

NC Floodplain Information on the Web

By Shuqin Jin

Introduction

Federal Emergency Management Agency (FEMA) and State of North Carolina (NC) have a joint project to publish digital flood maps on the Web. The information can be used for insurance rating or local/regional applications. The information includes base maps, flood maps, engineering data, inventory data, and images. They all can be downloaded from the Web. The information system uses these technologies: ArcGIS, ArcSDE, ArcIMS, SQL Server, and MS Datacenter. This paper will describe the whole system design and technologies involved.

Background

North Carolina has high vulnerability to hurricanes and flooding. There are about 15 federally declared disasters since 1989. Hurricane Floyd's damages was about \$3.5 billion and it also revealed limitations of flood data and maps. Over 75% of NC Flood Insurance Rate Maps (FIRMs) are over 5 years old. In 2000, NC signed a Cooperating Technical State (CTS) partnership agreement with FEMA and other Federal, State, and local agencies to re-map the entire State and to share cost. The key components are system design and implementation, scoping, data development/modification including DFIRMs, and data loading.

System Design and Implementation

1. System Requirements

The system manages and distributes flood hazard-related data including:

- DFIRMs
- Raw Light Detection and Ranging (LIDAR) data
- Processed Digital Elevation Model (DEM) data
- Engineering/Inventory supporting data
- Base and imagery data
- Flood Insurance Study (FIS) data
- Address locating data
- Data viewer and downloading
- Data maintenance and uploading
- Map printing
- Metadata

In general, the system is mainly web-based applications. It supports several user communities: the State, federal/local governments, general public, and contractors. The system is also designed to scale-up if new applications and data will be added.

2. System Design

Based on system requirements and applications' needs, the system is designed as the following:

2.1 Hardware Review

- FTP/Web Servers - They provide download services to support internet data delivery and file access.

- 2 ES2024 Dual Pentium 3 servers (clustered);
 - 2 1-GHz CPUs;
 - 512 MB RAM;
 - 2 10/100 Ethernet adapters;
 - 3 fibre channel HBA to access SANs
 - Windows 2000 Advanced Server OS

- Map Servers - They provide interactive user-defined data downloads and map services to support user applications requirements.

- 2 ES2024 Dual Pentium 3 servers;
 - 2 1-GHz CPUs;
 - 512 MB RAM;
 - 2 10/100 Ethernet adapters;
 - 3 fibre channel HBA to access SANs
 - Windows 2000 Advanced Server OS

- Database & SDE Servers - They provide data query and management services to support web and ArcIMS applications.

- Unisys ES7000 (single domain & 2 clustered servers);
 - 16*700 MHz Intel CPUs;
 - 16 GB RAM;
 - 2* 36 GB disks (mirrored);
 - 2 10/100 Ethernet adapters;
 - 3 fibre channel HBA to access SANs;
 - ESS software suite;
 - Windows 2000 Datacenter OS

- Terminal Servers - They provide access to central applications and servers.

- 2 ES2044 servers;

4 Xeon 700-MHz CPUs;
3 GB RAM;
2 10/100 Ethernet adapters;
Windows 2000 Advanced Server OS;
Citrix MetaFrame 1.8

- Domain Server - It provides domain and network management.

1 ES2024 Dual Pentium 3 server;
2 1-GHz CPUs;
512 MB RAM;
2 10/100 Ethernet adapters;
Windows NT Advanced Server OS

- Test Server - It provides a test environment for database, SDE, and data loading.

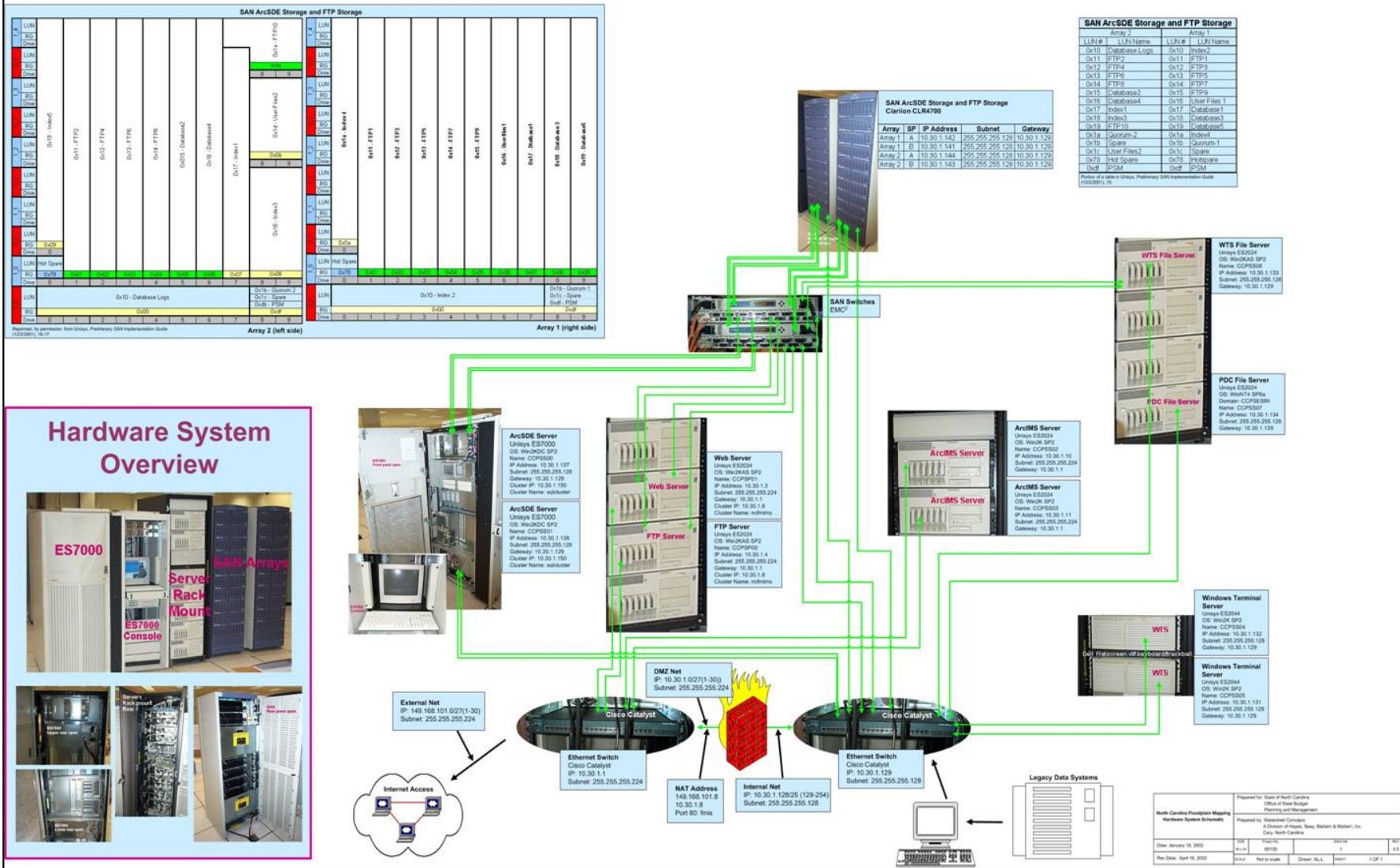
1 ES2024 Dual Pentium 3 servers;
2 1-GHz CPUs;
512 MB RAM;
2 10/100 Ethernet adapters;
3 fibre channel HBA to access SANs
Windows 2000 Advanced Server OS

- Storage Area Network (SAN) - It provides data storage for database servers and files.

ESM7900 (EMC FC4700);
10 TB SANs (Raid 5 or Raid 0+1);
SAN and brocade switches

Hardware Overview Picture:

North Carolina Floodplain Mapping Hardware System Schematic



2.2 Software Review

- SQL Server (SP3) - It hosts databases for SDE server, flood data, and applications.
- SDE 8.1 - spatial server.
- ArcIMS 3.1 - spatial map server
- ServletExec 4.1 - extract server
- ArcGIS 8.1 - data viewing and editing
- IIS - web server
- Citrix 1.8 - terminal server

- Embarcadero ER/Studio - database modeling tool
- StarTeam - change control tool

2.3 Database Review

The objectives are to support and manage all flooding data, hydrology models, digital mapping, web applications, and FEMA standards. FEMA database documents were reviewed and integrated into database structures. Data were grouped into Base, Map, Inventory, Engineering, Imagery, Terrain, and Metadata. Basic geodatabase models were used for GIS applications and tabular data.

Base Data includes base mapping data from the State or local sources. It provides information on road networks, imagery sources, grids, political boundaries, schools, airports, etc.

Map Data includes necessary data to produce DFIRMs. It may access other data groups too. It provides information on flood hazards, Base Flood Elevation (BFE), coastal data, cross sections, FIRM panels, water data, mapping data, etc.

Inventory and Engineering Data include field data and modeled hydrology data. It provides information on 3-D, gage data, field survey data, stream data, hydrology models, etc. These data are still in development stage and are not in production system.

Imagery is stored in SDE as pyramids. Original files are TIF format and can be downloaded from web base on panel grids.

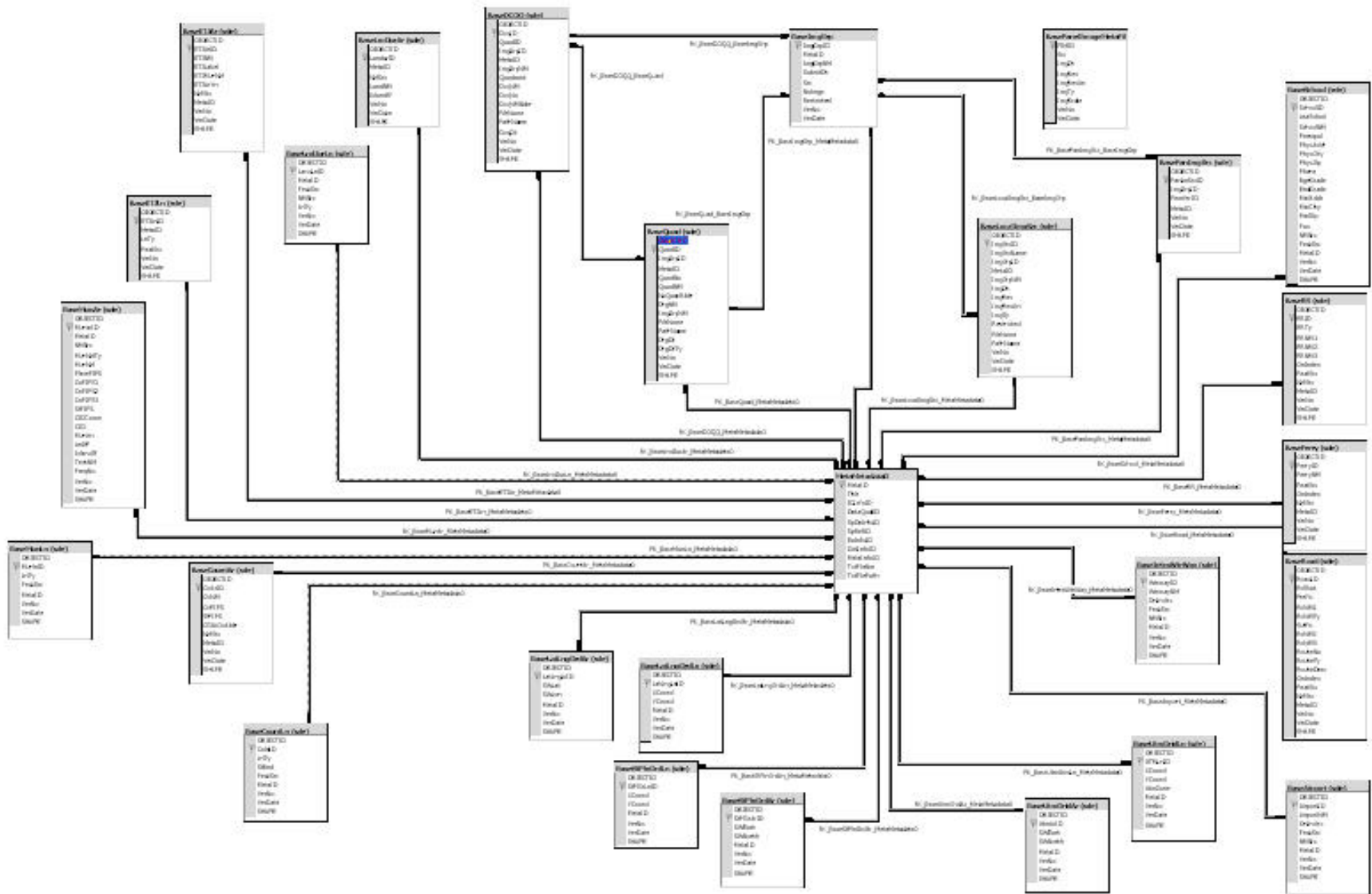
Terrain Data includes bare earth data, DEM20/DEM50. DEMs are generated from raw LIDAR data by contractors. All Terrain Data can be downloaded from the web using a special grids.

Current Metadata includes all FGDC components. All GIS data have Metadata and others are not ready yet.

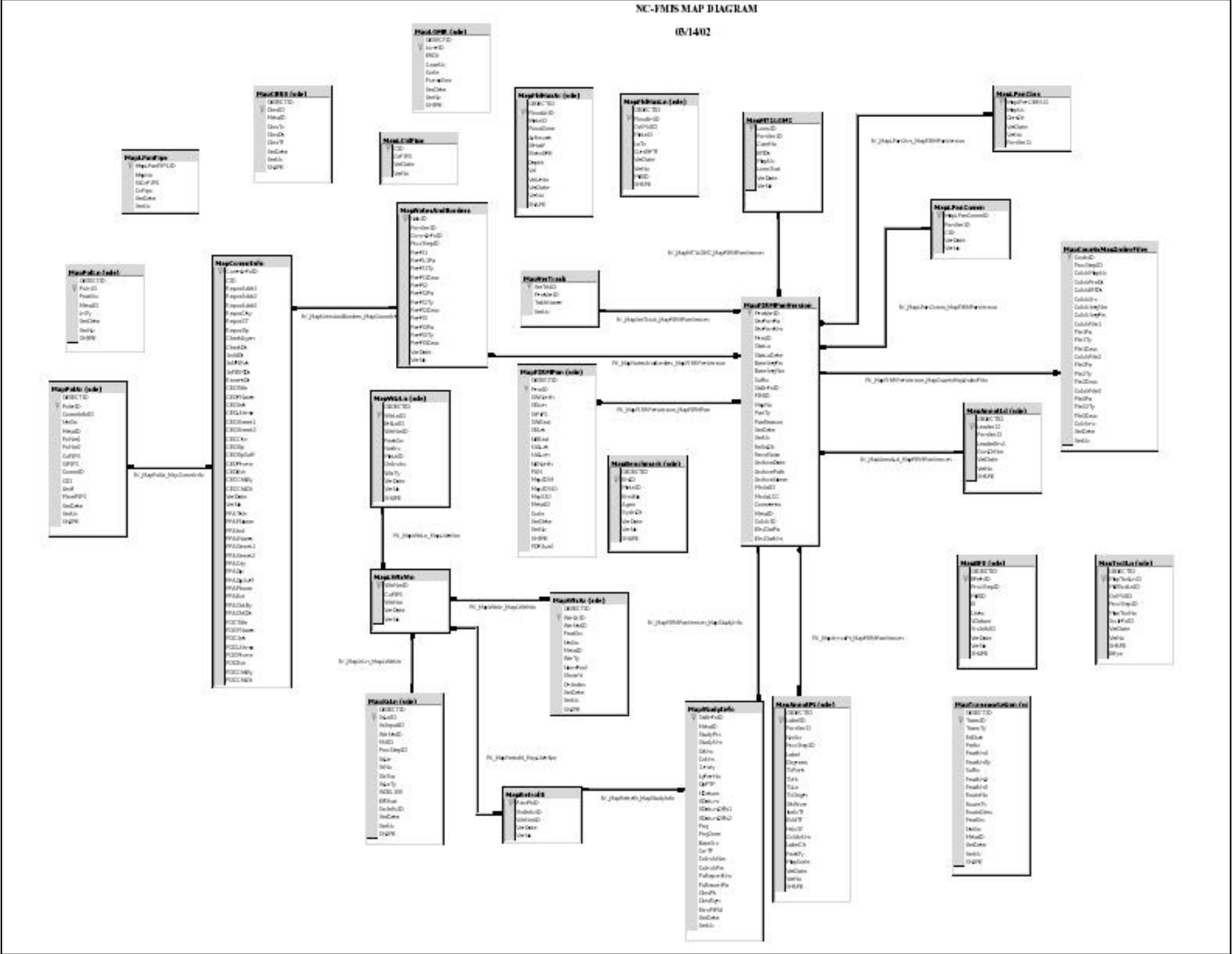
Base Data ERD:

NC-FMIS BASE DIAGRAM

03/14/02



Map Data ERD:



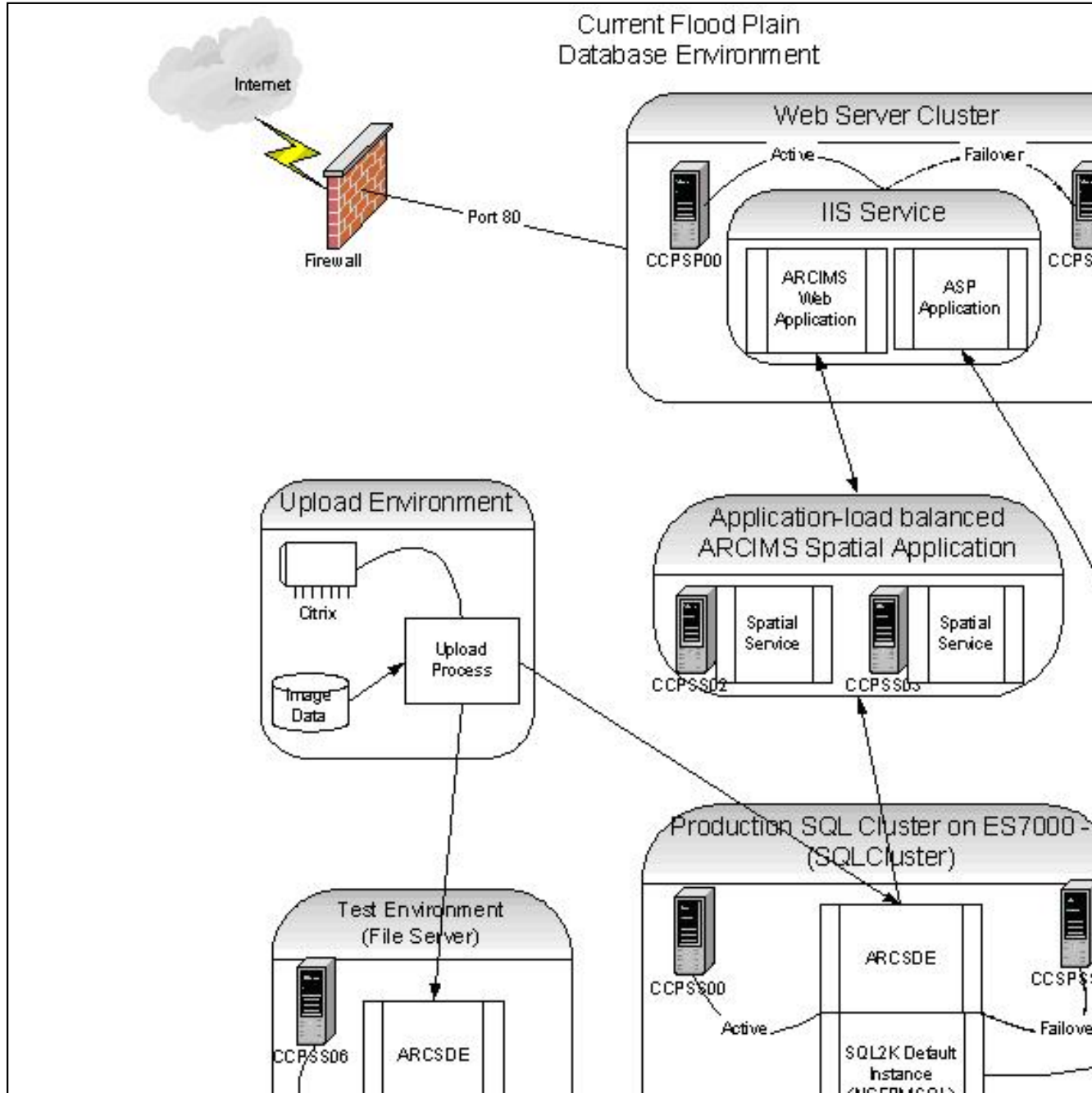
3. System Implementation

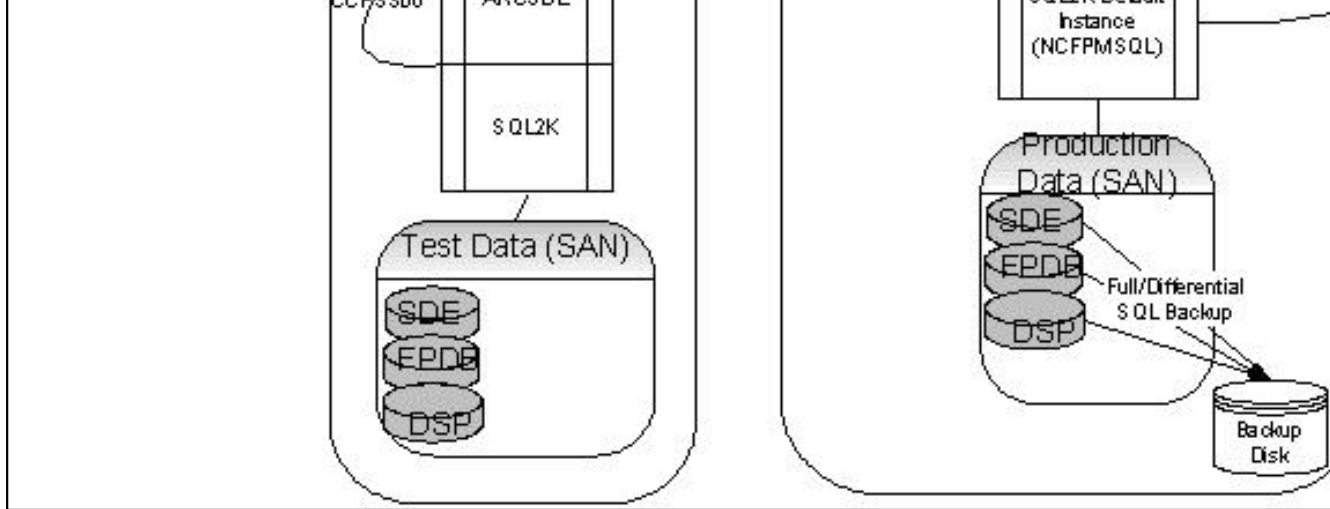
Production system is hosted by the State's Information technology Services (ITS) at a secure facility due to security and network issues. Hardware and storage were set up by contractors. Most applications and software are Commercial Off-The-Shelf (COTS). They were initially put together by contractors

and the State staff modified and enhanced them later. The most challenging issue was Firewall and the whole system had to be re-configured to accomplish that.

ArcIMS application is mainly a COTS. It accesses SDE data referenced by AXL files. Downloading application is using ASP application and ArcIMS passes information to the ASP application. The ASP application also access SQL Server data directly through ODBC connection.

The following picture is an overview of current system environment:





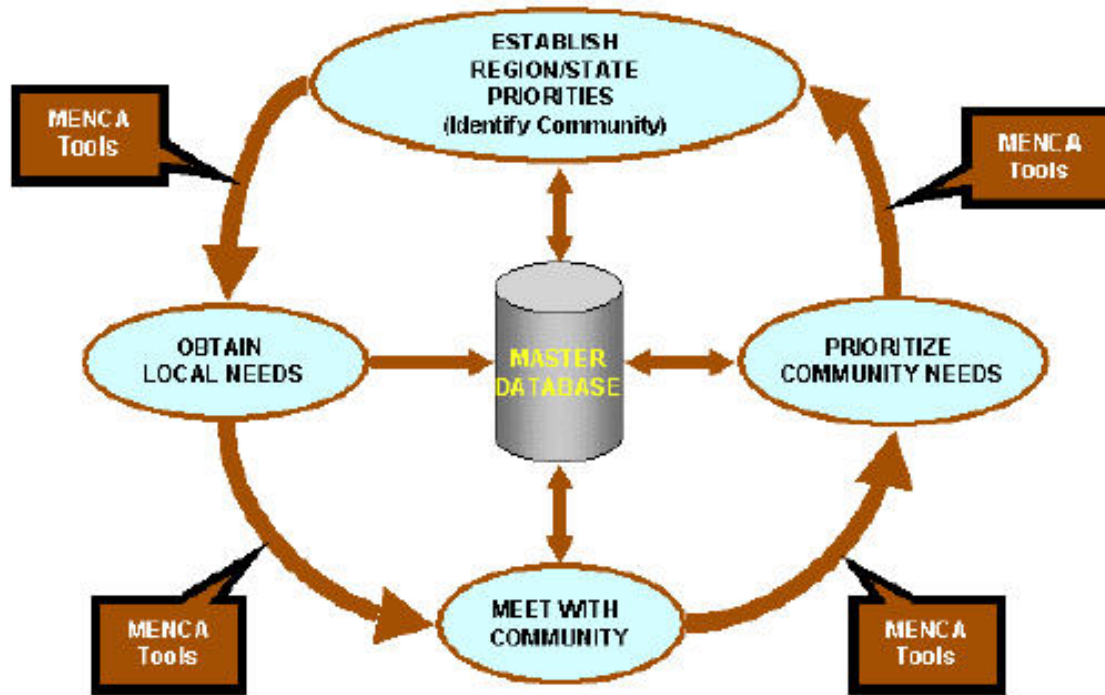
Scoping

Scoping is to collect the following information:

- ordinances and general community data
- contacts and scoping meetings
- GIS data and FIS/FIRM data
- stream study type and priorities
- recommendations

A tool was developed to assist scoping teams to collect, display, and report information.

Scoping Process



Data Development

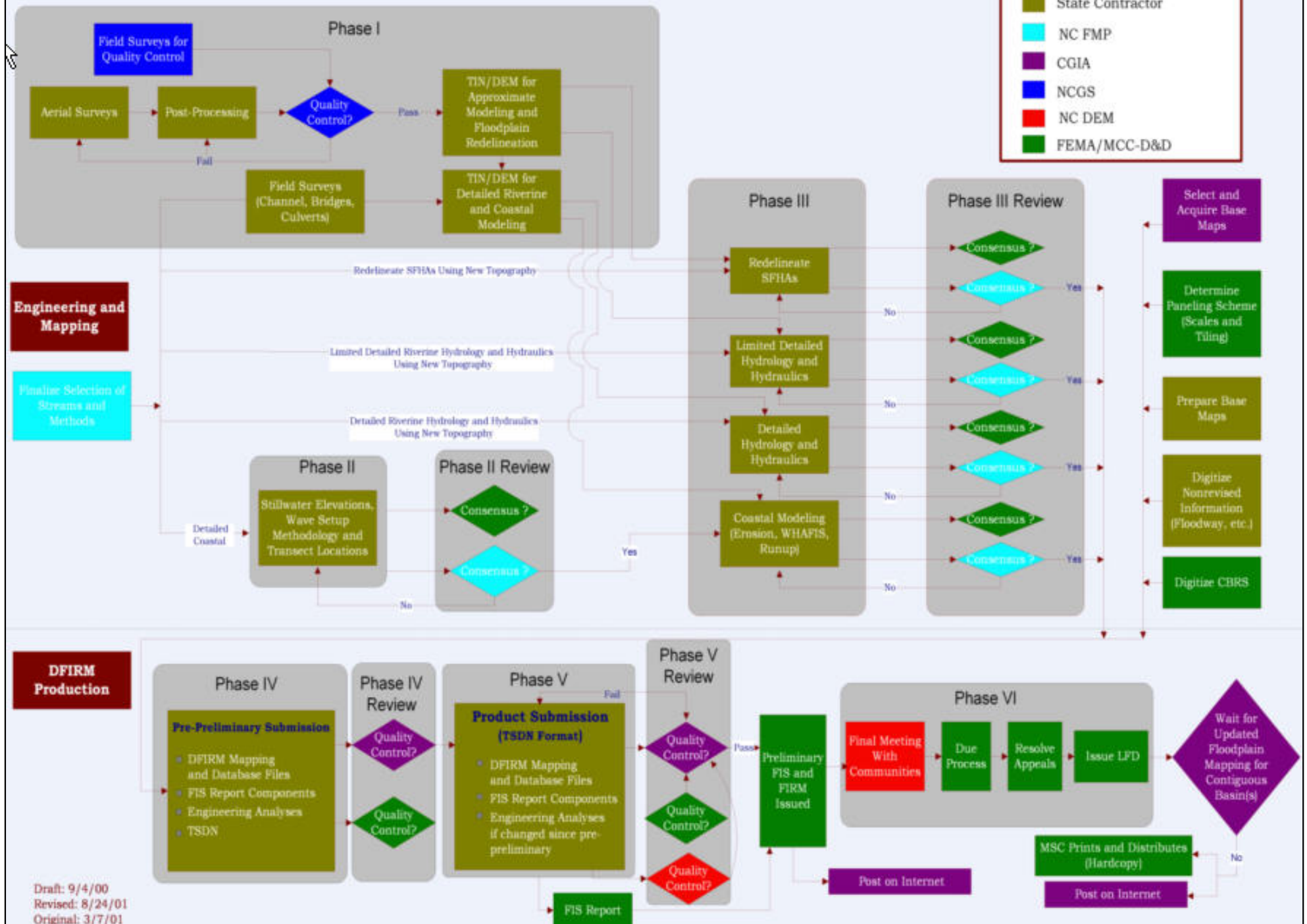
It starts with LIDAR and Hydrology studies because these data are required to generate GIS data or databases. DEMs and imagery may also be used in hydrology data processing. Then, Base Data, Map Data, and DFIRMs can be generated. The State's current contractors are using different approaches: **MicroStation + ArcGIS** and **ArcGIS only**.

The following picture is an overview of production process:

North Carolina Floodplain Mapping Program Production Process

Primary Responsibility

- State Contractor
- NC FMP
- CGIA
- NCGS
- NC DEM
- FEMA/MCC-D&D



Draft: 9/4/00
 Revised: 8/24/01
 Original: 3/7/01

Data Loading

GIS data from contractors are "access" databases and shapefiles. These data are validated and loaded to SDE and SQL Server databases in test environment first. SDE data and layers are QAed/QCed before loading them to production. Imagery files are TIF format and loaded to SDE as pyramids. Rebuilding pyramids are slow and the State plans to re-visit imagery storage settings and configurations.

Web Site DEMO

Some Web site windows:



The screenshot shows a Microsoft Internet Explorer browser window displaying the website for the North Carolina Floodplain Mapping Program. The browser's address bar shows the URL <http://www.ncfloodmaps.com/>. The website content includes a header for "Hyde County and Digital Flood Maps" with a "Download Maps & Data" link. Below this are sections for "Public Documents" (Look through our documents archive), "News" (News releases), "Status" (Project specific information), and "Links & Resources" (Links to sites and other related resources). A large image on the left shows a flooded area with a bridge and a lighthouse, with the text "NORTH CAROLINA Floodplain Mapping Program" below it. A paragraph of text describes the website as a free service provided by the state of North Carolina, offering the latest information on the Floodplain Mapping program and a link to learn about the State's partners.

North Carolina Floodplain Mapping Program - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Media Mail Print

Address <http://www.ncfloodmaps.com/> Go Links

Hyde County and
Digital Flood Maps
Download Maps & Data

NORTH CAROLINA
Floodplain Mapping Program

This website is a free service provided by the state of North Carolina. The latest information on the Floodplain Mapping program is provided here. Learn about the State's [partners](#) in this project.

Public Documents
Look through our documents archive

News
News releases

Status
Project specific information

Links & Resources
Links to sites and other related resources

North Carolina Floodplain Mapping Information System - Microsoft Internet ...



North Carolina Floodplain Mapping Program

WELCOME TO THE NORTH CAROLINA FLOODPLAIN MAPPING INFORMATION SYSTEM

The North Carolina Floodplain Mapping Information System (FMIS) is an integral part of the North Carolina Floodplain Mapping Program. Using a map-based interface, users have three sets of web-based applications available for viewing, downloading, and determining address/flood boundary information throughout the State of North Carolina.

Flood Data Availability Notice

[Go to Online Flood Maps](#)

Note: This online mapping website is optimized for monitors whose screen resolution is set to 1024x768. It will work with monitors whose screen resolution is set at 800x600, but your browser experience will not be as functional. Monitor resolutions under 800x600 are not supported.

Data Viewer Tool

This tool allows you to browse, navigate, and display data that is part of FMIS. The Data viewer also provides you with information what flood insurance rate maps and report are available for download. Depending on the map scale, layers become automatically visible for viewing and downloading.

[Home](#)

[Background](#)

[Public Documents](#)

[News](#)

[Maps](#)

[Status](#)

[Future Plan](#)

[Links & Resources](#)



N.C. Floodplain Mapping Information System

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Zoom In

[Flood Data Availability](#)

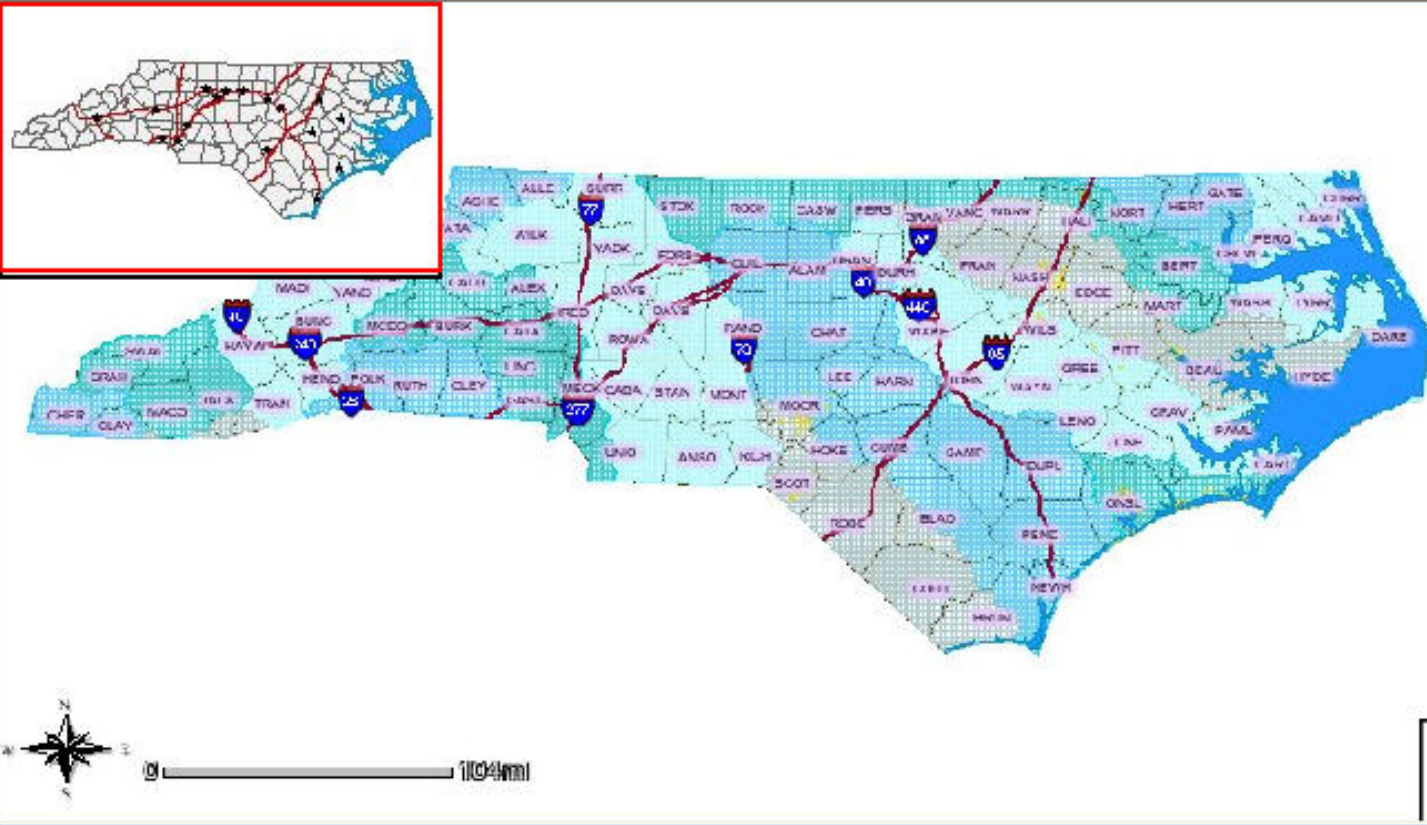
Notice

Map Data Layers

Visible Layers Active Layer Layer Name

Refresh Map

- Blue Ridge Parkway
- NHS
- Interstates
- Municipal Boundary
- Parks, Gameland, Forests, Reserves and Open Space
- Coastal Sounds
- Major River Basins
- County Boundaries



Conclusions

The project was implemented successfully and won several awards. About 20 of 100 NC counties' data were loaded as of June, 2003.

