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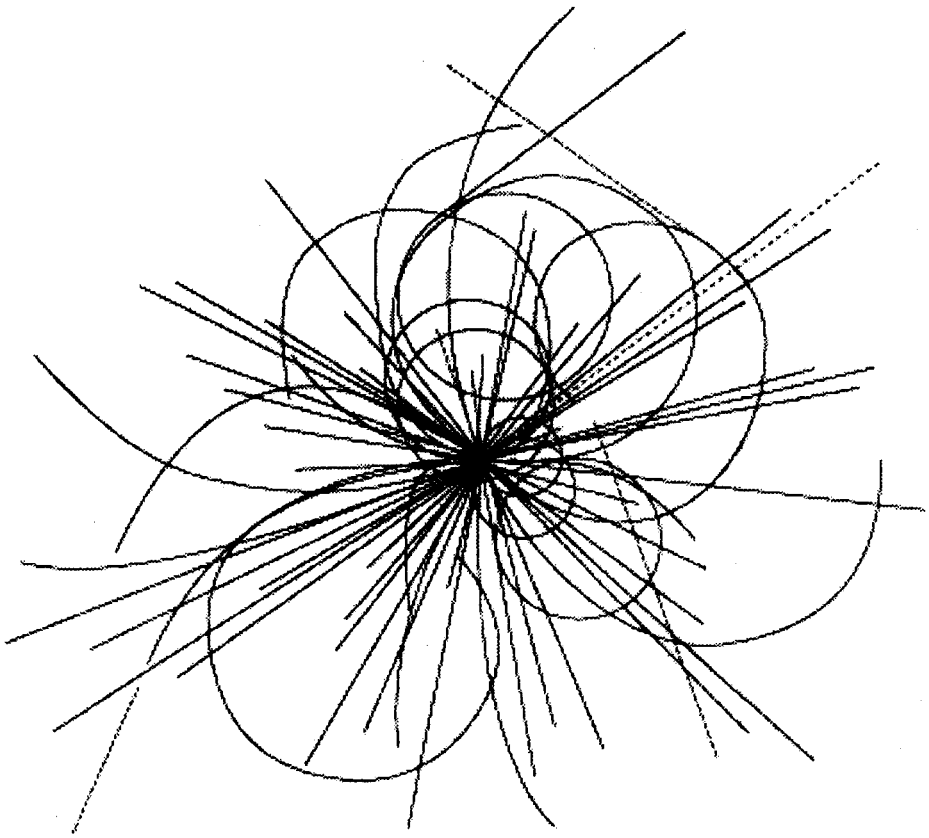

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CONSTRUCTION PHASE APPLICATIONS OF THE SSC GEOGRAPHIC INFORMATION SYSTEM

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INTRODUCTION

A Geographic Information System (GIS) was recognized as a tool for facility planning and public relations coordination early during SSC construction. Since October 1991, the SSC GIS group has been compiling regional, planning, engineering and surveyed information about surface and sub-surface features in the project area. Descriptive information (attributes) are stored in a relational database and associated with the mapped features. GIS provides a support service for many people working on the project by coordinating geographic database development between SSCL, DOE, PB/MK, Texas National Research Laboratory Commission (TNRLC), Ellis County, and the North Central Texas Council of Governments. Several construction phase applications have been identified and are in various stages of development, including GIS input to: site development planning; facility construction tracking; Land Information System (LIS); Real Property Inventory System (RPIS); building and structure naming; construction access routing; environmental permitting and annual impact reporting; chemical and hazardous material inventory system; emergency preparedness planning and E-911 system interface; land use management; and natural and cultural resource baseline characterization and monitoring.

GIS GENERAL DESCRIPTION

The SSC GIS is a computer-based system that provides a development, management and analysis environment for geographically positioned features integrated with descriptive information (attributes) in a relational database. GIS stores surface and sub-surface information about the project area as a series of coverages each representing a different theme or topic of information. The concept of coverage implies that an "intelligent" or topological structure exists between the geographic elements representing mapped features and database attributes associated with the features. Questions can be asked concerning the

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relationship between features and/or attributes. Maps and reports can be created to illustrate or summarize the results. GIS is an analysis tool where spatial relationships between various map features are identified then used to resolve conflict, evaluate impact and help manage project resources.

The system is being designed to encompass information that many users across multiple disciplines require for effective planning, design, engineering, construction, environmental monitoring and facility management. User needs will define the ultimate goals and informational content of the GIS and these needs vary from discipline to discipline. The SSC GIS will evolve to accommodate applications during all phases of the project's life. The GIS will integrate with other SSCL Technical Systems for applications that require geographic and related attribute data. In particular, site development planning, facility and real property management, environmental compliance and monitoring, radiation modeling, emergency preparedness and management, and materials management are identified as areas where technical systems integrate with GIS.

Intergraph, Arc/Info and ERDAS software are being used to develop two forms of geographic data; the vector model that represents map features as topologically structured points, lines or boundaries (polygons) and the raster model that represents information as images of pixels (picture elements) or grid cells. Attribute or descriptive data is to be maintained in an Oracle relational database with ties to the geographic data models. Digital data of potential use in the development of the SSC GIS include: Oracle and other relational database fields and records; ASCII data, File Maker Pro and spreadsheet files; CADD 2D and 3D drawings; point, line and polygon topological coverages; elevation and 3D models; digital orthophotography and satellite imagery; video and scanned photography; and scanned documents. These data types can be related to each other by a common geodetic network that provides NAD 83 Texas State Plane Coordinates to geographically tie the information together.

GIS application development is a process whereby the relationship between user needs, business functions, data sources and levels of accuracy are defined, then materialized into a system using documented standards. Several user groups from scientific, engineering and environmental disciplines have been identified. It is apparent that the SSC GIS must be multi-purpose and accommodate a wide variety of applications at different levels of map accuracy. Accuracy requirements have been grouped into six general categories; the survey level Land Information System (LIS), Engineering (1:480 to 1:2,400), Vicinity (1:4,800 to 1:9,600), Planning (1:12,000 to 1:48,000), Regional (1:100,000 and 1:250,000), and U.S./World Atlas (1:2,000,000). GIS provides digital base maps that can be used to manage attribute and other map information at these various levels of scale and accuracy.

CONSTRUCTION PHASE GIS APPLICATIONS

Site development planning is an ongoing process at the SSC. Now that GIS data is accessible, the system is being used in the design process. Potential conflicts can be identified when planning surface facilities or predicting surface impacts of underground structures. The GIS can overlay existing natural and man-made features as well as the proposed structure to "flag" interferences early in the design process. The GIS can also be used to calculate a rated plan for facility siting by indexing physical, environmental and other constraints. The system is used to evaluate design and alternatives so that better options can be forwarded through the design process. GIS is being utilized in this manner as the SSCL revises the Site Development Plan. GIS brings up-to-date facility and environmental resource information to the planning table so that master planning can progress efficiently.

Standard project maps have been prepared to locate facility sites, buildings and structures. The GIS Section coordinates with construction Task Leaders to ensure that building and structure numbers and names are consistent with the SSCL Standard Naming Convention. Buildings and structures are added to the composite database no sooner than the 90% design submittals. The location of buildings and structures is converted from the original CADD drawing files and processed into the GIS buildings and structures coverage, where structures are associated with descriptive information in the relational database. The geographic position of buildings and structures is updated throughout the remainder of the design process.

As-built footprints of buildings and structures will be entered into the database as they become available. However, there is a significant amount of time between when a building or structure is completed and when the as-built information is reflected in the contractor's CADD drawings. In this interim period, aerial photographs will be geo-referenced to satellite imagery and digital orthophotography, then used to temporarily map facility features. This expedites the visualization of major design changes and allows the database to track the location of temporary structures such as trailers and contractor lay down areas. GIS provides the location information to the Real Property Inventory System (RPIS), used by DOE to track real property.

A dynamic map has been developed by the GIS group to track contract awards, general construction activity and progress of the Tunnel Boring Machines. Information on construction status is collected at the beginning of each week and used to update the Collider Construction Progress Map. Copies of the map are posted bi-weekly at several locations throughout the Laboratory. A subset of this mapped information is illustrated in Figure 1.

The GIS is used to assist in the management of SSCL land. During the land acquisition process Universal Field Services, Inc. under the direction of TNRLC, compiled all surveyed parcels into a composite land base for the project. The GIS parcels coverage was processed from the composite land base. The coverage is used to track land ownership status for construction access and land use maintenance. Even though parcel boundaries within the site are no longer indicative of land ownership; historical, archeological, environmental, and land use management information is tied to the geographic features representing expired parcels. Utility easements, Right-of-Way boundaries, and survey markers will be extracted from the electronic plats for the land use management applications.

Applications are being developed for the SSCL Environmental Safety and Health (ES&H) Division and ES&H Oversight Department as well. Map and location information from the system is being used for permitting and other environmental compliance and mitigation issues. The GIS is working with ES&H groups to establish the environmental baseline to which changes will be measured and monitored. GIS coverages and spatial analysis capabilities are being utilized in emergency preparedness planning and management. The ES&H chemical inventory database will also interface to the GIS for location information and spatial analysis as required for material management.

Priority GIS construction phase tasks include: 1) development of all LIS and engineering coverages for use in construction, facility planning and land use management activities; 2) survey system integration for as-built and other coordinate data visualization; and 3) production of thematic coverages such as the Ellis County street network, construction access routes, geotech and soil information, hydrology, land use - land cover, political boundaries, utilities, and environmental resource data for planning and construction applications. GIS operation and maintenance is scheduled to begin Fall 1993 for critical applications such as land use and real property management, building and structures naming, site development planning, emergency preparedness, and survey information

system interface. Additional GIS applications will be defined as end user interfaces are developed for these critical projects. Ultimately, database query, cartographic system interface and menu options will be developed so that efficient links to other technical systems are provided for SSCL facility management.

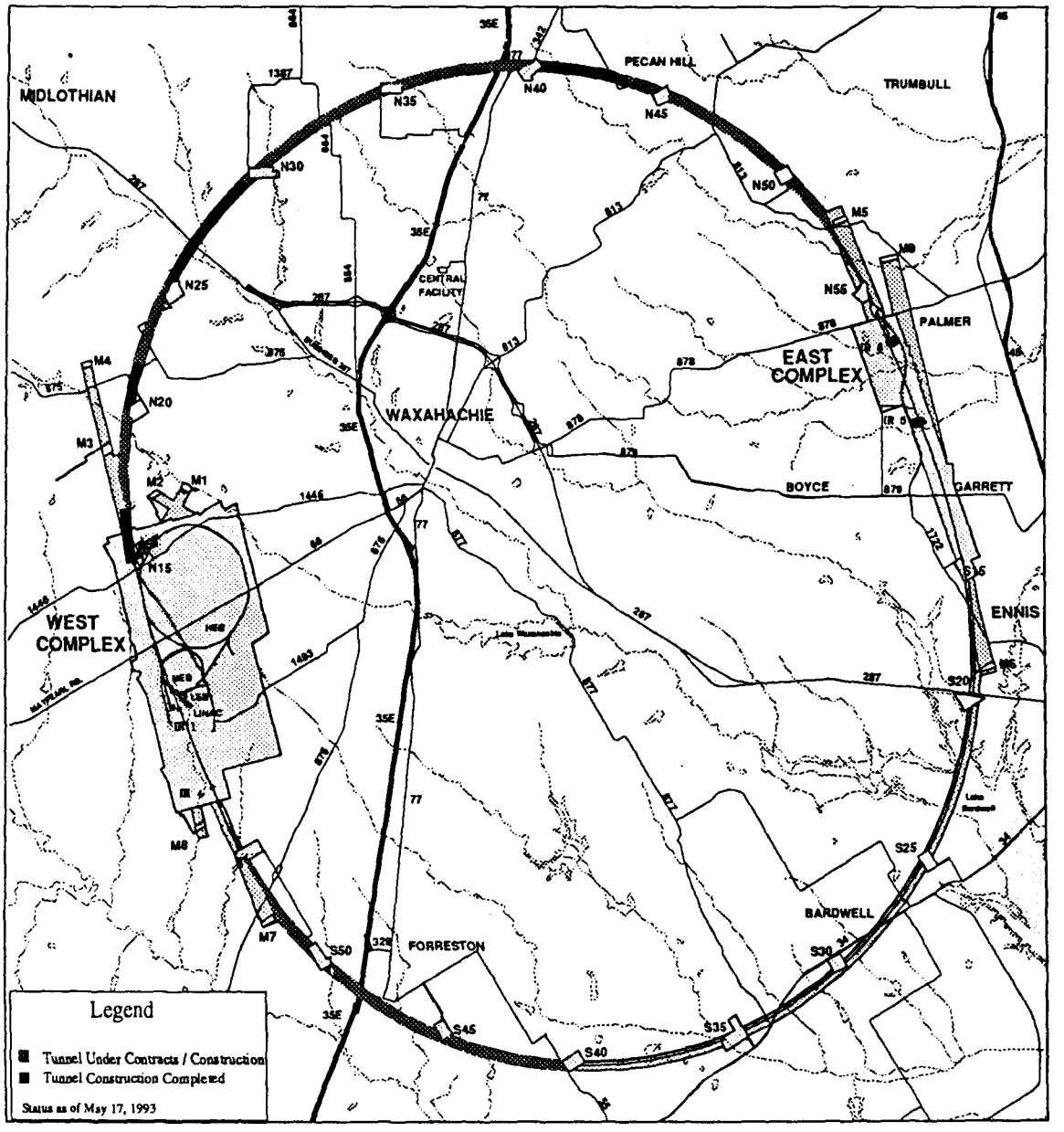

Figure 1. Information subset from the Collider Construction Progress Map showing weekly advancement of Tunnel Boring Machines.