DIGITAL IS OFFICIAL

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Acknowledgments

Table of Contents

Executive Summary

The Federal Emergency Management Agency (FEMA) publishes Flood Insurance Rate Maps (FIRMs) that are used for risk identification, floodplain management, and flood insurance in the National Flood Insurance Program (NFIP). In the NFIP Reform Act of 2004, Congress included *Section 107 – Geospatial Digital Flood Hazard Data* establishing digital geospatial flood hazard data distributed by FEMA as having equivalent legal standing to the paper maps. On November 29th, 2007 FEMA provided additional policy entitled: *Use of Digital Flood Hazard Data* that effectively separates or "unbundles" FEMA's official digital representations of flood hazard data from the base map features (e.g., streets, rivers and orthophotos).

FEMA is transitioning to the use of digital data in lieu of paper maps, but realizes that there are numerous constraints and issues for many States and local communities. At this time, these constraints predominately relate to State law and how communities can meet notice and other due process requirements when adopting the digital data. Other constraints come about since States and communities that are accustomed to only dealing with paper maps as the official map for floodplain management will need help adapting, managing and maintaining data in a digital environment.

The Association of State Floodplain Managers (ASFPM) was tasked by FEMA to identify any potential constraints and issues related to the official designation of digital flood hazard data as follows:
- Due process issues related to digital data
- State and local regulations regarding official digital data
- Solutions to improve use of digital data by State and local governments
- Examples of ordinance language that have adopted digital data
- Minimum requirements for States and locals to use digital data

The constraints and issues identified and presented herein have been divided into three subject related categories; (1) legal, (2) practical and (3) technological issues. There are obvious and sometimes blurred constraints and issues that cross between categories, but overall it provides an organized and consistent approach.

Legal Issues

Based on the documents, readings and analyses available from several States and local jurisdictions as of this writing, there has been no dissent by any State regarding use of digital flood hazard data being legally equivalent and interchangeable with printed products. And, in fact, digital databases and geospatial databases are being designated as official already with many local and State agencies converting paper products to GIS databases (i.e. the Santa Clara County, CA - GIS Zoning Map). But, in order for these electronic records or digital datasets to be considered official there are requirements beyond those required for paper or printed documents.

The major legal issues for FEMA, States and locals are:
  I. The requirement to maintain linkages between the digital data and all vital documents used to create or maintain that digital data, and

II. The requirement to maintain a system that can reproduce the original and historic data throughout the life of the electronic record

In order for Geospatial Digital Flood Hazard Data to become official electronic records FEMA, State and locals need to fulfill the requirements described in State statutes and regulations as appropriate. For example, Wisconsin's Administrative Code, which is clear about requirements for both the State and local communities and official electronic records. FEMA's current distribution of DFIRM datasets does satisfy the Wisconsin requirements. The legal issue may be less onerous in the future if State and local jurisdictions take on the roll of maintaining the official Flood Hazard digital data version as they would more likely be aware of State and local legal requirements related to digital data.

Practical Issues

For the digital flood hazard data to support legal requirement for accessibility by the general public, floodplain managers and a range of other users, States and communities would need the capacity to provide hardware and software tools for viewing (e.g. kiosks, web-based interactive maps); technical guidance on appropriate use; methods or procedures to print or display maps, reports and supporting documents (e.g. FIS, metadata); and educated staff to develop the hardware, software and guidance manuals as well as use the delivered products. Four basic capacity levels are suggested, starting from lowest level of capacity to highest:

(1) No capacity
(2) Basic/adequate capacity (minimum level)
(3) Intermediate capacity
(4) Full capacity

As the four levels increase, the capacity or ability to utilize digital data and/or electronic map products also increases. These levels suggest a more formal structure for understanding what digital products (e.g. print maps, images, digital datasets) can be delivered as well as identify the resources needed to offer more robust methods of data delivery and analysis related to flood hazard identification, mitigation and risk communication.

Beyond the hardware, software, network and staffing capacity requirements there is a need to better document the relationships between the flood hazard data and the other vital datasets and documents and provide cartographic templates and or specifications along with the digital database product. A Data Dictionary would provide a solution to the former while features like ESRI's *Cartographic Representations* could solve the latter.

Technological Issues

It is recognized that FEMA has developed the Data Capture Standards (DCS) that provide a consistent framework for submitting, storing and retrieving study data or "backup data" that are utilized to derive the FIS and FIRM. The DCS provides a solid foundation for a flood hazard data model that integrates all the spatial and non-spatial data into something similar to the Enhanced DFIRM database. Taking the current FEMA successes to the next step should include the development of a flood hazard mapping business process and data model capable of integrating State and local datasets developed or designed with higher standards.

Recommendations

The recommendations derived from the legal, practical and technological issues are:

I. **Develop the business process for the creation/maintenance of the Digital Flood Hazard Data Model to ensure reproduction**
Official documents or databases need to be reproducible in order to be legally defensible. The business process – creation/maintenance/validation process – would be encapsulated within the flood hazard data model to ensure spatial relationships, data validation (subtypes, domains) and transaction history and versioning of data features.

II. **Develop a robust Digital Flood Hazard Data Model to support explicit linkages between datasets described in the Data Capture Standards (DCS)**
A digital flood hazard data product/model should support full linking capabilities, by electronic means or direct reference, to all the vital datasets, documents, processes and procedures used to develop the Special Flood Hazard Areas, Base Flood Elevations, Insurance Risk Zones and other regulatory information. Features of a robust Digital Flood Hazard Data Model would prove valuable for integration and analysis – such as linking DFIRM features to the U.S. Geological Survey's National Hydrography Dataset. Linkages to the NHD by stream reach codes or Hydrologic Unit Codes for watersheds, basins and sub-basins would offer a structured, well-known system for locating flood hazard data. It would also facilitate accessing other water related data when flood hazard data are being developed or updated.

III. **Develop a set of guidelines for each defined capacity level (Section 4.2) so communities know which product matches with their capacity**
States and locals can assess their capacity levels in relation to available FEMA Digital Flood Hazard products or tools and can then choose the appropriate products or tools that match their capacity level (e.g. FIRM PDFs, the National Flood Hazard Layer for Google Earth).

IV. **Enhance metadata support and develop a Data Dictionary**
FEMA should amend metadata profiles to provide greater flexibility in adding free text so the metadata may more accurately describe the dataset it was meant to describe. If the metadata submission is final, the elements should reflect that status and date. Finally, metadata should reflect multiple process methodologies used to generate flood hazard boundaries such as those derived by redelineating a boundary or based on new detailed studies. Feature level capture of process methodologies may be a solution and would be in line with the recommendation for a robust data model suggested above (Recommendation II).

A data dictionary provides users more information beyond standard metadata with a quick reference for names of datasets, attributes and relationships through join fields or a possibly a cartographic display hierarchy.

V. **Develop Cartographic or Project templates**
Define default display parameters of vector datasets to help users ascertain appropriate symbology, display rules, hierarchy, annotation/text placement

and layer priority in support of usability. An example would be the use of ESRI's *Layer files* (.lyr) or *Cartographic Representations[1]*.

VI. Develop a broader definition of Digital Flood Hazard Data

For comprehensive floodplain management and analysis, a broader definition of digital flood hazard data may be required. A broader definition should incorporate beyond FEMA's published products and official designations to include the spatial and non-spatial flood hazard information (e.g. reports, datasets, models and applications) used to derive or display the SFHAs, BFE, risk zones and regulatory information. In other words, this definition should include all the input and output elements that allow the comprehensive management and analysis to occur.

VII. Develop additional Community Rating Systems (CRS) credits for Geospatial Digital Flood Hazard Data use and analyses

CRS credits could be evaluated for systems that capture more specific datasets or develop analyses and reports that support larger floodplain management goals. Additional datasets may include building locations with lowest level elevation and building footprints. Analysis that supports floodplain management goals may include using GIS to generate more accurate floodplain planning metrics, such as:
  o Acres of green space within the floodplain
  o Structure counts segregated by flood zone (e.g. floodway, flood fringe) and/or flood depths.
  o Past, present, future types of land-use in floodplain and
  o Changes in land-use based on FPM policies or regulations

The common characteristic that connects each of the issues presented here is the need to have State and local community involvement. The level of complexity and volume of data and information that will need to be managed to develop a fully integrated Enhanced DFIRM Database product will require considerable State participation. Legal authority for States to play the central role in all aspects of flood mapping has been a suggested goal and one that ASFPM endorses. Senate Banking Committee Chairman Richard Shelby stated these goals as part of the "Purpose and Summary of Legislation" for the Flood Insurance Reform Act of 2004. On May 13, 2004 Senator Shelby wrote:

> "The Committee also recognizes and encourages FEMA in its goal to eventually hand over the legal authority to oversee, maintain and administer flood mapping to states which are interested and capable of maintaining and administering their own flood mapping program. This includes the responsibility to publish maps, issue letters of map change, preliminary and post-preliminary processing and issuance of Flood Insurance Study reports, Digital Flood Insurance Rate Maps and authorize interested and capable states to charge review and processing fees for Letters of Map Change."

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[1] Cartographic representations have been designed especially for cartographers who need to manage how and where features will be symbolized and depicted on a map or multiple maps that are derived from a common database. From ESRI Website visited on July 10, 2008: http://www.esri.com/technology_trends/cartography/representations.html

1.0 Introduction

1.1 Digital is Official

The Federal Emergency Management Agency (FEMA) publishes Flood Insurance Rate Maps (FIRMs) that are used for risk identification, floodplain management, and flood insurance in the National Flood Insurance Program (NFIP). In the NFIP Reform Act of 2004, Congress included a section establishing digital geospatial flood hazard data distributed by FEMA as having equivalent legal standing to the paper maps. FEMA is transitioning to the use of digital data in lieu of paper maps, but realizes that there are legal and practical constraints for many communities. These constraints mostly relate to State law and how communities can meet notice and other due process requirements when adopting the digital data. States and communities that are accustomed to only dealing with paper maps as the official map for not only floodplain management, but for other land use regulation will need help adapting to a digital environment.

Transition from paper Flood Insurance Rate Maps (FIRMs) to geospatial digital flood hazard data and the derived printed and/or electronic products has a number of issues falling under three general categories that include the; (1) legal, (2) practical, and (3) technological aspects of digital data as the legal record. Legal issues focus on due process and model ordinances; practical issues deal with usability and the capacity of States and communities to work with the digital products; and technological issues consider data security and integrity, appropriate data models and the cartographic elements used to distribute and publish the approved digital datasets and their derived products.

As FEMA begins transitioning from paper to digital map products, States and communities have legal, practical and/or technological issues that need to be addressed to ensure that the digital products meet their needs – these issues include:

1. Community floodplain ordinances reference a specific map title and map date. Communities may be uncomfortable with referencing a digital vs. hard copy map due to concerns regarding the integrity of the information (e.g. they may be challenged in court to prove that the flood boundary lines have not been corrupted or altered inappropriately). Communities need proper guidance on how to reference digital maps in their ordinance and how to institute security protocols to maintain data integrity.

2. Procedures for Adopting Digital Data - Communities usually adopt floodplain management regulations under their State land-use enabling authorities and must meet notice and other due process requirements in order to adopt flood hazard data. Typically, this means that the map must be available for public inspection and an official copy filed before the ordinance can become effective. Communities are used to meeting these requirements using paper maps. The mechanics of the adoption process and technical limitations may limit a community's ability to adopt digital data. The challenge is to identify or develop protocols for meeting these notice and due process requirements for digital data.

1.2 Organization of this Report

The remainder of this report is organized as follows. Section 2.0 contains background material, definitions and specific FEMA policies that supply the groundwork for this paper. Section 3.0 describes the legal issues surrounding due process, adoption and model ordinances as they relate to "Digital is Official". Section 4.0 considers the practical implications for State and local authorities for the use of digital data in lieu of paper map products. Section 5.0 provides a technological perspective focusing on how new digital tools and products will be integrated within existing Geospatial technologies; the capacity of State and local communities to implement these tools and products; the structure of these new digital products and how these new and existing digital datasets and derived products will be maintained. In Section 6.0 the common threads that link the legal, practical and technological will be summarized followed by conclusions and recommendations.

2.0 Background

The Federal Emergency Management Agency (FEMA) has been providing flood hazard maps since the 1970s to help manage and reduce risk for the more than 20,000 communities that participate in the National Flood Insurance Program (NFIP). Historically, FEMA provided flood hazard information through paper Flood Insurance Rate Maps (FIRMs). FIRMs show zones with high flood risk, the height of the flood water and other contextual information such as roads and political boundaries. Digital geospatial data products that depict flood hazards were added to the product assortment in 2003 when Congress funded the Flood Map Modernization Program, which enabled the upgrade of paper FIRMs to the digital geo-spatial platform.

Section 107 of the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (42 USC 4101) established that digital geospatial flood hazard data distributed by FEMA has equivalent legal standing to the paper maps. Section 107 reads as follows:

> For the purposes of flood insurance and floodplain management activities conducted pursuant to the National Flood Insurance Program under the National Flood Insurance Act of 1968 (42 U.S.C. 4001 et seq.), geospatial digital flood hazard data distributed by the Federal Emergency Management Agency, or its designee, or the printed products derived from that data, are interchangeable and legally equivalent for the determination of the location of 1 in 100 year and 1 in 500 year flood planes, provided that all other geospatial data shown on the printed product meets or exceeds any accuracy standard promulgated by the Federal Emergency Management Agency.

A policy clarification to the NFIP approach to the implementation of Section 107 was issued on November 29th, 2007 titled *Use of Digital Flood Hazard Data* (*Attachment 1*). This policy in effect "unbundled" or separated the special flood hazard area from the base map features. The policy states that the "… special flood hazard area on new products is defined by geographic coordinates". In other words, the horizontal location of the flood hazard information is defined with respect to the primary coordinate system and not its relationship to the base map features such as streets and rivers.

For purposes of this paper, the term *digital data* will be used in place of *geospatial digital flood hazard data* unless needed for clarity.

2.1 FEMA Map Modernization

Since 1973, FEMA has compiled, printed and distributed Flood Insurance Rate Maps (FIRMs) containing flood hazard features (e.g., flood hazard areas, BFEs, risk zones) and base map features (e.g., roads, hydrography, municipal boundaries, and sometimes PLSS section lines). The original paper FIRM was a planimetric map that utilized grayscale printing and contained all the cartographic elements (e.g., legend, scale bar, title, panel #, locator map) needed to make the map usable.

Through the 1980's, digital data mostly in the form of Computer-aided Design (CAD) files were beginning to be used to process and produce the paper FIRMs. Geographic Information Systems (GIS) data came of age in the 1990's and FEMA joined the technology transformation by releasing Q3[2] data. However, due to limited horizontal control on the FIRMs, digitizing hardcopy FIRMs results in distortions of the floodplain boundaries. In addition, Q3 data were lacking BFEs, cross sections, and other features shown on paper maps making it difficult to use Q3 data within GIS for mapping applications related to flood insurance and floodplain management.

The accuracy standards developed with Map Modernization (e.g. the Floodplain Boundary Standard) enabled the DFIRM datasets developed during Map Modernization to be used more effectively with a variety of other more current and accurate GIS datasets, which include orthophotos, roads, building footprints and parcel boundaries to name only a few.

FEMA has two formats for DFIRM datasets – one that is called planimetric that looks very similar to the hard copy FIRMs and another format that includes orthophotos as a base layer. This new format requires different cartographic symbolization for usability. Additional color is required to make the map readable, which also requires different printing capabilities. It should be noted that some States (e.g. Delaware) have opted to continue using the planimetric format without orthophotos as a base map.

Through the transition from paper to digital data, FEMA's roles have also transitioned. Where local community and nonfederal sources of basemap data are not available, FEMA utilizes national GIS datasets for the basemap features such as U.S. Geological Survey orthophotos quadrangles or the U.S. Census Bureau's TIGER/Line features. As more States and locals produce GIS basemap datasets that meet FEMA's accuracy requirements for use with the digital flood hazard data, FEMA's role in performing quality control and distribution of the national basemap datasets has decreased. The increase in quality State and local datasets allows FEMA to focus less on base mapping and more on the flood hazard information. In this regard, the Nov. 29th policy described above (also Attachment 1), more clearly defines (1) FEMA's published products (Section VII Policy: B. Policy) and (2) FEMA's legislated responsibilities with regards to official FEMA designations of flood hazard information. The published products described are:
- Paper Maps - FIRMs
- Digital Map Images
  - Full Size FIRM Scans
  - Letter Size FIRMettes
- Digital Geospatial Flood Hazard Data – DFIRM Database

The legislated responsibilities provided by 42 U.S.C. 4101 make all the above products and the printed versions produced from the official digital products equivalent and official FEMA designations for:

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[2] Digital Q3 Flood Data has been developed by scanning the existing FIRM hardcopy and vectorizing a thematic overlay of flood risks. The vector Q3 flood data contains only certain features from the existing FIRM hardcopy.

- Areas of Special Flood Hazard (SFHA)
- Base Flood Elevations (BFEs)
- Insurance Risk Zones, and
- Other Regulatory Information

Digital flood hazard map products published by FEMA include the FIRM Scans and the DFIRM as described above and additionally include the National Flood Hazard Layer (NFHL) GIS data set and the NFHL Web Map Service (WMS). The NFHL is a statewide GIS dataset, only where FEMA has modernized maps, and includes Letters of Map Revisions (LOMRs). The WMS is a web map service with defined map symbology meant for use within a GIS or other mapping software.

Tools that provide access to print or view the digital flood hazard map products described above include:
- FIRMette Desktop (F-MIT) – desktop software to create a map from a portion of the FIRM Scan
- FIRMette Web – Internet software to create a map from a portion of the FIRM Scan
- MapViewer Desktop – Desktop software to make maps and view attribute data from the DFIRM or NFHL
- MapViewer Web – Internet software to make maps and reports from the NFHL
- NFHL Google Earth utility – files that allow the viewing of the NFHL Web Map Service in Google Earth

2.2 FEMA Digital Data Formats

As Map Mod has progressed FEMA has undergone a transition in its collection, storage and retrieval of technical and administrative data needed for a Flood Insurance Study (FIS) or Flood Insurance Rate Map (FIRM) revision. FEMA describes the Standard DFIRM database and the Enhanced DFIRM database in *Appendix L: Guidance for preparing Draft Digital Data and DFIRM Database* in the *Guidelines and Specifications for Flood Hazard Mapping Partners (April 2003)*:

> The **Standard DFIRM Database** is provided to end users who do not require the complete engineering backup data; however, it is not intended to limit the scope of the GIS data collected and submitted to FEMA. The full GIS database that contains all of the available flood study information is called the Enhanced DFIRM Database
>
> The Standard DFIRM Database was designed to present the effective flood hazard information published by FEMA. Users who only need to know whether a structure is in or out of the Special Flood Hazard Area (SFHA) or what the base flood elevation is for a location will be able to use the Standard DFIRM Database. Users who want to reference the engineering analyses or utilize any of the supporting data behind the effective flood hazard data will need to use the **Enhanced DFIRM Database**.

The DFIRM definition[3]:

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[3] Glossary: Guidelines and Specifications for Flood Hazard Mapping Partners (April 2003)

>   **Digital Flood Insurance Rate Map (DFIRM)** – A Flood Insurance Rate Map that has been prepared as a digital product, which may involve converting an existing manually produced FIRM to digital format, or creating a product from new digital data sources using a Geographic Information System environment. The DFIRM product allows for the creation of interactive, multi-hazard digital maps. Linkages built into an associated database to allow users options to access the engineering backup material used to develop the DFIRM, such as hydrologic and hydraulic models, Flood Profiles, data tables, Digital Elevation Models, and structure-specific data, such as digital elevation certificates and digital photographs of bridges and culverts.

The goal of the Enhanced DFIRM Database is to archive in an electronic and systematic format all of the data collected during the production of a FIS in a specific format. The Enhanced DFIRM Database specifications contain additional defined spatial and non-spatial data items and tables that are not in the Standard version including archives as available for engineering, modeling, surveying, topography, and mapping data and tables. According to the Enhanced DFIRM Database page on the FEMA Website[4] these include the following:
- Sub-basins with links to discharges, storm data, and regression equations;
- Gages, including rain gages, river gages, and coastal gages;
- Nodes with links to node discharge data and zipped hydrologic model(s);
- Profile base lines;
- Overbank flow paths;
- Additional cross section data including links to a frequency (rating) table and the zipped hydraulic model(s);
- Additional coastal transect data including links to the zipped coastal model(s);
- Primary frontal dunes;
- Modeled coastal shorelines;
- An outline of the studied area(s) with links to FEMA case information;
- Photographs, sketches, etc. linked to spatial features;
- Documentation for variable data that may be developed for the flood study (e.g., topographic data, land use, soils, roughness);
- Zipped files containing general information on methodology (e.g., Technical Support Data Notebook); and
- Zipped Flood Insurance Study (FIS) documents (e.g., FIS text, flood profiles, Floodway Data Tables).

The Standard DFIRM database, or DFIRM, is the currently implemented and distributed version of FEMA digital flood hazard data for each community. The DFIRM is delivered in three digital data formats:
1. ESRI Arc Shapefiles
2. ESRI Arc Export Files
3. MapInfo Files

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[4] FEMA's Enhanced Digital Flood Insurance Rate Map (DFIRM) Database Website (visited Sep. 2008): http://www.fema.gov/plan/prevent/fhm/dfm_eddb.shtm

The delivered digital data formats described above do not explicitly maintain the linkages described in the definition of the DFIRM, Standard DFIRM database or the Enhanced DFIRM database. Linkages in this case would be defined as having a direct reference within an attribute field or through metadata to the physical location of all datasets or models used to create the DFIRM products. While the standard DFIRM database has been implemented and distributed, the defined approach of the Enhanced DFIRM database has been tempered and transitioned into the Data Capture Standards (DCS) [5]. The current DCS provide a consistent framework for submitting, storing and retrieving study data or "backup data" that is utilized to derive the FIS and FIRM.

Essential flood hazard datasets and information used to derive the FIS, SFHAs, BFEs, insurance risk zones and map products include, but are not limited to:
- Engineering Models
  - Hydrology inputs/outputs
  - Hydraulic inputs/outputs
- Floodway Data Tables
- Cross-sections
- Digital Elevation Models (DEM)
- Coastal Transects
- Stillwater Elevations and wave setup
- Base map features
  - Road and railroad center lines
  - Political boundaries
  - Digital Ortho Quarter Quads (DOQQs) – FEMA default data
  - Orthophotos

The DCS provides for a common storage location of the essential and related components needed to derive the FIS and subsequently the DFIRM. FEMA includes many of the above flood hazard datasets and information elements in its definition of a DFIRM (previously provided) and the DFIRM Spatial Database [6]:

> **Digital Flood Insurance Rate Map (DFIRM) Spatial Database –** A database designed to facilitate collecting, storing, processing, and accessing data developed by FEMA, enabling Mapping Partners to share the data necessary for the DFIRM production and conversion process. Where possible, all mapping and engineering data elements are linked to physical geographic features and georeferenced. The use of a Geographic Information System as a component of the DFIRM spatial database provides the ability to georeference and overlay the mapping and engineering data, allowing the database to support a wide variety of existing and forthcoming FEMA engineering and mapping products.

The DFIRM Spatial Database definition requires a robust data model that would create explicit linkages between all the information and data captured under the DCS and potentially incorporate the additional datasets put forth by the Enhanced DFIRM database. The Data Capture Standards bring many of the essential elements together with the distinction of not including specific linkages between components. The data

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[5] Appendix M: Guidelines and Specifications for Flood Hazard Mapping Partners (Sep. 2008)
[6] Glossary: Guidelines and Specifications for Flood Hazard Mapping Partners (April 2003)

model required for a DFIRM Spatial Database has yet to be developed by FEMA; however its inclusion in this discussion demonstrates FEMA's awareness and understanding of the technology as it moves forward with Flood Map Modernization.

The choice to include and describe to the largest extent possible, a complete set of essential flood hazard datasets and information elements, such as those submitted to meet the requirements of the Data Capture Standards provides the capability to link the data and/or information used to produce the DFIRM with the DFIRM. The issue of maintaining data linkages is described in detail in section 3.0 Legal Issues, of this paper.

3.0 Legal Issues

A number of States and local jurisdictions have provided legal opinion and/or general analysis on the topic of official electronic data or geospatial digital flood hazard data as a legal equivalent format to current paper records. In this chapter, the first section summarizes the information from the Community Assistance Program - State Support Service Element (CAP-SSSE) assessment[7] of State legislation regarding automatic adoption (see Section 3.1 below). States were also asked whether in their State - digital maps have the equivalent legal status as hard copy maps. These opinions provide important information regarding due process as it relates to adopting ordinances regardless of the format (print vs. digital). FEMA's adoption process, including due process is provided below for reference with brief examples from two States describing how they use digital data within their adoption process. Then issues related to implementing Sec. 107 of the NFIP 2004 Reform Act are discussed in detail, followed by ways to improve how States and communities use digital data. The last section highlights communities that have already adopted digital data into their floodplain management ordinances and statutes.

3.1 State Attorney General Opinions on Auto-Adoption & Digital Data

As part of the Community Assistance Program - State Support Service Element (CAP-SSSE) assessment of State legislation, a request for Attorney General (AG) Opinions was made regarding the State's public notice requirements. Specifically – would the State allow community floodplain management ordinances to reference a Flood Insurance Rate Map and all subsequent updates or would the State require map revisions to go through due process and be public noticed. This has been termed – "auto-adoption" – if public noticing of map revisions is not required. Additionally, a follow-up question was asked of some States whether digital data may be adopted in lieu of paper maps. Of interest for this report is any indication by the States as to whether they do or do not allow digital forms of flood hazard maps as official in lieu of paper maps.

AG Opinions were received from twenty-two (22) States with fifteen (15) of those States describing auto-adoption as valid for local governments and communities. With regards to the digital geospatial flood hazard data issue, three (3) State AG's – Pennsylvania, Washington and Vermont – discuss the use of digital data in lieu of paper maps at the State and local levels. Appendix A presents a brief summary table that lists the States offering opinion along with the name and office providing the opinion.

There are instances in which States or communities have written into their ordinances that digital flood hazard data has equal status with paper flood maps (see *3.5 Community Case Studies – Adopted Digital Data*).

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[7] Attorney General opinions were received from 22 States. Copies of these opinions are available through FEMA's Community Assistance Program - State Support Service Element (CAP-SSSE).

3.1.1 Digital Issues in CAP-SSSE Assessment

None of the Attorney General opinions specifically state that a digital form of the Flood Insurance Rate Maps is prohibited. And, to date, ASFPM has not found any State or local jurisdictions that prohibit the use of digital data as a legal equivalent to print or hardcopy representations. Pennsylvania, Vermont and Washington provided some comment on the issue of digital data and of these three States providing opinion, the general consensus is that there is nothing prohibiting the State from using digital data and maps in lieu of paper maps.

However, as acknowledged by the State of Washington's Assistant Attorney General, there may be cases where some local governments require that an official paper copy of an ordinance be maintained on file somewhere. The Assistant Attorney General sees this essentially as a local question, stating that "… if e-maps are the wave of the future, something should be put in the model flood ordinance to the effect that the FIRM maps may be either paper or electronic". Winnebago County, Wisconsin, provides an example of language that can be put in local ordinances for this purpose. See Section 3.5.1 - References to Digital Data and the "Official Map". Additional examples are provided in Section *3.5 Community Case Studies – Adopted Digital Data*.

3.2 Due Process and Public Notice

FEMA's adoption process is described below showing how communities can meet due process requirements with digital data. This is followed by various approaches that a few States follow to make paper and digital maps available to the public as part of the due process requirement.

3.2.1 FEMA's Adoption Process for Flood Insurance Rate Maps

Each time that FEMA provides a community with additional flood hazard data, the community must adopt new floodplain management regulations or amend existing regulations. to incorporate the new data and meet any additional requirements that result from any changes in the data, such as the designation of a floodway. Floodplain management regulations must also meet any additional State requirements and be adopted through a process that complies with any procedural requirements established in that State for the adoption of ordinances or regulations.

The process for developing new flood hazard data or revising existing data starts with FEMA working with communities during the flood study process. FEMA's preliminary and post-preliminary processing of Flood Insurance Studies (FISs) and Flood Insurance Rate Maps (FIRMs) involve the following steps[8], which typically require 1 to 1½ years to complete:

- The flood hazard analyses are completed and incorporated into the FIS and FIRM. The proposed FIS and FIRM (i.e., draft FIS and FIRM) that FEMA issues to the community are known as a Preliminary FIS and FIRM.

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[8] FEMA Adoption of Flood Insurance Rate Maps Timeline – Website visited July 9, 2008: http://www.fema.gov/library/file?type=publishedFile&file=fema_495.pdf&fileid=9b1ac7503e42-11dd-ad57-001185636a87

- FEMA provides a period (usually 30 days), known as the comment period, for the community to review the Preliminary FIS and FIRM and provide comments.
- Following the comment period, typically a Final Community Meeting is held to present the Preliminary FIS and FIRM.
- The proposed flood elevations are published in the *Federal Register* and the community's local newspaper. FEMA notifies the community by letter and publishes the proposed flood elevations in a prominent local newspaper twice during the 10-day period immediately following the notification to the community. The second newspaper publication initiates the 90-day appeal period. The 90-day appeal period is required by the National Flood Insurance Act and Part 67 of the National Flood Insurance Program (NFIP) regulations.
- After resolution of any appeals and/or protests, FEMA issues a Letter of Final Determination. This letter establishes the effective date of the FIS and FIRM and initiates the 6-month compliance period. During the 6-month compliance period, the community must adopt new, or amend existing, floodplain management ordinances that meet the requirements of Section 60.3 of the NFIP regulations and account for the new FIS and FIRM. Also during this period, FEMA performs final Quality Control (QC) checks and revisions and archives the back-up data, and the Government Printing Office prints the final FIS and FIRM.
- At the end of the 6-month compliance period, the FIS and FIRM become effective and are distributed by FEMA's Map Service Center.

3.2.2 State and Community Role in Adoption Processes

The FEMA adoption process requires that the Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) be made available for the 30 day comment period and the 90 day appeal period. If the community receives digitally formatted FISs and DFIRMs, the question becomes how will the State or community make this data available for comments and public inspection?

The State of **Indiana** Department of Natural Resources has been directed by the Governors office to make an attempt to notify any property owner impacted by revised floodplain boundaries (i.e. putting them in or taking them out of the mapped floodplain). This requirement goes well beyond the simple FEMA adoption process requirements. Interestingly, requiring that notice be given to all individual property owners may provide an incentive to designate the digital data as official. Within a GIS – using digital geospatial datasets in conjunction with property owner records and parcel boundaries – floodplain managers could quickly determine which parcels are affected by changes in the flood hazard boundary. The manual process of identifying the property owners would be more costly and time consuming and possibly less accurate.

The **New Hampshire** Office of Energy and Planning (NHOEP) offers preliminary and effective panels (in PDF format) of the of countywide DFIRMs, DFIRM databases and FIS reports through the University of New Hampshire (UNH), Complex Systems Research Center (CSRC) Website[9], the Cooperating Technical Partner (CTP) for NH. During the map adoption process NHOEP provides these links as part of the standard

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[9] http://www.granit.unh.edu/dfirms/index.html

public notice initiated by FEMA. NHOEP additionally informs the public of the location of digital maps and data through Ordinance Compliance processes and at public hearings and meetings. At present, New Hampshire has requests from a majority of communities for printed versions of FIRM panels. Limited internet access and printing capabilities are the main obstacles to using digital maps for many of these communities. All printing requests for preliminary FIRM panels are initially received by NHOEP. Print requests for the preliminary maps are then forwarded to CSRC, which provides the actual printing service. Presently FEMA' Map Service Center provides hard copies of "effective" DFIRM maps to the NHOEP, other State agencies and communities free of charge. Communities that receive letters of final determination after September 30, 2009 will be limited to one hard copy of the FIRM.

North Carolina provides 24-hour access to preliminary and effective DFIRMs via the NC Flood Mapping Program (NCFMP) website, which includes a Floodplain Mapping Information System (FMIS) that contains FIS Reports, digital FIRM panels, and GIS files that can be downloaded. This website is free and available to the public at preliminary and effective stages via www.ncfloodmaps.com. One of the goals of the NCFMP is that during the Preliminary DFIRM and public participation meetings local officials were encouraged to use the digital flood hazard data available online. The NCFMP recognizes that there are communities that will continue to need printed maps and also need assistance with digital data due to limited internet, staffing and computer resources.

3.3 Legal Status of Digital Data

The FIS and FIRM become "official" upon adoption by the community. Based on State and local ordinances (see Case Studies below) and FEMA policy that give equal weight to the digital data used for the FIRM, the digital version (DFIRM) is also official. This section looks directly at the issues that need to be addressed to implement Section 107 of the NFIP Reform Act of 2004.

3.3.1 Electronic Records

The Wisconsin Floodplain Management Program obtained a legal opinion (Attachment 2) of current Wisconsin law related to electronic records and whether communities in Wisconsin could adopt digital floodplain maps instead of paper maps to satisfy the requirements in s. NR 116.09, Wis. Adm. Code.

The Wisconsin statutory definition of "public record" in Wis. Stats. 16.61(2)(b) includes any "electronically formatted documents." Wis. Stats. 16.61(5) specifically allow a State agency to "maintain in optical disk or electronic format any public record in its custody and retain the public record in that format only." The corresponding statute allowing local governments to maintain records in electronic format is Wis. Stats. 19.21(4)(c). Municipalities must pass an ordinance or resolution allowing the maintenance of such electronic records. Both statutes require that the electronic record meet the applicable standards set out by the Wisconsin Department of Administration.

The section of the Wisconsin administrative code that lays out the specific requirements for retention of records maintained solely in electronic format is Adm. 12.05, Wis. Adm. Code. Adm. 12.05, Wis. Adm. Code requires that electronic records comply with all existing public record rules and statutes and all of the following additional requirements:

(1)   Maintain electronic public records that are accessible, accurate, authentic, reliable, legible, and readable throughout the record life cycle.

(2)   Document policies, assign responsibilities, and develop appropriate formal mechanisms for creating and maintaining electronic public records throughout the record life cycle.

(3)   Maintain confidentiality or restricted access to records or records series maintained in electronic format, limiting access to those persons authorized by law, administrative rule or established agency policy.

(4)   Utilize information systems that accurately reproduce the records they create and maintain.

(5)   Describe and document public records created by information systems.

(6)   Document authorization for the creation and modification of electronic public records and, where required, ensure that only authorized persons create or modify the records.

(7)   Design and maintain new information systems so that these systems can provide an official record copy for those business functions accomplished by the system.

(8)   Develop and maintain information systems that maintain accurate linkages, electronically or by other means, to transactions supporting the records created where these linkages are essential to the meaning of the record.

(9)   Utilize information systems that produce records that continue to reflect their meaning throughout the record life cycle.

(10)   Utilize information systems that can delete or purge electronic records created in accordance with the approved retention schedule.

(11)   Utilize information systems that can export records that require retention to other systems without loss of meaning.

(12)   Utilize information systems that can output record content, structure and context.

(13)   Utilize information systems that allow records to be masked to exclude confidential or exempt information.

Several of the above requirements are discussed in detail in later sections.

3.3.2 Access and Security of the Electronic Record

The Wisconsin legal opinion raises the issues of access and ensuring the security of electronic records. Related to access, the legal opinion states the following:

> Difficulty may be encountered when the public demands access to a record that is maintained exclusively in electronic form Wis. Stat. 19.34(2) requires a record custodian to provide access to public records. Wisconsin Public Records Law: Wis. Stat. §§ 19.31 - 19.39: Compliance Outline, 28, Wisconsin Department of Justice, August 2005, available at http://www.doj.state.wi.us/dls/docs/ publicrecords805.pdf. With electronic records, the requestor may not have the appropriate computer programs to read such records. The Attorney General has stated that a record custodian can provide a requestor access to a machine needed to read the data. Id. at 28-29. Another option would be for the record custodian to produce a paper version of the floodplain maps in order to fulfill a request for review. See Id. and Wis. Stats. 19.35(1)(e).

FEMA provides a variety of products for accessing and/or viewing digital flood hazard data such as the FIRM Scan images or FIRMettes (see Section 4.2.1). Additionally, more and more States, counties and local agencies are providing access to digital flood hazard data through web mapping applications. These products and applications may effectively minimize the difficulties or legal challenges related to accessing the digital data described in the Wisconsin legal opinion.

In the event that the adopted paper map is lost or destroyed, there would be a need to reproduce the official paper map from the digital flood hazard data. To ensure the integrity of the digital data, Wisconsin administrative code, Adm. 12.05, Wis. Adm. Code, contains several sections that require limited access to the electronic data and tracking of any modifications. Adm. 12.05(3) requires that a government party "[m]aintain confidentiality or restricted access to records or records series maintained in electronic format, limiting access to those persons authorized by law, administrative rule or established agency policy." Modification and creation of the electronic records is limited to authorized parties under Adm 12.05(6), Wis. Adm. Code.

FEMA currently stores, maintains and modifies – through the LOMC process – the digital flood hazard data for the nation. FEMA policies govern access and modifications to the digital records within its domain. The digital flood hazard datasets maintained by FEMA is the official version of the digital flood hazard data with official copies distributed to the communities. Due to FEMA's access and security policies, FEMA's digital flood hazard data would meet Wisconsin requirements for ensuring security. Thus, communities would be able to reproduce the printed map or make available the flood hazard data for viewing by using the official copy of the flood hazard data. If a community were required to ensure that the local version of the digital flood hazard data was not corrupted, it could compare the local version against the official version held by FEMA.

3.3.3 DFIRM Linkages – FIS, Engineering Models, Data tables, etc…

The DFIRM is derived using flood elevations established by an engineering model at stream cross sections compared to best available topographic data. The Flood Insurance Study report (FIS) provides information on the processes utilized, types of modeling conducted and data sets used to produce the DFIRM. The DFIRM is also a unique product in that it contains information that is not provided within the FIS, engineering models or other datasets. For example, the flood hazard boundary is a result of the mapping process alone. It is recognized that once the map is adopted by a local community, the map becomes official having met all due process requirements. The geospatial digital flood hazard data used to print the map has been given equivalent status by FEMA under Section 107 at the Federal level. And under the Wisconsin Adm. 12.05 (above), municipalities in Wisconsin should be able to maintain the official floodplain zoning map exclusively in electronic format if desired.

To support appeals and revision (LOMR) requests, FEMA maintains vital backup data in the form of engineering models, tables and documents. Outside of the appeals process or revision requests, the FIS serves as the linkage between the data used to determine the SFHAs and the maps. Within the FIS, community map history, limits of detailed study, models used, topographic data source, discharges, flood profiles and floodway data tables are all reported, but in text format with static tables and graphs.

The Data Capture Standards (DCS), previously described (Section 2.2) provide clear guidelines and specifications for delivery of the backup data, however it does not provide comprehensive specifications for a dynamic data format and update process. For example, the delivery specifications for the outputs have not been developed so that the tables and graphs could be readily reproduced and updated as LOMRs are introduced or new studies added to the geographic area covered by the DFIRM. The new DCS have standard files for some aspects of the engineering submittals that allow for the input data

and actual models to be delivered in their native formats allowing for consistent delivery and retrieval of the submitted materials.

3.3.4 Conclusion: Legal Status of Digital Data

At least for Wisconsin, under the Wisconsin Adm. 12.05, municipalities in Wisconsin should be able to maintain the official floodplain zoning map exclusively in electronic format if desired. The authority to maintain records solely in electronic form is found at Wis. Stats. 16.61(5) for State agencies and Wis. Stats. 19.21(4)(c) for local municipalities. To be considered the official floodplain zoning map, the electronic record would need to contain all information required under NR 116.09, Wis. Adm. Code. A map maintained exclusively in electronic format would need to address all of the considerations in Adm. 12.05, Wis. Adm. Code.

The process as it stands now – with FEMA maintaining the official digital flood hazard data – does not appear to conflict with State or local requirements such as those described for Wisconsin. The legal issue may be less onerous in the future if State and local jurisdictions take on the roll of maintaining the official version as they would more likely be aware of State and local legal requirements related to digital data.

3.4 Improving State and Community Use of Digital Data

3.4.1 State and Community Regulations

This section explores ways to identify solutions that can be provided to States to modify State regulations if needed and/or improve the number of States and local governments using the digital FIRMs and encourage the use of the digital FIRM as official.

Looking at the issue of which State or community regulations would need to be modified to enable Sec. 107 of the NFIP Reform Act of 2004, Pennsylvania's Office of Chief Counsel for the Department of Community and Economic Development (DCED) affirmed that ordinances adopted by Pennsylvania local governments to carry out the NFIP may be based upon, and incorporate the FEMA Flood Hazard Data in digital form in place of an official paper flood map. They continue their analysis with the following statement:

> This office is of the opinion that the enactment by a Pennsylvania local government of a flood plain ordinance would not violate Pennsylvania law either because the ordinance incorporated digital FEMA Flood Hazard Data by reference instead of attaching an official paper flood map provided by FEMA, or because it provided that the FEMA Flood Hazard Data upon which the ordinance was based would be the data as upgraded from time to time, so long as the FEMA Flood Hazard Data was at all times reasonably available to members of the public.

The Pennsylvania Office of Chief Counsel also states that as federal legislation, Sec. 107 of the 2004 Act would "preempt any provision of Pennsylvania law that would require a paper map, instead of digital data, for such to be incorporated by reference into any local ordinance". And finally, concluding that "So long as the applicable FEMA Flood Hazard Data is reasonably available, so that no one is forced to guess as to its meaning or application, no local ordinance adopted under the authority of the Pennsylvania Flood Plain Management Act (PFPMA) should be constitutionally vulnerable".

The issues related to making the Flood Hazard Data "reasonably available, so that no one is forced to guess as to its meaning or application" and other concerns with regards to accessibility, data integrity and reliability were previously discussed as they relate to due process and public hearing. Based on Wisconsin Adm. 12.05, Wis. Adm. Code:

(1)   Maintain electronic public records that are accessible, accurate, authentic, reliable, legible, and readable throughout the record life cycle.

If a State or community were to move toward only maintaining digital data, they would have to find some way to make it available to the public. There is nothing that describes how that data needs to be made available, which provides many opportunities to use web-based and other digital technologies, including FEMA's National Flood Hazard Layer Viewer, FIRMette and FIRM Scan tools.

3.5 Community Case Studies - Adopted Digital Data

This section provides examples of States or communities that have adopted digital data in lieu of paper maps either for floodplain management or other purposes. The major items that will be highlighted from these cases studies are digital data referenced in the State or local ordinances and how the State or local community file flood hazard maps as the "Official Map" if required. There is also a brief example of a community zoning map maintained in digital form that has official status and references of digital floodplain data within State and local building codes.

3.5.1 References to Digital Data and the "Official Map"

Winnebago County, Wisconsin is located in the east-central part of the State and has been actively creating, acquiring and maintaining digital geospatial data, due in part to a FEMA funded pilot project, since the late 1980's. The County makes flood hazard area digital data primarily available through its web-based interactive mapping portal as part of the Winnebago County Geographic Information System (WINGS) Project. Winnebago County references their official floodplain maps in Section 17.21 F.P. Floodplain Zoning District as follows:

1.5 General Provisions
(2) Official Maps & Revisions
The boundaries of all floodplain districts are designated as floodplains or A-Zones on the maps listed below and the revisions in the Winnebago County Floodplain Appendix. Any change to the base flood elevations (BFE) in the Flood Insurance Study (FIS) or on the Flood Insurance Rate Map (FIRM) must be reviewed and approved by the DNR and FEMA before it is effective. No changes to regional flood elevations (RFE's) on non-FEMA maps shall be effective until approved by the DNR. These maps and revisions are on file in the office of the Winnebago County Zoning Office, Winnebago County; City of Oshkosh, Wisconsin. If more than one map or revision is referenced, the most current approved information shall apply.

References in the local ordinance to digital data for Winnebago County are found in the Town-County Zoning Ordinance, Section 17.01 with further definition of Digital Compilations in Section 17.37 a follows:

17.01 INTRODUCTION (1) AUTHORITY

(8) MAPS. Where any map is referred to in this ordinance and said map is a digital compilation within the Winnebago County Geographic Information System (WINGS), said digital map shall be the regulatory map for purposes of enforcement of this ordinance.

17.37 DEFINITIONS.
(28) DIGITAL COMPILATION. An electronic method of mapping and storing map and text data in a raster, vector, text, or similar format within a computerized records system

Since the DFIRM would be a digital compilation within WINGS, the DFIRM is treated as the Official Map for the county.

The **Louisville & Jefferson County Metropolitan Sewer District** (MSD) in Kentucky references digital flood datasets in Ordinance No. 125, Chapter 157 – Floodplain Management:

§ 157.04 ADMINISTRATION.
(A) Administering Agency.
The Louisville and Jefferson County Metropolitan Sewer District shall be the administering agency for this chapter. As administering agency it shall:
(1) Keep on file and make available to the public for its inspection up-to-date copies of the Flood Insurance Study (FIS) and accompanying Flood Insurance Rate Maps (FIRM), which are in digital format, published by the Federal Insurance Administration (FIA) or FEMA for the geographic boundaries of the Louisville/Jefferson County Metro Government and any cities within such geographic boundaries, dated December 5, 2006 and any amendments made by FEMA to such maps from time to time. Effective December 5, 2006, the Flood Insurance Study (FIS) and accompanying Flood Insurance Rate Maps (FIRM), dated December 5, 2006 and any subsequent amendments thereto, are hereby adopted and incorporated by reference. Prior to December 5, 2006, the Flood Insurance Study (FIS) and accompanying Flood Insurance Rate Maps (FIRM), published by the Federal Insurance Administration (FIA) or FEMA for the geographic boundaries of the Louisville/Jefferson County Metro Government and any cities within such geographic boundaries, dated February 2, 1994 and any amendments that have been made thereto, shall be kept on file and made available to the public for inspection.

No examples were found of current local ordinances containing language that directly references digital flood hazard datasets by name and date. Formerly, floodplain ordinances for Winnebago County, WI considered direct references to the name and date of the digital flood hazard dataset. The North Carolina *Flood Damage Prevention Ordinance – Article 3. Section B –* provides as optional, a section to list the names and dates of all referenced engineering studies and maps. States and local jurisdictions could be encouraged to add similar language that requires the name and date of digital flood hazard datasets when available. The Winnebago County and Louisville examples described previously, provide concrete examples of how digital data can be referenced as official within Floodplain Management ordinances.

3.5.2 Zoning Maps as Official
Tax and community zoning maps can offer relevant examples of situations in which digital data is being utilized to replace printed map versions. From the Durham, N.C. City-County Zoning Unified Development Ordinance - Latest Revision dated March 24, 2008 (Attachment 3) the official zoning map is described:

4.1.3 Official Zoning Map

A. The location and boundaries of zoning districts shall be as shown on a geographic coverage layer entitled "Zoning" that is maintained as part of the City's and County's geographic information system (GIS) under the direction of the Planning Director, or designee. This depiction of zoning boundaries as shown on the GIS system shall constitute the Official Zoning Map for the City's and the County's zoning jurisdiction, and is adopted into this Ordinance by reference. The City or County Clerk, as applicable, may upon validation by the Planning Director, or designee, certify a paper copy of the Official Zoning Map, or portions of the map, as a true and accurate copy of the Official Zoning Map, or a portion thereof, under the authority of GS 160A-79(b) and GS 153A-50.

B. The Planning Director, or designee, shall revise the Official Zoning Map when amendments are passed by the governing body in accordance with Sec. 3.5, Zoning Map Change. The Planning Director, or designee, shall correct errors in the map as they are discovered.

C. No unauthorized person may alter or modify the Official Zoning Map. Errors in the Official Zoning Map shall be corrected as they are discovered, and the corrected information shown on the GIS system.

D. The Planning Director, or designee, may authorize printed copies of the Official Zoning Map to be produced, and shall maintain digital or printed copies of superseded versions of the Official Zoning Map for historical reference.

In Santa Clara County, California, the Environmental Resources Agency recently recommended that the current Official Zoning Maps be replaced with GIS maintained Zoning Maps (Attachment 4). The recommended action to the Board of Supervisors was to:

Adopt as the Official Zoning Maps the set of Geographic Information Systems−Maintained Maps (referred to herein as "GIS Zoning Maps") to Replace the Existing Map Set Located within the Planning Office (see GIS Map Set, Exhibit 1).

Many of the reasons given by the Environmental Resources Agency for recommending the switch from paper to digital GIS formats strongly parallel FEMA's motivations to have official flood hazard data in a digital geospatial format. Additionally they discuss the due process issues for the official digital data as being the same as that used for paper maps – hence, there is no change. See Attachment 4 for a complete list of the reasons provided for the recommendation to adopt the GIS Zoning Maps as Official.

4.0 Practical Issues

As flood hazard maps transition from paper to digital, there will be a need to have the capacity to make the digital data available to the public. As an example, for the digital data to be accessible to the general public, there would be a need to provide hardware and software tools for viewing (e.g. kiosks, web-based interactive maps); technical guidance on appropriate use (e.g. data dictionary); methods or procedures to print or display maps, reports and supporting documents (e.g. FIS, metadata); and educated staff to develop the hardware, software and guidance manuals as well as use the delivered products. Several States and locals along with FEMA are capable of offering a full range of services from printing maps to digital only displays, while others are not. This chapter explores the practical issues surrounding what products need to be delivered to a community so that it can meet the needs of its constituents.

4.1 Improving State and Community Use of Digital Data

4.1.1 Delegated Authority and Stewardship

As digital data replaces printed maps or becomes the base for printing the official map, the issue of improving State or community usage of this digital data is tightly coupled with the overall State or community level involvement in FEMA's flood hazard mapping program. States and local jurisdictions are moving toward full stewardship that allows them to update and maintain dynamic geospatial flood hazard databases with new flood studies and map changes to keep digital data as current as possible. With full authority States gain the potential to reduce redundancy of digital features, data or databases that may currently be maintained as one or more database features or entirely separate databases. For example, one database version is needed to support State higher floodplain standards, while other versions would be maintained to meet FEMA's minimum standards and possibly a third version that it used to support the National Flood Hazard Layer that incorporates LOMRs. Multiple databases and version issues are discussed more in Section 5.2 – Multiple Databases, Data Versions and Revisions.

Overall, it is anticipated that cost reductions will be achieved by FEMA, States and locals that incorporate the use of FEMA digital flood hazard data products or tools. By allowing States to become the legal custodians of DFIRM databases, the income or cost savings realized could be used as an incentive. For example, FEMA estimated the benefit-cost ratio of North Carolina's Flood Mapping Program – which has considerable investments in GIS technology – to be 2.2 to 1 and the U.S. Geological Survey (USGS) Center for Science Policy estimated the benefit-cost ratio to be 3.35 to 1[10].

States could become service providers to counties and local communities with limited capacity to implement GIS technologies. Those communities could benefit from the flood mapping and management expertise at the State level. Cost saving could be realized by

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[10] Estimates provided in North Carolina's 3MS Business Plan FY2008-20012. Website visited July 2, 2008 - http://www.ncfloodmaps.com/pubdocs/default.htm

removing redundancies in people, software, hardware and supporting devices (e.g. printers). Cost recovery and fees could be realized through services such as Print-On-Demand or Web-hosting as well as customized products and GIS analyses.

4.1.2 Community Rating System (CRS)

FEMA has provided direct incentives for using digital data, Geographic Information Systems (GIS), web-mapping, web sites and other related technologies through the Community Rating System (CRS) program. For instance in *CRS Activity 440 – Flood Data Maintenance* it states:

> Credit is provided for keeping the community's floodplain maps and elevation reference marks more current, useful, or accurate in order to improve local regulations, planning, disclosures, and property appraisals. Additionally, keeping old FIRMS also qualifies for credit.

CRS also credits systems that improve access, quality, and/or ease of updating flood and FIRM data. These systems are usually a Geographic Information System (GIS) or other digitized mapping system or a database management program for parcel records.

To receive these credits, the system must meet the following prerequisites[11]:
- The system must be used regularly by the community regulatory staff.
- New data, including annexations, new subdivision maps, flood insurance restudies, Letters of Map Revision (LOMRs), Letters of Map Amendment (LOMAs), and studies performed for site-specific analyses, must be added at least annually to the data base or overlay map.
- Digitized data must be made available annually to FEMA at no cost (if requested).

ASFPM supports the above incentives and recommends that additional CRS credits could be evaluated for systems that capture more specific datasets or that develop analyses and reports that support larger floodplain management goals. Additional datasets might include:
- Surveying structure locations as:
  - Point locations with first floor elevation
  - Building footprints with first floor elevation

Analysis that supports floodplain management goals might include:
- Using GIS to generate more accurate floodplain planning metrics, such as:
  - Acres of green space within the floodplain in acres
  - Structure counts segregated by flood zone (e.g. floodway, flood fringe) and/or flood depths.
  - Past, present, future types of land-use in floodplain and
  - Changes in land-use based on FPM policies or regulations

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[11] FEMA's Community Rating System Toolkit Website – visited on July 9, 2008: http://www.training.fema.gov/emiweb/CRS/m6s6main.htm

4.2 Capacity Requirements for Using Digital Data

What digital data should be delivered to Clark County, Wisconsin? Should they receive electronic PNG image files or can they integrate ESRI Shapefiles into their GIS environment and display flood maps properly along with other local datasets? In order to meet a community's needs so they can provide the appropriate level of service to their constituents; there is a need to know their capacity to utilize the various digital formats.

Flood hazard digital datasets are distributed in a wide variety of formats, from DFIRM databases to electronic format (e.g. PDF or PNG) map panels. To understand the minimum requirements for using digital data it would help to categorize various levels of user capacity that would be needed to use, manage and maintain these digital datasets. This section puts forth and describes four capacity levels that State and local communities may require while using digital data and the derived map products. Following are the four basic levels that will be discussed, starting from lowest level of capacity to highest:

(1) No capacity
(2) Basic/adequate capacity (minimum level)
(3) Intermediate capacity
(4) Full capacity

As the four levels increase, the capacity or ability to utilize digital data and/or electronic map products also increases. These levels suggest a more formal structure for understanding what products (e.g. print maps, images, digital datasets) can be delivered as well as identify the resources needed to offer more robust methods of data delivery and analysis related to flood hazard identification, mitigation and risk communication.

4.2.1 Published and Distributed Products

The range of digital datasets, derived map products and methods or tools to be considered for delivering those datasets or map products to the general public are:

Digital Datasets
* Geospatial Digital Vector Data – ArcExport, ArcShape (Shapefiles), MapInfo, GDB (Includes Cross-sections, BFE lines, flood hazard area, etc…)
* Flood Insurance Study (FIS) – PDF, Hardcopy
* Digital Elevation (e.g., DEM, TIN, contours, LiDAR, breaklines)
* Digital Orthophotos (temporal issue, currency)
* Basemap datasets (local, regional, State, Federal – must meet FEMA map requirement)

Derived Map Products
* Hardcopy Maps – printed locally from digital datasets
* Electronic Formats – PDF, GeoPDF, Image files (PNG, TIFF, GeoTIFF, JPG, JPG2000) – includes FEMA's FIRM Scan images

Applications and Tools to Deliver Digital Datasets and/or Map Products
* FEMA MSC Viewer
* FEMA Flood Map Viewer (MIP)
* FEMA FIRMette tool
* Web Map Service (FEMA) – Google Earth (kml, kmz files)
* Web Map Service (FEMA) – integrated into local GIS software
* Web Map Service (Local) – published by State and local providers
* Local Office Kiosks/Viewers
* FTP data download

- DVD/CDROM
- Portable hard-drives

The Geospatial Digital Data category would include DFIRMs, the National Flood Hazard Layer, and local Flood Hazard datasets based on higher standards. The above list is not comprehensive since the potential for derived map products and methods of delivery are constantly evolving and generally becoming faster, better and more efficient.

4.2.2 Capacity Resources

In order to provide access to digital flood hazard data, any State or local agency would need the capacity and necessary resources to work with the digital datasets described above. Capacity issues and resources (listed below) to be considered range from hardware, software, network and professional staffing. This list is not comprehensive as the potential of hardware, software and networks is constantly evolving and again generally becoming faster, better and more efficient:

Hardware
- Computers – desktops, laptops, kiosks
- Servers – web hosting, relational databases, WMS/WFS
- Printers – large/small format, color/black & white, high-speed
- Monitors – standard, touch-screen
- CD/DVD Drives – read only, read/write
- Other Peripherals – portable hard-drive, data storage, backup & archiving

Software
- GIS Software (ESRI, MapInfo, Google Earth, Open Source)
- Adobe Acrobat (Standard, GeoPDF Viewer)
- Image Viewers (PNG, TIFF, JPEG)
- Security Software – firewall, virus check
- Database – Access, Oracle, SQLServer
- Archival Software

Networks
- Internet access/connection speed (T1, T10, Broadband)
- Intranet capabilities

Professional Staff
- GIS Staff – analysts, editors, cartographers
- Engineering Staff – reviews, approvals, revisions
- Technical Staff – usage specifications, help desk, printing
- Administrative Staff – computer operation

4.2.3 Documentation and Guidelines

One element that crosses all capacity levels is the delivery of appropriate documentation along with any digital or print map format. Users at all levels will require clear-cut data descriptions, guidelines and procedures that define appropriate usage and display of the delivered data no matter the format. Descriptions, guidelines and procedures to be considered include:

Metadata
- Standard metadata requirements - date, sources, contacts

Data Dictionary
- Feature class/shapefile definitions and descriptions

- Attribute definitions
- Domain values and ranges
- Data types – character, integer, floating point

Cartographic Specs and Templates

- Annotation and/or text placement
- Layer symbology – default color, pattern, size, scale
- Display hierarchy – order of displayed features
- Scale thresholds – controls display based on scale

Usage Guidelines and Procedure (Usability)

- Feature priority (vector data) – what is required vs. optional for map displays
- Appropriate scale/accuracy of use
- Viewing software – acrobat, image viewer, web viewer
- Printing guidelines – readability, proper display size, paper size, map component requirements (scale bar, north arrow, legend)
- Security requirements and protocols – authorized personnel, editing protocols, transaction history

Metadata provides the best opportunity to offer unambiguous descriptions of the data and the processes used to originate or modify that data. FEMA requires metadata for a variety of submittals including the DFIRM. Only the DFIRM metadata is submitted as part of the final deliverable, with all the others being submitted early in the process. According to FEMA's guidelines on completing metadata, several of the elements within the metadata imply that the data sets are not final. Specifically, they are the: *Time_Period_of_Content* (must be MIP submission date) and the *Currentness_References*, which must be listed as "MIP Submission Date". Another element is *Status* element which is required to be filled in as "in progress", which is misleading if the dataset was final. It is recommended that if the metadata submission is final, the elements should reflect that. The *Time_Period_Of_Content* should be "Effective Date" and the *Status* should state "Complete".

FEMA provides metadata profiles that are useful in determining what content is required in certain metadata elements. In some instances, the profiles provide restricted domains for completing metadata elements that exclude adding free text so that the metadata may more accurately described the dataset it was meant to describe. Furthermore it is crucial that if domains are used they should be relevant to their assigned datasets as part of the profile. Inconsistencies have been noted between domain descriptions and the metadata element within a dataset. These inconsistencies may be the result of using a single metadata template within a profile and modifying it for different datasets.

There are many nuances within a county-wide study that should be reflected in the metadata but are not. There are counties that have a combination of digitized floodplain boundaries adjusted to Digital Raster Graphic (DRG) files; redelineated boundaries using old studies and newer topographic data; and new detailed studies. The metadata does not reflect these different processes, which may suggest a need to capture process methods at the feature level through attribution; more robust metadata domains and profiles that allow free text; and a commitment to thorough metadata reporting. Capturing the process methods within an attribute(s) at the feature level would be similar to feature level capture of deprecated or historic floodplain boundaries discussed in Section 5.2.

States and locals may print or display FEMA's digital flood hazard data with a variety of other geographic features – base map features or otherwise – in a wide array of output formats and products including printed maps, electronic map files, desktop computer and web-based map viewers, and raw digital flood hazard datasets. The increased ability to display the official flood hazard layer with: (1) a variety of cartographic representations; and (2) with a myriad of other geographic features may produce a flood hazard map that creates confusion or misuse, thus decreasing usability and potentially setting up legal challenges or liability claims. Guidelines, criteria and recommended templates for cartographic representations would greatly enhance the usability of flood hazard data no matter the author.

4.2.4 Minimum Capacity

Capacity levels may then be defined based on the range of the digital datasets offered and the resources available to support them. The minimum capacity level to support digital data would be based on characterizing the lowest level of digital data that would be delivered. A digital image – PDF or PNG – containing a basic FIRM panel delivered via a CDROM disk would be considered the lowest or simplest form of digital data that could be delivered. To display or print this image file, the following capacity requirements would be needed:

Hardware
- Computer – includes standard components (monitor, CD-drive, keyboard, mouse)

Software
- Image viewing software (e.g. Adobe Reader) with print capabilities

Network
- No network needed

Professional Staff
- Staff familiar with computer operations and image file formats

Metadata
- Standard metadata

Usage Guidelines & Procedures
- Appropriate usage
- Viewing Software
- Printing Guidelines

The intent of this section is to describe various capacity levels and highlight the range of issues that need to be addressed in order to make some form of digital data available to every user community. Beyond the minimum capacity level, the larger goal is to provide defined capacity levels that can be used to understand exactly what digital data can be utilized by to a community based on their current and future capacity. For example, if Clark County currently has a GIS Specialist with 2-years of experience, an 11"x17" black/white printer and is budgeted with 20% time to floodplain mapping – What digital data would best meet their needs? It should be noted that initial budgeting and cost issues would need to be considered when implementing GIS solution; however this increase should be measured against the long-term benefits. Additionally it should be recognized that there will always be some communities that will require a paper map.

5.0 Technological Issues

Integration of digital geospatial flood hazard data into an enterprise level information system that reaches from the local to Federal level has already begun. However, the full impact of the technological issues related to this integration are just beginning to make themselves known as States and locals use these digital flood hazard data in their own floodplain management programs. At the same time it should be recognized that FEMA needs to fulfill its responsibilities to distribute and publish flood hazard data and maps for the nation.

The legal and practical issues addressed previously will help determine who should be responsible for the various roles in the data maintenance process. Solutions include delegating authority, determining where data will reside and mechanisms for supporting the required software, hardware and staffing resources.

Overall, technological issues look at how the digital flood hazard data will be maintained, integrated, distributed, published and documented. Related issues include:
- Data Linkage – DFIRM, FIS (paper or digital), engineering models, etc.
- Multiple Databases, Data Versions and Revisions
- Map and Data Distribution and
- Map and Data Accuracy Standards

5.1 Data Linkage Issues

The problem of maintaining a link between the flood hazard maps and the supporting reports and data is not new. With the transition to digital geospatial flood data the links to the supporting data can be embedded into the flood datasets, supporting a complete document management system. Metadata and robust data models allow connections to be embedded by storing links (e.g. hyperlinks, join fields or table links) to relevant documents in the attribute tables provided with the DFIRM or referenced within the metadata.

5.1.1 FEMA's Enhanced DFIRM Database

The goal of the Enhanced DFIRM Database (see Section 2.2), is to archive in an electronic and systematic format all of the data collected during the production of a FIS in a specific format. The Enhanced DFIRM Database specifications contain additional defined spatial and non-spatial data items and tables that are not in the Standard DFIRM database. The Enhanced DFIRM goes beyond the Standard DFIRM by suggesting the following items as part of a larger data model:
- Sub-basins with links to discharges, storm data, and regression equations;
- Gages, including rain gages, river gages, and coastal gages;
- Nodes with links to node discharge data and zipped hydrologic model(s);
- Profile base lines;
- Overbank flow paths;
- Additional cross section data including links to a frequency (rating) table and the zipped hydraulic model(s);
- Additional coastal transect data including links to the zipped coastal model(s);

- o Primary frontal dunes;
- o Modeled coastal shorelines;
- o An outline of the studied area(s) with links to FEMA case information;
- o Photographs, sketches, etc. linked to spatial features;
- o Documentation for variable data that may be developed for the flood study (e.g. topographic data, land use, soils, roughness);
- o Zipped files containing general information on methodology (e.g. Technical Support Data Notebook); and
- o Zipped Flood Insurance Study (FIS) documents (e.g. FIS text, flood profiles, Floodway Data Tables)

The Data Capture Standards (DCS) bring many of the essential spatial and non-spatial elements of the Enhanced DFIRM database together, but as described previously does not include specific linkages between components. Additionally, as of the writing of this report, limited implementation of the DCS precluded their evaluation.

The GIS spatial layers and related tables provide details for the flood hazard analyses but generally are not shown on the paper flood hazard map. Another feature the Enhanced Database may include is certified high-water marks.

5.2 Multiple Databases, Data Versions and Revisions

Multiple databases or data versions come about due to various reasons such as:
- Data models that do not satisfy the needs of all users
- LOMRs that are at various stages in the approval process
- Historic flood hazard feature locations and geometry that needs to be maintained

An example of the first might include, flood hazard data that meets FEMA's mapping requirements but might not meet a State's mapping requirements since the State uses a higher standard or shows future conditions for its floodplain mapping. The State, in this case, must maintain one version of data for FEMA and another for its own internal purposes.

LOMRs that have been incorporated into a State's database for their own needs or into the National Flood Hazard Layer require sufficient oversight to maintain data integrity and thus the official or legal status of the map. Current geospatial database technologies allow feature level editing and can support various levels of processing status. Additionally, features can have restricted access providing a higher level of security and integrity that is required by law for the digital data to be recognized as official (see Wis. Adm. Code. Adm. 12.05)

And finally, by maintaining historic flood hazard feature geometry, any agency has the means to reproduce formerly approved flood hazard boundary delineations or feature locations. These historic flood hazard boundary delineations are needed to verify that land use permitting decisions were appropriate based on the map that was in effect when the permit was issued. The different versions can be managed in various ways from maintaining separate databases to transaction management and versioning at the feature level.

This issue requires more in depth research to evaluate if an optimized data model could be designed that would incorporate the needs of both FEMA and State floodplain mapping programs. The intent of this section is to highlight the issue since there are States or local jurisdictions already in this situation.

5.3 Map and Data Distribution

Since FEMA can deliver digital geospatial flood hazard data that is "unbundled" from the base map data and orthophotos, there are issues related to the various methods and formats for producing maps. Distribution of digital geospatial data versus distribution of the derived maps products, such as paper maps or digital map images, is very different. Digital geospatial data in vector format are stored as points, lines and polygons with various attribute values that help determine which features should be placed on the map and how they should be symbolized (e.g. color, size, and pattern). For example, how would a GIS technician with no knowledge of floodplain mapping know that *floodway* features should not only be labeled differently, but also be symbolized differently than the *Zone AE* features?

Derived map products distributed by FEMA in raster format (e.g. PDF, PNG) contain all the cartographic elements needed for immediate map display. Legends, borders, locator diagrams, coordinate grids along with feature symbology are defined to make the map readable and intuitive for a specific map scale and print size. But, derived map products – printed maps from GIS, digital map images and web mapping applications – developed by State or local GIS departments require production staff that can design unambiguous maps. For example, the ambiguity problem arises when the NFHL is displayed in Google Earth or other web-mapping applications since there is a need to use different symbology and labels to represent the NFHL in contrast to different geographic data being displayed in each different application. The misuse and/or misinterpretation of the flood hazard data could be reduced if guidelines were available for a recommended "official" map display of the flood hazard data when used in conjunction with other geographic features not controlled by FEMA.

Currently, the digital data do not inherently contain the necessary elements needed to create cartographic output or control for map scale and print size. Cartographic ambiguity could result in maps that are incorrectly designed and/or used by the general public and people trained in GIS and not cartography. Data dictionaries that describe attributes and their appropriate map usage would help remove the ambiguity. Cartographic specifications delivered as templates or associated files with the feature geometry would also help remove the ambiguity. It is recognized that templates or associated files (i.e. ESRI *Layer Files* or *Cartographic Representations* for Geodatabases) are generally based on the underlying feature geometry format, but they could prove to be useful for a large group of GIS map-makers. Cartographic templates would work for distribution of GIS data in both print and web-based delivery formats.

Having orthophotographs unbundled from the DFIRM maps impacts usability issues by allowing DFIRMs to be produced with or without the orthophotographs. DFIRMs produced without the orthophotographs as planimetric maps can be printed in black & white on high-speed printers. This option is not possible when orthos are used, due to the color required to make the flood hazard layer readable on the map. Without orthophotos the digital data can also be used within web-mapping applications. As noted

previously, these datasets should still be distributed with cartographic specifications as templates or associated files if possible and also include a data dictionary.

6.0 Conclusions and Recommendations

6.1 Legal Issues

Based on the documents, readings and analyses available from several States and local jurisdictions as of this writing, there has been no dissent by any State regarding use of FEMA's DFIRM being legally equivalent and interchangeable with printed products. And, in fact, digital databases and geospatial databases are being designated as official already with many local and State agencies converting paper products to GIS databases (i.e. the Santa Clara County, CA - GIS Zoning Map). But, in order for these electronic records or digital datasets to be considered as official there are requirements beyond those required for paper or printed documents.

In order for DFIRMs to become official electronic records, States and locals will need to fulfill the requirements described in State statutes and regulations as appropriate, such as Wisconsin's Administrative Code, which is clear about requirements for both the State and local communities in relation to official electronic records. FEMA's current distribution of DFIRM datasets does satisfy the requirements identified by the State of Wisconsin.

6.2 Practical Issues

For the digital flood hazard data to be accessible to the general public, floodplain managers and a range of other users, States and communities would need the capacity resources to provide hardware and software tools for viewing (e.g. kiosks, web-based interactive maps); technical guidance on appropriate use; methods or procedures to print or display maps, reports and supporting documents (e.g. FIS, metadata); and educated staff to develop the hardware, software and guidance manuals as well as use the delivered products.

The next step would be to work with a State and local jurisdiction to assess and refine these capacity categories, essentially resulting in a greater understanding of any barriers to digital data accessibility by the public.

6.3 Technological Issues

It is recognized that FEMA has developed the Data Capture Standards that provide a consistent framework for submitting, storing and retrieving study data or "backup data" that is utilized to derive the FIS and FIRM. The DCS provides a solid foundation for a flood hazard data model that integrates all the spatial and non-spatial data into something similar to the Enhanced DFIRM database. Taking the current FEMA successes to the next step should include the development of a flood hazard mapping business process and data model capable of integrating State and local datasets developed or designed with higher standards.

6.4 Recommendations

The recommendations derived from the legal, practical and technological issues are:

I. **Develop the business process for the creation/maintenance of the Digital Flood Hazard Data Model to ensure reproduction**
Official documents or databases need to be reproducible in order to be legally defensible. The business process – creation/maintenance/validation process – would be encapsulated within the flood hazard data model to ensure spatial relationships, data validation (subtypes, domains) and transaction history and versioning of data features.

II. **Develop a robust Digital Flood Hazard Data Model to support explicit linkages between datasets described in the Data Capture Standards (DCS)**
A digital flood hazard data product/model should support full linking capabilities, by electronic means or direct reference, to all the vital datasets, documents, processes and procedures used to develop the Special Flood Hazard Areas, Base Flood Elevations, Insurance Risk Zones and other regulatory information.

Features of a robust Digital Flood Hazard Data Model would prove valuable for integration and analysis – such as linking DFIRM features to the U.S. Geological Survey's National Hydrography Dataset. Linkages to the NHD by stream reach codes or Hydrologic Unit Codes for watersheds, basins and sub-basins would offer a structured, well-known system for locating flood hazard data. It would also facilitate accessing other water related data when flood hazard data are being developed or updated.

III. **Develop a set of guidelines for each defined capacity level (Section 4.2) so communities know which product matches with their capacity**
States and locals can assess their capacity levels in relation to available FEMA Digital Flood Hazard products or tools and can then choose the appropriate products or tools that match their capacity level (e.g. FIRM PDFs, the National Flood Hazard Layer for Google Earth).

IV. **Enhance metadata support and develop a Data Dictionary**
FEMA should amend metadata profiles to provide greater flexibility in adding free text so the metadata may more accurately described the dataset it was meant to describe. If the metadata submission is final, the elements should reflect that status and date. Finally, metadata should reflect multiple process methodologies used to generate flood hazard boundaries such as those derived by redelineating a boundary or based on new detailed studies. Feature level capture of process methodologies may be a solution and would be in line with the recommendation for a robust data model suggested above (Recommendation II).

A data dictionary provides users more information beyond standard metadata with a quick reference for names of datasets, attributes and relationships through join fields or a possibly a cartographic display hierarchy.

V. **Develop Cartographic or Project templates**
Define default display parameters of vector datasets to help users ascertain appropriate symbology, display rules, hierarchy, annotation/text placement

and layer priority in support of usability. An example would be the use of ESRI's *Layer files* (.lyr) or *Cartographic Representations*[12].

VI. Develop a broader definition of Digital Flood Hazard Data

For comprehensive floodplain management and analysis, a broader definition of digital flood hazard data may be required. A broader definition should incorporate beyond FEMA's published products and official designations to include the spatial and non-spatial flood hazard information (e.g. reports, datasets, models and applications) used to derive or display the SFHAs, BFE, risk zones and regulatory information. In other words, this definition should include all the input and output elements that allow the comprehensive management and analysis to occur.

VII. Develop additional Community Rating Systems (CRS) credits for Geospatial Digital Flood Hazard Data use and analyses

CRS credits could be evaluated for systems that capture more specific datasets or that develop analyses and reports that support larger floodplain management goals. Additional datasets might include building locations with first floor elevation and building footprints. Analysis that supports floodplain management goals might include using GIS to generate more accurate floodplain planning metrics, such as:
- o Acres of green space within the floodplain
- o Structure counts segregated by flood zone (e.g. floodway, flood fringe) and/or flood depths.
- o Past, present, future types of land-use in floodplain and
- o Changes in land-use based on FPM policies or regulations

The Association of State Floodplain Managers strongly supports FEMA's transition from the analog print map world to the dynamic geospatial digital world for its flood hazard data. The issues and recommendations provided in this paper are intended to help FEMA recognize potential problems or concerns at the State and local levels during this transition and into the future as FEMA embarks on its Risk MAP (Mapping, Assessment and Planning) Strategy.

The common characteristic that weaves all the issues presented here is the need to have State and local community involvement. The level of complexity and volume of data and information that will need to be managed to develop a fully integrated DFIRM Database product will require considerable State and local government participation. Several State and local governments are leading the way and contributing vital knowledge that can be used to educate others that will follow. Congress also recognizes that States play a central role in all aspects of flood mapping. This was highlighted by

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[12] Cartographic representations have been designed especially for cartographers who need to manage how and where features will be symbolized and depicted on a map or multiple maps that are derived from a common database. From ESRI Website visited on July 10, 2008: http://www.esri.com/technology_trends/cartography/representations.html

Senate Banking Committee Chairman Richard Shelby in the "Purpose and Summary of Legislation" for the Flood Insurance Reform Act of 2004. On May 13, 2004 he wrote:

> The Committee also recognizes and encourages FEMA in its goal to eventually hand over the legal authority to oversee, maintain and administer flood mapping to states which are interested and capable of maintaining and administering their own flood mapping program. This includes the responsibility to publish maps, issue letters of map change, preliminary and post-preliminary processing and issuance of Flood Insurance Study reports, Digital Flood Insurance Rate Maps and authorize interested and capable states to charge review and processing fees for Letters of Map Change.

Appendix A. CAP-SSSE Auto-Adopt Assessment

#	State	Auto-Adopt valid	Opinion by:	Date of Opinion	Comments
1	Alabama	Yes	Troy King, AG - by Brenda F. Smith, Chief - Opinions Division	10/22/04	~ Refer to supporting data being part of automatic adoption, but no specific mention of digital maps ~ The memo states that municipalities are subordinate to the state, so municipals can auto-adopt ~ The memo provides court case reference backing auto-adopt by municipals
2	Arkansas	No	Edward Swaim, General Counsel	5/4/04	~ Post-adoption would be subject to challenge in the courts as unlawful delegation ~ Prevents a legis. body from giving its powers/responsibilities to make law to another agency (i.e., FEMA) ~ Suggested that model ordinance be changed to provide that communities incorporate by ref. only current studies/maps - when subsequent studies/maps published, need to re-visit their ordinance to make appropriate changes
3	Arizona	No	Patrick Schiffer, ADWR Chief Counsel	5/31/05	~ Nothing prohibiting or authorizing auto-adopt by political subdivisions ~ Nothing prohibiting auto-adopt to FEMA studies and maps, but auto-adopt to other AZ laws considered unconstitutional ~ AG's from 2 other states (SC, ND) have opined that auto-adopt is unconstitutional ~ AZ Attorney General (AG) did not render a legal opinion ~ Possibly need amendment to state's constitution to allow auto-adopt
4	California	Yes	Scott R. Morgan, Staff Counsel, DWR Office of the Chief Counsel	5/25/05	~ Reference statutes incorporating criterion that will be determined by a third party, like FEMA, are common in CA law ~ CA courts accept, as valid, statutes that incorporate another statute by reference, in whole or in part
5	Delaware	No	Kevin P. Maloney, Deputy Attorney General	2/22/06	~ J. Zagone writes about DE auto adopt - Yes, it is legal in DE since it's never been challenged and at muni. level in DE it has been defined as legal ~ Deputy AG not in position to provide opinion if local ordinance requires public participation in adoption ~ But, at state level auto-adopt can be challenged in 2 ways (1) beyond scope of agency's power to auto-adopt, (2) arbitrary and capricious - agency is abdicating responsibility
6	Florida	Yes	Alfred O. Bragg, III, Assistant General Counsel	4/2/04	~ Nothing in FL Statutes prohibits local gov. to incorporate by reference future amendments to outside documents of reference ~ Thus it was concluded that local gov. have the legal and constitutional authority to do so (incorporate by reference?)

7	Georgia	Yes	John Walden, Legal Executive Assistant, GA DNR	11/17/03	~ In GA statute several cases where revisions to the standard are being incorporated by reference ~ The model ordinance, which include auto-adopt, do not conflict with GA law ~ This language (revisions accepted by reference) is common to Flood Damage Prevention Ordinances for cities in GA and other states (includes Charleston, SC - interesting because AZ says that SC opined that auto-adopt is unconstitutional)
8	Kentucky	Yes	Mary Stephens, Attorney, Water Legal Branch - thru: C. Michael Haines, Deputy General Counsel	8/2/04	~ Good statement about the issue - describes the question in straightforward manner - ... in order to avoid multiple amendments of zoning regulations because of changes in the maps, may the model ordinance include language automatically adopting by reference any revisions to the FIRMs and FHBMs? ~ Also, the most frank answer - "No. A change in a zoning map may not be 'automatically' adopted by reference as part of the zoning regulation" ~ Per phone conversation with Rhonda Montgomery and Rachel Sears and document as of 5/17/2007 - KY does allow auto-adopt
9	Louisiana	Yes	James B. Frederick, Jr., Attorney Supervisor, Dept. of Transportation & Development	8/23/05	~ Good description for updates - "We find no legal provisions prohibiting LA governing authorities from adopting federal standards, codes and maps in their current form and as they may thereafter be amended or revised by the fed. govt. ~ They frequently adopt fed. codes and standards "as they are subsequently amended"
10	Maryland	Yes	Adam D. Snyder, Assistant Attorney General	7/27/05	~ Good argument related to due process - map amendment process provides affected owners notice and opportunity to be heard, and ~ Map revisions undergo extensive public notice process, including hearing, opportunity to comment and 90-day appeal ~ Redundant to require full due process twice - initial revision, adoption of map change ~ Allows incorporation by reference - material is revised or repealed w/o having to amend the incorporating statute
11	Mississippi	No	Steve Lawrence, Assistant Attorney General	10/25/04	~ Based on Section 21-13-11 of Mississippi Code - certification, recordation and publication prerequisites must take place before an ordinance can become effective
12	North Carolina	No	Cheryl A. Perry, Assistant Attorney General	9/14/05	~ Unlawful delegation can occur when - a law or rule is incorporated as amended or as revised ~ If NC law incorporate a fed regulation, as amended, then NC law will automatically change when amendment does w/o action of the Legislature - assertion is that state's legislative authority has been given to the federal agency (FEMA) ~ Unconstitutional applies to another statute, code, regulation, standard, or guideline ~ must amend the ordinance, not just the maps
13	Nevada	Yes	Michael L. Wolz, Deputy Attorney General, Conservation & Natural Resources Division	3/14/05	~ Assuming that Model Floodplain Management Ordinance for NV **is not a zoning ordinance** as represented by FEMA there are no specific NV statutes that would invalidate a community's use of the automatic adoption clause to update the floodplain ordinance

#	State		Contact	Date	Notes
14	Ohio	Yes	Joan I. Fishel, Assistant Attorney General, Environmental Enforcement Section - OH DNR	7/28/04	~ Brings up issue of unlawful delegation, but does not believe it is so - "All statutes, resolutions and ordinances enjoy a strong presumption of constitutionality. The burden is on the challenger to show beyond a reasonable doubt that the law/resolution/ordinance and the constitution are incompatible" (see page 3, OH memo)
15	Oregon	No	Steve Shipsey, Assistant Attorney General (as described in "News & Views" article)	6/26/05	~ Can get copy of legal opinion - email brenda.white@state.or.us or call (503) 373-0050, x236 ~ Invalid based on "unconstitutional delegation of legislative authority"...
16	Pennsylvania *(Digital issue discussed)*	Yes	Dept. of Community & Economic Development (DCED) Office of Chief Counsel (no name provided)	4/18/06	~ Ordinances adopted by PA allow local gov't to incorporate FEMA Flood Hazard Data in digital form in place of an official flood map ~ Can incorporate digital data by reference ~ Section 107 of 2004 Act would preempt any PA law requiring a paper map (see section 107 for language - good guideline) ~ Use same reasons as OH to validate - a "statute is presumed to be constitutional, ..."
17	South Carolina	No	Robert D. Cook, Assistant Deputy Attorney General	4/14/05	~ SC states that the adoption of future legislation, rules or regulations or amendments thereof "constitutes unlawful delegation of legislative power"
18	Texas	Yes	Kerrie Jo Qualtrough, Staff Attorney - thru Perdue, Division Director - Env. Law Division - thru Martinez, Sr. Attorney, Water Rights & Utilities	5/2/05	Yes, valid but - "cities should consult with their own legal counsel before adopting any ordinance"
19	Vermont *(Digital issue discussed)*	Yes	William E. Griffen, Chief Assistant Attorney General	4/28/05	No prohibitions on automatic adoption or use of digital data and maps in lieu of paper maps
20	Washington *(Digital issue discussed)*	Yes	Thomas J. Young, Assistant Attorney General	2/4/04	~ Floodplain statute states that the basis for floodplain management shall be the areas designated as special flood hazard areas "on the most recent maps" provided by FEMA - "most recent maps" appears to authorize local ordinances to incorporate ~ Interesting - opinion states that failure to include "and any revisions thereto" (automatic adoption) language could render the local ordinance as non-compliant since the local ordinance would not include the revision and therefore would not include "the most recent map"
21	West Virginia	Yes	Darlene Ratliff-Thomas, Assistant Attorney General	1/21/05	The phrase "the most recent revisions thereof" should be sufficient for use in your (locals) ordinance
22	Wyoming	No	Patrick J. Crank, Attorney General	10/12/04	

Attachments

Attachment 1: FEMA Digital Policy – Use of Digital Flood Hazard Data

Attachment 2: State of Wisconsin Memo – Legal Analysis of Digital Floodplain Maps

Attachment 3: Durham, NC, Unified Model Ordinance – Official Zoning Map

Attachment 4: Santa Clara County, CA – GIS Official Zoning Map