

Hydrologic Engineering Center
Training Course on
Flood Damage Analysis with GIS
Davis, California

Objectives: This course provides Corps of Engineers hydraulic engineers, economists, study managers, and other water resources professionals with detailed instructions for using the comprehensive set of HEC analytical tools for performing flood damage reduction studies using Geographic Information Systems (GIS). Participants will gain hands-on experience in the use of the tools by applying them in workshops. Included in the course are: the Flood Damage Analysis (HEC-FDA), Flood Impact Analysis (HEC-FIA), and IWR-CEFIT (with Marshall-Swift options) programs. The course emphasizes the GIS approach for structural inventories and subsequent formulation and evaluation of flood damage reduction plans. The computations and procedures presented are consistent with requirements of ER 1105-2-100, "Planning Guidance Notebook", and ER 1105-2-101, "RISK-BASED ANALYSIS FOR EVALUATION OF HYDROLOGY/HYDRAULICS, GEOTECHNICAL STABILITY, AND ECONOMICS IN FLOOD DAMAGE REDUCTION STUDIES".

Description. The presentations and workshop applications associated with the suite of integrated software will feature the use of GIS approaches to aid the analysis and output display of results. Alternative methods for structure inventories will include: grid-cell land use; census block data; spatially referenced business databases; parcels, and field surveys including use of GPS. Analysis examples will demonstrate the use of GeoRAS for integration of hydraulic data into the flood damage analysis framework. Interactive GIS flood damage calculations for single or user defined groups of structures will be illustrated. Output will be tabular, graphical, and spatial depictions. Plans may also be spatially displayed and compared.

Prerequisites. Nominees should be assigned (a) Occupational Series: Selected 0000-0100, 0800, and 1300; (b) Grade: GS-07 or above. Nominees for the course should be primarily working level professionals; however, supervisory personnel in planning sections or economic analysis sections would benefit significantly by being exposed to modern computational method

Monday

8:00 - 9:00 a.m. **INTRODUCTION and PRETEST**

9:00 - 9:15 a.m. **BREAK**

9:15 – 10:15 a.m. Lecture 1.1: **OVERVIEW OF FLOOD DAMAGE ANALYSIS PROCESS**
Overview of Flood Damage Analysis terminology, guidance, planning and study procedures.

10:15 – 11:15 a.m. Lecture 1.2: **CONCEPTS OF RISK ANALYSIS**
The concepts of risk-based analysis as applied to performing flood damage reduction studies will be discussed. The interrelationship of discharge-probability, stage, and damage functions and their uncertainties will be discussed. Plan formulation and evaluation within the risk-based analysis framework will also be reviewed.

11:15 – 12:00 p.m. Lecture 1.3: **DEMONSTRATION OF HEC-FDA**
Demonstration of version 1.2 of the HEC-FDA program.

12:00 – 1:00 p.m. **LUNCH**

1:00 – 2:45 p.m. Workshop 1.4: **CALCULATION OF EAD**
Students will perform a hand calculation of EAD. For extra credit, they will compute EAD with the existing FDA program.

2:45 – 3:00 p.m. **BREAK**

3:00 – 3:45 p.m. Lecture 1.5: **OVERVIEW OF GIS**
What is GIS? (Tom)

3:45 – 5:00 p.m. Lecture 1.6: **USE OF GIS IN THE FLOOD DAMAGE ANALYSIS PROCESS**
Description of the use of GIS in the Flood Damage Analysis Process. Describing the Susquehanna River Basin “case study”.

Tuesday

- 8:00 – 9:00 a.m. Lecture 2.1 **GIS CONCEPTS: FEATURES AND TABLES**
Vector GIS and topology. Using GIS as a database.
- 9:00 – 9:15 a.m. **BREAK**
- 9:15 – 10:15 a.m. Workshop 2.2 **VIEWING DATA IN ARCVIEW**
The ArcView user interface, projects and map layouts.
- 10:15 – 11:15 a.m. Lecture 2.3 **DATA SOURCES IN ARCVIEW, GETTING DATA INTO ARCVIEW**
Describing sources of GIS data and how ArcView uses them. Sources of Census, Tiger, and parcel data.
- 11:15 – 12:00 p.m. Workshop 2.4 **DATA SOURCES IN ARCVIEW**
Add new themes to a view, set theme and view properties, query a theme and select out a subset of the records, then save that selected set to a new theme, add an image to a view, label features, join tables together, and perform a spatial query.
- 12:00 – 1:00 p.m. **LUNCH**
- 1:00 – 1:45 p.m. Workshop 2.4 **DATA SOURCES IN ARCVIEW (continued)**
- 1:45 – 2:00 p.m. **BREAK**
- 2:00 – 2:45 p.m. Lecture 2.5 **TERRAIN MODELS, TINS, GRIDS, DEM DATA**
Grid data structure. Continuous and categorical data layers. Grid operations. Introduction to Digital Elevation Models. Introduction to Geo-RAS.
- 2:45 – 4:30 p.m. Workshop 2.6 **USE OF GIS IN THE FLOOD DAMAGE ANALYSIS PROCESS**
Use ArcView Spatial Analyst to open, view, and manipulate grids related to Flood Damage Analysis. Calculation of stage-aggregated damage in the Susquehanna Basin. (Jason, Stan, Cam)
- 4:30 – 5:00 p.m. **WORKSHOP REVIEW**

Wednesday

8:00 – 9:30 a.m.

Lecture 3.1 **DESCRIPTION OF THE HAZUS AND FIT PROGRAMS –
FUNCTIONALITY, DATA, AND DEVELOPMENT SCHEDULE**

This presentation will describe the development of FEMA's hazard mitigation tools as they relate to flood damage analysis. They include the HAZUS and FIT programs. The lecture will include discussion of the development of structure values and damage functions and the use of Census Block data.

9:30 – 9:45 a.m.

BREAK

9:45 – 11:15 a.m.

Lecture 3.2 **CASE EXAMPLE: SACRAMENTO / SAN JOAQUIN
COMPREHENSIVE STUDY**

A discussion of the Sacramento / San Joaquin Comprehensive Study, Sacramento District, will be given. It will include a description of the complexity and scope of the study as well as the use of two phases of study. The two phases incorporate different levels of detail and utilize GIS.

11:15 – 12:00 p.m.

Lecture 3.3 **DESCRIPTION AND DEMONSTRATION OF THE IWR-CEFIT
PROGRAM**

This lecture and demonstration will present the current development of IWR's CEFIT program and how it can be used in conjunction with HEC-FDA. It will describe it's functionality as well as the basis of deriving values.

12:00 – 1:00 p.m.

Lunch

1:00 – 2:15 p.m.

Lecture 3.4 **QUANTIFYING UNCERTAINTIES IN FLOOD DAMAGE**

Approaches defined in ER 1105-2-101 for estimating the uncertainty of the stage-damage relationships and for estimating the uncertainty associated with each approach will be presented. The corresponding effects of projects that modify the stage-damage relationship will be discussed.

2:15 – 2:30 p.m.

BREAK

2:30 – 4:00 p.m.

Workshop 3.5 **STAGE-DAMAGE RELATIONSHIP UNCERTAINTY ANALYSIS**

Compute uncertainties in economic data.

4:00 – 5:00 p.m.

Lecture 3.6: **DEVELOPING FLOOD INUNDATION BOUNDARY MAPS AND
DEPTH GRIDS**

Data required for calculating water surface profiles with HEC-RAS will be identified. Discusses the development of flood inundation boundary maps and depth grids for use in flood damage analysis.

Thursday

- 8:00 – 9:00 a.m. Workshop 4.1 **DISPLAYING RESULTS WITH ARCVIEW**
Display results from the current HEC-FDA program (version 1.2) using ArcView.
- 9:00 – 9:15 a.m. **BREAK**
- 9:15 – 10:30 a.m. Lecture 4.2 **USE OF GIS TO MANAGE DATA AND COMPUTE DAMAGE IN THE GALVESTON DISTRICT**
Case study of Galveston District flood damage reduction benefit study.
- 10:30 – 11:30 a.m. Lecture 4.3 **DESCRIPTION OF CRREL'S SOFTWARE FOR DOING FLOOD DAMAGE ANALYSIS**
Description of CRREL's software for flood damage analysis.
- 11:30 – 12:30 p.m. **LUNCH**
- 12:30 – 1:30 p.m. Lecture 4.4 **DESCRIPTION AND DEMONSTRATION OF THE BLENDED HEC-FDA PROGRAM; ENTERING ECONOMIC DATA**
Describes and demonstrates current design of the blended HEC-FDA program. Compares the current and proposed versions. Gives instructions on entering economic data into HEC-FDA. Describes the aggregation methodology.
- 1:30 – 1:45 p.m. **BREAK**
- 1:45 – 2:45 p.m. Lecture 4.5 **DESCRIPTION, DEMONSTRATION AND WORKSHOP IN CONFIGURING A WATERSHED**
Describes the necessary steps and data requirements for configuring a watershed using the new HEC-FDA program. The program will be demonstrated and the students will do a short workshop using the FDA program to configure a watershed. (Penni)
- 2:45 – 3:45 p.m. Workshop 4.6 **CREATION OF A NEW STUDY AND ENTERING CONFIGURATION AND ECONOMIC DATA USING PROTOTYPE HEC-FDA**
Add configuration and economic data to a new study.
- 3:45 – 4:15 p.m. **Workshop Review**
- 4:15 – 5:00 p.m. Lecture 4.7 **CASE STUDY: VASSER**
A case study demonstrating the use of the current functionalities of the Blended Program for the evaluation of non-structural flood damage reduction alternatives for Vassar, MI. (Stan)

Friday

8:00 – 8:45 a.m. Lecture 5.1: **EVENT ANALYSIS**

Participants will be introduced to the capabilities and features of FDA's event analysis option. Event-based computations will be described. Interactions between the more conventional risk-based features and the event-based features will be discussed as will the data required to perform an event-based analysis. Output resulting from this analysis will be viewed and described.

8:45 – 9:00 a.m. **BREAK**

9:00 – 10:30 p.m. Lecture 5.2: **APPLICATION OF EVENT ANALYSIS IN ROCK ISLAND DISTRICT**

10:30 – 11:30 a.m. **POST TEST, CRITIQUE, AND CLOSING**