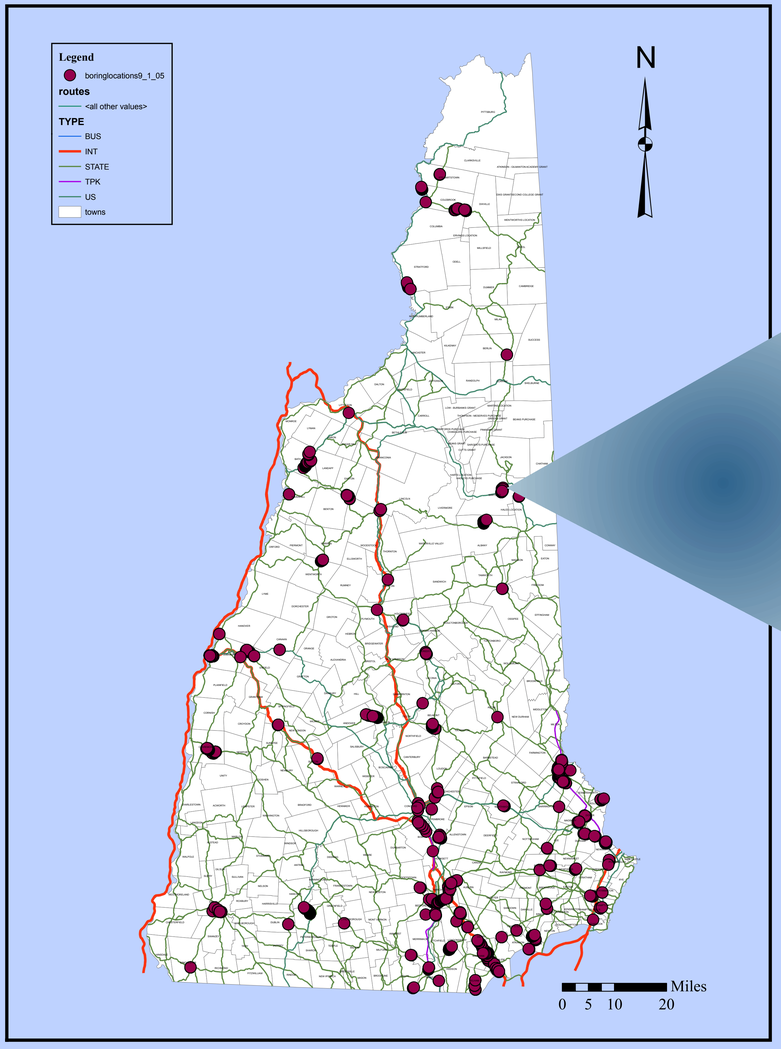
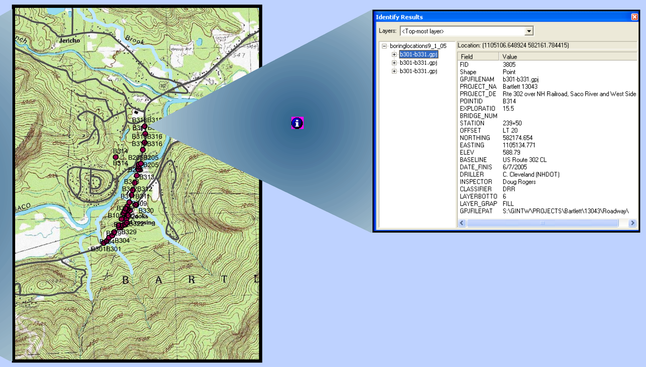
Geotechnical GIS

With Three Dimensional Modeling Capabilites

ABSTRACT

The New Hampshire Department of Transportation initiated this research to develop a geographical information system (GIS) that visualizes subsurface conditions three dimensionally by pulling together geotechnical data containing spatial references. The research procedure encompassed taking subsurface data housed on one of the Department's computer servers and exporting the data as text delimited files into a GIS running a 3D modeling extension. A statewide GIS layer was created to access all the available subsurface data so existing data in close proximity to new projects could easily be recognized. By observing where the least confident data is located, the 3D modeling extension helps to determine where and how many additional explorations are needed to adequately map the subsurface conditions to a defined level of confidence. For any particular geotechnical project, soil and bedrock surfaces can easily be identified and the bedrock surface can be exported into a CAD system where project cross sections can be drawn depicting the bedrock depths along a new roadway centerline.





USING THE GIS

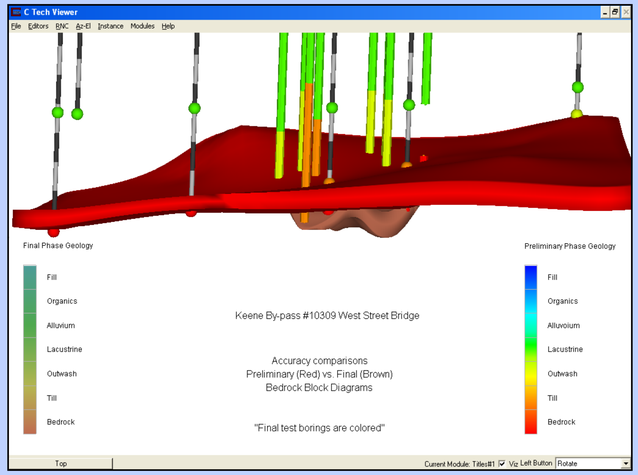
- Subsurface explorations from completed geotechnical projects are added into a geographical information system (GIS).
- These exploration locations are represented as point or line features.
- The statewide GIS layers of "Towns", "Hydro_All", "Roads" and "Routes" are used as base maps which helps to locate project areas.
- When new geotechnical projects are initiated, the GIS is checked for the locations of existing subsurface data
- Through a "mouse click" a table opens up, which displays all of an explorations attribute data.

BENEFITS

- The GPJSwitchboard Program quickly mines spatially referenced exploration data that has already been collected and entered into a NHDOT computer server.
- Easily developed 3D models create a better understanding of the subsurface soil and bedrock conditions over the entire area of the project.
- Statistically based bedrock elevation contours are easily developed in digital format which helps to improve accuracy and eliminates the process of drawing the bedrock lines by hand on the project cross sections.
- An uncertainty analysis provides a statistical basis for drilling the optimum number of test borings to help control time and costs while achieving a predetermined level of accuracy.

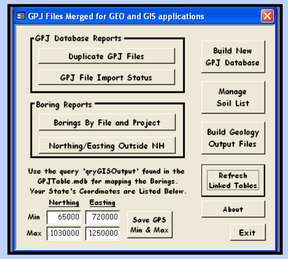
ACCURACY

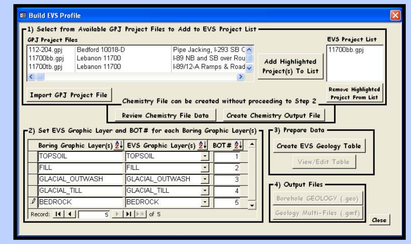
- Confidence diagrams are developed to help determine the optimal location and quantity of additional subsurface explorations required to achieve the desired level of confidence for any 3D model.
- Contour lines are developed for subsurface layers and are used to predict the layer depths at which the additional subsurface explorations will encounter that layer.
- When the desired level of confidence is achieved and the elevations on the contour lines match the depths at which the additional subsurface explorations encountered that layer, an accurate 3D model of the project's subsurface conditions is developed.

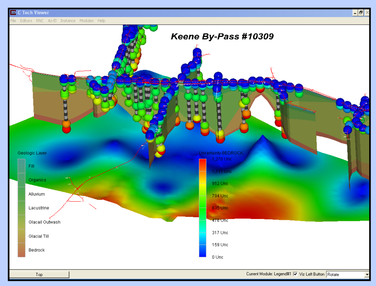


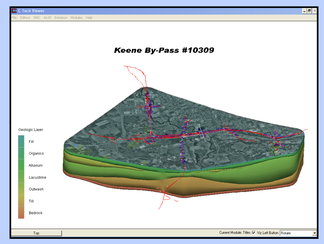
GPJ SWITCHBOARD PROGRAM

- Develops files for 3D modeling using structured query language that extracts all the subsurface exploration information stored in the numerous database files on the Department's server.
- The user combines separate exploration files together and then develops a geological hierarchy for the project.
- Through a simple "mouse-click" a specialized text file is written containing the data necessary to develop a 3D model.



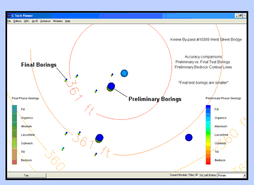


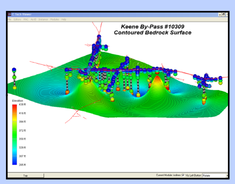


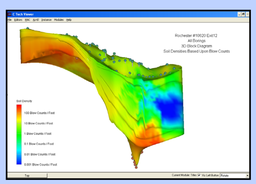


CONCLUSION

The development of the Geotechnical GIS with 3D modeling capabilities has proven to work well and its use and maintenance requires little additional work. Existing data already contained on the Bureau's server is the source of information. A statewide subsurface exploration layer is created and the existing exploration locations and attribute data are visible within the GIS viewer as point and line features. New projects initiated in close proximity to the existing subsurface data can easily be recognized and through a "mouse click" the existing data can be displayed in the form of a table. Specific test boring databases are identified and through the GPJSwitchboard Program a geological hierarchy and a specialized text file is developed. The 3D modeling extension is then used to view the existing data and to help determine where and how many additional explorations are needed to achieve the desired level of confidence for the project.







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