

## Session 16

**Course Title:** Floodplain Management

**Module Four:** Risks to Human Settlements (river corridors as hazards)

**Session 16:** What is a Risk?

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**Time: 75 minutes**

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### Objectives (**POWERPOINT 16-1**):

At the end of the session, students should be able to

- 16.1 Define terms and explain risk in non-technical terms that could be understood by local decision-makers.
  - 16.2 Prepare a basic flood risk assessment.
  - 16.3 Apply risk assessment to flooding problems in a watershed.
  - 16.4 Prepare a Vulnerability Assessment and complete the Flood Hazard Assessment
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### Scope

The overall goal of Session 16 is for students to assess the risk present in a river system where human development is subject to hazards. The instructor will introduce how "floodplain" is used in a legal construct and how the basic approach differentiates between floodway and flood fringe. The floodplain will be explained in its legal construct and we will explore how that is used in development, planning, and mitigation decisions.

Hazard may exist, but risk is not present until something that could be impacted by the hazard is at risk. Risk categories range from risk to human life, risk to property or infrastructure, and risk to the natural resource. We will examine factors that contribute to the various categories of risk; the concept of temporary risk, such as driving through floodwater, and continuing risk, such as developing and living in hazard areas. Homework may include asking students to apply a risk assessment to the watershed they live in, with class discussion in a later session of the various findings.

### Readings

## *Student and Instructor Readings*

Federal Emergency Management Agency. 2001. "STEP ONE. identify hazards; STEP TWO. flood hazard profiles; STEP THREE. flood hazard asset inventory; STEP FOUR. flood hazard loss estimation." *Understanding Your Risks. Identifying Hazards and Estimating Losses. State and Local Mitigation Planning how-to guide*. FEMA 386-2. Washington, D.C. August.

Schwab, J., K.C. Topping, C.C. Eadie, R.E. Deyle, and R.A. Smith. 1998. "Chapter 7. Hazard Identification and Risk Assessment." *Planning for Post-Disaster Recovery and Reconstruction*. Planning Advisory Service Report No. 483/484. Washington, D.C.: American Planning Association.

### **Requirements:**

Prepare a class handout of

- PowerPoints 16-2,16-3, of previous terms and definitions for students to use in class team discussion and review.
- PowerPoints 16-4, 16-5, 16-6 of new terms and definitions to add to their personal glossaries.
- the homework assignments.

### **Remarks**

#### **Objective 16.1 Define terms and explain risk in non-technical terms that could be understood by local decision-makers.**

##### **I. Agree on Meanings**

- A. As professionals, we must agree on the meaning of terms so we can more effectively communicate with other professionals, local decision-makers, and the general public.
  1. If you can avoid any misunderstandings when speaking to floodplain management, you will have done a service to your community by saving them time and money
- B. You are serving as the interpreter (translator) of technical concepts for local officials and decision-makers with little if any training, experience, or background in floodplain management.
  1. As students and practitioners, you should develop a **personal glossary** that you continually update as we work through these session and, more importantly, as you move into your professional career.

##### **II. Review selected terms (POWER POINT'S 16-2, 16-3)**

### Note

Ask students to form groups of two to three and to take 10 minutes or so to quiz each other on the terms that have used so far in class. Ask them to discuss among themselves any issues they have with the definitions or terms and bring those issues back for a general class discussion.

- A. **BASE FLOOD** - The selected flood frequency for regulatory purposes. The National Flood Insurance Program has adopted the 1% chance ("100-year") flood as the base flood to indicate the minimum level of flooding to be used by a community in its floodplain management regulations and where flood insurance may be required.
- B. **FLOODPLAIN** - Low lands adjoining the channel of a river, stream, or watercourse, or ocean, lake or other body of water, which have been or may be inundated by floodwater, and those other areas subject to flooding.
- C. **100-YEAR FLOOD** - A term commonly used to refer to the one percent annual chance flood. The "100-year" flood is the flood that is equaled or exceeded once in 100 years on the average, but the term should not be taken literally as there is no guarantee that the "100-year" flood will occur at all within the 100-year period or that it will not recur several times.
- D. **REGULATORY FLOODWAY** - The area regulated by federal, state or local requirements to provide for the discharge of the base flood so the cumulative increase in water surface elevation is no more than a designated amount (not to exceed one foot as set by the National Flood Insurance Program).

### III. Introduce New Terms (~~POWERPOINT 16-4, 16-5, 16-6~~)

#### Note

The Instructor now introduces terms that will be used during Session 16. Some of these terms are similar to those presented in Session 15, for example floodway vs. regulatory floodway. Remind students that they should always be alert to variations on a single concept and that they should be adding new terms to their personal glossary they started as part of Session 15. This glossary should be continuously updated during the term and throughout their professional career. (POWERPOINT 16-4)

- A. **DIRECT EFFECTS** - 1. Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.8). May also be called primary impacts and applies to both adverse and beneficial impacts. 2. Are caused

immediately by the event itself, such as a bridge washing out during a flood (FEMA, 2001, p. ix).

- B. FLOOD FRINGE** - Areas outside the regulatory floodway but still inundated by the designated one percent annual chance flood (often referred to as the floodway fringe).
- C. FLOODPLAIN VALUES** - The qualities of or functions served by floodplains which include but are not limited to: a) water resources values (natural moderation of floods, water quality maintenance, groundwater recharge); b) living resource values (fish, wildlife, plant resources and habitats); c) cultural resource values (open space, natural beauty, scientific study, outdoor education, archaeological and historic sites, recreation); and d) cultivated resource values (agriculture, aquaculture, forestry).
- D. FLOODWAY** - The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without causing any cumulative increase in the water surface elevation. The floodway is intended to carry the dangerous and fast-moving water.
- E. INDIRECT EFFECTS** - 1. Impacts that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). May also be called secondary impacts and applies to both adverse and beneficial impacts. 2. Usually involve interruptions in asset operations and community functions, also called functional use. For example, when a bridge is closed due to a flood, traffic is stopped, delayed or rerouted, which impacts individuals, businesses, and public services, like fire and police departments that depend on the bridge for transportation (FEMA, 2001, p. ix).
- E ONE-PERCENT ANNUAL CHANCE FLOOD** - A flood of the magnitude that has a one-percent chance of being equaled or exceeded in any given year. Often referred to as the "100-year" flood or base flood, the one-percent annual chance flood is the standard most commonly used for floodplain management and regulatory purposes in the United States.  
**POWERPOINT 16-5**
- F. CRITICAL FACILITIES** - type and location of police stations, fire and rescue facilities, hospitals, shelters, schools, nursing homes, water supply and waste treatment facilities, and other structures the community identifies as essential. **POWERPOINT 16-6**
- G. RISK** - The potential losses associated with a hazard, defined in terms of expected probability and frequency, exposure, and consequences. (Schwab et al., 1998, p. 329)
- H. RISK** - the possibility of suffering harm from a hazard (Deyle, et al., 1998, p. 121).

- I. **RISK** - the probability of an event or condition occurring (Mileti, 1999, p. 106).
- J. **RISK** - the probability of being flooded (L.R. Johnston Associates, 1992, p. C-8).
- K. **RISK** - The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard (FEMA, 2001, p. a-6).
- L. **RISK ANALYSIS** - estimates of the probability of various levels of injury and damage to provide a more complete description of the risk from the full range of possible hazard events in the area Deyle, et al., 1998, pp. 121-122).
- M. **RISK ANALYSIS** makes "a quantitative estimate of damage, injuries, and costs likely to be experienced within a specified geographic area over a specific period of time" (Deyle et al. 1998, p. 133-134).
  - 1. Risk = magnitude X probability
  - 2. Magnitude is defined through the vulnerability assessment.

**Objective 16.2 Prepare a basic flood risk assessment. (PowerPoints 16-7, 16-8)**

**I. 100-year Flood**

- A. For our purposes, we are interested in a flood that has a one-percent chance of being equaled or exceeded in any given year.
  - 1. Often referred to as the "**100-year" flood or base flood**, the one-percent annual chance flood is the standard most commonly used for floodplain management and regulatory purposes in the United States.

**II. The Floodplain (POWERPOINT 16-7)**

- A. The floodplain may be divided into two parts: **the regulatory floodway and the flood fringe.**
  - 1. Floodway—a physical phenomenon.
  - 2. Regulatory Floodway— an institutional concept.
- B. Floodways vary with the size of the flood.

1. Consequently, the floodway for a flood that has a two-percent annual chance (the 50-year flood) or a ten-percent chance (the 10-year flood) will be smaller.
  - a. However, velocities within the floodway may be equal to the larger event.
2. Representations of the regional extent of an event and expected depths of inundation appear on the Flood Insurance Rate Map (FIRM).

### III. Magnitude and Intensity

- A. The **magnitude** of an event may also be thought of in terms of **intensity**, the number of people and structures exposed to it, and the effectiveness of pre-event mitigation measures (Godschalk, et al., 1999, p. 4).
- B. The Flood Insurance Study (FIS) prepared through FEMA presents additional information.
  1. The FIS delineates the SFHA (and perhaps the 500-year floodplain), the designated flood risk zones, and a flood profile that establishes the base flood elevations plotted along the watercourse.
  2. FIRMs and FIS are available from FEMA's Map Service Center (877-336-2627 or 877-FEMA MAP) at no charge to local governments. Copies are usually available for viewing onsite by contacting the state floodplain management office (NFIP coordinator), office of emergency preparedness/response, or the county, parish, or municipal floodplain management, zoning, or building code office.

### III. The Distinction between Risk and Vulnerability (POWERPOINT 16-8)

- A. **Risk** identifies the geographic areas most likely to be affected by a given natural hazard, which in our case is the base flood.
  1. We usually show risk areas on a map. FEMA has done this for us on the FIRM.
  2. People can live and work within a risk area and be less vulnerable to the hazard. Some buildings within the defined SFHA do not flood because they are flood proofed, elevated, or in some other way protected. (POWERPOINT 16-9)
- B. The people and the infrastructure that serves them are still **vulnerable**.

1. Getting to and from a structure, having power or water, etc. may still present a major problem and cost.
2. Many people and structures in the SFHA are vulnerable. These properties will flood and suffer damages.

**IV. Discussion -Ask students in class:**

- A. Who or what is at risk?
  1. Can you identify structures in our community that are in the floodplain and have not been damaged during a flood? What are some costs of providing service to those structures?
- B. Who or what is vulnerable?
  1. Can you identify examples of individuals who live or work in the floodplain?
    - a. Individuals who live or work in the floodplain may be injured or even killed. And people who do not live or work in the floodplain are also vulnerable.
    - b. For example, the individual who drives across a flooded street may be swept away by the current. These people are susceptible to flooding just as much as those who occupy the floodplain.
  2. Can you identify environments that may be vulnerable as well?
    - a. Think of the riverbanks that erode, destroying habitat for birds or mammals.
    - b. Riverbeds (gravel beds or reaches of submerged aquatic vegetation) are scoured or covered by sediment destroying nesting or breeding areas or shellfish beds.
- C. Can you identify other floodplain functions or values that may be adversely impacted by flooding? What are some natural values that benefit from flooding?

**V. What will be damaged? (POWER POINT 16-10)**

For determining what will be damaged, we divide the community into clusters:

- critical facilities,
- social enclaves,
- economic activities, and

- environmental components.

### POWERPOINT 16-11

- A. **Critical facilities** include type and location of police stations, fire and rescue facilities, hospitals, shelters, schools, nursing homes, and other structures the community identifies as essential.
1. Once you have completed an inventory, you can determine if these critical facilities are in the SFHA.
  2. Taking it to the next step, you can analyze their **vulnerability** by collecting data on their construction type and quality, age, size, footprint, elevation compared to the 1% chance flood, building capacity, presence of auxiliary power, use during an event, potential evacuation routes, etc.
  3. We also want to know the **exposure** of these critical facilities.
    - a. Are critical facilities located within the 10-year floodplain (the area that has a ten-percent probability of being flooded in a given year); or the 25-year floodplain (the area that has a four-percent chance of being flooded in a given year); or the 50-year floodplain (the area that has a two-percent chance of being flooded in a given year)?
    - b. Have you factored in erosion or sedimentation from floodwaters?
- B. Our analysis contributes significantly, to how we address the problem.
1. For example, should we protect a critical facility that may be frequently flooded but the impact is low?
  2. Or should we assign scarce dollars to flood proofing a structure that may flood less frequently, but if damaged would have a devastating affect on the community for a long period?
- C. Information on critical facilities may be obtained from the administrating agencies, boards (drainage, levee), commissions (planning), departments (public works), or institutions (university departments) at the main office or the building manager, the state office of emergency preparedness, tax assessors, financial institutions, and state/federal agencies (geological survey). If the community has a hazard mitigation plan (many do), the critical facilities are usually identified in that plan. (POWERPOINT 16-12)

## VI. Who will be affected?–Social Enclaves

- A. It is essential that local decision makers know which segments of the community (**social enclaves**) will be affected as a result of flooding.
- B. You as a planner/decision maker can assist in providing this information by analyzing the vulnerability of a population using age, income, ethnicity, capabilities, and experience in hazards.
  - 1. For example, we know that areas of low to moderate income people will be more likely to be located in flood prone areas in riverine communities and to need more public assistance and services to recover.
    - a. In many instances, structures are under insured or uninsured and property owners will have only limited finances for mitigation.
  - 2. Some segments of the community such as older neighborhoods may have an elderly population that depends on assistance in evacuation.
  - 3. Other enclaves may have a primary language other than English (American) and will have difficulty understanding written or verbal evacuation orders and instructions.
  - 4. Information on these populations may be collected from Census data, churches, social organizations, clubs, fraternal groups, relief organizations, and meetings with local officials. (POWERPOINT 16-13)

## VII. What will be affected? – Economic Activities

- A. We can anticipate that **floods will also directly and indirectly affect economic activities.**
  - 1. In many communities, transportation systems (docks, railroads, or bridges) were historically located near the river to expedite commerce.
  - 2. In addition, though they were constructed to a level above the known flood, the flood threat was not often known or completely understood.
- B. Compounding the historic problem is increasing flood frequency and levels as lands upstream and outside the floodplain are developed.
  - 1. Hydrographs from developing watersheds show higher flood peaks that occur sooner and more frequently as urbanization covers open space with impervious surfaces (roofs, streets, parking lots, etc.).

- C. Information on economic activities may be obtained from the chamber of commerce, the state and local departments of economic development, tax assessors, business associations, planners, university departments, and meetings with local officials. Information on impacts of past flooding may be available from newspaper reports. (POWERPOINT 16-14)

### VIII. The Impact on the Environment

- A. The **environment** will be affected by flooding and in turn will have indirect (secondary) impacts throughout the community.
- B. When you hear environment you immediately think of jeopardizing habitat, critters (animals, birds, and fish), water quality, and similar physical and biological elements.
  - 1. But the environment also includes public health, the economy, and quality of life.
- C. A flood may destroy wetlands (gravel beds, shellfish beds) by covering them with sediment or erosion, turning productive swamps, marshes, and channels into sterile watercourses.
  - 1. These are **direct (primary) effects** (impacts) that are caused by the action and occur at the same time and place (40 CFR 1508.8).
  - 2. But also consider the **indirect (secondary) effects** (impacts), which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8).

### IX. What Are the Costs? (POWERPOINT 16-15)

- A. Floods can have major adverse direct and indirect effects on the local economy. If primary centers of the business community are vulnerable, you as a planner or decision maker must identify these vital sectors and initiate mitigation measures to reduce or eliminate these impacts to sustain economic development.
- B. Working with local business leaders, universities, and government agencies, you can develop a general overview of the local economy. From this, you will be able to identify and locate these important industries and businesses and prioritize their importance to the well being of the community.
- C. With this established you should determine which of these are at risk. Do they exist within the floodplain? If yes, how vulnerable are they?

1. Remember to involve licensed engineers, architects, and landscape architects when determining the vulnerability of buildings and infrastructure.
  2. When investigating social, economic, and environmental issues, retain the correct professional for the job.
- D. Once you know and understand the vulnerability of parts of your community, mitigation plans can be initiated to reduce their structural and operational vulnerabilities.
1. Step 4 (Estimate Losses in FEMA, 2001, pp. 4-1 - 4-15) provides a more detailed discussion of losses. (The instructor should determine how much detail on estimating losses to include in the course.)
- E. Information about your community can be obtained from several sources. These include, but are not limited to the U.S. Census Bureau (see for example the Economic Census and the County Business Patterns), the local chamber of commerce, reports from a state's department of economic development or commerce (or similarly name agency), universities, county/municipal planning departments, and trade associations.
- F. Building on previous discussions and sessions, it is now clear that a basic risk assessment
- identifies the hazard,
  - profiles the hazard event,
  - inventories the assets that would be impacted (affected), and
  - estimates the losses that would result from events (floods) of different probability.
1. More complex approaches exist than what is presented here. But our effort is to help you prepare a baseline estimate of what will happen to your community as the result of a flood.

## **IX. Class Discussion or Small Group Discussion**

### **Note**

The Instructor can pose the following scenario and either discuss as a class or have students break into small groups to discuss and do a short report out. This is a very useful exercise to help students synthesize this week's class session.

- A. To understand these action/response issues, consider the following. A flood may erode a bottomland hardwood habitat and at the same time inundate a sewage pond, destroy or flood a warehouse, or break a pipeline.

- B. What are the direct and indirect affects effects on the wetlands, the plant and business structures, and the pipeline? Can you estimate some of the costs involved and here do you think the greatest costs are?
1. The direct effects occur on the wetlands, the plant and business structures, and the pipeline. But the indirect effects are displacing game (deer) and birds, discharge of raw sewage from the plant which will impact water quality (and possibly a water supply area), release of chemicals and other hazardous materials from the plant and the warehouses, or destruction of transportation systems that haul hazardous cargoes (railroads, highways, docks, and pipelines). Not only will the wetlands be degraded, but Federal, state, and local officials can anticipate major cleanup and restoration costs and activities.
- C. Discussion Summary
1. Activities that will have an adverse impact on the environment when flooded need to be located and mapped to determine if they exist in the SFHA and data collected on them. One then can analyze how vulnerable these sites are and estimate the possible impacts and costs if these uses are flooded.
  2. Information on environmental areas may be collected from:  
Federal and state conservation, environmental, and regulatory agencies (Wildlife and Fisheries, game and fish departments, Natural Resources Conservation Service, and the Corps of Engineers);  
State office of emergency management or preparedness;  
Boards/districts (levee, drainage, soil and water conservation, parks);  
Commissions (game and fish; river basin);  
Local agencies (parks and recreation);  
The private sector (hunting clubs, non-government organizations);  
and meetings with local officials.  
Points of contact and availability of information and data may be accessible on the Internet.

### **Objective 16.3 Apply risk assessment to flooding problems in a watershed.**

#### **I. Reviewing Terms and Definitions**

- A. Mileti (1999, p. 210) builds on the definition of disaster from Charles Fritz:

1. an event, concentrated in time and space, in which society, or a relatively self-sufficient subdivision of a society, undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and the fulfillment of all or some of the essential functions of the society is prevented (Fritz, 1961, p. 655).
- B. Focusing more directly to our concern for flooding in this course, we turn to Godschalk et al. (1999, p. 4).
1. He proposes that we experience a disaster when extreme natural forces, such as floods, strike individuals and properties.
  2. We do not consider an extreme event a disaster if it occurs in unpopulated places, thereby not affecting developed areas.
- C. Tracking from the general to the most specific, the sequence is:
1. Disaster—extreme event
  2. Natural hazard—extreme event from the normal course of events that adversely impacts people and property, such as a flood.
  3. Hazard assessment—characteristics of the hazard, such as, severity, temporal distribution, location, and time span of the event.
  4. Risk—probability of an event (flood).
  5. Risk assessment—estimates of probability of impacts.
  6. Vulnerability - susceptibility to damage.
  7. Vulnerability assessment - impacts of a range of events (floods) on the existing and future built environment and natural environment at a specific location

## **II. Hazard**

- A. Session 15 discussed the concept of a hazard.
1. From these definitions, a hazard must be related to human activity(ies).
  2. Second, hazards are extreme events from the normal course of events.
  3. Third, hazards pose a risk of damage, loss, or harm to people and/or their property.

4. Finally, the primary cause of our hazard is flooding.
- B. From a hazard analysis, we defined which areas of our community are most susceptible to flooding, that is, the floodplain (the area of land that would be inundated by a flood having a one-percent chance of occurring in any given year). These are the areas at risk.

### **III. Identifying Vulnerability**

- A. Session 16 showed that structures within the Special Flood Hazard Area may be flooded and can be identified using the information shown on the Flood Insurance Rate Map (FIRM) and the FEMA "Q3" flood data.
  1. These structures are therefore identified as vulnerable to flooding.
- B. A vulnerability assessment of these structures tells us which of these structures would most likely flood during a flood event.
  1. Some structures even though they are in the floodplain would not flood because they are elevated above the base flood, or flood proofed, or in some other way protected from damage.
- C. The vulnerability of critical facilities, social enclaves, economic activities, and environmental systems can also be identified. Once we know what is vulnerable we can estimate the direct and indirect (primary and secondary) adverse impacts resulting from flooding.
  1. This serves as the base for preparing a mitigation plan and implementing mitigation measures.
  2. In Session 18, we will discuss floodplain management as the foundation and guide upon which we prepare a mitigation plan.

### **16.4 Prepare a Vulnerability Assessment and complete the Flood Hazard Assessment.**

Now that you know the flood hazard and the risk that affects your community, you are able to determine the vulnerability of your community and consequently complete your Flood Hazard Assessment. Vulnerability "describes how exposed or susceptible to damage an asset is.

#### **I. Vulnerability**

- A. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another.

1. For example, many businesses depend on uninterrupted electrical power. If an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.” (FEMA, 2001a, p. a-7)
- B. Vulnerability is "the measure of the capacity to weather, resist, or recover from the impacts of a hazard in the long term as well as in the short term (Mileti, 1999, p. 106).

## II. Vulnerability Assessment (POWERPOINT 16-16)

- A. You can determine your vulnerability by conducting a **vulnerability assessment**. A vulnerability assessment presents "the extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment." (FEMA, 2001a, p. a-7)
- B. Deyle et al. (1998, p. 121) defines a vulnerability assessment as a characterization of "the exposed populations and property and the extent of injury and damage that may result from a natural hazard event of a given intensity in a given area."
- C. In the vulnerability assessment, you combine what you learned from the hazard identification with an inventory of existing property and population exposed to flooding (Deyle et al., 1998, p. 129).
  1. The result is a better understanding of whom and what are vulnerable to flooding in a geographic area and an estimate of the damages and casualties that may result from different flood events.
  2. From this planners and local officials should be better able to predict how different types of property and populations are affected by a flood (Deyle et al., 1998, p. 131).
- D. A vulnerability assessment can build support for hazard management. As such, it may be used to formulate, design, or justify various land use planning and management tools, such as floodplain management ,(Deyle et al., 1998, p. 123). The following indicates the application of a vulnerability assessment:
  1. Common Practice: Local emergency management plan; Building relocation; Acquisition of damaged buildings.

2. Sometimes used: Hazard component of the comprehensive plan, recovery/reconstruction plan; Special hazard resistance standards; Retrofit standards for existing buildings; Location requirements for critical facilities; Impact taxes; Public information program; Hazard disclosure requirements.
3. Rarely used: the Vulnerability assessment may be applied to Zoning ordinances; Subdivision ordinance; Hazard setback ordinance; Building code; Acquisition of underdeveloped lands; Acquisition of development rights; Capital improvements programs; Location of public facilities and infrastructure in less hazardous areas; Reduced or below market taxation.

**Notes for discussing the student homework assignments and for completing the Flood Hazard Assessment Handout 15H-1 began in Session 15.**

The following discussion describes how an instructor could prepare the class for their homework assignments. As the Instructor, you have the choice of determining if the students teams turn in a report **and** make a class presentation or just turn in their reports to you. If they do both, you will need to determine the appropriate session and allocate the time for the in class presentations.

**Student Homework Exercise—Prepare a Basic Risk Assessment**

**Purpose:**

Students will prepare a basic risk assessment on a watershed that includes their municipality and its expanding (developing) fringes.

**Process:**

Students will be assigned to one of four groups: critical facilities, social enclaves, economic activities, and environmental systems.

They will then inventory the elements of concern within their assigned category and determine if these elements are vulnerable to flooding.

For those elements that are vulnerable, the students would divide them into groups and assess the degree of vulnerability of one component by collecting data and information.

**Final Report:**

Each team should prepare a report to the class on the sources of information used, the methodology, and the results of their analysis.

From this data, the student teams will prepare a risk assessment for the selected community.

**Student Homework Exercise—Complete the Flood Hazard Assessment**

Review the instructions form Session 15. Student teams will complete the Flood Hazard Assessment they began during the previous class (Session 15):

**V. The vulnerability of the community to flooding**

**VI. Conclusions, summary, and estimation of risk**

**VII. Bibliography**

**VIII. Appendix**

**(POWERPOINT 16-17)**

Once the Flood Hazard Assessment is complete, student teams will present their document to the class and discuss the exercise. **Session 17 is devoted to the Flood Hazard Assessment and Vulnerability Assessment you have been preparing. Each team will have ten (10) minutes to make its presentation. This is not much time so you must be prepared. I encourage you to use supporting materials, such as graphics, maps, tables, and handouts. Be forewarned. When you make a presentation to the County Commission or the City Council, you will be lucky to get ten (10) minutes. So come prepared to speak to individuals who are not knowledgeable in the arena of flooding, flood plain management, and mitigation. We will then discuss the reports.**

**REFERENCES**

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### POWERPOINT (see accompanying file)

- 16-1 FLOODPLAIN MANAGEMENT. What is Risk
- 16-2 FLOODPLAIN MANAGEMENT. Reviewing Key Definitions
- 16-3 FLOODPLAIN MANAGEMENT. Floodway Definitions
- 16-4 FLOODPLAIN MANAGEMENT. Reviewing Key Definitions
- 16-5 FLOODPLAIN MANAGEMENT. Critical Facilities
- 16-6 FLOODPLAIN MANAGEMENT. Defining Risk
- 16-7 FLOODPLAIN MANAGEMENT. Flood Disasters – a slide
- 16-8 FLOODPLAIN MANAGEMENT. Risk vs. Vulnerability
- 16-9 FLOODPLAIN MANAGEMENT. Risk vs. Vulnerability – a slide
- 16-10 FLOODPLAIN MANAGEMENT. What will be damaged?
- 16-11 FLOODPLAIN MANAGEMENT. Critical Facilities – a slide
- 16-12 FLOODPLAIN MANAGEMENT. Social Enclaves – a slide
- 16-13 FLOODPLAIN MANAGEMENT. Economic Activities – a slide
- 16-14 FLOODPLAIN MANAGEMENT. The Environment – a slide
- 16-15 FLOODPLAIN MANAGEMENT. What are the costs?
- 16-16 FLOODPLAIN MANAGEMENT. Vulnerability Assessment
- 16-17 FLOODPLAIN MANAGEMENT. Vulnerability Assessment

