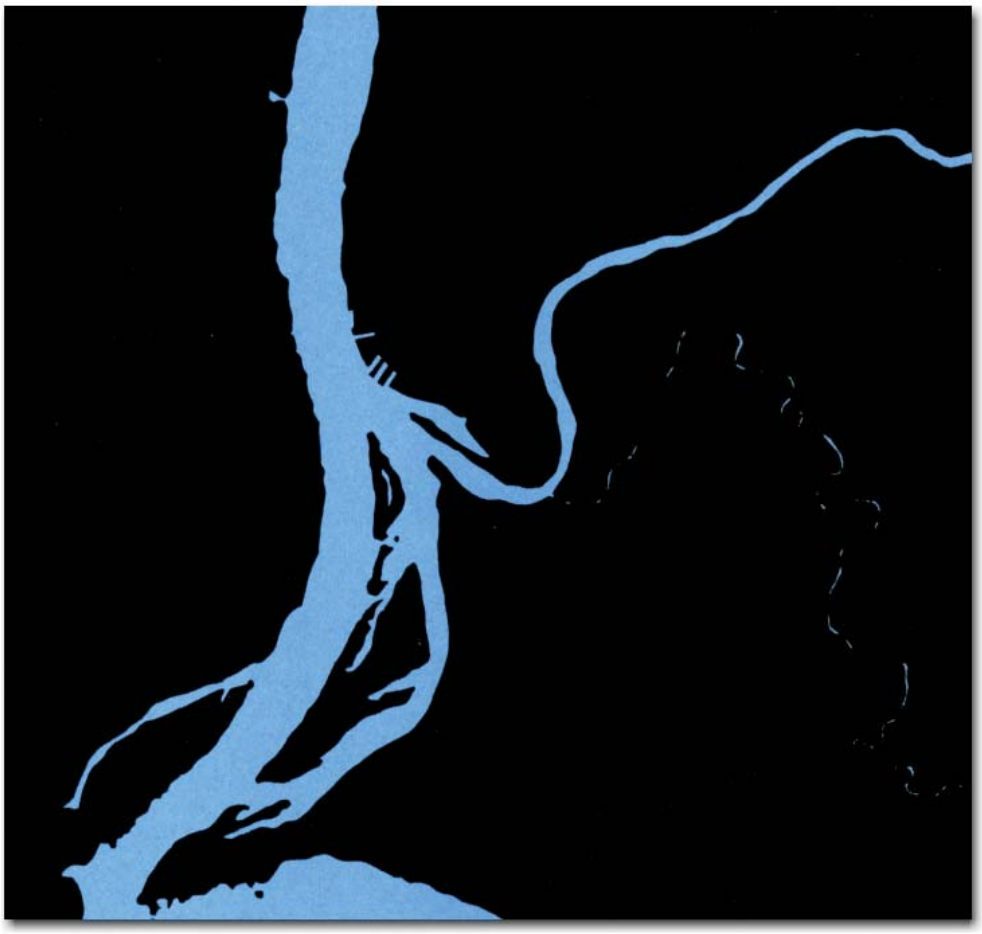

Comprehensive Planning for Flood Hazard Management

A guidebook prepared by the Department of Ecology for local governments preparing comprehensive flood control management plans under Chapter 86.26 RCW, Chapter 173-158 WAC, and Engrossed Substitute Senate Bill 5411.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

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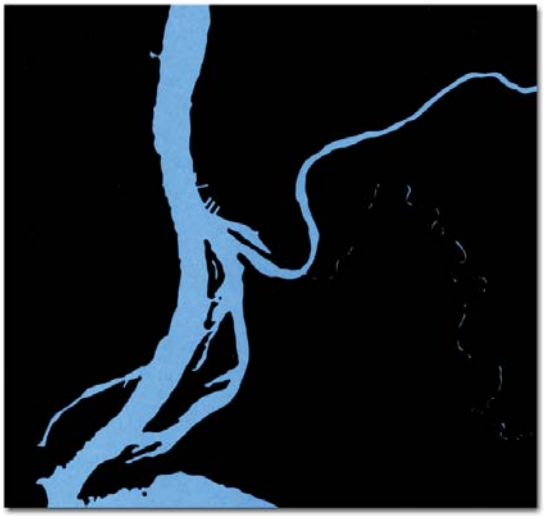

Comprehensive Planning for Flood Hazard Management

First Edition - August 1991

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If you need this publication in an alternate format, please call Ecology's Shorelands and Environmental Assistance Program at 360-407-7000. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Acknowledgements

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The project team consisted of members of the Department of Ecology Flood Plain Management Section working with the consulting firm of MAKERS Architecture and Urban Design. John Owen and Rebecca Rudd were the MAKERS' personnel responsible for preparing the guidebook.

In addition, the following persons and organizations provided valuable assistance and guidance from the perspective of local governments and professionals preparing flood hazard management plans.

Joan Lee - Kramer Chin and Mayo, Inc.
Dave Carlton - Kramer Chin and Mayo, Inc.
Deborah Hendrickson - King County Surface Water Management Division
Meagan Smith - King County Surface Water Management Division
Sky Miller - Snohomish County Public Works Department

Excerpts form several Flood Control Management Plans and other documents were included in this document as examples, including:

Dungeness River Comprehensive Flood Control Management Plan for Clallam County Public Works Department by Kramer, Chin & Mayo, Inc., March 1990.

City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville, and Meadowdale, for City of Edmonds and Snohomish County Department of Public Works by R.W. Beck and Associates, November 1990.

King County Comprehensive Flood Control Management Plan Phase I Report: Inventory and Analysis by King County Surface Water Management Division, February 1990.

Puyallup River Basin Comprehensive Flood Control Management Plan for Pierce County Department of Public Works - Pierce County River Improvement Section by James M. Montgomery Consulting Engineers Inc., May 1991.

Snohomish River Comprehensive Flood Control Management Plan by the Snohomish County Public Works Surface Water Management Division, August 1991.

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Chapter I: Comprehensive Flood Hazard Management--Planning Principles and Legislative Overview

Introduction

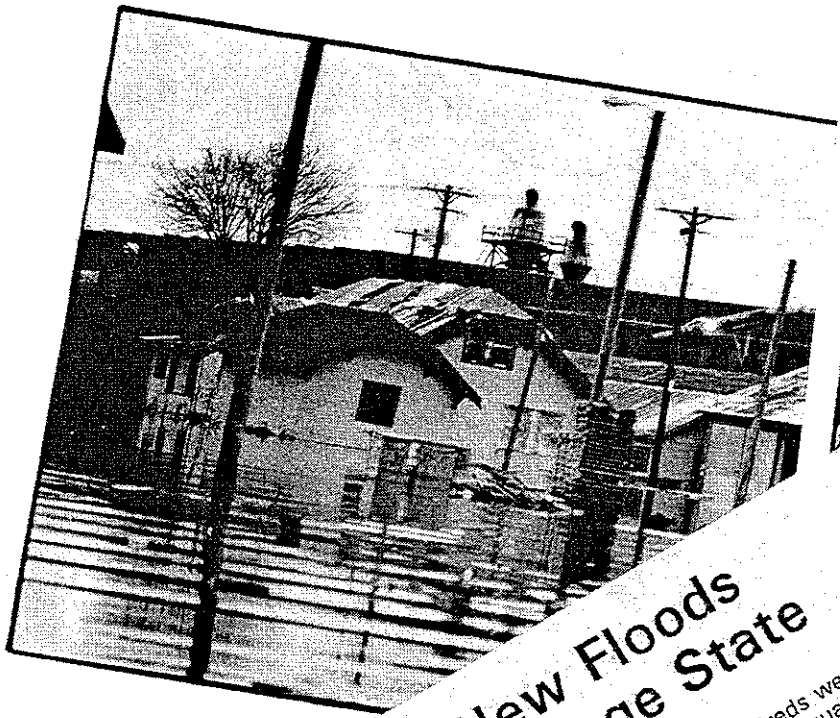
Purpose

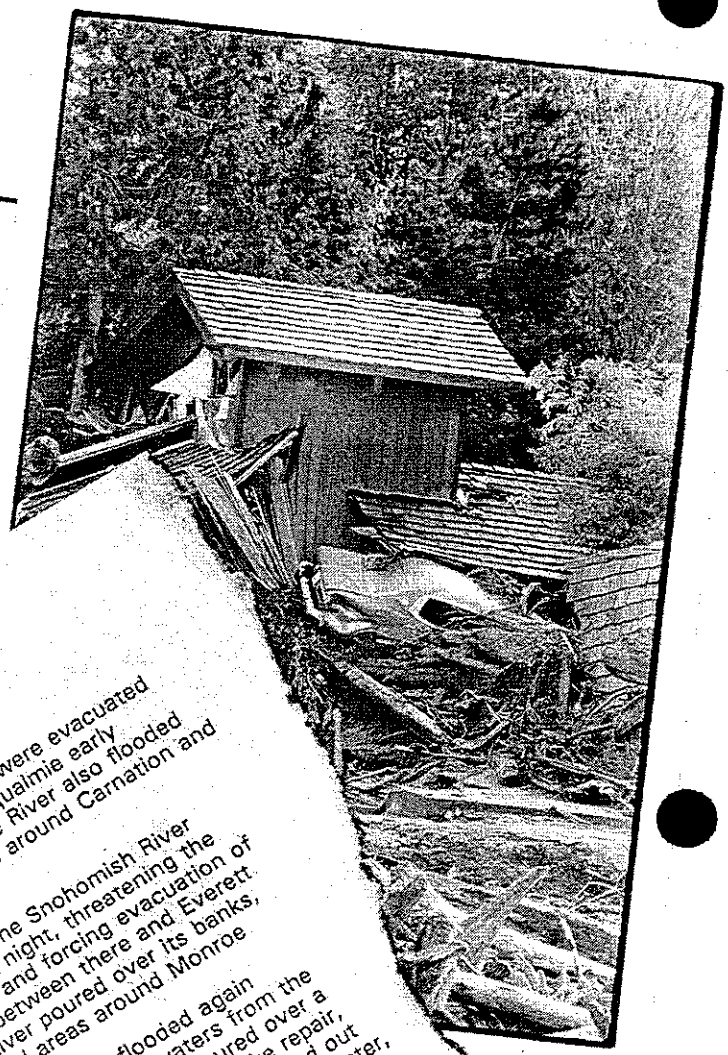
In recent years Washington's state and local governments have focused increased attention on flood hazard management. Severe flooding and rapid development have made citizens and public officials more aware of the interrelated and difficult challenges as well as the critical importance of flood damage protection, stormwater management, resource protection, and comprehensive planning. In acknowledging our responsibilities, we must realize that floods are natural events. All that can really be managed are the human activities that affect a watershed in ways that make flooding a hazard to our lives, our property, and our natural resources. The State of Washington has enacted state statutes establishing programs to assist local governments in undertaking flood protection activities. The Washington State Department of Ecology (Ecology) has developed this guidebook to assist local governments in preparing Comprehensive Flood Hazard Management Plans (CFHMPs) that comply with state laws and to enable communities to receive grant funds through the Flood Control Assistance Account Program (FCAAP).

Organization

The guidebook is organized into 4 chapters. Chapter I provides an introduction to this document and discusses the major principles of and the Washington State legislative framework for comprehensive flood hazard management planning. Chapter II discusses the procedures for initiating a Comprehensive Flood Hazard Management Plan under Chapter 86.12 RCW and Chapter 86.26 RCW. Chapter III describes the contents and elements of a Comprehensive Flood Hazard Management Plan and Chapter IV presents recommendations regarding a process to prepare a CFHMP. Most of the detailed information regarding the plan's preparation is located in Chapter IV. Appendix A is also included which describes the programs and regulations relating to flood hazard management as an aid to local governments in sorting through the myriad of associated governmental requirements and assistance opportunities.

Principles of Comprehensive Flood Hazard Management Planning





New Floods Ravage State

East King County. Hundreds were evacuated around North Bend and Snoqualmie early yesterday. The Snoqualmie River also flooded farmland and closed roads around Carnation and Duvall.

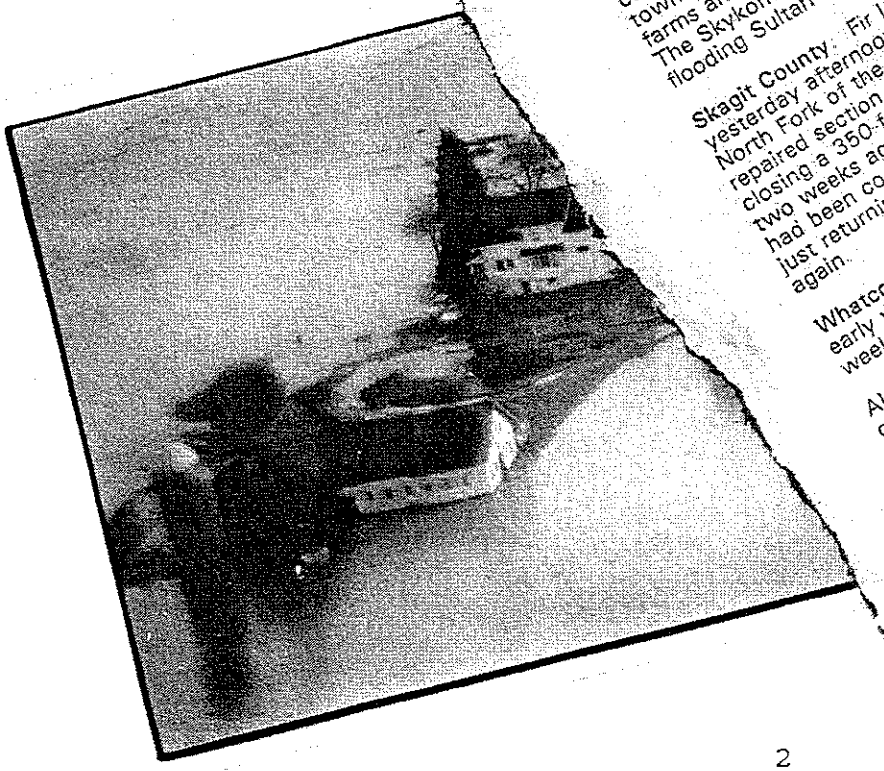
Snohomish County. The Snohomish River continued to rise last night, threatening the town of Snohomish and forcing evacuation of farms and homes between there and Everett. The Skykomish River poured over its banks, flooding Sultan and areas around Monroe.

Skagit County. Fir Island flooded again yesterday afternoon. Flood waters from the North Fork of the Skagit River poured over a repaired section of the dike. The dike repair, closing a 350-foot section which washed out two weeks ago and left the island under water, had been completed the day before. Families just returning to their homes were evacuated again.

Whatcom County. The Nooksack River crested early yesterday, doing less damage than two weeks ago.

Altogether, 16 Western Washington rivers overflowed, causing damage and forcing people from their homes from Aberdeen, Hoquiam, Chehalis and Centralia north to Bellingham.

Sightseers were asked to stay away from flooded areas. Many roads were expected to stay closed today.



These were the Seattle Times/P.I. headlines November 25, 1990. The disastrous floods of 1990 came after decades of diking, channeling and flood control measures. Why, after all of these engineering efforts, had the floods been so destructive? How could future floods be avoided? Within a month after the flood, a team of local, state and federal flood officials formed a study group to address these questions. Their first conclusion, as reported in the December 27, 1990 Seattle Post Intelligencer, was that poor flood hazard management had permitted too much development in the flood plain, destroying the river system's ecological balance. The dependence on structural flood controls was also blamed. As stated by a senior engineer for King County's Surface Water Management Division: "The levee systems have given people a false sense of security. I look all over and I see the levees are built right on top of the rivers. But you have to give the river room to move." The solution proposed by the team of experts was basically: "Don't build on flood plains. And don't try to alter the course of rivers for agriculture, urban development or even flood control measures." This is difficult to achieve because of long established land use patterns and the continuous challenge of managing private development and growth in flood plains. Moreover, effective watershed management is often politically unpopular and requires the coordination of numerous governmental jurisdictions and agencies. The relocation of flood plain development and the preservation of undeveloped flood plain, are expensive, but may be less expensive in the long run than construction and maintenance of dikes, levees, dams and other structures.

Need for Comprehensive Flood Hazard Management

One thing is clear from the recommendations of this team and earlier reports and studies; "comprehensive flood hazard management" is the most effective way to address "flood control" issues. The perceived distinction between **"flood hazard management"** and **"flood control"** is an important one. As a senior disaster relief coordinator with the Federal Emergency Management Agency (FEMA) states, the basic choices to avert flood damage are "to build the levees up, to direct the water, or to stop growth in critical flood plain areas." Stated most simply, traditional "flood control" deals with the first two methods, while **comprehensive flood hazard management includes a balance of all three approaches** including non-structural and structural solutions.

Flood Hazard Management Terminology

The term "flood hazard management" encompasses "flood plain management" which seeks to plan flood plain use from a standpoint that balances resource protection, environmental enhancement, flood damage protection and land use development. Flood plain management is rapidly emerging as an important planning and growth management tool because it focuses on the opportunities and constraints of these unique geographical areas. The guidebook utilizes the term "flood hazard management" rather than "flood plain management" because flood hazard management activities, including forestry practices and stormwater management can extend beyond the designated 100-year flood plain. Whereas flood plain management could be construed as only being applicable to activities occurring in the flood plain.

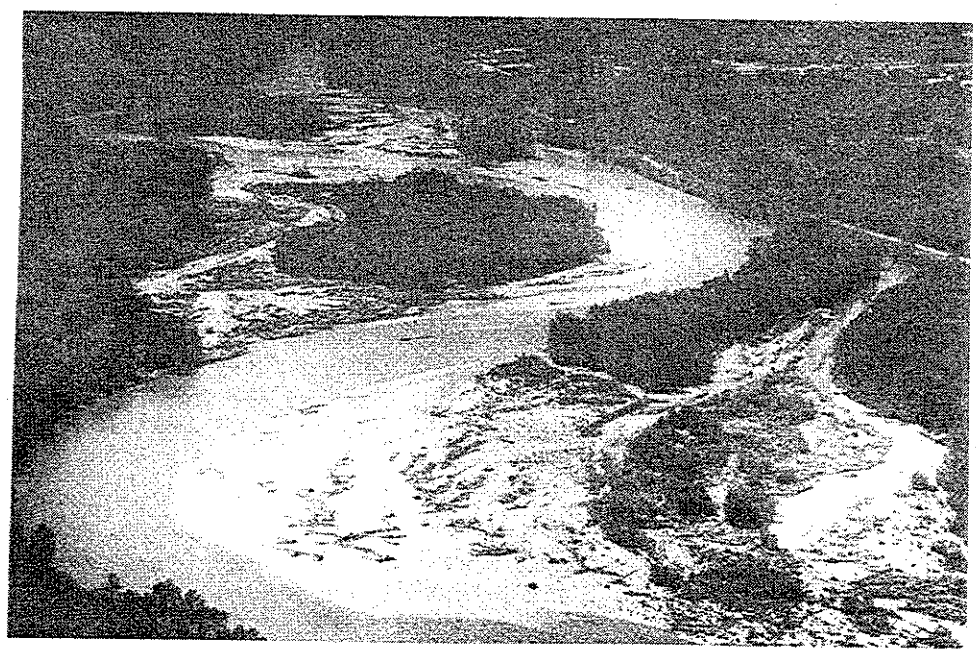
The question of terminology is important because the terms "flood plain management" and "flood control management" are utilized in different interrelated Washington State statutes. For example, Chapter 86.26 RCW sets requirements for "comprehensive flood control management plan(s)" which are the basis for Flood Control Assistance Account Program eligibility, while Chapter 86.16 RCW sets flood plain management regulations. **For the purpose of this guidebook, the term "flood hazard management" includes the concepts of both flood control management and flood plain management.** A Comprehensive Flood Hazard Management Plan includes the state's requirements for both "comprehensive flood control management plans" and "flood plain management plans."

The concept of flood hazard management embraces several fundamental values, principles and techniques. Among the most important of them are:

Principles of Comprehensive Flood Hazard Management

1. Respect for Rivers' Natural Hydrological Processes

Rivers are dynamic systems and flooding, erosion, stream braiding, sediment deposits and channel migration can result from natural processes. Whereas flood control seeks to overcome or control these processes, flood hazard management recognizes that it may be more cost-effective and environmentally sound to work within a river's hydrological dynamics. In some cases, constructing dikes or channeling beds may be appropriate, but in other cases, letting the river take its natural course which includes overbank flow, a natural event critical to the maintenance of fish and wildlife habitat. Restricting adjacent development or using bioengineering solutions, such as wetland storage areas, may be more cost effective than structural solutions.



Rivers and other shorelines are dynamic, constantly changing systems.

True flood hazard management emphasizes **minimum impact to natural processes,** since experience has shown that fighting a river's natural tendencies is often more costly and results in other problems downstream.

2. Focus on the Cause of Flood Damage

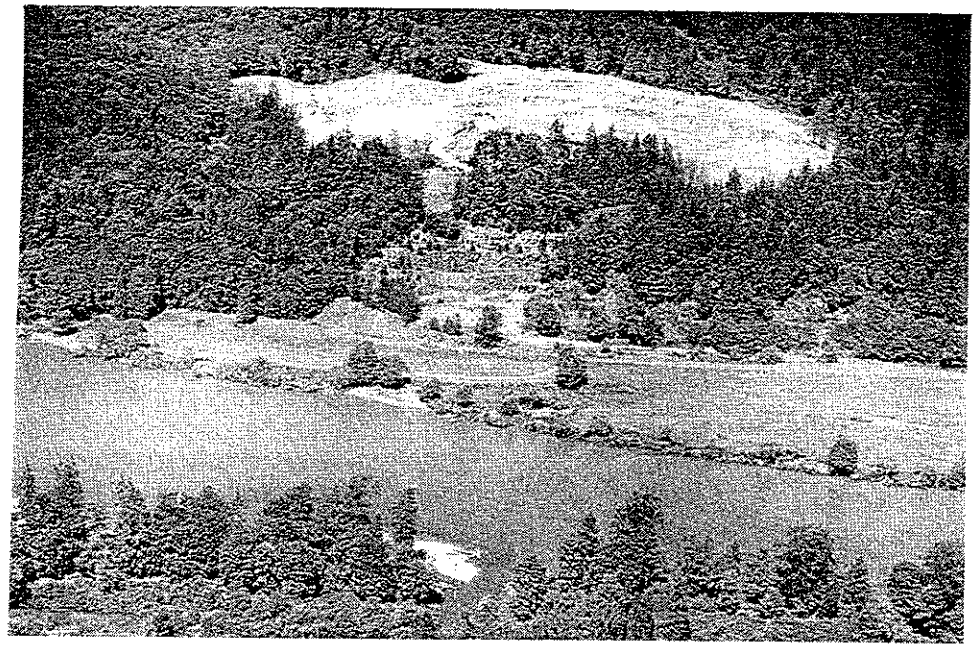
Traditionally, flood control has sought to prevent flood hazard by treating its symptoms. If a river flooded a town, then the answer was to build up the flood walls to channel the higher water levels without reversing the land use practices upstream or in the flooded area that were exacerbating the flooding in the first place. Contemporary flood hazard management practices recognize the **need to treat the causes** as well as the symptoms of chronic flooding.

3. Consideration of the Entire Watershed, Not Just Local Conditions

The watershed represents the "physical" context of flood hazard management. Poor management of one part of the watershed can result in flooding problems in another. For example, poor forestry, agricultural or development practices upstream can cause additional water runoff to peak, surge or accumulate downstream. Consequently, comprehensive flood hazard management encompasses: flooding in rural, suburban and urban environments; flooding associated with major river systems and small urban streams; and the range of solutions needed to address flooding associated with a variety of conditions/causes and landscapes, from on-site stormwater management development standards in King County's rapidly urbanizing areas to the relocation of homes located within the flood plain of the Snohomish River in Snohomish County.

Since watersheds typically cross city and county jurisdictions, state lines and possibly federally owned or tribal lands, inter-jurisdictional cooperation is required. The complexity of the natural systems, as well as the jurisdictional overlap that often occurs, points to the importance of comprehensive flood hazard management at the level of the entire watershed.

This principle has important political and funding questions. For example, if poor development and stormwater management practices upstream cause flooding downstream, why should downstream communities be forced to solve the problem?



Development in uplands can affect flooding downstream.

4. Public Participation and Inter-Agency Coordination

Because flood hazard management encompasses a broad spectrum of environmental, social/cultural, political, engineering and resource utilization issues, an explicit public decision-making process is needed to develop a recommended course of action. Citizen participation is essential to consider community concerns and to educate local residents on the fundamentals of responsible, effective flood hazard management.

Local governmental agencies, the State Departments of Fisheries, Wildlife, Ecology, and Natural Resources, State Department of Parks and Recreation, Interagency Committee for outdoor recreation, federal agencies such as the U.S. Army Corps of Engineers, U.S. Geological Survey, National Park Service, other forestry interests, agricultural interests, local tribal governments, diking, drainage and flood control districts, interest groups such as the Audubon Society, the Association of Realtors, Master Builders, and neighborhood associations should be considered to have a voice in defining the goals and parameters of flood hazard management plans. Comprehensive flood hazard management planning must be a team effort which integrates community development regulations and environmental enhancement activities.

5. Process-oriented Examination of Issues

Comprehensive Flood Hazard Management Plans should provide a process for examining the causes of flooding by evaluating alternative non-structural and structural solutions that are based on short- and long-term goals, objectives and solutions, including:

- o Construction and maintenance costs;
- o Environmental impacts, both site specific and cumulative;
- o Funding capabilities;
- o Public acceptance;
- o Recommended solutions prioritized.

The **planning process** offers broader perspective by re-examining current flood maintenance activities as they relate to established and understood goals and objectives. The plan represents documentation, the flood hazard management planning process is ongoing.

An open planning process will help government officials balance the costs of specific flood hazard management measures against benefits. For example, benefits to individual property owners from diking projects should be weighed against the monetary and environmental costs born by the general public.

6. Pursuit of Other Resource Protection Goals

Dikes and levees traditionally used to control flooding destroy wildlife habitat, degrade a river's natural beauty, reduce water quality, diminish fisheries resources and cause further downstream flooding and erosion. Flood hazard management, being comprehensive in approach, embraces these environmental conditions and considers them along with the prevention of flooding. Since protection of environmental resources is often dependent upon maintenance of natural hydrological processes, this principle is mutually supportive of Principle 1.

7. Coordination between Public Works, Planning, and Building Departments and other Department Activities

A major challenge is improving interagency and interdepartmental coordination. For example, public works departments' responsibilities include construction and maintenance of structural flood hazard management measures while building departments review new construction proposals to implement National Flood Insurance Program (NFIP) standards; and planning departments regulate shoreline activities, including development in unprotected Federal Emergency Management Agency (FEMA) floodways. Too often, activities are not interdepartmentally coordinated. Comprehensive flood hazard management planning, ideally,

brings all interested parties together so that one department's efforts support the others. Note: park and recreation departments should also be coordinated with regarding recreation and public access features.

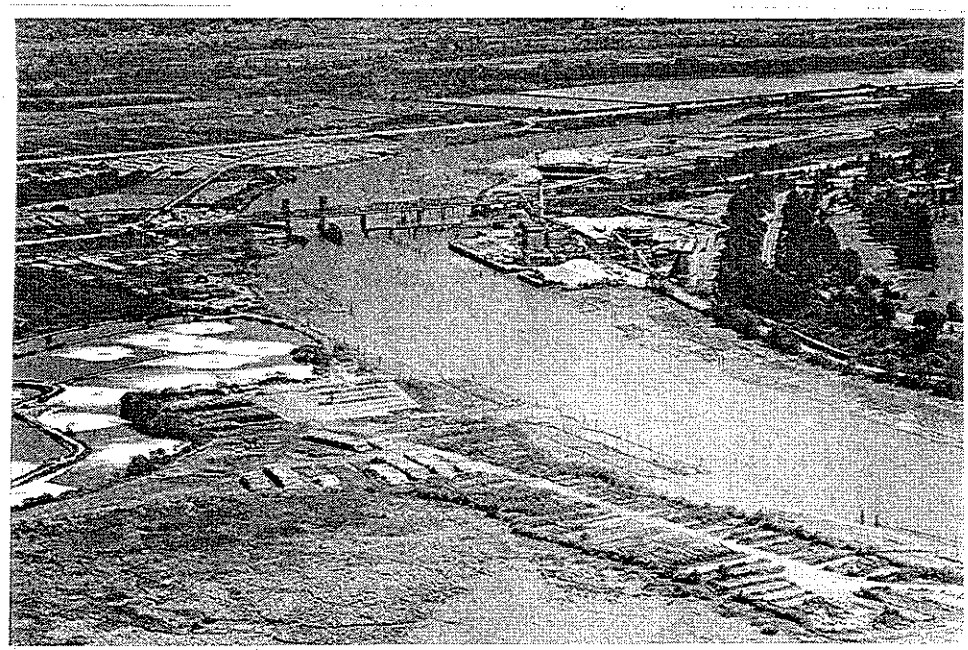
8. Incorporation of Comprehensive Planning Solutions

Human use of rivers and flood plains encompasses a broad range of environmental, public and private objectives; flood hazard management seeks to incorporate the full range of comprehensive planning tools to achieve those objectives, including:

- The acquisition of flood sensitive areas for compatible land use such as low impact recreation activities.
- Land use zoning and site development standards that are responsive to flood protection issues such as the requirement for on-site detention/retention systems.
- Forestry management and agricultural practices that reduce runoff and attenuate peak flows.
- Shoreline Master Program regulations that restrict inappropriate development and encourage compatible land uses.
- The use of existing dikes and levees for recreational trails and public access to water as part of park and recreation plans.
- Designing transportation facilities to reduce their impact on the watershed.
- Protection and creation of wetlands for stormwater storage and biofiltration as well as fish and wildlife habitats.
- Stormwater management planning that requires individual or cooperative retention/detention systems.
- Carefully designed structural flood control projects that reduce, as much as possible, negative impacts to other public objectives.
- Retrofitting/floodproofing of existing structures.

Consequently, flood hazard management planning provides an excellent framework to systematically address those elements of other planning activities normally carried out by local governments. A comprehensive flood hazard management plan can:

- Provide a flexible, cost-effective program of steps to reduce flood damage.
- Address the issue of cumulative environmental impacts that arise in reviewing development permit applications.
- Fulfill some of the requirements for comprehensive land use planning set by the Washington State Growth Management Act (GMA), especially in the areas of critical area protection and intergovernmental coordination.
- Serve as the basis for zoning ordinance and Shoreline Master Program updates.
- Fulfill some of the requirements for participation in the National Flood Insurance Program and examine the possibility for more stringent requirements that are cost effective in terms of a reduction in flood insurance rates and increased flood protection.
- Add impetus to recreational lands acquisition and assist in comprehensive recreational planning.
- Support stormwater management planning.
- Support a new or amended Shoreline Management Program.



Comprehensive flood hazard management planning encompasses multiple objectives including water quality, shoreline use, and resource protection.

Washington State Statutes Governing Comprehensive Flood Hazard Management Activities

There are three principal interrelated Washington statutes that, along with their administrative guidelines, address flood hazard management activities. Chapter 86.12 RCW-Flood Control by Counties authorizes county governments the power to levy taxes, condemn properties and to undertake flood control activities directed toward a public purpose. Chapter 86.16 RCW-Flood Plain Management finds that prevention of flood damage is a matter of state-wide public concern and places regulatory control within the responsibilities of the Washington State Department of Ecology. Chapter 86.26 RCW-State Participation in Flood Control Maintenance establishes the Flood Control Assistance Account Program to provide funding for local flood hazard management efforts and sets criteria for the use of FCAAP funds. Portions of these three statutes were amended in 1991 by Engrossed Substitute Senate Bill 5411 (ESSB 5411) to strengthen and coordinate flood hazard management activities state-wide.

The important provisions for each of the three statutes are summarized below as an introduction to flood hazard management planning. **Local engineers, planners and administrators dealing with flood hazard management activities are strongly advised to keep current copies of the RCW and WAC chapters to refer to during the planning process.**

Chapter 86.12 RCW-Flood Control by Counties

Chapter 86.12 RCW authorizes county governments the power to levy taxes, exercise eminent domain and take action to control and prevent flood damage. Chapter 86.12 RCW was substantially enlarged in 1991 by ESSB 5411 which added three new sections to Chapter 86.12 RCW. ESSB 5411 (Section 3) authorizes counties to adopt comprehensive flood control management plans (CFCMPs) **"for any drainage basin that is located wholly or partially within the county."** The statute further states that the plan shall include the following elements (bold face type added for emphasis).

> ***(1) Designation of areas that are susceptible to periodic flooding, from inundation by bodies of water or surface water runoff, or both, including the river's meander belt or floodway;***
>
> ***(2) Establishment of a comprehensive scheme of flood control protection and improvements for the areas that are subject to such periodic flooding, that includes: (a) Determining the need for, and desirable location of, flood control improvements to protect or preclude flood damage to structures, works, and improvements, based upon a cost/benefit ratio between the expense of providing and maintaining these improvements; (b) establishing the level of flood protection that each portion of the system of flood control improvements will be permitted; (c) identifying alternatives to in-stream flood control work; (d) identifying areas where flood waters could be directed during a flood to avoid damage to buildings and other structures; and (e)***

identifying sources of revenue that will be sufficient to finance the comprehensive scheme of flood control protection and improvements;

(3) Establishing land use regulations that preclude the location of structures, works, or improvements in critical portions of such areas subject to periodic flooding, *including a river's meander belt or floodway, and permitting only flood-compatible land uses in such areas;*

(4) Establishing restrictions on construction activities in areas subject to periodic floods *that require the flood proofing of those structures that are permitted to be constructed or remodeled; and*

(5) Establishing restrictions on land clearing activities and development practices that exacerbate flood problems by increasing the flow or accumulation of flood waters, *or the intensity of drainage on low-lying areas. Land clearing activities do not include forest practices as defined in chapter 76.09 RCW.*

ESSB 5411 (Section 3) goes on to say that: *The comprehensive flood control management plan shall be subject to the minimum requirements for participation in the national flood insurance program, requirements exceeding the minimum national flood insurance program that have been adopted by the department of ecology for a specific flood plain pursuant to RCW 86.16.031, and rules adopted by the department of ecology pursuant to RCW 86.26.050 relating to flood plain management activities.*

The language in this section contains several key points. **Section 3(2a) calls for evaluating the need for flood control measures based on a cost/benefit ratio between expenses and public benefits.** This alludes to the fact that structural repairs should not be undertaken without determining that real benefits, in terms of economic productivity and resource management, outweigh project costs. Also, it acknowledges that restricting development within flood prone areas is often more cost-effective than structural improvements.

Section 3(2c) calls for identifying alternatives to in-stream flood control work. This is an important expansion from the earlier language of Chapter 86.12 RCW which emphasized structural improvements. This statement, along with Section 3 items (3),(4), and (5) listed above, brings Chapter 86.12 RCW into greater consistency with Chapter 86.16 RCW and Chapter 86.26 RCW by placing greater emphasis on alternatives to structural flood control projects such as land use planning, flood proofing and resource management.

ESSB 5411 emphasizes county authority to prepare plans for drainage basins lying wholly or partially within respective jurisdictions, recognizing that effective flood hazard management should be undertaken on a watershed-wide basis.

One of the issues that has arisen in flood hazard management planning is the relationship between county and city governments. ESSB 5411 (Section 4) adds a new section to Chapter 86.12 RCW which outlines a process whereby city and county governments are to work together in preparing CFCMPs and establishes the authority of such adopted plans stating (bold face type added for emphasis):

> ***A comprehensive flood control management plan that includes an area within which a city or town, or a special district subject to chapter 85.38 RCW, is located shall be developed by the county with the full participation of officials from the city, town, or special district, including conservation districts, and appropriate state and federal agencies.*** *Where a comprehensive flood control management plan is being prepared for a river basin that is part of the common boundary between two counties, the county legislative authority of the county preparing the plan may allow participation by officials of the adjacently located county.*
>
> *Following adoption by the county, city, or town, a comprehensive flood control management plan shall be binding on each jurisdiction and special district that is located within an area included in the plan. If within one hundred twenty days of the county's adoption, a city or town does not adopt the comprehensive flood control management plan, the city or county shall request arbitration on the issue or issues in dispute. If parties cannot agree to the selection of an arbitrator, the arbitrator shall be selected according to the process described in RCW 7.04.050. The cost of the arbitrator shall be shared equally by the participating parties and the arbitrator's decision shall be binding. Any land use regulations and restrictions on construction activities contained in a comprehensive flood control management plan applicable to a city or town shall be minimum standards that the city or town may exceed. A city or town undertaking flood or storm water control activities consistent with the comprehensive flood control management plan shall retain authority over such activities.*

To assist in intergovernmental coordination ESSB 5411 (Section 5) adds a third new section to Chapter 86.12 RCW which encourages counties to establish advisory committees that include representatives from affected jurisdictions, districts and agencies as well as "other interested persons."

Chapter 86.16 RCW - Flood Plain Management

In enacting Chapter 86.16 RCW-Flood Plain Management, the state of Washington assumed full regulatory control over the waters in the state for the purposes of alleviating recurring flood damage and promoting public health and safety. Ecology was given the responsibility for coordinating flood plain management regulation aspects of the National Flood Insurance Program (NFIP). Under Chapter 86.16 RCW counties and incorporated cities are required to adopt flood plain management ordinances that comply with the minimum standards of the NFIP and Chapter 86.16 RCW. Flood plain management ordinances are typically aimed at reducing the risk of flood damage by restricting

development in floodways and by controlling development and/or requiring flood proofing in flood prone areas. Chapter 173-158 WAC-Flood Plain Management outlines the administrative rules for implementing Chapter 86.16 RCW. It adopts the standards in 44 CFR parts 59 and 60 in the NFIP and sets additional standards dealing with construction in the floodway. WAC 173-158-080 suggests communities avoid negative impacts to wetlands because of their biological productivity and role in hydrological stabilization.

Funding Comprehensive Flood Hazard Management Planning

Flood hazard management planning is clearly a desirable activity for local governments. Successful flood hazard management is difficult because it requires combining scientific technical analysis, public consensus building, and intergovernmental coordination which can be a complex effort. With all of the other tasks facing local planning and public works departments, how can city and county governments find the resources to undertake such a comprehensive effort? Fortunately, there is a Washington State program that funds flood hazard management planning.

Chapter 86.26 RCW-State Participation in Flood Control Maintenance

In 1984, the Washington State legislature enacted Chapter 86.26 RCW-State Participation in Flood Control Maintenance and established the Flood Control Assistance Account Program to assist local jurisdictions in comprehensive planning and flood control maintenance efforts. Ecology administers the program and distributes matching grants out of the FCAAP account to cities, counties and other special districts that are responsible for flood control. These funds, coupled with other state funds, such as Centennial Clean Water Funds (available through Ecology - Water Quality Financial Assistance Program), Coastal Zone Management Funding (grants), Department of Transportation, and other local funding sources increase available dollars for plans and projects.

FCAAP Program

To provide for grants and for program administration state-wide, four million dollars is placed in the Flood Control Assistance Account by the Treasurer at the beginning of each fiscal biennium (July 1 of odd-numbered years).

In order to be eligible for FCAAP assistance, the flood hazard management activities of a local jurisdiction must be approved by Ecology in consultation with the Department of Fisheries and the Department of Wildlife. Also, a Comprehensive Flood Hazard Management Plan ("Comprehensive Flood Control Management Plan" per Chapter 173-145 WAC) must have been completed and adopted by the appropriate local authority or be in the process of being prepared in order to receive FCAAP maintenance project funds for a particular planning area. Local jurisdictions must participate in the NFIP and meet all of its requirements, and must restrict land use in the meander belt or floodway of rivers to only flood-compatible uses.

FCAAP Grants

Matching grants are available on a reimbursable basis for three different activities:

- **Comprehensive flood control management plans** - Grants up to 75% are available to assist local jurisdictions in preparing a comprehensive plan for an appropriate planning area. A plan must include a determination of the need for flood control work, a thorough assessment of alternatives, a thorough analysis of environmental impacts to resources, an evaluation of problems and proposed solutions, and prioritized recommendations. In order to remain eligible for FCAAP grants for maintenance work, the final CFCMP must be adopted by the local jurisdiction after it has been approved by the Department of Ecology in consultation with the Departments of Fisheries and Wildlife. In addition, the Department of Community Development must certify that an acceptable local emergency management plan is being administered. Note: the title of this plan can be tailored to meet the jurisdictions' needs and does not have to be called a CFCMP (Chapter 173-145 WAC).

- **Flood Control Maintenance Projects** - Grants up to 50% are available for non-emergency work necessary to preserve or restore natural conditions or to restore man-made flood control facilities to their former condition. Maintenance projects must be consistent with the CFCMP. Initial maintenance work may be funded during the development of the plan under some circumstances.

- **Emergency Flood Control Projects** - Grants up to 80% are available to respond to unusual, unforeseen, and emergent flood conditions for the preservation of life and property. To release such funds, a declaration of an emergency by the appropriate authority must be made. Funds are available for both construction of emergency projects and flood fighting costs, with payment based on a first-come first-serve basis and not on a priority system. These funds will only be made available to projects which have been given approval for matching funds by the Department of Ecology prior to construction.

Special Tip

ESSB 5411 states that state participation may include enhancement measures. For example, FCAAP can be considered a potential funding source for the purchase of flood prone properties or land to be used for flood storage, after such measures have been identified as possible flood hazard management solutions/ alternatives as documented in the plan.

Other funding is available through various agencies and can be used as a "grant packaging" scheme to increase local resources. Typically the process requires a considerable investment of time, particularly for the initial start-up, and then requires careful planning and coordination to get all the participants on track. The effort, however, is worthwhile. FCAAP funds can be expanded through matching funds pooled from

such resources as Coastal Zone Management grants, State Centennial Clean Water grants, Department of Transportation, and various County and City funding sources and others.

Special Tip

Any allocated funds that are not spent during a biennium are lost and may not be carried over to the next biennium. State bienniums are two year periods beginning July 1 and ending on June 30 of odd-numbered years. Eligible work continuing into a new biennium can only be funded from appropriations made for the new biennium. Funding from FCAAP does not carry over from one biennium to the next. Comprehensive plans should be written to address these limitations, readjusting funding for different bienniums.

Since the FCAAP program constitutes the most direct funding program for comprehensive flood hazard management planning, the program's requirements are outlined below. In the past, some local governments prepared CFCMPs solely to be eligible for the maintenance funds. While the use of CFCMPs as a way to identify and prioritize flood control projects is still valid, more recent experience shows that this narrow use is unnecessarily limiting. If FCAAP funds are used to prepare a Comprehensive Flood Hazard Management Plan, then the benefit from flood maintenance projects can be greatly extended through a broader spectrum of actions. In any event, the plan must meet the requirements for a CFCMP as stated in Chapter 86.26 RCW and Chapter 173-145 WAC from the Administration of the Flood Control Assistance Account Program. These requirements are outlined below. (Bold type face is added for emphasis.)

Requirements for a Comprehensive Flood Control Management Plan (Chapter 173-145 WAC)

RCW 86.26.050 states that:

No participation with a county or other municipal corporation for flood control maintenance projects may occur unless the county engineer of the county within which the flood control maintenance project is located certifies that a comprehensive flood control management plan has been completed and adopted by the appropriate local authority, or is being prepared for all portions of the river basin or other area, within which the project is located in that county, that are subject to flooding with a frequency of one hundred years or less. Participation for flood control maintenance projects and preparation of comprehensive flood control management plans shall be made from grants made by the department of ecology. CFCMPs and any revisions to the plans must be approved by the department of ecology, in consultation with the department of fisheries and the department of game (Note: now called the Department of Wildlife).

RCW 86.26.105 states that a CFCMP must be completed and adopted within three years of the certification that it is being prepared for as provided in RCW 86.26.050. Therefore, a CFCMP is required within three years of the award of an FCAAP flood control maintenance grant for the area where the project is located. RCW 86.26.105 and the supporting Chapter 173-145 of the Washington Administrative Code describes the elements in a CFCMP. WAC 173-145-040 states the CFCMP must include:

Elements of a CFCMP (Chapter 173-145 WAC)

*(1) **Determination of the need for flood control work.***
- *(a) Description of the watershed.*
- *(b) Identification of types of watershed flood problems.*
- *(c) Location and identification of specific problem areas.*
- *(d) Description of flood damage history.*
- *(e) Description of potential flood damages.*
- *(f) Short-term and long-term goals and objectives for the planning area.*
- *(g) Description of regulations which apply within the watershed, including but not limited to local shoreline management master programs, and zoning, subdivision, and flood hazard ordinances.*
- *(h) Determination of instream flood control work being consistent with applicable policies and regulations.*

*(2) **Alternative flood control work.***
- *(a) Description of potential measures of instream flood control work.*
- *(b) Description of alternatives to instream flood control work.*

*(3) **Identification and consideration of potential impacts of instream flood control work on the following in-stream uses and resources.***
- *(a) Fish resources.*
- *(b) Wildlife resources.*
- *(c) Scenic, aesthetic, and historic resources.*
- *(d) Navigation.*
- *(e) Water quality.*
- *(f) Hydrology.*
- *(g) Existing recreation.*
- *(h) Other.*

*(4) **Area of coverage for the comprehensive plan shall include, as minimum, the area of the one-hundred-year frequency flood plain within a reach of the watershed of sufficient length to ensure that a comprehensive evaluation can be made of the flood problems for a specific reach of the watershed. The plan may or may not include an entire watershed.** Comprehensive plans shall also include flood hazard areas not subject to riverine flooding such as areas subject to coastal flooding, flash flooding, or flooding from inadequate drainage. Either the meander belt or floodway shall be identified on aerial photographs or maps which will be included with the plan.*

*(5) **Conclusion and proposed solution(s). The CFCMP shall be finalized by the following action from the appropriate local authority:***
- *(a) Evaluation of problems and needs;*
- *(b) Evaluation of alternative solutions;*

(c) *Recommended corrective action(s) with proposed impact resolution measures for resource losses; and*
(d) *Corrective action priority.*

(6) A certification from the state department of community development that the local emergency management organization is administering an acceptable comprehensive emergency operations plan.

Beyond the minimum requirements for a CFCMP, WAC-173-145-080 lists the following criteria which assists Ecology in setting funding priorities and allocation of grants to specific projects:

FCAAP Project Funding Criteria

The priority given to projects by Ecology, the counties, and other eligible municipal corporations shall involve consideration of the following criteria:

(1) The relationship of public benefits to total project costs.

(2) The priority which has already been established by each county.

(3) Intensity of local flood control management problems, including but not limited to their inter-relationships with:
(a) Population affected;
(b) Property and related development affected;
(c) Land management and zoning;
(d) Existing flood control management practices.

(4) Where the CFCMP is completed and adopted, the following will be considered:
(a) Consistency with the plan or plan recommendations;
(b) Priority of project as identified in the plan;
(c) Implementation of plan or plan recommendations;
(d) Potential impacts of instream uses and resources;

(5) Where a CFCMP is being developed or has not been initiated, the following will be considered:
(a) Evidence of multijurisdictional cooperation necessary for development of a comprehensive county or multicounty comprehensive flood control management plan (CFCMP);
(b) Availability of qualified personnel or resources for planning purposes;
(c) Availability of qualified personnel or resources for project construction purposes;
(d) Other planning efforts undertaken or proposed within the planning jurisdiction and their relationship to flood control management;
(e) Ability to make rapid progress toward development of a comprehensive flood control management plan;

(f) *Existing and proposed participation of community groups, private industry, professional organizations, the general public, and others toward the development and implementation of the proposed comprehensive flood control management plan.*

Requirement for public participation

It is important to note that the criteria include conformance to a county-wide prioritization (implying interjurisdictional coordination between local and county governments), the interrelationship of land management and zoning and potential impacts. Also, where a CFCMP has not been adopted, public participation in the development of a CFCMP is listed as item (5f), above, indicating that public participation is a general requirement for CFCMP acceptance.

Beyond the criteria for project fund allocation stated in Chapter 173-145 WAC, RCW 86.26.050 states that:

(2) *No participation for flood control maintenance projects may occur with a county or other municipal corporation unless the director of Ecology has approved the flood plain management activities of the county, city, or town having planning jurisdiction over the area where the flood control maintenance project will be, on the one hundred year flood plain surrounding such area.*

Engrossed Substitute Senate Bill 5411

ESSB 5411 was the Washington State Legislature's response to the recent flooding problems within the state and the need for better more comprehensive flood hazard management efforts. The bill's first section clearly states the legislation's intent:

(1) *Legislature finds that: (a) Floods pose threats to public health and safety including loss or endangerment to human life; damage to homes; damage to public roads, highways, bridges, and utilities; interruption of travel, communication, and commerce; damage to private and public property; degradation of water quality; damage to fisheries, fish hatcheries, and fish habitat; harm to livestock; destruction or degradation of environmentally sensitive areas; erosion of soil, stream banks, and beds; and harmful accumulation of soil and debris in the beds of streams or other bodies of water and on public and private lands; (b) Alleviation of flood damage to property and to public health and safety is a matter of public concern; (c) Many land uses alter the pattern of runoff by decreasing the ability of upstream lands to store waters, thus increasing the rate of runoff and attendant downstream impacts; and (d) Prevention of flood damage requires a comprehensive approach, incorporating storm water management and basin-wide flood damage protection planning.*

(2) *County legislative authorities are encouraged to use and coordinate all the regulatory, planning, and financing mechanisms available to those jurisdictions to*

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address the problems of flooding in an equitable and comprehensive manner.

(3) It is the intent of the legislature to develop a coordinated and comprehensive state policy to address the problems of flooding and the minimization of flood damage.

Items (1d),(2) and (3), listed above, are particularly significant because they mandate a comprehensive basin-wide approach including stormwater management practices as well as structural solutions. ESSB 5411 Section 2 amplifies this intent by stating that: *Sections 3 through 13 of this act is to permit counties in cooperation and consultation with cities and towns to adopt a comprehensive system of flood control management protection within drainage basins and to coordinate the flood control activities of the state, counties, cities and towns and special districts within such drainage basins.*

A major impact of ESSB 5411 is to clarify and coordinate the state's flood hazard management planning requirements and procedures. As noted above, the fact that rules for state and local flood hazard management planning activities have been divided among several programs and statutes have been made a comprehensive planning approach more difficult. Several of ESSB 5411's sections amend Chapter 86.12 RCW, Chapter 86.16 RCW, and Chapter 86.26 RCW and bring the requirements of the three chapters into clearer conformance. This means it will be easier for cities and counties to prepare a single Comprehensive Flood Hazard Management Plan that satisfies all the state's requirements. The diagram on the following page illustrates some of the key relationships and requirements of each of the statutes.

Comparison of State Flood Hazard Management Statutes

Topic	Chapter		
	86.12 RCW	**86.16 RCW**	**86.26 RCW**
Title	Flood Control by Counties	Flood Plain Management	State Participation in Flood Control Maintenance
Supporting WAC		173-158 WAC	173-145 WAC
Focus	Authorizes counties to undertake flood control measures.	State regulatory authority & Administration of NFIP program.	Provides funding assistance to local flood management activities (FCAAP program)
Administering Agency		Ecology, FEMA, local government	Ecology
Planning Requirement	ESSB 5411 language mandates comprehensive Flood Control Management Plan (CFCMP)	Flood Plain Management Ordinance in accordance with NFIP	CFCMP required (or in process) to receive FCAAP funds
Planning Area	ESSB 5411 allows basin wide plan within and outside political jurisdiction	Special flood hazard areas within the jurisdiction	At a minimum, 100-year flood plain
Intergovernmental Coordination	ESSB 5411 outlines intergovernmental coordination procedures	Each local government does their own ordinance	Governments are encouraged to combine efforts in order to consider watershed.
Typical Flood Management Measures	- Authorizes taxes, use of eminent domain & construction - Purchase of properties - Restrictions to land clearing - Comprehensive flood protection improvements - Storm water management program - Alternatives to structural measures must be considered	- Flood plain management ordinance to regulate land use - Public facility location - Flood proofing	FCAAP funds may be used for: - Structural improvements - Non-structural improvements - Enhancement of improvements - Preparing Flood Hazard Management Plans - Storm Water Management Plans and improvements - Feasibility studies

Chapter II: Initiating A Comprehensive Flood Hazard Management Plan

Starting a comprehensive flood hazard management planning process can be a daunting prospect because of the complexity of technical issues, the myriad of regulatory programs surrounding flood hazard and resource management, the volatility of flood control and land use issues, and the expense of the planning activities. On the other hand, the economic and environmental benefits are great. Moreover, future funding sources may be dependent upon having such a plan. Much of the work is also necessary to comply with other directives such as growth management and wetland protection, and resources are being made available that place effective flood hazard management within the capabilities of all Washington communities. Below are answers to frequently asked questions regarding comprehensive flood hazard management planning.

Q: Where can I get the funds for comprehensive flood hazard management planning?

A: The Flood Control Assistance Account Program (FCAAP) program will pay for up to 75% of the amount spent on a Comprehensive Flood Hazard Management Plan (CFHMP) prepared to the FCAAP standards which are outlined in this guidebook. Other governments have also used funds from Centennial Clean Water Funds, Coastal Zone Management Funds, Washington State Growth Management and local funds.

Q: How much does a local government have to pay for a CFHMP?

A: The cost varies with the planning area, the special needs of the planning activity, the ability of the local jurisdiction to cost share, the amount of current information available vs. the need to gather new information, etc. Contact the Flood Plain Management Section of Ecology for examples of cost estimates for other plans and/or obtain a preliminary estimate from qualified professional consultants.

Q: How do I apply for a FCAAP Grant?

A. Prior to each biennium, typically in the fall, Ecology sends invitations to local governments to apply for FCAAP grants along with applications to representatives of flood prone communities. The initial selection of applications and allocation of funds takes place prior to each biennium. Applicants may submit applications to Ecology at any time during the biennium. These applications will be kept on file; applicants will be notified during the course of the biennium should additional funds become available.

Q: How big an area do I include in the plan?

A: Ideally the plan should include the whole watershed because the hydrology and land use of the watershed as a system can be affected by changes to any part of it. WAC 173-145-040(4) states that the area should include at least the 100-year flood plain within a reach of the watershed of sufficient length to ensure that a comprehensive evaluation can be made of the flood problems for a specific reach of the watershed. Often the study area must extend beyond the jurisdictional boundaries of the local government.

Q: What can a local planner do if the planning area extends beyond the local government's jurisdiction?

A. The best solution is to coordinate with the neighboring government or agency and submit a joint proposal for a plan that covers both or multiple jurisdictions. ESSB 5411 states that a county may adopt a comprehensive flood control management plan (CFCMP)(Chapter 173-145 WAC) for any drainage basin that is located wholly or partially within the county. ESSB 5411 also states that a CFCMP that includes an area within a city, town or special district shall be prepared by the county with the full participation of representatives from those jurisdictions as well as appropriate state and federal agencies. The section includes provision for arbitration of disputes between jurisdictions and the local conformance to adopted plans. Clearly, the emphasis of both this bill and the Chapter 86.26 RCW requirements for planning in order to receive FCAAP funds stress the need for interjurisdictional coordination and provide a legal framework for undertaking joint planning efforts. For more advice on this issue and examples of multijurisdictional plans and planning grants, contact the Department of Ecology Flood Plain Management Section.

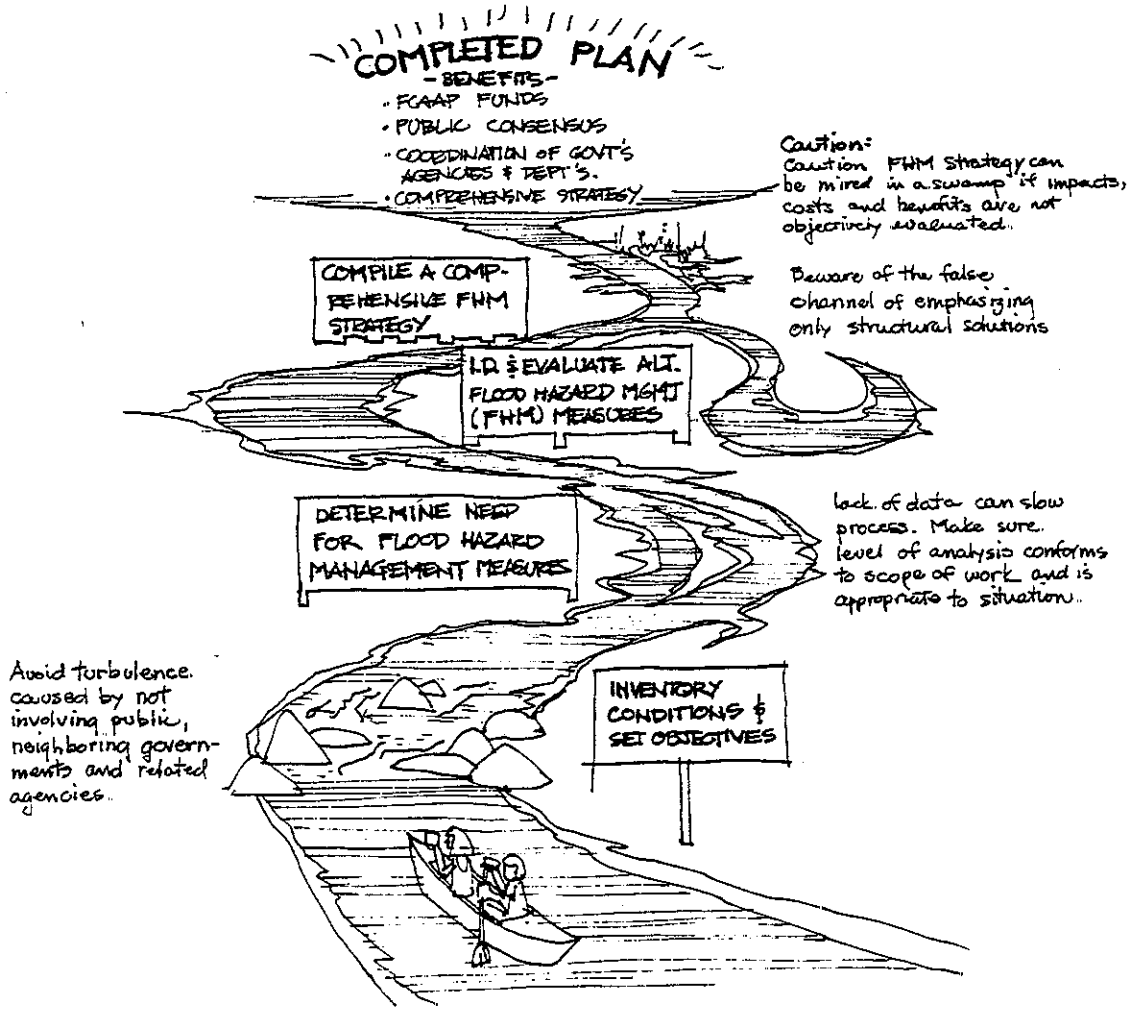
Q: What is the required minimum level of detail for technical analyses for tasks such as problem identification, hydrological analysis, impact evaluation and cost/benefit projection?

A: The plan's level of analysis, should be negotiated at the time the grant is written and project scope is outlined. The scope will be based on available funding, existing background information, the severity of the problem and the complexity of planning issues involved. Consult with the Department of Ecology FCAAP grant

staff in the Flood Plain Management Section for assistance on this issue prior to grant application. The scope of work must include, at a minimum, all the required components for a comprehensive flood control management plan as listed in WAC 173-145-040 (Administration of the Flood Control Account Assistance Program).

Q: How long does a plan usually take?

A: The process outlined in the guidebook generally takes about 2 years. During the first year, the process is established, background information compiled and the need for flood plain management measures substantiated. During the second year, the planning team can identify and evaluate alternate flood control measures, and prepare a draft and final plan. The time it takes Ecology to review and approve the submitted draft and final plan in consultation with Washington Department of Fisheries and Washington Department of Wildlife can vary widely depending on the complexity of the Plan and the amount of coordination during review.



Q: You mentioned that the Comprehensive Flood Hazard Management Plan is subject to Ecology review. What are the criteria for approval?

A: WAC-173-145-040 outlines what must be in a plan at a minimum, and this guidebook is intended to provide further guidance in preparing plans. Ecology's approval process includes a review of the minimum requirements of WAC 173-145-040, the tasks outlined in the grant agreements' scopes of work and Ecology's consultation with Departments of Fisheries and Wildlife. (see Chapter IV, Step 10 for a description of the approval process).

Q: What are the most common difficulties in preparing Comprehensive Flood Hazard Management Plans?

A: In past years, the most common shortcoming of the plans submitted for review has been the emphasis on short-term structural measures at the expense of long-term non-structural solutions such as restricting and managing development, wetland storage, and runoff management. Another common difficulty has been sorting out the web of overlapping agency regulations, resource protection programs, and planning requirements. This guidebook includes an appendix describing how these regulatory programs affect flood hazard planning. Also, our advice is to include members of relevant organizations such as Washington Departments of Fisheries or Wildlife, Native American tribes and other interests on the project committee early in the planning process so that their concerns and suggestions are automatically considered as part of the plan.

Q: Do I need to do a SEPA environmental checklist (checklist) or environmental impact statement (EIS)?

A: Generally speaking, we recommend that the environmental assessment in the form of a SEPA checklist or EIS be integrated into the planning process by evaluating the impacts of proposed alternative flood control measures within SEPA guidelines so that work is not duplicated. If it is suspected that the alternative flood hazard management solutions analyzed during the planning process might cause significant environmental impacts, we recommend that an EIS be done. The SEPA checklist or EIS should reflect an analysis of alternative flood hazard management solutions should the plan be implemented as a whole; impacts caused by individual solutions as well as cumulative impacts should be described even if the document is a "programmatic" SEPA checklist or EIS.

Q: Can FCAAP funds be used for SEPA documentation?

A: Yes.

Q: How does this effort relate to the Growth Management Act?

A: This new state law requires counties (and all cities within those counties) with populations over 50,000 or populations that have increased at least 10% over the past 10 years to prepare and adopt a comprehensive land use plan. As part of their comprehensive plans, cities and counties must provide for the protection of ground water quality and quantity, and where applicable, plan for needed drainage, flooding and surface water runoff control measures. Local governments must designate flood prone and frequently flooded areas and wetlands as critical areas. Development regulations for critical areas must be developed to prevent incompatible land uses.

The Growth Management Act (GMA) also requires that local governments coordinate with neighboring jurisdictions to solve planning issues of common concern, an aspect of flood hazard management planning that is mandated by RCW 173-145-040. Therefore, GMA and CFHMP requirements share common goals. The GMA should facilitate preparing a CFHMP in at least 4 ways:

1. Population forecasts and development projections can be used in predicting increased stormwater runoff and flooding problems.

2. The critical areas inventory required by the GMA will provide important flood plain data.

3. The GMA requires the establishing of urban growth boundaries which, if properly located, can minimize the need for flood control structures.

4. The GMA requires that capital improvements be coordinated and funded to adequately service new growth. Flood hazard management improvements, as part of a capital improvement program, must reverse the same attention.

Local communities should adopt a joint approach to growth and flood hazard management. Exchanging technical information and developing regulations and improvements tailored to comply with GMA and CFHMP requirements will reduce costs and expedite the planning process.

Q: How does flood hazard management relate to stormwater management ?

A: **In one sense, flood hazard management and stormwater management are one and the same.** Both seek to manage surface water through a variety of structural and non-structural techniques in an attempt prevent the damage (human and environmental) caused by flooding. Stormwater management is characterized by an emphasis on local drainage issues associated with urbanized or urbanizing areas. Flood hazard management is characterized by an emphasis on major rivers, their tributaries

and catastrophic flooding events. Local public works departments may have separate stormwater and flood hazard management programs within a larger "surface water management" department. **For the purposes of this document, flood hazard management includes the principles and techniques of stormwater management.**

Q: My community already participates in the National Flood Insurance Program (NFIP). Why should we have to do more planning?

A: The NFIP mandates that local communities regulate development through a permitting system using the mapped 100-year frequency Federal Emergency Management Agency (FEMA) flood plain, but in many cases these efforts are not necessarily adequate to prevent flood damage and do not assure good flood hazard management planning. Communities with Comprehensive Flood Hazard Management Plans are eligible for FCAAP funds (see RCW 86.26.105) which can be used toward a variety of flood hazard management activities.

Q: Besides making us eligible for FCAAP maintenance project grants, what are the benefits of preparing a comprehensive flood hazard management plan?

A: A CFHMP provides a forum for addressing numerous inter-related issues. We are learning that flood plains are laden with complex planning issues ranging from biological resource protection, geohydrological engineering, land use development and aesthetics, open space and recreation objectives. Therefore, it makes sense to address these issues comprehensively, and a plan provides the impetus and funding to do so. Most importantly it offers the opportunity for differing interest groups and parties to sit down and resolve their often conflicting objectives. In this way, the planning process is a forum for conflict resolution regarding planning and resource protection issues based on community needs. Current conflict mediation theory recommends that a mutually agreeable solution be sought through outlining goals and identifying options to produce solutions that optimize all participant objectives. This is just the type of process that is recommended for flood hazard management planning.

The plan also provides the technical foundation for future flood hazard management recommendations. For example, following a flood in which levees are destroyed, the plan will provide insight as to whether those levees should be rebuilt to preflooding conditions or if they should be lowered, modified (overtopping levees, setback levees) or eliminated all together.

Q: Who normally leads the planning effort?

A: Traditionally, flood hazard management has been the responsibility of local public works or engineering departments. With the increasing emphasis on resource protection, growth management, non-structural flood protection measures and intergovernmental coordination, it may be more appropriate that the local planning department take the lead role. The important thing is that the two departmental functions work closely together and with all interested parties during the planning process.

Q: I understand that I am competing with other applicants for the funds. What are the application criteria which you use to select the grant recipients?

A: The criteria in WAC 173-145-080 is used by Ecology to assign priorities to projects. A selection committee conducts an evaluation of each proposal and makes recommendations for final selection.

Q: Sounds good. Who should I call for more help?

A: Call Washington State Department of Ecology Flood Plain Management Section staff persons in the Shorelands and Coastal Zone Management Program.

Chapter III: Comprehensive Flood Hazard Management Plan Contents

WAC 173-145-040 describes the required elements of a comprehensive flood control management plan (CFCMP). Organizing the elements into a cohesive planning tool and determining the level of detail required for each element can be difficult. Below is outlined a suggested format for a Comprehensive Flood Hazard Management Plan (CFHMP), along with a brief narrative discussing the contents of key sections. Where applicable, the relevant steps and tasks described in Chapter 4 of this guidebook are referenced for further information on how to accomplish each element.

I. Executive Summary

- A. Statements of goals, problems, and issues.
- B. Brief description of project methodology and public and agency participants.
- C. Description of proposed solutions listed in an action plan with estimated costs, timing, participating agencies and priority for each recommended action.

II. Introduction

- A. Authority and Scope.
  1. Legal authority under Chapter 86.26 RCW
  2. Sponsorship of local government
- B. Background.
  1. Need for plan
  2. Description of Flood Control Assistance Account Program (FCAAP)
  3. Historical background
- C. Planning Process and Methodology.
  1. Role of the project committee (see page 35 Task 1-A)
  2. Public participation process (see page 36 Task 1-B)
  3. Agency, Tribal, and special interest coordination

4. Overview of technical planning methods

III. Short- and Long-Term Goals and Objectives

These should be organized into general goals supported by more specific objectives. Categorize these into short- and long-term goals (see page 38 Step 2).

IV. Description of Planning Area Characteristics

A. Planning area boundaries with map and a statement describing how the study area was defined and the boundaries determined.

B. Climate: precipitation, temperature, etc.

C. Topography, soils, geology, mineral resources.

D. Hydrology including surface drainage patterns, channel morphology, geohydrology.

E. Biological resources including fisheries and wildlife resources, forests, vegetation and habitat.

F. Water resources including water quality, watershed, hydrology and groundwater systems.

G. Land use including forestry, recreation, agriculture, aquaculture, and residential, commercial and industrial uses. Describe current land use, zoning and projected development trends.

H. Population, current and projected trends.

I. Transportation and utility systems including navigation characteristics of area.

J. Scenic, aesthetic and historic/cultural resources.

V. Description of Relevant Regulatory and Capital Improvement Programs

A. Local.

1. Comprehensive land use plan; open space, parks and trail plans; construction and improvement plans; and zoning of relevant jurisdictions.
2. Flood damage prevention or reduction ordinance
3. Shoreline Master Program
4. Wetland ordinance/sensitive areas ordinance
5. Local building code
6. Stormwater management ordinance
7. Dikes/drainage districts

B. State.

1. Flood Plain Management Act
2. Department of Natural Resources (DNR) lease or permit
3. Shoreline Management Act (SMA)
4. Centennial Clean Water
5. Stormwater Management
6. State Environmental Policy Act (SEPA)
7 Section 401 permit (Ecology)
8. Washington State Hydraulic Code
9. Growth Management Act
10. Forest Practices Act

C. National.

1. Army Corp of Engineers
   a. Section 10 permit
   b. Section 404 permit
2. National Environmental Policy Act (NEPA)
3. National Flood Insurance Program (NFIP)
4. National Pollutant Discharge Elimination System (NPDES)
5. Forest Practices Act

(see page 45 Task 3-C and Appendix A of this guidebook for a discussion of these programs)

VI. Flood Damage History, Flood Frequency Patterns and Current and Projected Problems (see page 45 Task 3-D)

A. Record of historic flood events.

B. Damage cost estimates by land use type, if available (e.g., commercial, residential, agriculture).

C. Prior flood control investigations and actions.

D. List of current and past problem areas and maintenance needs as well as a summary of implemented projects with cost and funding. Include environmental and resource utilization problems as well (The problems and maintenance areas should be identified on a map).

E. Potential problems due to projected land development or resource utilization trends (this item is not explicitly called out in WAC 173-145-040 but it makes sense to plan for the future as well as current conditions) (see page 47 Task 3-E).

VII. Alternative Flood Hazard Management Measures

Here should be described structural and non-structural options for addressing the problems and issues identified above. The

location and extent of each measure should be defined and illustrated on a map. Also, it should be noted which problem(s) each measure would address, and the extent of its effectiveness. Both non-structural and structural solutions should be described in specifics. Alternatives combining structural and non-structural measures should be explored (see page 48 Step 4).

VIII. Evaluation of Alternative Measures

For each alternative measure the following information should be provided:

A. Potential environmental impacts to:
   1. Fish resources
   2. Wildlife resources
   3. Scenic, aesthetic and historic resources
   4. Navigation
   5. Water quality
   6. Hydrology
   7. Existing recreation
   8. Other as applicable

   (see page 78 Step 6-Item A)

B. Consistency with applicable regulations and policies (see page 80 Step 6-Item B).

C. Cost and method of payment.

   Costs for operations, maintenance, administration and land acquisition should be factored into the estimates. The funding sources for each alternative should be identified (see page 80 Step 6-Item C).

D. Scheduling and Term of Benefit.

   The proposed schedule for implementing each alternative should be discussed and the potential term of benefit projected. The intent of this is to identify which are short term, remedial actions and which are longer term, comprehensive solutions (see page 81 Step 6-Item D).

E. Conformance to Public Goals and Objectives.

   A brief statement or summary table should be provided to indicate how each alternative responds to the individual objectives stated in Chapter III (see page 82 Step 6-Item E).

Note: For easy reference and alternative comparison, the evaluation analysis should be summarized into one or more charts or matrices (see page 78 Step 6 for several examples).

XI. Recommended Plan

A. Discussion of the method of selecting and assembling the preferred alternatives into a comprehensive plan.

B. List of recommended actions indicating:

1. Costs and funding sources
2. Scheduling
3. Participating governments, agencies, groups
4. Impacts and impact mitigation measures
5. Benefits of programmed actions with respect to goals, objectives and problems
6. Relationships to other planning efforts such as shoreline management, growth management, stormwater management, etc.
7. The actions' relative priority

C. Map illustrating actions.

D. Diagrams and/or sketches of proposed actions

X. Appendices

A. Certification from the Washington State Department and Community Development that the local emergency management organization is administering an acceptable comprehensive emergency operations plan.

B. Environmental assessment documentation according to SEPA and/or NEPA regulations.

C. Technical hydrological data and analysis.

D. Other maps and information as applicable.

E. Other exhibits as applicable.

Chapter IV: Process to Prepare a Comprehensive Flood Hazard Management Plan

Introduction

The process to develop a Comprehensive Flood Hazard Management Plan in conformance with Chapter 86.26 RCW and Chapter 173-145 WAC mirrors many of the procedures and steps of general comprehensive planning. Namely:

1. Establish citizen and agency participation process.
2. Set flood hazard management short- and long-term goals and objectives.
3. Inventory and analysis of physical conditions.
4. Determine need for flood hazard management measures.
5. Identify alternative flood hazard management measures.
6. Evaluate alternative measures.
7. Hold public alternative evaluation workshop(s).
8. Develop flood hazard management strategy.
9. Complete draft Comprehensive Flood Hazard Management Plan and SEPA documentation.
10. Submit final Comprehensive Flood Hazard Management Plan to the Department of Ecology (Ecology).
11. Hold public hearing and pass intent to adopt resolution.
12. Notify Ecology that the final plan is adopted.

Based on previous experience, it is envisioned that the tasks to prepare an approvable CFHMP will take approximately 2 years, although this schedule can vary widely. Given this time frame, it may make sense to consider the process as having two phases. Phase I could logically include Steps "1" through "4" described below and result in the background documentation and determination of need. Phase II would then begin with identification of alternative solutions and carry the project through to completion. The diagram on the following page illustrates the various steps in the process and the discussion below outlines the activities that take place in each step. The exact order of each step is not critical. Several of the steps can take place concurrently. However, the general structure of the process outlined on the following page should be used as a guide.

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Process to Prepare a Comprehensive Flood Hazard Management Plan

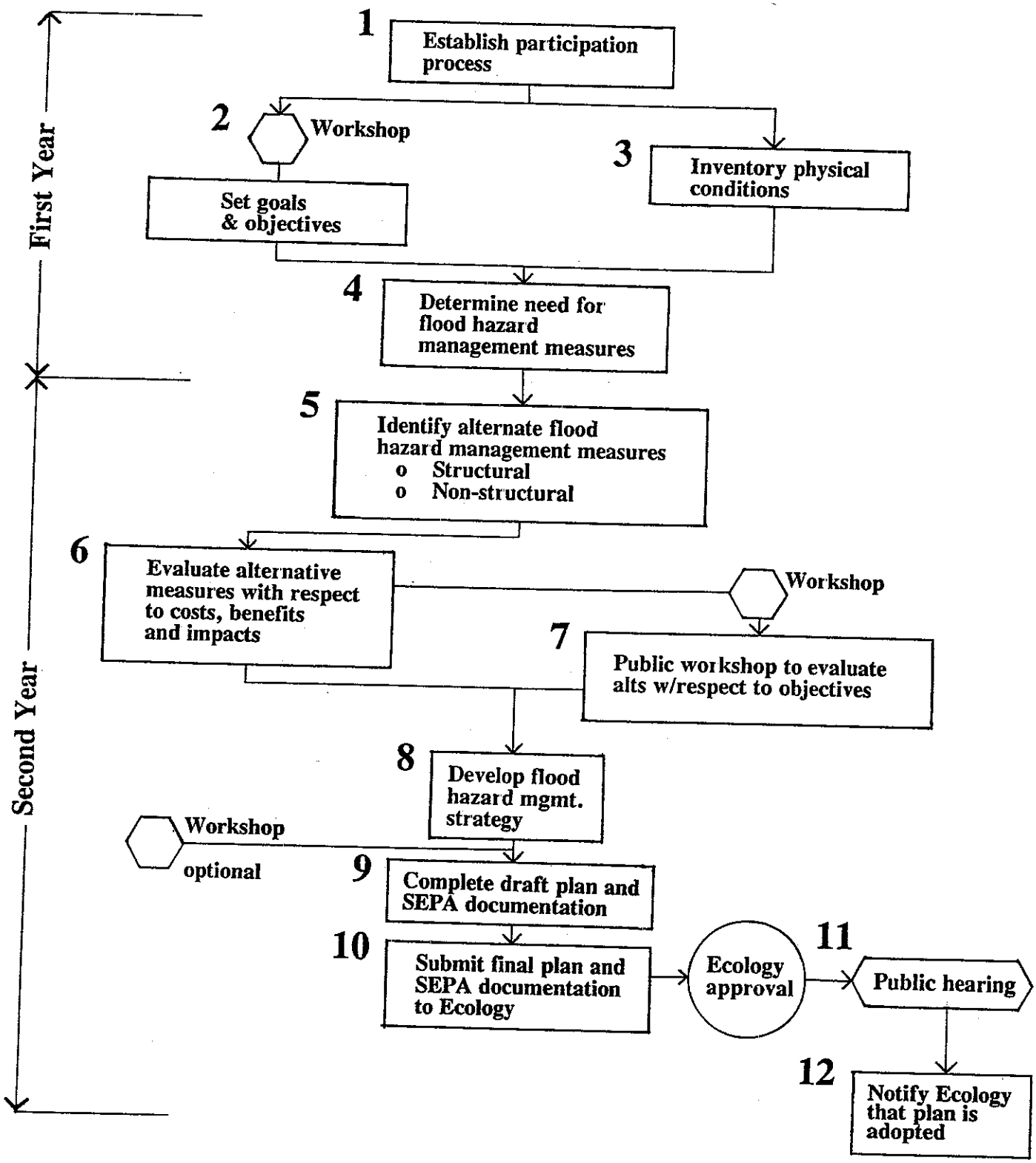


Diagram of Comprehensive Flood Hazard Management Plan (CFHMP) process.

Step 1: Establish Citizens and Agency Participation Process

Participation by the public and affected public agencies is critical to a flood hazard management plan's success for several reasons:

1. Proposed measures will affect many local property owners and their support will be needed to take action.

2. WAC 173-145-070 calls for the review of all Flood Control Assistance Account Program (FCAAP) projects by associated state agencies and affected parties. Therefore, appropriate public agencies such as the State Department's of Fisheries, Wildlife and Natural Resources as well as affected Native American tribes and other public entities should be involved throughout the process for plan formulation and comments.

3. Special interest groups such as the Audubon Society, recreation clubs or associations, real estate development interests, and business organizations may also have an interest in the plan and their objectives should be considered.

4. Since watersheds typically cross jurisdictional lines, representation from neighboring local governments must be incorporated in the process.

5. Since the plan must ultimately be adopted by the local government, it is important to build support among the local constituency.

6. The planning process offers an opportunity for educating the public to the issues, opportunities and public responsibilities of flood hazard management.

Task 1-A: Establish Planning Committee

Purpose and Composition of Advisory Committee

Public and agency participation should be accomplished in at least two ways. First, a planning committee or task force should be formed that includes a representation of public groups and property owners. Since flood hazard management actions may affect other governmental jurisdictions, it is advisable to include staff persons or public officials from neighboring jurisdictions. Other public agencies such as the State Departments of Ecology, Fisheries and Wildlife, as well as key entities such as port or diking districts and Native American tribes should be invited to participate. Since flood hazard management is a broad based planning effort and not solely an engineering exercise, it is important that a wide range of interests and backgrounds be incorporated in the process.

The role of the committee and its tenure must be carefully defined. Such committees or task forces are generally advisory, providing

direction throughout the process and recommending adoption of the final plan to the local government body actually adopting the plan. Under the process recommended in this guidebook, the committee would ideally meet at least once during each major step to review technical work, make decisions regarding alternate proposals and direct the technical planning team regarding the next step.

The size of the committee is an important consideration. Generally speaking, an 8 to 16 person committee has proven large enough to provide comprehensive representation but small enough to allow meaningful discussions and active work sessions. It may be appropriate to structure a two-tiered committee with representatives from within the local jurisdiction as primary members and representatives from state agencies and outside organizations as advisory members. This would provide good communication to the agency representatives but not require that they attend every meeting. In some cases it may make sense that the committee be formally disbanded after adoption of the plan. In other cases, maintaining the committee to review flood control project proposals and to provide advice on flood hazard management planning issues may be advantageous. The situation to avoid is having the committee continue on in a quasi-official capacity after the plan is adopted without a clear set of responsibilities.

The aim of the committee should be to build a consensus that balances competing objectives rather than favors a particular interest group. Therefore, attention should be given to the selection of representatives and committee procedures. It is recommended that in preparing committee recommendations, the committee attempts to define consensus positions rather than resort to divisive voting on individual issues.

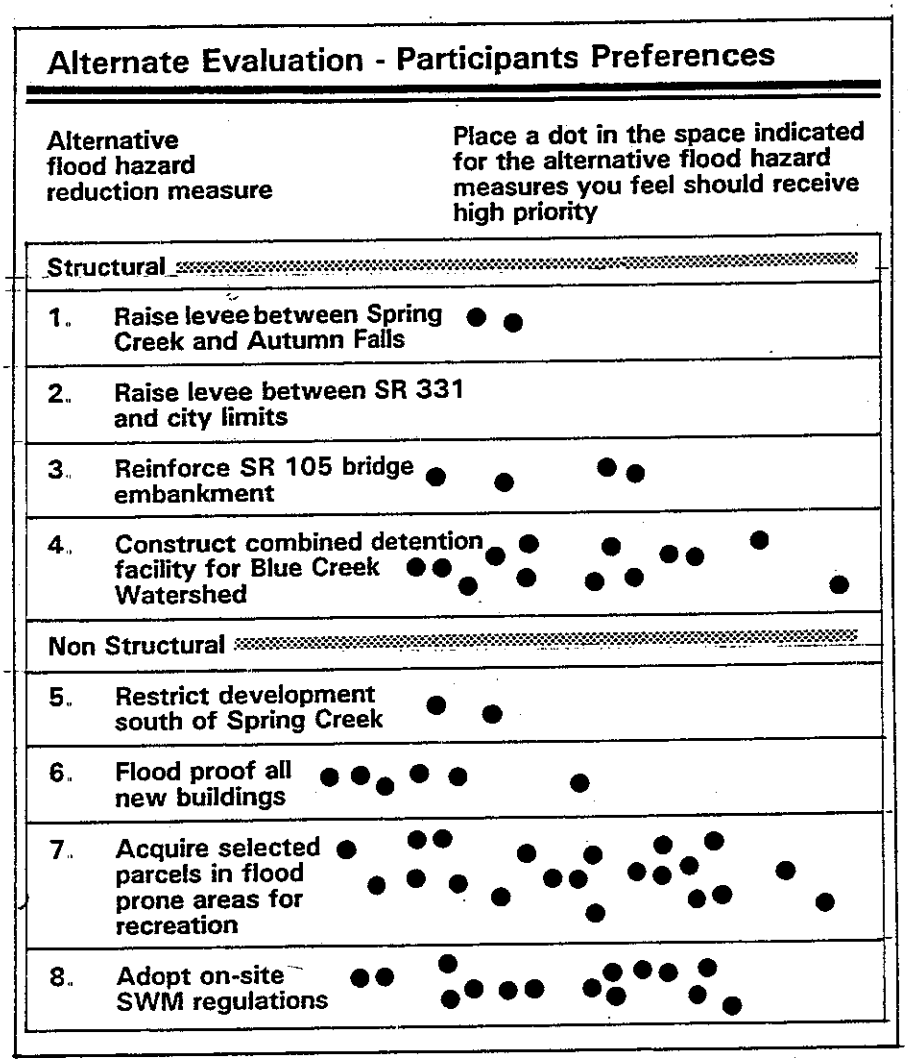
Task 1-B: Define Public Participation Process

The second recommended means to incorporate public input is through a series of public open house/workshops at which citizens can express their views. Experience has shown that public workshops are most effective at the goal formulation, alternative evaluation, and final review steps of the process, although it may be advantageous to add public meetings at other points as well. Asking citizens to describe their goals and objectives is an effective way to begin a public input process. At least one flood hazard management planner has found it very helpful for participants to relate their experiences of flooding using forms or maps on which participants can record historical and anecdotal information.

Citizens also find it relatively easy to compare and evaluate alternative flood hazard management actions when they can respond to a set of proposals. Finally, a presentation to the public just prior to the formal documentation and adoption process is a good way to check public response to the proposed plan.

Public Workshops

Public workshops are especially productive when participants can work in small groups on particular exercises. The small groups can then report back to the larger group and have the results compiled. Usually it is helpful to carefully design and test exercises and to prepare work materials in advance of the workshop. For example, asking people to help set goals and objectives can go much more easily if work groups are asked to comment on specific issues or to respond to a series of questions that require cooperative discussions about key topics. During the alternative evaluation workshop, participants can be given individual and group score sheets with places to grade each alternative with respect to the stated criteria. Another useful technique is "dot" exercises where participants place stick-on dots on a "score sheet" list of alternative flood hazard management measures to determine priorities or alternative preferences.



Prioritizing flood hazard management alternatives.

It is important to get comments from citizens outside the flood plain since their tax dollars help pay for flood hazard management measures. Public workshops must be well advertised in advance with the results carefully documented. Persuading the local media to publicize upcoming workshop dates and the location of previous workshops is also helpful.

Questionnaire Survey

A third way to gauge the public's values is a questionnaire survey which can be useful in providing a sense of community opinions regarding specific issues, and is also a good technique when used in conjunction with public workshops. The difficulty in an opinion survey is obtaining a statistically accurate set of responses. Usually, surveys are published in the paper and mailed to a given zip code. In this case, because there is no control over who mails the questionnaires back, the survey will not necessarily give a true sampling of community opinion. Statistically based telephone or mail-back surveys with follow-up research are often expensive. Even with these difficulties, a survey can be useful in gauging public opinion so long as its limitations are recognized. Opinion surveys are not an effective substitute for public workshops because they do not offer the opportunity for the public to learn more about the issues, to cooperatively tackle problems, and to build a consensus for action. Moreover, opinion surveys tend to elicit responses from the more vocal, flood-damaged property owners as opposed to the less vocal, unaffected public.

Step 2: Set Flood Hazard Management Short- and Long-Term Goals and Objectives

Without carefully thought-out comprehensive goals and objectives, CFHMPs lack an organized framework for flood hazard management. Unless basic project goals are agreed upon, disagreement can easily arise regarding fundamental issues throughout the process, and there will be no set criteria on which to evaluate alternative measures. Therefore, it is critical to carefully define the short- and long-term goals and objectives arising from all interested parties and relate them to the full spectrum of flood hazard management issues.

Difference Between Goals and Objectives

In planning parlance, "goals" are the broadest expression of a jurisdiction's desires. "Objectives" are more specific targets or benchmarks to be achieved in the ongoing implementation of stated goals. Goals tend to have long-term purposes, whereas objective statements often indicate how goals are accomplished. An example of a goal and objectives statement might be:

Goal A: Improve Water Quality

Objective A-1: Reduce point source pollution in industrial areas.

Objective A-2: Reduce non-point specific pollution through biofiltration systems at Bubbling Brook and Silvery Stream.

Objective A-3: Reduce nutrient loading from fertilizer laden runoff in agriculture areas, especially Peter's Prairie and Heavenly Valley.

Objective A-4: Preserve wetlands in accordance with local sensitive areas ordinance.

Performance Standards that Strengthen Goals and Objectives

Both goals and objectives can be strengthened by setting performance standards. For example, the above example goal is more useful if it includes a measurable target to define when the goal is met. For example, the statement "Goal A - Improve water quality to meet Ecology Class AA (extraordinary) water quality standards" sets the expected level of performance and carries implications for the level of effort needed to meet the goal.

Task 2-A: Conduct a Public Goals and Objectives Workshop

Since the goals and objectives should account for interests of all affected parties, the public should be invited to participate in this step. A public open house/workshop is an ideal way to inform the public about the project and to elicit participation from the outset. Therefore, a "goals and objectives" workshop is recommended early in the process. Adequate notification and publicity is essential to achieve a substantial turnout.

Suggested Workshop Formats

There are many formats for such a workshop. One method is to conduct two exercises: first, consider the most broad range goals, interests, and concerns, and second, focus on the more specific objectives, topics or problems as perceived by people. During the first exercise (which can be done with the whole group working together or with several smaller groups working individually), participants would be asked to describe the goals or issues they think are important. The resulting list can then be prioritized by giving each participant a number of sticky-back dots (5 each is a good number), and by asking them to place one or more dots on each issue or goal that they feel is especially important.

To arrive at more specific objectives, it is suggested that during the second exercise the participants be divided into smaller groups, each

with a special focus area dealing with specific issues or geographic areas.

Each of these groups should then consider specific problems related to their subject area and then formulate objectives that address the issues. Often it is helpful for each group to be given a list of questions to consider, just to spark discussion. For example, the "erosion protection" group might be asked:

- What are the primary bank erosion problems in the study area?
- What, if any, are the primary threats to property or the environment?
- How can those threats be reduced?

The responses from each group should be shared with the whole group. Often it is found that the same or related objective will be mentioned in more than one sub-group.

Task 2-B: Prepare Goals and Objectives Statement with Criteria to Evaluate Alternative Flood Hazard Management Measures

The workshop results should be summarized into a working report and presented to the committee who can add their comments and revise the list into a clear goals and objectives statement. This statement is combined with the physical inventory/analysis of conditions which determines the need for flood hazard management measures. An emphasis should be made for both short- and long-term goals in this report. Also, the goals and objectives should be stated in a way that they can be applied as criteria to evaluate the alternate flood hazard management measures (see example on following page).

Step 3: Inventory and Analysis of Physical Conditions

This step can be accomplished concurrently with Step 2, and is aimed at gathering and analyzing background information necessary to determine the need for flood hazard management measures. Whereas Step 2 deals with setting the plan's public policy framework, Step 3 provides the technical information necessary to make informed decisions during subsequent steps.

Task 3-A: Determine Planning Area

Ideally, planning boundaries will be defined prior to project initiation in order to prepare grant requests or to set up the administrative

Table ES.1

Goals and Objectives for Comprehensive Flood Control

Subcategory	Goal	Objectives
Prevent the Loss of Life and Property and Preserve River Character	Prevent the loss of life or property, preserve to the fullest extent possible, the scenic, aesthetic and ecological qualities of the Dungeness River in harmony with those uses which are deemed essential to the life of its citizens, and wherever possible, enhance the instream and riparian uses of the River.	Nonstructural measures should be preferred over structural measures. Land use and related regulations (i.e., SMP's) and zoning should reflect the natural constraints of the Dungeness River flood plain, meander zone, and riparian habitat zone. Together, these plans, programs and codes should present constant goals and objectives. Changes in land use should try to restore the natural character of the river to the predegradation state whenever possible. The need for emergency measures should be reduced or prevented through planning, structural and nonstructural measures.
Maintain the River's Varied Uses	Flood control management on the Dungeness River should occur in the context of the river's varied uses including agricultural and residential, fish and wildlife habitat, water supply, open space, and recreation.	Flood control measures should preserve to the fullest extent possible opportunities for other uses. Structural flood control measures shall not obstruct fish passage. Structural flood control measures should preserve or enhance existing flow characteristics for fisheries, irrigation, and other river uses. Flood control activities should not result in net loss of or damage to fish and wildlife resources, but wherever possible develop or improve diversity of habitat of those resources, particularly with respect to the spring chinook and pink salmon runs.

Goals and objectives for comprehensive flood hazard management.
Source: Dungeness River Comprehensive Flood Control Management Plan.

procedures between jurisdictions. If this has been the case, the planning area should be reviewed at this time to see if the limits are sufficient to allow adequate technical analysis. More often than not, however, it is discovered during the scope of work negotiation that the planning area must be extended to include additional watershed areas outside of the sponsoring government's jurisdiction. In this case coordination and perhaps cost sharing with adjacent government jurisdictions or agencies may be necessary. Lead agency and cooperative interjurisdictional agreements to familiarize the relationship should be adopted. Ecology can provide assistance on this.

WAC 173-145-040(4) states that:

> *Area of coverage for the comprehensive plan shall include, as a minimum, the area of the one-hundred-year frequency flood plain within a reach of the watershed of sufficient length to ensure that a comprehensive evaluation can be made of the flood problems for a specific reach of the watershed. The plan may or may not include an entire watershed. Comprehensive plans shall also include flood hazard areas not subject to riverine flooding such as areas subject to coastal flooding, flash flooding, or flooding from inadequate drainage. Either the meander belt or floodways shall be identified on aerial photographs or maps which will be included with the plan.*

A general criteria for determining whether or not a watershed portion must be included in the plan area is if that section may undergo a change that will affect other sections of the watershed. For example, if logging and residential development is projected in upstream watershed tributaries, then that portion of the watershed should be included because increased runoff could affect downstream portions of the flood plain and the long-term effectiveness of the selected alternatives. On the other hand, if the area is designated as a protected watershed and will not change over time, then it could be left outside of the plan area. In the case of uncertainty over an area's designation, planners may designate both a primary planning area and an outlying secondary planning area for analytical purposes that may be in the urban growth area or cross jurisdictional lines or both.

Special Tip

ESSB 5411 adds language to Chapter 86.12 RCW that defines county and city roles in interjurisdictional planning. Refer to Sections 4 and 5 of ESSB 5411 (see page 12 of this guidebook).

Task 3-B: Gather Background Information

Effective flood hazard management depends on accurate technical analysis that incorporates river hydrology, geology, environmental biology, urban growth projections and civil engineering. Therefore, adequate base line information must be collected which includes the following physical characteristics.

a. **Physiography**, including topography, surface drainage patterns, channel morphology, tidal influences and other conditions that

affect river morphology, flooding impacts and land use development. The United States Geological Survey (USGS) is the primary source of topographical information. Tidal information can be obtained from the National Oceanographic and Atmospheric Administration (NOAA). Local public works/engineering departments, the United States Army Corps of Engineers (COE) (Seattle and Walla Walla Districts) the Washington State Department of Ecology (Ecology) Water Resources Program, the US Environmental Protection Agency (EPA) Water Resources Division and the United States Fish and Wildlife Service (USFWS) (National Wetlands Inventory) may all be sources of information regarding existing surface drainage patterns.

b. **Climatological parameters**, including precipitation patterns, snow cover, temperature, wind, evapotranspiration, and other conditions that effect water runoff and river hydrology. NOAA and the National Weather Service are able to provide background climatological information.

c. **Geology**, including bedrock and soil considerations that affect river channeling, drainage, hydrology, land use, and erosion. Refer to the United States Department of Agricultural, Soil Conservation Service (publications include Soil Survey for Washington State and Hydric Soils of the State of Washington). In addition, local public works/engineering departments and state and local health departments may also be a source of background information.

d. **Surface hydrology**, including water bodies, wetlands, runoff patterns, water usage, and water control structures (dams, dikes, levees, etc.). USGS is the primary source of surface hydrology information. Other sources of information include the COE Hydrology and Hydraulics Branch (Seattle District); the COE Hydrology Branch and Planning (Walla Walla District); EPA's Environmental Services Division & Water Division (Water Planning and Wetlands Section); Ecology's Water Resources Program; USFWS' National Wetlands Survey; and local stream and wetland surveys.

e. **Ground water**, including hydrogeology, groundwater recharge, and stream aquifer relationships. Sources of information include USGS, The Washington Department of Ecology Water Resources Program (Ground Water Section); Washington State Department of Health and local health departments; and EPA's Water Division (Superfund and Drinking Water Sections). Groundwater recharge areas are being identified by local governments as part of the Growth Management Act (GMA) comprehensive planning process.

f. **Water quality**, including degree of conformance to WAC 173-201-045(1) water quality standards and identification of areas or issues of special concern. Refer to Ecology's Water Resources Program and state and local health departments. The United

States Geological survey is a source of ambient water quality information as well.

g. **Fisheries resources**, including identification of migratory species and fish habitat resources. Washington Department of Wildlife (WDW) has a database of priority habitats and species including resident and anadromous fish.

h. **Wildlife habitat**, including significant habitat areas, environmentally sensitive areas, and endangered species locations. Refer to WDW database, USFWS's National Wetlands Inventory and local sensitive areas inventories which are required under the GMA.

i. **Population and land use patterns**, including the type, amounts and density of land uses and identifying historical and projected development patterns. This information is being developed by local governments as part of the GMA comprehensive planning process.

j. **Stormwater runoff and drainage systems in urban areas**, including type of system and level of service. Consult local public works/engineering departments.

k. **Recreation resources**, including parks, trails, wilderness areas. Consult with local, state and national park systems as well as state and national forests.

l. **Visual resources**, including view sheds of special significances, open areas, landmarks, and scenic areas. A "windshield" visual survey recorded on a base map is often the easiest way to obtain this information.

m. **Cultural resources**, including native American sites and historical and cultural landmarks. Refer to the Washington State Department of Community Development, Office of Archeology and Historic Preservation. Also, the county or city preservation office may have a list of historical and cultural resources.

n. **Other significant factors** affecting flood hazard management activities such as large structures, bridges, special activities or resources. A "windshield" survey recorded on a base map is a good way to obtain this information. Consult long-time residents, local community groups and local public works/engineering and planning departments for anecdotal information.

Task 3-C: Identify Regulations and Flood Hazard Management Activities that Affect the Watershed

WAC 173-145-040(1)(g) requires that comprehensive flood hazard management plans describe the regulations that apply within the watershed. These programs include federal (e.g., National Flood Insurance Program (NFIP), Section 10 Rivers and Harbors Act, Section 404 Clean Water Act, etc.), State (e.g., State Environmental Policy Act and Shoreline Management Act), and local (e.g., City and County Comprehensive Plans, flood damage prevention ordinances, zoning ordinances, building codes, etc.) regulations. It is a clear benefit to accomplish this early in the process since it will help involve key players in the process, project future land use and resource utilization trends, and identify potential regulatory tools used in flood hazard management. For the convenience of local flood hazard management planners, a description of federal, state and local regulatory programs that typically apply is included in the appendix of this document. It is intended that this description can be modified and incorporated as appropriate into the flood hazard management plan.

Task 3-D: Document Flood Event History and Identify Specific Problem Areas

WAC 173-145-040 (1)(d) requires that comprehensive flood control management plans include a description of flood damage history. At a minimum, the date, peak discharge (in cubic feet per second (cfs)), maximum elevation and estimated degree of frequency should be noted. Past flood damage assessments should also be compiled.

Local citizen's past experience with flood damage problems can provide a useful perspective regarding problem areas.

The Federal Emergency Management Agency (FEMA) keeps records of all claims made by federal flood insurance policy holders. Although information is tabulated on a "community basis," which may include more than one river system, FEMA's records are often useful to provide a general picture of the amount of damage.

WAC 173-145-040(1)(d) requires that specific problem areas in the watershed be identified. "Problem areas" may include the following types of conditions:

- Areas with the potential for flooding.
- Structures and other man-made features including bridges, utilities, fish hatcheries, water systems, etc. that could potentially be damaged or which require repair due to chronic flooding, siltation, etc.

Bridges and other structures are potential constrictors of water flow and are also subject to erosion and damage.

- Areas with destructive erosion or accretion.
- Areas with common blockage, debris collection, or joining problems.
- Areas with chronic or the potential for channel migration.
- Significant natural and economic resources which could potentially be eroded from chronic flooding (e.g. habitat degradation, fish spawning area loss, agricultural crops, soils and facilities damage, etc.).

- o Areas where chronic flooding causes septic tank drainfield failure.
- o Over-topped roadways.
- o Potential or chronic failure of structures along riverbanks.
- o Threats to water quality.

Anecdotal information gathered from public workshop participants may be useful in assembling a comprehensive picture of flood damage.

The locations of these conditions should be accurately depicted on a detailed map for further analysis.

Special Tip

Many flood hazard management planning efforts are moving in the direction of watershed management plans which emphasize water quality and resource protection. This direction is encouraged by Ecology and is consistent with state flood hazard management statutes. Therefore, it is strongly recommended that resource management issues are included in Task 3-D.

Task 3-E Project Effects, Future Trends or Actions that Affect Flood Hazard Management

Need for Projecting Future Conditions

Flood hazard management could be much simpler if new development and resource extraction were not changing the river's hydrological characteristics. However, most urbanizing flood plains are experiencing increased growth that is reducing rivers' natural characteristics and exacerbating the potential for flood damage. Moreover, intensive development, farming, and logging can increase runoff. Therefore, it is important not only to plan for current conditions, but to take into account the conditions that may occur in the future without additional regulation. To do this, the potential "build-out" of development in the flood plain must be calculated. That is, the amount of development permitted by current zoning, comprehensive plans, and other regulations should be projected on available land area. Keep in mind that future rezones can amend zoning ordinances, and will thus change projected densities. This will yield two conditions for hydrologic analysis; current and projected. The potential impacts to runoff quantities in upland urbanizing areas and areas where additional logging is planned should also be entered into the equation.

Step 4: Determine Need for Flood Hazard Management Measures

Identify Opportunities As Well As Needs

This is the step that documents the need for "flood control work" as required by WAC 173-145-040(1). As was noted in the introduction, effective flood control measures must be considered as part of the broader spectrum of flood hazard management activities. Therefore, the scope of this step should be extended to identify the need for environmental protection, development of resource management regulations, emergency response capabilities, and coordinated planning activities as well as structural flood control measures. Indeed, local planners should look beyond the **need** for these actions to identifying the **opportunities** for addressing flood hazard management objectives. This step brings together the public goals and objectives from Step 2, the background information from Task 3-B, flood history and problem area documentation of Task 3-D, and projections of future trends from Task 3-E. It should be emphasized that a 100-year flood has a 1 percent probability; 50-year flood has a 2 percent probability; and a 25-year flood has a 4 percent probability. Too often people incorrectly believe that if a 100-year flood occurred in the current year, then it won't occur for another 99 years. Thorough hydrological analysis of the potential damage for a 50-year, 25-year flood can be estimated for existing land uses and current conditions. What is more difficult is determining the potential damage to future buildings and assessing the impact of new development on river hydrology. It is often necessary to model the river's hydrological response to a given precipitation and snow melt level assuming future development or land utilization projected in Task 3-E. New development can affect flooding problems in several ways, including:

1. Exacerbating the pattern of runoff by reducing the permeability and holding potential of soils (e.g. paved areas).

2. Increasing runoff by vegetation removal.

3. Restricting conveyance capacity of the floodway channel.

4. Reducing the natural storage capacity of flood plains through filling of wetlands, floodway fringe areas, overflow channels or sloughs.

5. Building new developments that are flood prone, thereby necessitating further structural controls.

If the hydrological analysis can determine potential impacts of separate land development trends, then potential problems can be predicted and needed flood hazard management actions can be more strategically applied to mitigate the cause of the problems rather than the effect. For example, if it is determined that new development in a portion of a flood plain would cause a rise in the mapped flood elevation and place the development and other downstream areas at greater risk, then it

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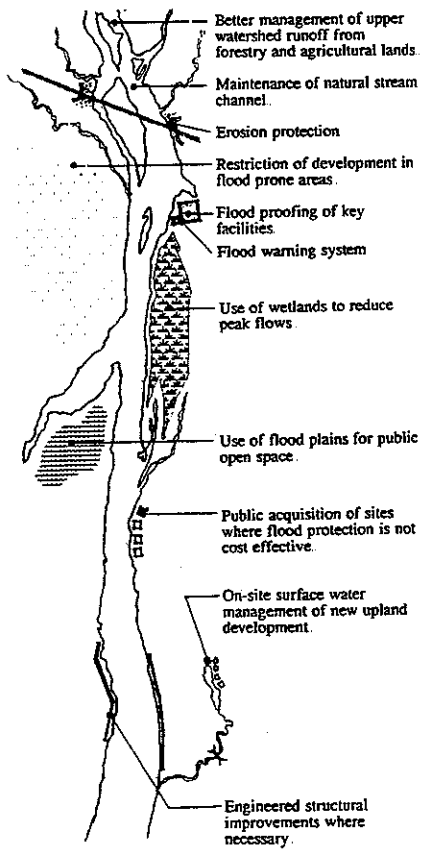
may be advisable not to develop that portion of the flood plain, rather than construct expensive structures to accommodate higher flood waters. Or, if it is determined that intense logging increases the rapid release of run off, then it may be necessary to take upstream measures to mitigate this impact, rather than rely on down stream structures to handle the increased water.

Step 5: Identify Alternative Flood Hazard Management Measures

In a 1970 report titled *Guidelines for Establishing Economic and Engineering Flood Criteria* several members of a joint University of Washington and Washington State University team noted that flood damage control measures might be classified into either of two categories, structural and non-structural. Structural measures refer to engineering or construction activities on or near the stream channel. Non-structural alternatives include land use regulations and other regulatory measures such as runoff reduction, flood proofing, advance warning and forecasting, flood plain drainage, land acquisition, conservation easements, and removal or relocation of strict uses. Comprehensive flood hazard management emphasizes a multi-objective approach, incorporating a variety of engineering, environmental protection and planning measures as well as local planning innovation. Listed below are some of them.

Comprehensive Flood Hazard Management Measures



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The purpose of Step 5 is to determine which of these measures are potentially appropriate within the study area. As stated earlier, it is important early in the process to consider both structural and non-structural actions so that they can be evaluated in Step 5 for their cost effectiveness and environmental impacts. Below are described in general terms several of the alternative measures. Naturally, the application of these measures requires engineering and planning expertise in order to determine the feasibility, degree of effectiveness, costs and impacts of each measure.

Non-structural Alternatives

A. Regulatory Measures

Land development directly affects flood damages in several ways: 1) it encroaches upon the waterway so that channel or floodway capacity during flood stage is gradually reduced to the point where flow rates which once caused no flooding now produce considerable inundation; 2) it places increased capital investment in "flood-prone" zones so that flooding causes greater monetary losses; and 3) it reduces the permeability and natural storage capacity of the flood plain and may redirect or reroute watershed and additional water sources affecting flood characteristics.

Local flood damage prevention ordinances are the primary means of controlling development in the flood plain. Regulatory measures including local zoning ordinances, comprehensive plans and shoreline master programs are also effective. Enactment of such regulatory measures should consider the agency or agencies that will hold enforcement power. Enforcement practices may not significantly affect the flood plain areas within the jurisdiction of one agency. It is quite possible, however, that upstream lands, outside the jurisdiction of that same agency, may well be the cause. Therefore, interagency cooperation should be established for such enforcement. Creation of such regulations should be based on comprehensive investigations of physical land conditions, land use, and hydrologic data.

1. Local Zoning and Land Use Regulations

Under the Washington State Constitution and Chapter 35 RCW, cities and counties possess the authority to adopt ordinances and take actions to promote the general public's health, safety and welfare within their boundaries. This authority includes the protection of lives and properties from flood damage by construction of flood control improvements and adopting regulatory controls. Comprehensive planning, as implemented by zoning codes, is the most traditional land use control measure. However, reducing the amount or intensity of land use within the flood plain will often mean "downzoning," an action that is usually strongly opposed by land owners. Because land owners' object to restrictions on what they regard as their property rights, downzoning is often politically impossible even though it is entirely legal and appropriate in many situations. It must be remembered that there are often public safety and property protection consequences for not taking actions.

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Growth Management Act Mandates Critical Area Protection

The argument for local land use controls in flood plains has been strengthened by the recent Growth Management Act which directs those cities that are required or choose to plan under the GMA to designate those areas that are susceptible to flooding as "critical areas." Critical areas must be regulated to preclude development or land uses that are inconsistent with frequently flooded areas (see RCW 36.70A0.60 and RCW 36.70A.170). A local "sensitive areas ordinance" conforming to state guidelines will prove an effective method of resource protection and can be useful in flood hazard management as well.

2. Development Standards for On-site Stormwater Management Facilities

The following discussion on stormwater management is based on Ecology's *Stormwater Management Manual for the Puget Sound Basin* (Public Review Draft, June 1991).

Increased stormwater runoff is directly related to an increase in impervious surfaces (roads, parking lots, and rooftops) which prevent water from soaking into the ground. Development, in addition to limiting the potential for surface water infiltration, also alters the land's natural drainage features (streams are culverted, ponds and wetlands are filled and grassy low lying areas are developed). Increased runoff effectively enlarges the area that may experience flooding (the flood plain). Flooding caused by stormwater runoff is a serious problem in urbanized and newly urbanizing areas where the ratio of impervious to non-impervious surfaces is high and the natural landscape has been highly altered.

Traditionally, stormwater management has been achieved through stormwater detention and conveyance systems built during urban development. Culverts, catch basins, detention ponds, concrete lined channels and storm sewers are typical conveyance system components. These systems require considerable capital expenditure and in many cases are undersized, designed only to handle present peak flows without taking into account the cumulative effects of future development.

As a non-structural flood hazard management alternative, local governments may adopt comprehensive regulatory and enforcement programs for the design, construction and maintenance of on-site detention and retention facilities.

Detention Facilities

Detention facilities are designed to hold water during runoff events and then slowly release water to downstream channels or storm sewers. In general, these facilities control the rate of runoff but do not reduce runoff volume. Detention facilities can be either wet or dry and either above ground or below ground. The term "wet" indicates the presence of water in the facility at all times. Dry facilities typically hold water only during runoff events. Detention facilities include:

- o constructed wetlands
- o constructed or excavated ponds (wet and dry)
- o underground tanks or vaults (wet and dry)

Detention storage can provide for the settling of sediment and other suspended pollutants to eliminate the direct input of pollutants into receiving waters.

Infiltration Facilities

Infiltration facilities may include natural and biological systems such as wetlands and vegetated swales that naturally retain the water on site for a period of time. Infiltration facilities retain runoff while releasing it via on-site infiltration. In this way, infiltration provides runoff control as well as runoff volume reduction. Infiltration facilities include:

- o basins (ponds)
- o trenches (swales)
- o constructed wetlands
- o porous pavement
- o urban forestry

Additional benefits of infiltration are sedimentation control, stormwater treatment, preservation of base flow in streams, ground water recharge and reduction or elimination of expensive stormwater conveyance systems.

Special Tip: PSWQA/Ecology Stormwater Rules and GMA Requirements

The Puget Sound Water Quality Authority is currently writing a stormwater rule for counties within the Puget Sound basin (defined by the rule) which will require adoption and implementation of local stormwater programs. The rule will provide procedural requirements for stormwater management, such as adoption of local ordinances for new development and operation and maintenance programs. Ecology is producing a companion rule which contains minimum standards (for example, minimum technical requirements) for urban stormwater management. The draft rules are expected to be adopted by early 1992. Ecology has also prepared a Stormwater Management Manual addressing erosion and sedimentation control, and control of pollution from urban land uses for the Puget Sound Basin which is currently undergoing public review. The manual will serve as a technical guide for local governments. Volume III of the draft Manual is devoted to runoff control.

The 1990 Growth Management Act requires counties (and the cities located in those counties) with populations greater than 50,000, or that have experienced a population increase of more than 10 percent in the last ten years, to adopt comprehensive land use plans.

A mandatory element of each county's comprehensive plan is to provide for the protection of the quality and quantity of groundwater supplies, and where applicable, for the local jurisdiction to "review drainage, flooding, and store water runoff in the area...and provide guidance for corrective actions to mitigate those discharges."

Federal, state and local regulations associated with stormwater management as referenced in a 1991 staff memo to the Washington Senate Environment and Natural Resources Committee, include:

- The Federal Water Quality Act of 1987 which reauthorized the Clean Water Act and requires municipalities above 1,000 population to obtain a National Pollution Discharge Elimination System (NPDES) permit from the EPA for stormwater discharge.

- Existing Washington law which allows for the construction and operation of stormwater control facilities in order to lessen property damage resulting from increases in surface water or stormwater accumulation. The law is intended to control stormwater flows beyond that which naturally occurs on or over real property, which results from altering or interrupting natural drainage patterns.

- Local governments which are directed to manage and control stormwater runoff as part of other planning efforts, but the ability to do so is primarily hampered by lack of technical expertise and financial resources.

The following represent current laws which allow local governments to plan for stormwater management and abatement:

- Cities and Municipal Corporations. If a metropolitan municipal corporation (like the Municipality of Metropolitan Seattle (Metro)) is authorized to perform the function of pollution abatement, it shall also prepare a comprehensive water pollution abatement plan that includes provisions for stormwater drainage. The municipal corporation may also develop facilities for the collection of stormwater in portions of its metropolitan area not serviced by another local jurisdiction (RCW 35.58.200).

- Cities are authorized to construct and fix rates for sewer systems, including facilities for storm or surface sewers (Chapter 35.67 RCW).

- Municipal planning commissions acting to adopt or enforce comprehensive plans for the physical development of the municipality must review drainage, flooding, and stormwater runoff pattern in the area, and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute Puget Sound (RCW 35.63.090).

- Washington Department of Fisheries Stormwater Guidelines via Hydraulic Project Approval.

3. Local Shoreline Master Program

Under the State Shoreline Management Act of 1971, all local governments which include shorelines of the state (i.e., all rivers and streams with a mean annual flow over 20 cfs or greater) must prepare a shoreline master program for the purpose of regulating shoreline uses and activities within the shoreline jurisdiction. Shoreline jurisdiction on rivers extends at least 200 feet laterally from ordinary high water mark of floodway, whichever is greater and may extend throughout the entire 100-year flood plain if the local government so chooses (see discussion of Washington State Shoreline Management Act in Appendix A). Local governments prepare, adopt and enforce local shoreline master programs. Ecology has approval authority over all shoreline master programs and several types of shoreline permits and may appeal all shoreline permits for development within shoreline jurisdiction. Ecology's responsibility to safeguard the state's interests and review authority makes the shoreline master program an especially powerful flood hazard management regulatory tool for several reasons.

Advantages of SMP's in Flood Hazard Management Planning

First, because Ecology reviews all master programs, the department can serve a valuable coordinating role by assisting local governments in preparing master program updates and in insuring that changes to one government's master program does not adversely affect a neighboring jurisdiction. Second, the legal authority for the shoreline master program is based not only on the state constitutional powers of enabling legislation, but also on the public trust doctrine that requires the state to safeguard the properties of the state's citizens that are held in public trust, including submerged lands and water resources. Therefore, the state has an interest in preventing development in the flood plain that would affect water quality, fisheries, and other resources.

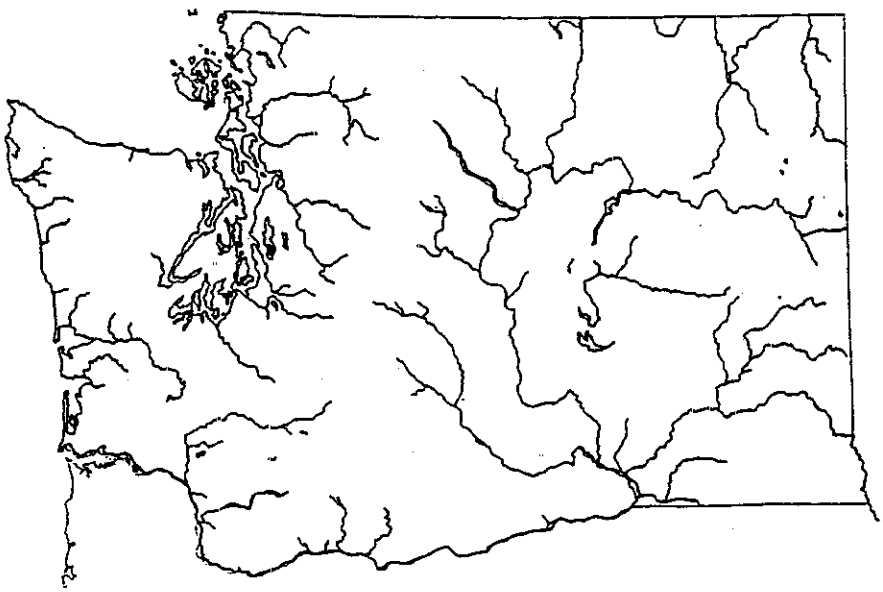
While local governments may be subject to local political pressures against "downzoning" or flood plain planning, the state is more clearly responsible to environmental and resource management objectives. During the review of local shoreline master program updates, Ecology may require additional provisions that restrict undesirable development on the flood plain. This "higher authority" becomes especially useful when Ecology and local planning staff work together in formulating master program provisions and where potential impacts of flood plain development can be documented.

Shorelines of State-wide Significance

There is another provision in the Shoreline Management Act (SMA) that applies to "shorelines of state-wide significance (SSWS)." Rivers that are identified as shorelines of state-wide significance include all rivers west of the Cascade Crest downstream of a point where the mean annual flow is 1000 cubic feet per second or more, and all rivers east of the Cascade Crest down stream of a point where the annual flow is two hundred cubic feet per second or more or from a point downstream from the first 300 square miles of drainage areas, whichever is greater. For such rivers, still stronger state law directives apply.

The SMA sets specific priorities for the management of shorelines of state-wide significance, giving preference to uses which adhere to the seven objectives discussed below. RCW 90.58.020 and WAC 173-16-

040(5) interprets these principles into guidelines for writing master programs. It is important to remember that the SMA lists these objectives in order of preference. Therefore, objective 1, "Protecting state-wide interest over local interest" takes priority over objective 2, "Preserving the natural character of the shoreline." Listed below and on the following pages are the seven criteria with a brief discussion of how the priorities have been applied in specific situations.



Schematic map of shorelines of state-wide significance.

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1. Recognize and protect the state-wide interest over local.

This means that where a resource of state-wide interest, such as fisheries, is in jeopardy from some proposed use, state-wide concerns will prevail over local interests. The local jurisdiction should take every opportunity to solicit comments and opinions from citizen groups and individuals representing state-wide interests (e.g., Sierra Club, Audubon Society, Trout Unlimited, etc.). Appropriate state agencies, universities, colleges, and Native American Nations should also be involved along with comments, opinions and advice from experts in ecology, oceanography, geology, liminology, aquaculture and other scientific fields pertinent to shoreline management.

Administratively, the consequence of this guideline is that all state-wide interests prevail, and any proposed use or master program that does not recognize and comply with those state-wide interests will be rejected.

2. ***Preserve the natural character of the shoreline.***

This guideline means that any action that adversely affects the natural character without enhancing the public interest, will probably be denied. Numerous Shorelines Hearings Board (SHB) decisions have been made against private/community boat launches, bulkheads, and the like where the "natural character" of the shoreline would be altered and where there was no benefit for the public at large. The intent is to minimize man-made intrusions on SSWS. There is also a desire in this guideline to upgrade those areas of more intensive development by reducing their adverse impacts on the natural environment. Urban environments that have natural qualities or resources should preserve those low intensity uses compatible with resource protection while accommodating high intensity use in areas already developed. In urban environments this also means that riparian corridors and natural vegetation cover should be preserved (through appropriate structural setbacks and clearing and grading regulations) even in this intensive use environment. This guideline also concerns commercial timber cutting, allowing a maximum of 30 percent of the timber selectively cut from lands designated as SSWS within a ten year period.

3. ***Result in long-term over short-term benefit.***

The purpose here is to ensure for future generations the possibility to use the shorelines either in their natural state or for preferred uses such as those that are water-dependent or water-related. That is to say, if a mixed-use development is slated for an urban waterfront, it should not preclude the possibility of a water-dependent use. The intent here is to evaluate short-term economic gains in relation to long-term and potentially costly impairments to the environment. This provision gives clear priority to long-term flood hazard management solutions.

4. ***Protect the resources and ecology of shorelines.***

The master program should recognize the importance of the unique or fragile natural resources (e.g., wetlands) found along the shorelines and leave those areas undeveloped. This guideline extends beyond the natural shoreline to include the prevention of erosion and sedimentation that would alter the natural function of the water body. Any advances in technology or methodology, as in bioengineering, should be employed to maintain good water quality. In natural areas where it is too difficult to maintain the integrity of the environment under human use, public access should be restricted.

Flood plain planners should be aware that even projects for the greater public good, like in the SHB case of Henderson v. Snohomish County and Barber, the proposed project is subject to scrutiny on the basis of this objective. In this case the SHB ruled that if the proposed camp site is not designed and conditioned to assure preservation or replacement of trees and vegetation, the permit would not be issued.

5. ***Increase public access to publicly owned areas of shorelines.***

The emphasis here is on providing public access to all publicly owned lands, including all federal and state agencies holding shorelands, tidelands and bottom lands, as well as local parks departments and port districts.

Master programs should give priority to developing a path/trail or pocket park system providing water access to and along the shorelines as well as to upland parking and adjacent parks facilities. Master program's general provisions for public access should place special emphasis on providing public access for port district or government sponsored developments on shorelines of state-wide significance. For large industrial sites where direct public access is dangerous or physically undesirable, a port or government agency can provide substantial off-site public access as approved by the local government and Ecology.

6. ***Increase recreational opportunities for the public on the shorelines.***

Any master program update that includes the redesignation of environments on shorelines of state-wide significance should include planning for the encouragement of recreational use of the shorelines. Insure that areas are reserved for lodging and other related facilities on the upland side accompanied by provisions for non-motorized access to the shorelines.

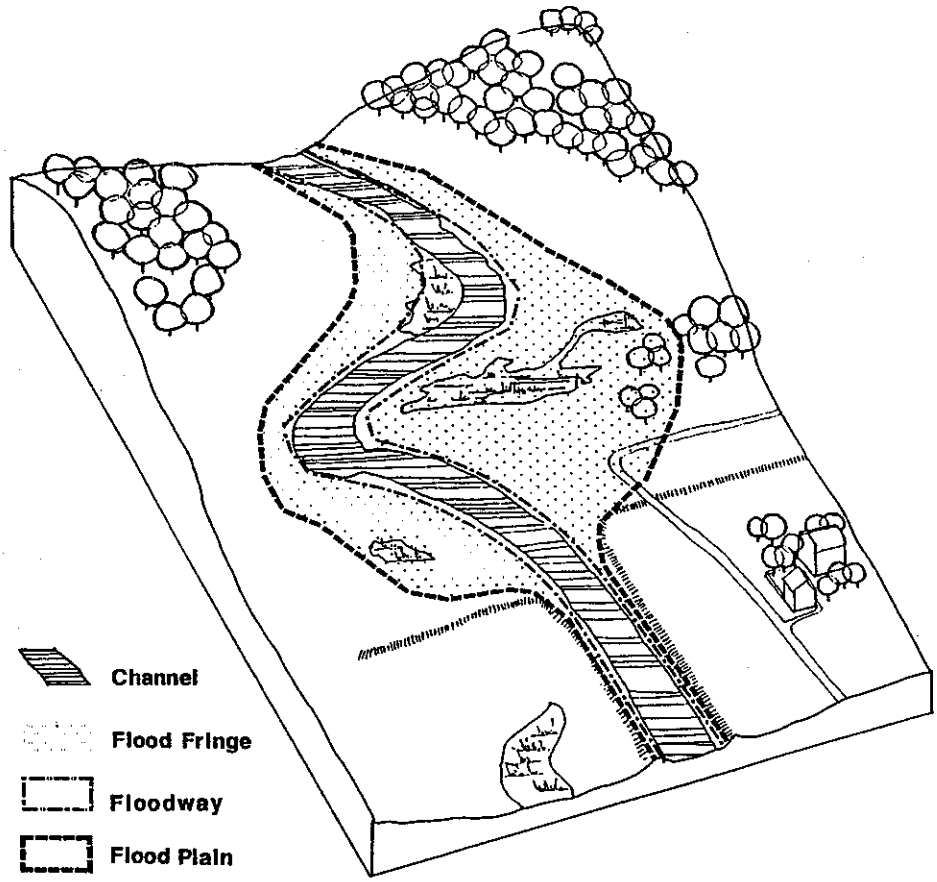
Here, the flood hazard management planner needs to recognize the need to include long-range planning recreational facilities and amenities for their community. The master program should clearly state goals which favor the public and long-range goals.

All of these criteria provide a strong legal basis for protection of flood plain ecology and other resources by restricting development and limiting construction of structures that would degrade natural processes. For all of these reasons it is critical that the shoreline master program be considered as a primary regulatory tool available for local planners to use in flood hazard management planning.

7. ***Provide for any other elements as defined in RCW 90.58.100 deemed appropriate or necessary.***

4. Local Flood Hazard Ordinances to Implement National Flood Insurance Program

The National Flood Insurance Program includes two types of regulatory programs. First, participatory local governments must require that any new construction in the 100-year flood plain be flood proofed (see Item E, Flood Proofing, on page 63). Second, participatory local governments must adopt some measure of land use regulations to insure that the FEMA "floodway" will not be further restricted. In theory, this means that local governments must prohibit new development within the FEMA floodway.



Floodway.

A local means to control development is the use of flood plain management ordinances. Ecology is responsible for coordinating and approving local flood plain management ordinances to make sure that they conform to NFIP standards (Chapter 86.16 RCW) (see Item E, Flood Proofing, on page 63). A flood plain ordinance must, at a minimum, specify the potential flood areas, the type of development permitted (or prohibited) in these areas, development standards, a process for review of development proposals, and an enforcement

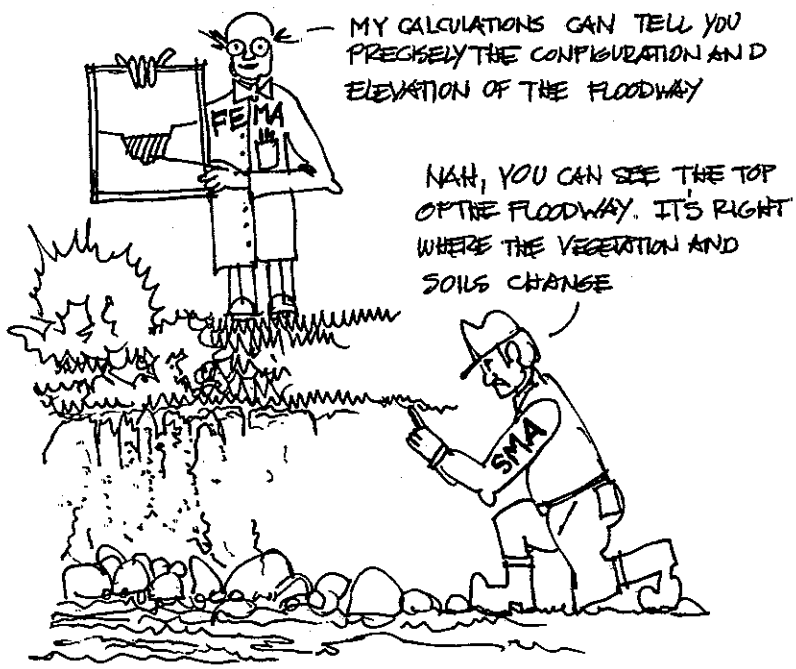
policy. The ordinance need not eliminate all development. For example, one performance criteria for granting a permit in the flood plain could be the requirement that a SEPA environmental assessment find that the development does not contribute to flood hazards either as an individual project or as a contributor to cumulative impacts resulting from a general pattern of development. Analysis done as part of the Comprehensive Flood Hazard Management Plan could provide the background for helping to make that determination.

Special Tip: Floodway Definition

The floodway is the portion of the flood plain where the highest flood velocities and greatest flood depths usually occur. The floodway defined by FEMA is not necessarily the same as defined in the Washington State Shoreline Management Act.

FEMA defines floodway as, "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 cumulatively increasing the water surface elevation more than one foot."

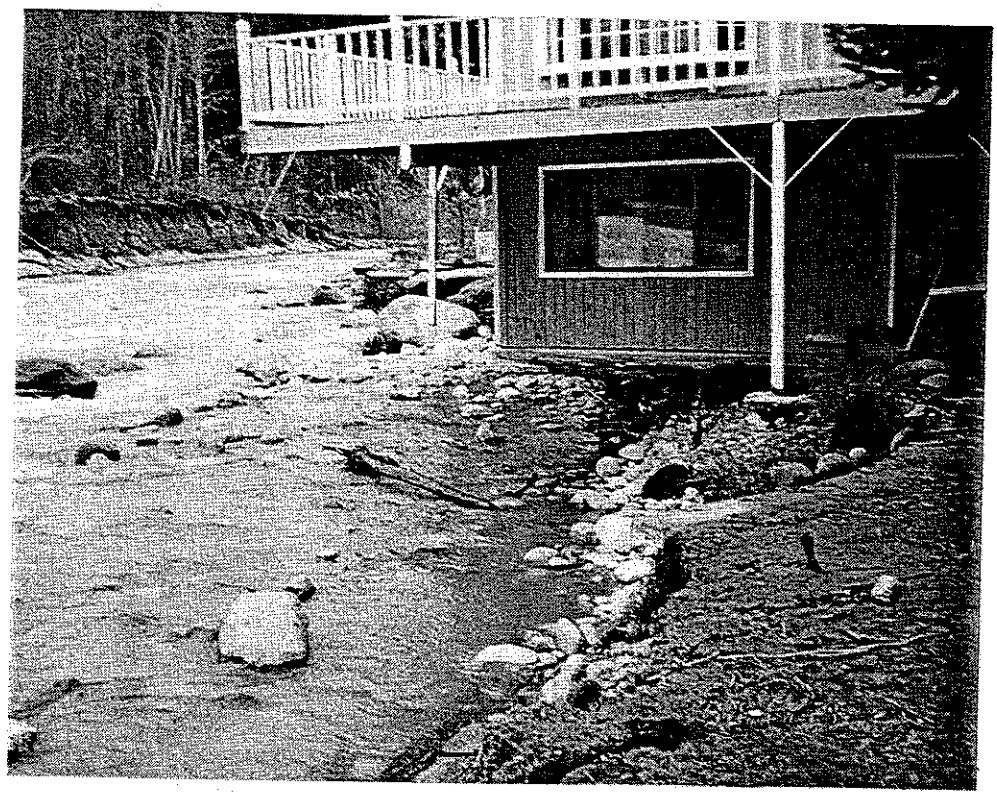
The SMA defines floodway as, "those portions of the area of a river valley lying streamward from the outer limits of a watercourse upon which flood waters are carried during periods of flooding that occur with reasonable regularity, although not necessarily annually, said floodway being identified, under normal condition, by changes in surface soil conditions or changes in types or quality of vegetative ground cover condition. The floodway shall not include those lands that can reasonably be expected to be protected from flood waters by flood control devices maintained by or maintained under license from the federal government, the state, or a political subdivision of the state. The limit of the floodway is that which has been established in flood regulation ordinance maps or by a reasonable method which meets the objectives of the act."



THE GREAT FLOODWAY DEFINITION DEBATE

Local agencies may adopt a more restrictive definition of floodway. For example, King County's Sensitive Areas Ordinance employs a "zero-rise" floodway standard. The "zero-rise" standard prohibits development in the flood plain which would cause a perceptible rise in the floodway, in effect, enlarging the area defined as the floodway to include almost the entire flood plain.

The following photo, taken in November 1990, illustrates how channel migration (or river meander) can affect the accuracy of FEMA floodway maps. This home, located on the Raging River in King County's Snoqualmie River Valley lies outside the flood hazard area on the existing Flood Insurance Rate Map (FIRM).



Home located on the Raging River in King County. This home is located outside the flood hazard area identified on the existing FIRM.

B. Public Acquisition of Flood Prone Properties

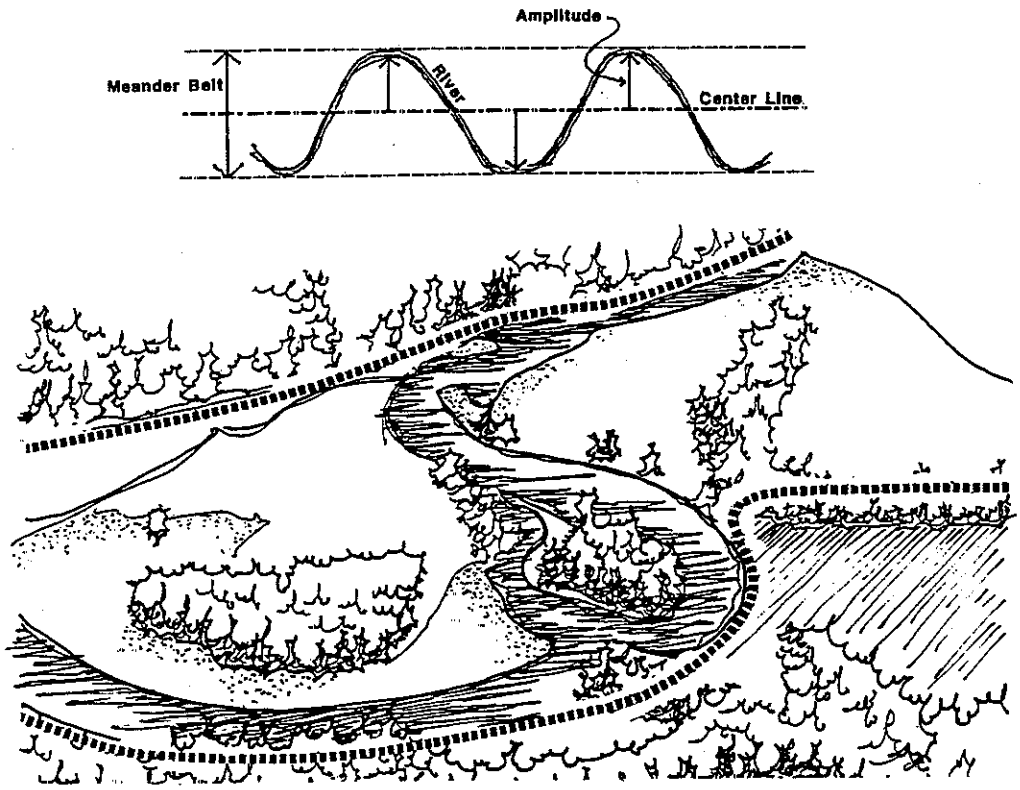
Another way to control growth in flood prone areas is for the public to purchase key properties for flood compatible use such as recreation or passive open space. With increased public interest in preserving greenbelts and open space in urban areas, flood plains and river corridors located within meander belts make excellent choices for acquisitions, riverfront parks, wildlife preserves, and trails. Golf courses can also be appropriate in flood prone areas if they are designed to protect environmentally sensitive areas and prevent herbicides and fertilizers from entering the watershed. Often, such uses can incorporate wetlands and other sites that are only marginally

developable. Communities can also purchase development rights to agricultural lands, insuring that these properties are not developed and property taxes are not raised to reflect "highest and best use."

Of course, the difficulty in this approach is coming up with the funds for purchase. Several options are available. Open space bond levies are one method. Bond issue initiatives are generally most successful when the land purchase is tied to a comprehensive recreation open space plan with recreation features linked by a trail system such as was the case in King County. This provides better public access and "something for everyone," making the bond issue passage more likely.

Special Tip

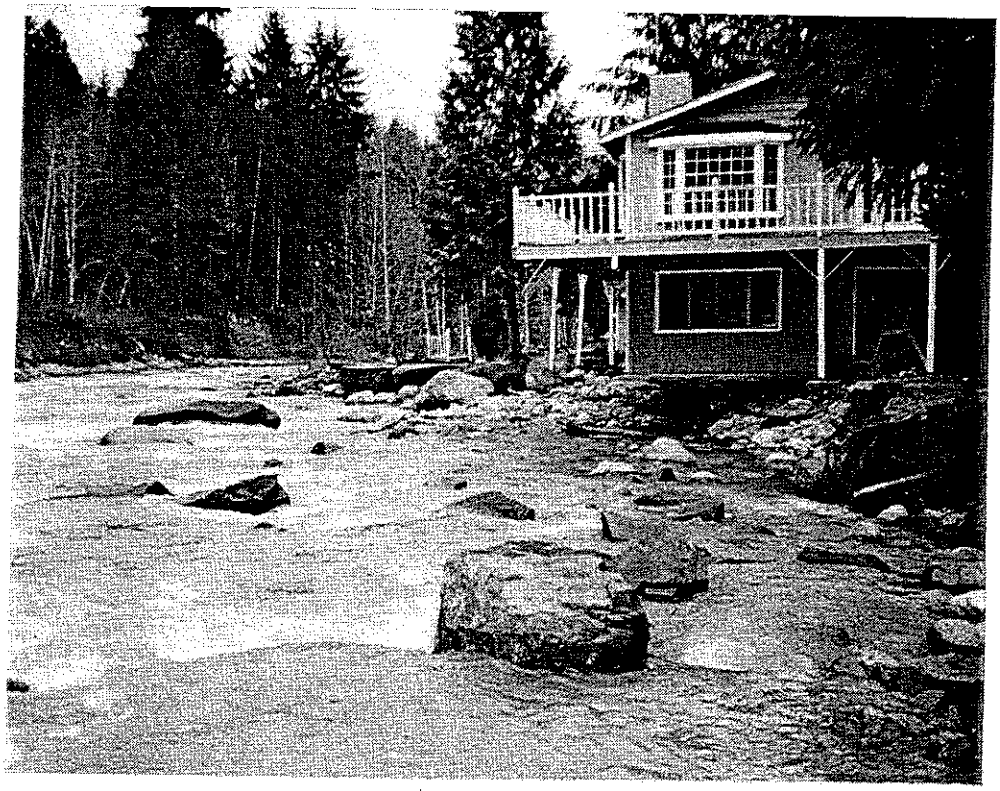
The meander belt of a river is the amplitude of the meanders of a river about the centerline of the river, or the width of the meander of a river, on both sides of the river in the historical flood plain.



River meander belt.

FCAAP funds may be considered a potential funding source for the purchase of flood prone properties or land to be used for flood storage, after such measures have been identified as possible flood hazard management measures/alternatives as documented in the CFHMP. One other source of acquisition funds is the NFIP section 1362 funds which allow property owners, if insured under NFIP, to sell substantially damaged properties to the federal government rather than apply for insurance payments for damage repairs. Section 1362 funds were used

to purchase homes destroyed by flooding caused by the eruption of Mount Saint Helens, to create Toutle Park and to purchase flood damaged properties in Whatcom County to create a small public park on Lake Whatcom and most recently to purchase thirty seven (37) properties damaged during the November, 1990 floods.



King County has received preliminary approval to acquire this home with NFIP Section 1362 funds.

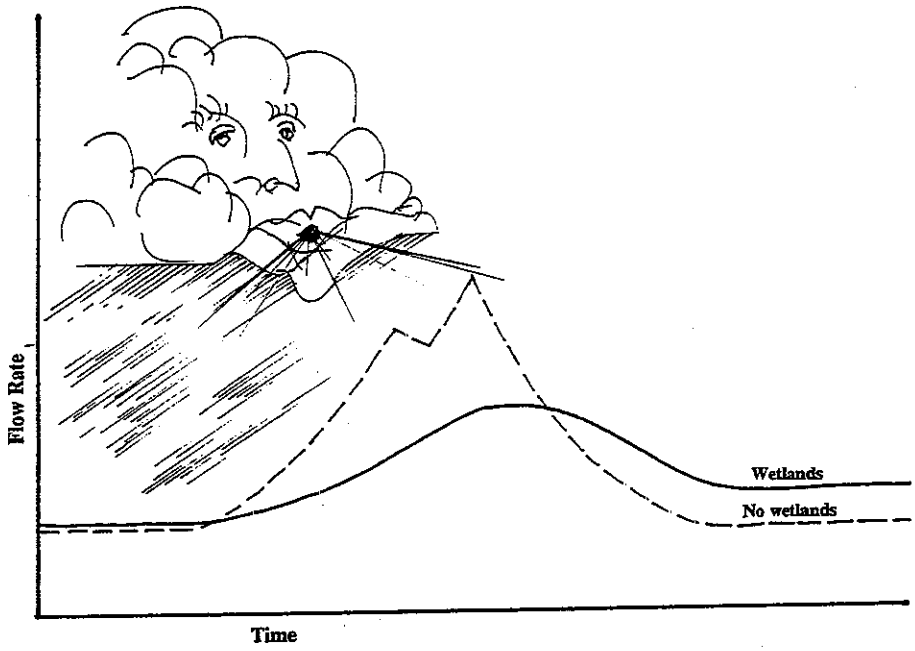
C. Resource Management Regulations

Many renewable resource management and environmental protection practices including forestry, fisheries and water quality relate directly to flood hazard management planning. Concisely, flood hazard management objectives can be furthered through more effective resource management practices. For example, logging on steep slopes can exacerbate runoff.

D. Environmental Protection Measures

Because environmental protection measures, such as wetland conservation, vegetation maintenance and wildlife habitat enhancement are typically dependent upon preserving the natural hydrology of the flood plain, the environmental protection measures generally dovetail with non-structural flood hazard management efforts. For example, wetland protection through local ordinances which restrict development on designated wetland areas as called for in the Growth Management Act, can also serve a useful flood hazard management function by

preserving wetlands that serve as flood water overflow and storage areas. Maintenance of vegetation on side slopes also cuts down on stormwater runoff, and maintaining open space in the flood plain itself increases the average permeability of the area. The following figure illustrates the ability of wetlands to reduce peak flows.



Wetlands provide peak flow reduction.
Source: Washington Coastal Currents Vol. XV, No. 7, January 1991.

E. Flood Proofing

The general description of flood proofing and examples related to different types of development is adapted from *Guidelines for Establishing Engineering and Flood Criteria* by P.W. Barkley et.al. Flood proofing might be defined, generally, as the construction or remodeling of physical structures such that during floods they can either be closed or their occupancy can be modified so that inundation, siltation, or velocity damage can be minimized. While it may be rather expensive and impractical to completely flood proof all developments, this method together with land use regulation, is useful in reducing flood damages.

The feasibility of such activity depends considerably on the use of flood plains. Existing activity may be flood proofed but, in general, this would probably be more difficult and costly than designing flood proofing into new developments. In urban areas where development proceeds at a rather rapid pace, flood proofing practices would find advantageous application. Examples of flood proofing techniques for different types of development are briefly outlined on the next page.

Light Industry:

Typical flood proofing measures might include elevating all processing operations and storage facilities of materials, especially hazardous materials, subject to damage above the flood plain elevation.

Commercial Enterprise:

Firms selling products and/or services for human consumption may find flood proofing relatively more difficult and costly than in the case of industry. Nevertheless, it may be entirely feasible in this instance, to develop customer parking and receiving and delivery areas directly on the flood plain. Suitable access could then be provided to upper level trade areas (perhaps only one-half of normal flood height above existing grade). Inundation would thus occur only to areas which could be evacuated. As an alternative, flood doors and other partitions with sealing mechanisms could be provided so that areas could be closed with advancing flood threat.

Residential Occupation:

Flood proofing here would appear to be the least practical of the three examples cited. Physically, the difficulty would not be insurmountable, but in terms of relative cost requirements, the benefit-cost ratio may be very low for existing structures. However, it may be entirely feasible and possible (if the terrain of the flood plain so allows) to construct new residences on existing "backgrounds" or on built-up areas. Yards, parks, school playfields, and public recreation could then be placed on lower levels of the flood plain. The NFIP standards (see below) require that the first floor of all new residential buildings be at or above the 100-year flood level.

Any development on the flood plain will require that certain utilities (e.g., lights, heat, and water) be available to them. Placement of utilities on the flood plain should be designed to withstand sedimentation, erosion and other forms of damage. This is particularly important if activity is to continue on the flood plain under flood conditions.

National Flood Insurance Program

The most useful tool for local cities and counties to require flood proofing of structures in the flood plain is participation in the National Flood Insurance Program. The National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973 establish a somewhat comprehensive set of regulations relating to the mitigation of flood damage. A flood insurance program is established to pay for flood damage. A county or city may participate in the flood insurance program, which allows property owners to purchase flood insurance, by both adopting certain zoning restrictions in the 100-year flood plain and requiring construction in the 100-year flood plain to be "flood proofed" or built in such a manner as to limit flood damage.

Technically, it is "voluntary" for a county or city to participate in this program. However, severe consequences arise from not participating in the program, including: (1) limitations on federal disaster assistance that is provided for flood damage; (2) the unavailability of federal loans, as well as mortgages that are sold on the secondary market regulated by the federal government, to finance construction in the flood plain; and (3) inelegibility to participate in the FCAAP.

Need for Inter-Departmental Coordination

Approximately 245 of 270 "flood prone" communities in Washington currently participate in the NFIP. These communities must adopt a "flood hazard ordinance" which sets flood proofing standards for all new development. Generally, city and county building departments enforce the ordinance through the building permit review process. The real key to a successful flood proofing program is to coordinate this activity with land use controls and structural flood hazard management measures so that the most cost effective approach is taken for a given situation. For example, in some undeveloped sections of a watershed, flood proofing may be much more cost effective than dikes or levees. To achieve this coordination, the flood hazard management planning process must bring together those in charge of building permit review, land use regulations and public construction. Usually, this requires the often difficult task of framing a common strategy among the local departments of planning, building and public works.

Special Tip: Increased Flood Proofing Standards

Ecology does not require that local flood plain management ordinances exceed the NFIP standards. However, in many cases it may be advisable for local governments to set higher standards than those imposed by the NFIP. For example, the NFIP requires that the first floor of new residential construction be at or above the 100-year flood level. A local community may wisely elect to set the minimum elevation at 2 feet above the 100-year flood elevation to allow a greater margin of safety for several reasons, including:

- **Projection of higher flooding levels due to changing conditions in the watershed.**
- **Lack of data in hydrological modeling.**
- **Special conditions that could exacerbate flood conditions.**

The photo on the following page, taken in November 1990, is a home under construction along the Cedar River in King County. This type of development is allowed in communities whose flood hazard regulations meet the minimum standards for participation in the NFIP. King County adopted new regulations in September 1990 which greatly exceed federal minimum standards, precluding this type of development which was approved under the federal minimum standards and before King County adopted its new regulations.

Home under construction on the Cedar River in King County. Illustrates the type of development allowed in communities which meet minimum requirements for participation in the NFIP. Note: King County's new regulations, adopted in September, 1990 exceed NFIP standards.

Structural Alternatives

Note: The discussion of impoundments, dikes, levees and channel improvements is adapted from *Guidelines for Establishing Economic and Engineering Flood Criteria* by P.W. Barkley, et.al and from other sources as noted.

A. Impoundments/Regional Detention

An impoundment (or reservoir) is developed on a stream to provide a storage volume that can be used to "hold" flood waters from proceeding uncontrolled downstream. Utilizing this storage, the flood waters can be released in such a manner that the downstream flow rate is controlled to something equal to or less than the capacity of the channel.

Man-made impoundments may remain full, particularly if the impoundment used for other purposes such as water supply, recreation, or power generation in addition to flood damage reduction. In this event, prediction of future flood flows plays an important role. With adequate warning, the reservoir can be emptied in a well-controlled manner thereby creating reservoir volume to store approaching flood waters. Adequate hydrologic analysis can determine the size of impoundment required. Sediment deposition may occur in a reservoir, however, and over a period of years, may fill part of the reservoir volume. Consequently, reservoir design should include allowances for this deposition. Impoundments are known to affect parameters of temperature, dissolved oxygen and nitrogen, and nutrients. The size and shape of the reservoir and its operating criteria should be planned to minimize any adverse affects.

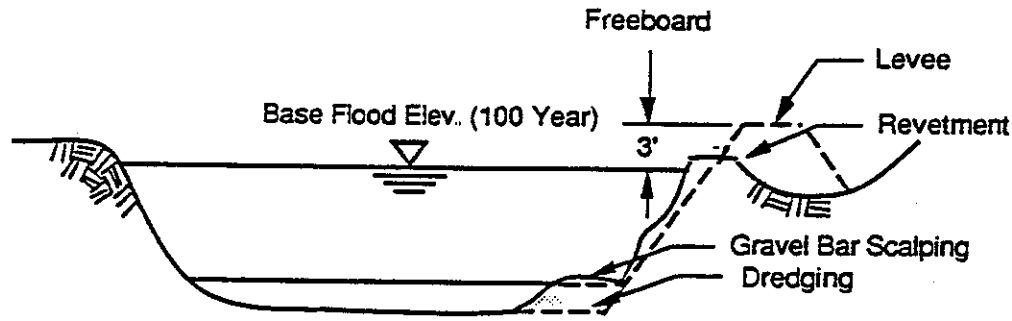
As a practical matter, off-stream impoundments such as dams or detention ponds have the most potential. In-stream impoundments will rarely be allowed within environmental and resource protection regulations.

B. Dikes or Levees

The term "dikes" generally is used to denote linear structures along saltwater shorelines, while a levee is a structural embankment along a river. In many instances, it may be more feasible to confine waters to the stream channel by raising its banks than it would be to control the streamflow rate with impoundments.

While such dikes or levees can reduce flood damage in many instances, they may, in other cases, actually create more flood damage than would occur with the natural channel unaltered. As flood waters rise and the water surface increases in elevation, a certain elevation difference occurs between this water level and the surrounding land areas behind the levees or dikes. If the levee or dike should fail because of overtopping or seepage and subsequent erosion, an initial surge will occur over or through the dike. Inundated land is then

subject not only to submergence, but to impact and erosion from damaging velocities much like what occurred on Fir Island in Skagit County during the November 1990 flooding.



Levee and revetment.
Source: Puyallup River Basin Comprehensive Flood Control Plan

Another situation where increased damages result from construction of dikes and levees is one where such construction occurs to "protect" a relatively low density and low value land use. Economic considerations establish a level of protection for this land use. The levee or dike, when built for this protection level, then leaves the wrong impression that all future floods will be "controlled" and the land use changes to high intensity, high-value occupation. A dike or levee breach subsequently occurs and damages are many times greater than even before the dike was built.

A natural stream channel is capable of passing a maximum rate of flow without overtopping. The dike or levee installation increases this flow capacity. The designer of the levee must consider, however, the hydrology of the stream in question. There is always some probability, however small, that the largest historical flood will be exceeded in the future, either because of natural phenomena or because of unforeseeable changes in upstream drainage basin characteristics. Floods derived on the basis of historical events will also be exceeded.

The materials used for the construction of a dike system will dictate the cost of the project and land area requirements for such construction. This material may be rock and earth fill, concrete, or combinations thereof. In many cases, particularly in urban areas, aesthetics play an important role in the design of levees. Water ecology should be considered here also. A rubble mound or earth levee often requires that excavated material be brought to the construction site. This material may have a deleterious effect on water quality, particularly during periods immediately after construction. Such an influence may actually change natural water ecology which in turn would affect resident aquatic life.

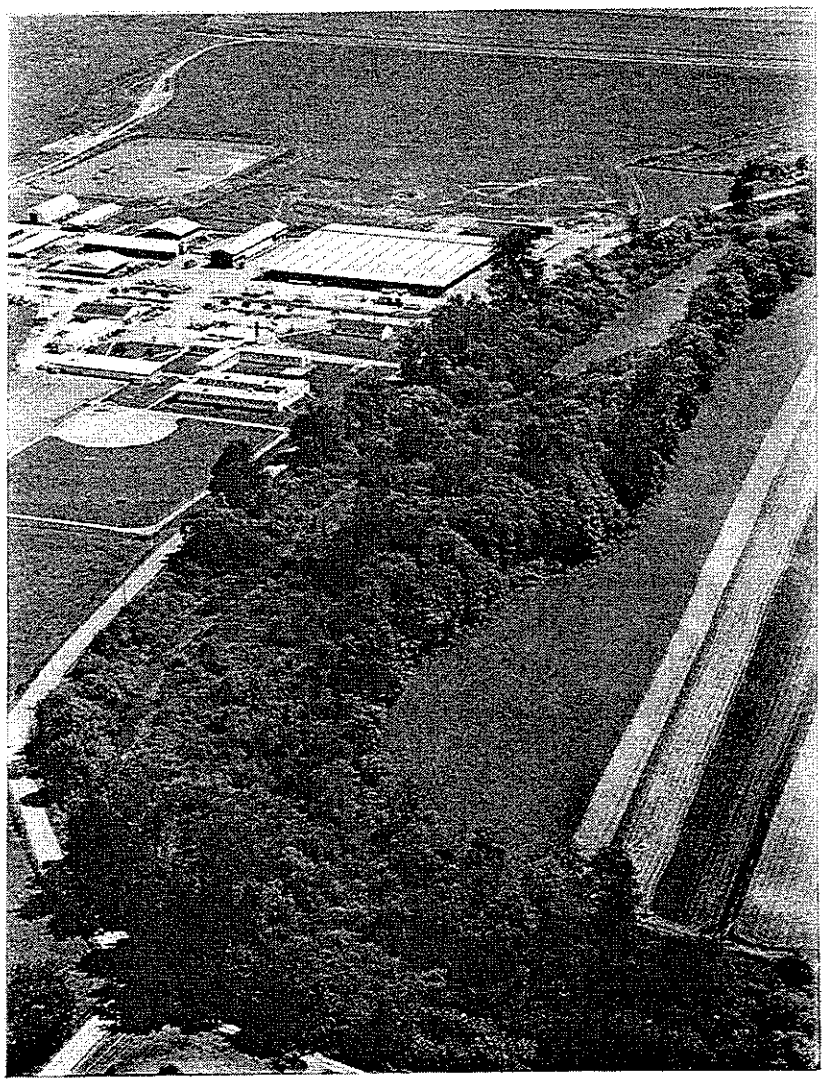
12

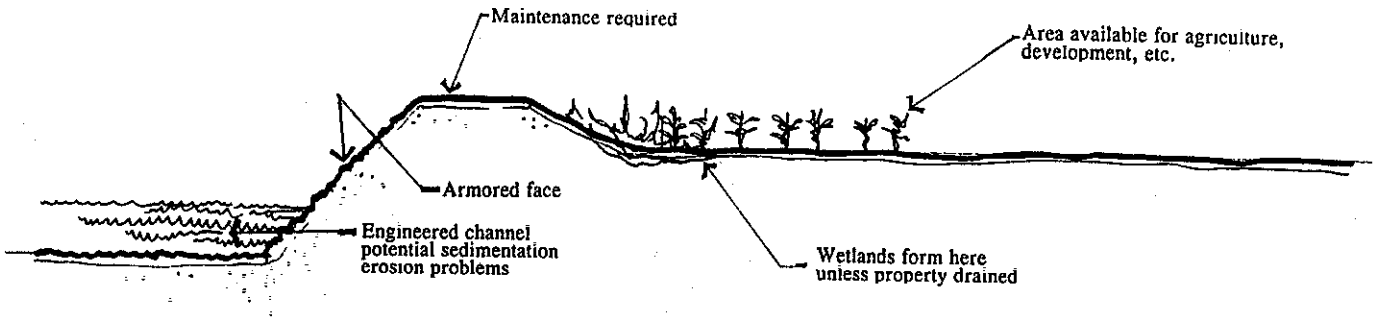
Floodwalls

Floodwalls perform much like levees except that they are vertical sided structures which require much less surface area. Because floodwalls are usually constructed of reinforced concrete, the expense of installation is often prohibitive and the structure will degrade adjacent habitat.

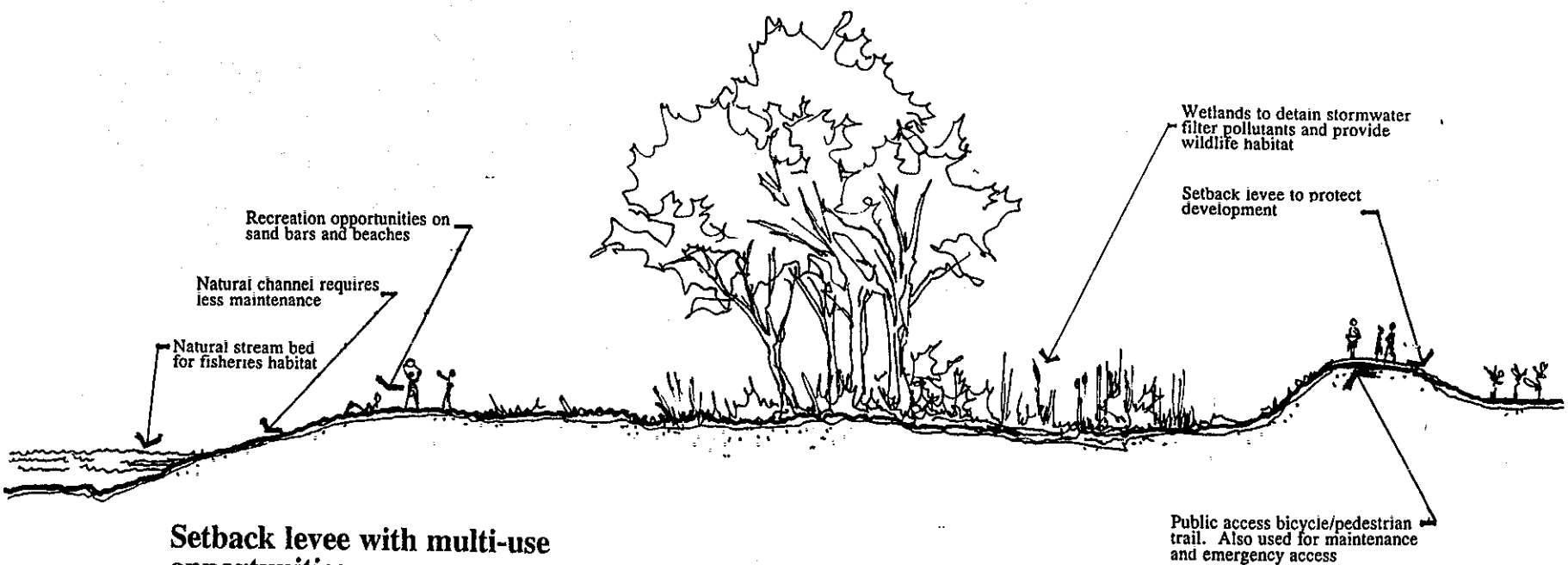
Setback Levee- An Attractive Alternative

A variation of the standard levee, which is usually located as close as possible to the river channel is the "set back levee" in which the river-side toe of the levee is "setback" from the river banks at a minimum distance determined by the regulated FEMA floodway. Of course, the setback may be wider. An optimum setback distance should satisfy other criteria: 1) exceed the meander belt of the river, 2) allow for recreation use of the area contained within the levees, either in a natural condition or augmented by play fields, bike paths or picnic areas, 3) would not interfere with existing standards of vegetation, and 4) avoid interference with particular wildlife habitat. Since setback levees allow natural biological and hydrological systems to occur in the setback, the setback levee is a structural solution that merits careful consideration as an alternate to the conventional levee. On the other hand, setback levees require more land area for the project, which may be a disadvantage. The figure on the following page provides an example of a setback levee with multiple use opportunities.



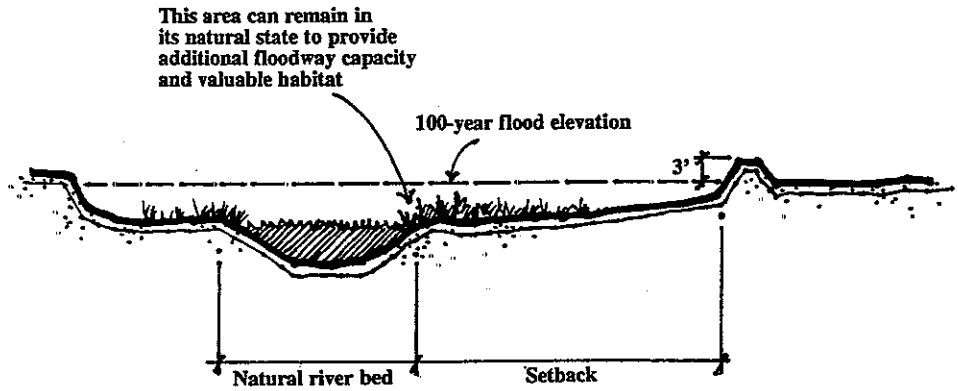


Typical levee



Setback levee with multi-use opportunities

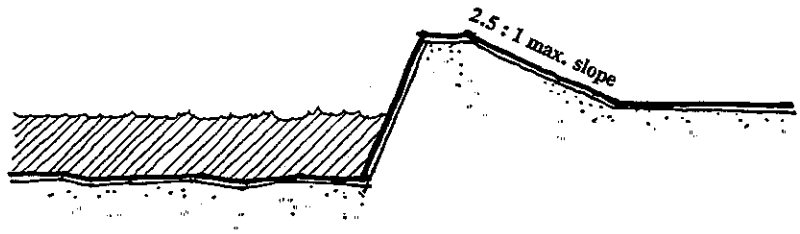
The illustration of the setback levee illustrates the concept of using floodplains for a variety of objectives. Flood hazard management planning should maximize resource utilization while minimizing the potential for flood damage.



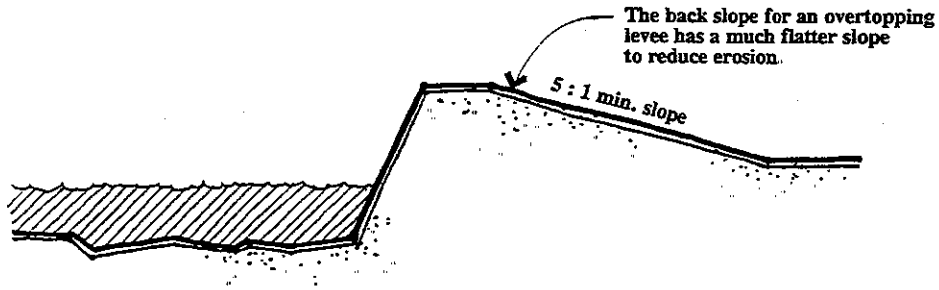
Setback levee.

Overtopping Levees

The level of protection a levee provides is defined as the largest flood which does not overtop the levee. This definition of level of protection does not take into account the ability of that levee to withstand overtopping. "Overtopping levees" are designed to withstand overtopping and thus to minimize levee failure. Levees designed to overtop are initially more expensive than non-overtopping levees, however given the eventuality of overtopping, overtopping levees provide a way to take water safely onto the flood plain. The goal of this flood hazard management measure is to reduce flood damages to the greatest extent possible, not to keep out the largest flood possible.



Regular levee



Overtopping levee.
Source: Snohomish County Comprehensive Flood Control Management Plan.

C. Stream Channel Improvement and Realignment

Stream channel improvement may result in much the same effect as those which would occur from dikes or levees. Here, however, the improvements would involve dredging operations (removal of obstructions and/or straightening the channel course). Channel improvements of this type have a distinct advantage over the levee system in that when flood waters rise, any inundation is relatively slow. The velocity or surge associated with a dike failure mentioned above does not exist.

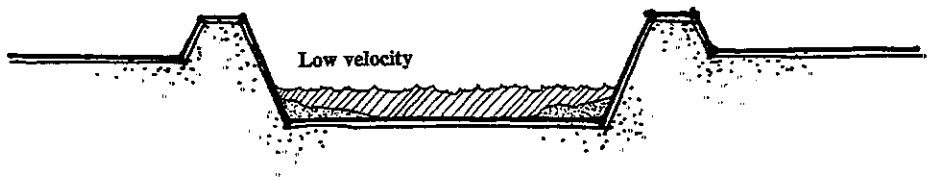
Dredging

Dredging operations will be controlled by the surrounding topography, and attempts to go beyond such limitations will either reap no benefit or will simply move the flood problem to other areas. Attempts to reduce stream roughness must recognize the possibility of vegetative regrowth or sediment deposition, both of which may return the roughness to its original value.

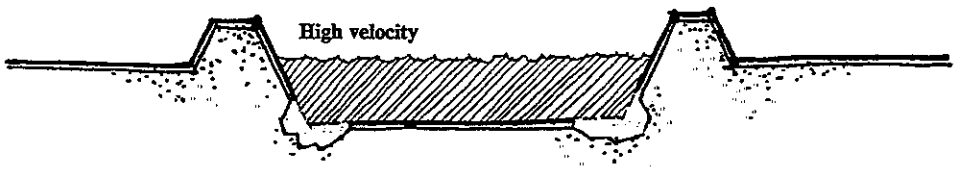
Drawbacks to Engineered Channels

It is reasonable to expect that channel improvements and realignment may require more land area than other alternatives. In many cases, this land area may not be available at acceptable cost. Thus, a concrete-lined or other-lined channel may be necessary. In any event, the aesthetics of the improvements must not be ignored nor must the corresponding loss of fish and wildlife habitat. If dredging and realignment are undertaken, stream water ecology and other environmental impacts (e.g., shallow water habitats) may be affected as discussed earlier. Forces created by flowing water are often underestimated; it is quite difficult to force a meandering channel to assume an "artificial" path in all instances. Unless suitable protection is designed to offset erosive energy of the stream, the meander of the natural channel will reoccur.

Engineered channels and levees are subject to damage or degradation by a river's natural hydrological processes. If the channel's cross section is too wide and allows the river's velocity to decrease, sedimentation is likely to occur. This will eventually obstruct the channel and could lead to flooding during peak flow. If the channel is too narrow, the stream's velocity could lead to erosion at the base of the channel's walls. Since river flow typically varies widely during the years, it is quite likely that there will be periods of erosion and sedimentation. Natural river channels accommodate these dynamic processes by continuously modifying their configurations and/or location. Fixed engineered channels do not allow for these changes and are therefore subject to damage.



During low flow periods the velocity slows and sediment can deposit in the channel, reducing channel capacity.



During high flow periods high velocity currents can erode channel walls.

Stream bed degradation associated with engineered channels.

D. Bank Protection Measures

In their work on the *Dungeness River Comprehensive Flood Control Management Plan* for Clallam County, the firm of Kramer, Chin and Mayo identified several bank protection and in-stream control measures to reduce erosion and damage to nearby properties. The description of these structural alternatives, listed below, are adapted from the plan below.

Bioengineering

Bioengineering is the term given to the practice of using natural materials (vegetation) consisting of bundles of reeds, root systems, and living plant material to stabilize channel side slopes and prevent future erosion. The process includes embedding the more structural organic materials (logs, reeds, etc.) into the slope and planting live materials for surface coverage. Plantings can be selected which enhance fisheries habitat by providing canopy over the normal water surface of the river with a resulting cooling and food source benefit. Other wildlife may also be attracted to this natural environment.

Bank Slope Reduction

Steep banks threatened by erosion can be "flattened" or have the slope reduced and then revegetated using other methods described in this section. The highest portion of the back is cut back away from the channel to reduce sloughing and slide potential during high water conditions. This may not be an appropriate measure if the top of bank

is already heavily vegetated with trees and large shrubbery.

Crib Dams

Crib dams use logs buried length-wise into the slope to achieve bank stability. Vegetation is then planted in the soil between the logs set side by side to provide canopies above the river water surface. However, the use of crib dams has limited application in northwest streams.

Riprap

Along stream reaches where real constraints will not permit bank slope reduction or where there is the potential for a vegetated slope to be undermined, the use of riprap may be acceptable. Riprap is placed in the critical erosion area and is sometimes combined with bioengineering techniques.

Sod/Pavers Along Banks

This method uses a combination of man-made, earth stabilizing materials intermixed with sod or plantings to achieve slope stability. Earth reinforcement could also be based on a geotextile fabric which lays on the surface of the slope and allows seeded plants to grow through the fabric to maturity, leaving the appearance of a vegetated slope.

Gabions

Gabions are cylindrical wire mesh baskets filled with concrete or rocks which can be used in revetment construction and streambank protection. It is possible to combine vegetation with gabions along streambanks or shorelines incorporating bioengineering techniques.

E. In-Stream Controls

Off-channel Gravel Traps and Mining

Mining gravel within the river bed would disrupt the fisheries habitat of the river and require particular construction and mitigative measures. Mining adjacent to the river could have multiple benefits: 1) produce aggregate material, 2) increase river conveyance and 3) enhance fish habitat. Depending on the type of facility, gravel could be mined on a one-time basis or with a frequency based on the river's average bedload transport and resulting replenishing rate. Gravel traps must be properly sited so the river does not cut into the pit.

Anchor Logs in Stream

This alternative, which involves anchoring fallen trees near banks experiencing severe erosion, is used to redirect flow or reduce flow velocity within the stream bed. This may be used as a temporary

remedy or as part of a structural diversion to mitigate the effects on the fisheries habitat. Care must be taken so that the anchor logs do not collect debris and block the channel.

Deflector Structures

Deflector structures are placed across a channel or may jut out from a channel bank to redirect the streamflow away from an eroding side slope or to maintain a minimum flow channel. Their height is generally set below the dry season mean water levels. The structures must be securely anchored and made of a material that can withstand the effects of continuous stream flow. As in the case of other in-stream measures, the structures must be located and designed so that they do not catch debris, obstruct the channel and produce higher velocities.

Spur Dikes

Spur dikes are built from the channel bank into the river bed to direct the main channel flow away from the bank and to create a low velocity zone between the dikes to minimize erosion. The lengths and spacing of the dikes are set based on the hydraulic conditions of the river over the affected reach to achieve particular results. The length of the dikes are limited by the main channel conveyance required by the river and by the effects on the opposite bank and downstream locations. The dikes usually exceed the normal river water surface elevation and are overtopped in moderate and severe flooding conditions.

A recent proposal to use spur dikes along the west bank of the Dungeness River just downstream of Ward Bridge for the protection of Ward Road has received the approval of the reviewing agencies. The project is now in the final design phase to determine the appropriate size and alignment of the dikes to create the desired hydraulic effect which will eliminate the destruction of the river bank.

Chevron Dams

These structures are V-shaped, low water weirs built across a stream to redirect flow. The "V" faces upstream to move water toward the center of the main channel. The weirs are generally submerged and may be notched to allow extreme low flows to pass and prevent stranding fish. Chevron dam application is usually restricted to small streams.

Split Channel/Bypass Channel

This alternative can be described as diverting stream flow during times of high volume to a parallel bed or restoring an abandoned channel for the purpose of increasing river conveyance. However, this concept may require a flow control structure at its confluence with the main channel and/or a section of man-made channel where a natural channel is not available. Moreover, split channels must include appropriate measures to prevent fish stranding.

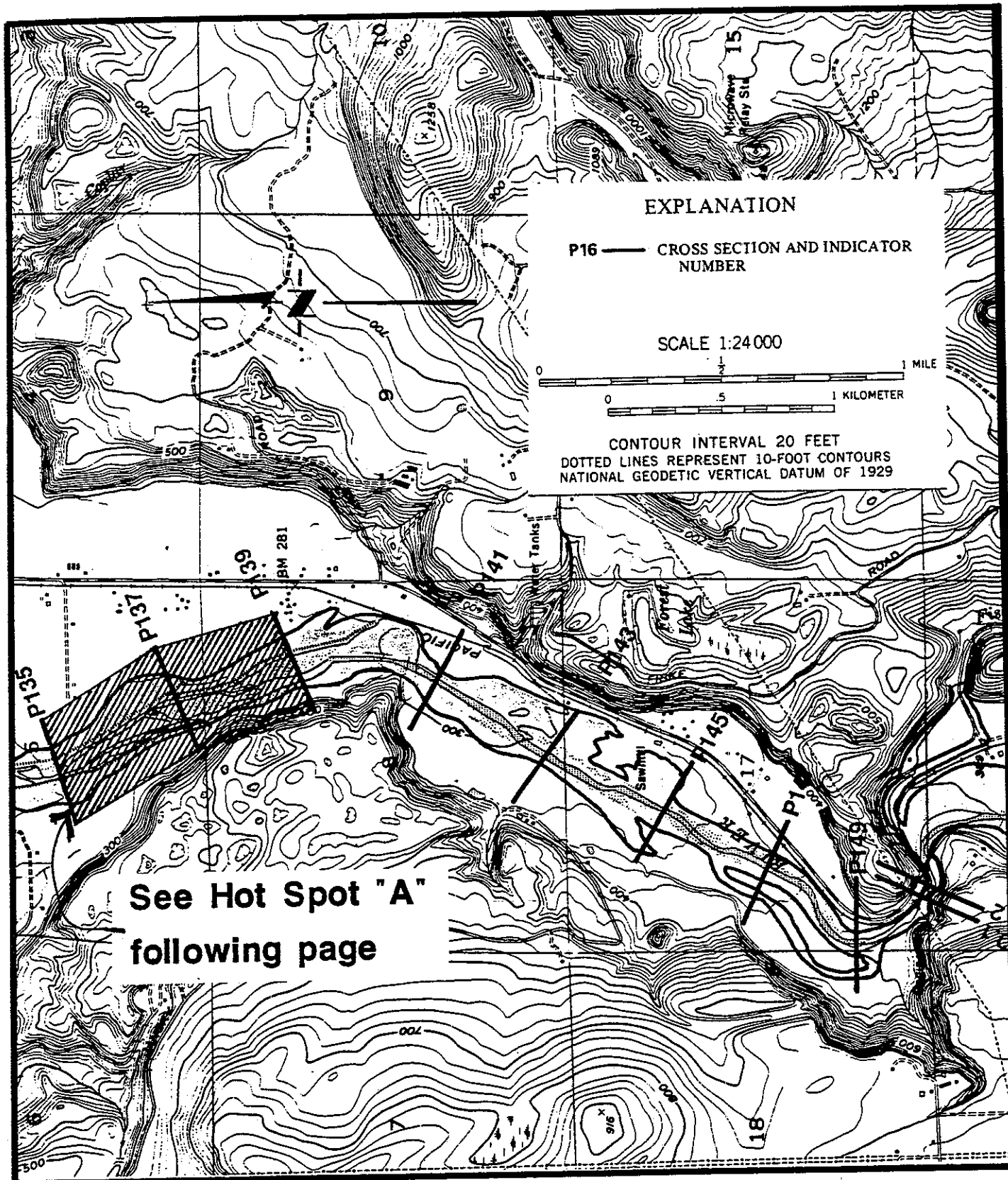
Gravel Bar Scalping

This structural alternative may be considered a maintenance measure because it must be repeated regularly to keep up with the continual bedload deposition along the river in order to be effective. Gravel bar scalping should only be used in areas of confirmed deposition and aggrading river channel. If areas of programmed removal are determined, permanent access easements and structures could be established that would minimize the effects of working within the stream banks.

Summary of Alternative Measures

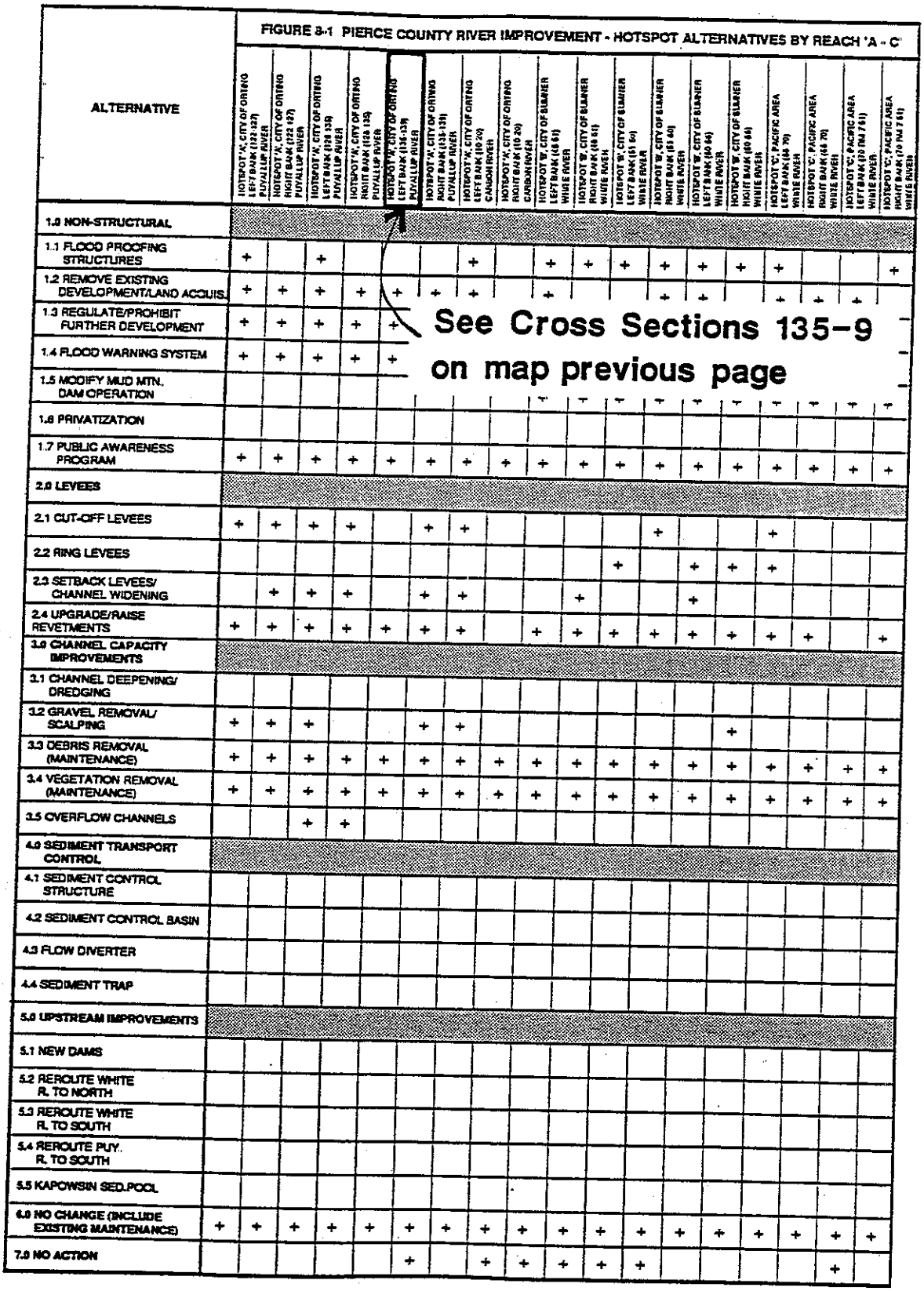
It is important that the alternative measures be described in specific terms and located on a map. This is also true for non-structural measures. If an alternative calls for protecting wetlands, for example, then the schematic location and size of the wetlands should be shown to illustrate what the measure involves and how it relates to other measures. If a regulatory program is suggested, then the applicability, intent, basic regulations and authority for the program should be described.

It is also useful to indicate which measures solve or contribute to solving which problems. This will help to evaluate the alternatives and to organize preferred measures into a comprehensive strategy in later steps. The following map and matrix, excerpted from the Puyallup Comprehensive Flood Control Management Plan prepared by JMM Consulting Engineers Inc., indicates which of the proposed measures would help to solve problems at various problem areas or "hotspots" along the river. The plan includes a series of detailed maps locating the referenced locations. A sample map is included on the second page following.



PIERCE COUNTY RIVER IMPROVEMENT
PUYALLUP RIVER COMPREHENSIVE FLOOD CONTROL MANAGEMENT PLAN
100 YEAR FLOOD PLAIN BOUNDARIES
PUYALLUP RIVER
CROSS-SECTIONS P135 - P150.2

FIGURE 1-5



Problems or "Hot Spots" and proposed solutions.
Source: Puyallup River Comprehensive Flood Control Management Plan.

Step 6: Evaluate Alternative Measures

Once feasible alternative measures have been identified, they must be studied in enough detail to determine the effectiveness, costs, benefits, and impacts of each one. The purpose of Step 6 is to determine this information so that the alternatives may be compared during Step 7 and the preferred alternatives organized into a flood hazard management plan in Step 8. To be complete, the alternative evaluations should include a description of each measure's characteristics with respect to the following criteria.

A. Environmental impacts.
B. Consistency with applicable policies.
C. Cost, benefits and method of payment.
D. Scheduling and term of benefit.
E. Goals and objectives set in Step 2.

Suggested methods for evaluating measures with respect to each of the criteria is outlined below.

A. Environmental Impacts

The most thorough and, in the long term, expeditious way to assess the measures' potential impacts is to model this task after the procedure for analyzing alternatives in a State Environmental Policy Act (SEPA) programmatic environmental impact statement. That is, the potential impacts with respect to the natural and human system elements as noted in the SEPA guidelines should be identified. Those that are potentially substantial, especially the potential impacts to geohydrological, water quality and biological systems of structural measures should be investigated. At this point it may not be necessary to quantify all the impacts and a summary of impacts may be condensed into a matrix such as the following example from the *Dungeness River Comprehensive Flood Control Management Plan* (see table on following page).

Of course, the key consideration is to provide sufficient analysis so that a SEPA checklist or EIS can be easily developed from the information. Although the planning team may elect to perform more extensive environmental analysis for the alternative measures chosen in Step 8, it is the recommendation of this guidebook that the SEPA impact assessment be integrated into the planning process in a way that can facilitate alternative selection as well as provide SEPA documentation.

Special Tip: Other Impacts to Consider

The impact analysis should pay special attention to other hydrological impacts in other parts of the watershed system. For example, if a proposed channel straightening is proposed that will speed water past a flood prone area down into a neighboring community, the downstream impacts should certainly be addressed.

Table 8.1
Environmental Impacts Associated with Structural Methodologies

Exhibit No.	Structural Methodology	Impact Categories: Fish Resources	Wildlife Resources	Scenic Aesthetic Historic	Water Quality	Hydrology	Existing Recreation	Other
8.1	Approach dikes	---	1	---	---	2	---	---
8.2	Cabling Trees	3,5	---	4	5	---	---	---
8.3	Flow realignment	6,7	---	---	6,7	2	---	---
8.4	Gravel bar scalping	---	---	---	---	2	---	---
8.5	Instream boulders	6,8,9	---	---	9	9	---	---
8.6	Low dikes	---	10	---	---	11	---	---
8.7	Setback levee	---	10	---	---	11	---	---
8.8	Spur dikes	5,6	---	---	5,6	12	---	---
8.9	Reestablish riparian vegetation	5	13	14	5	---	---	---

NOTES:

1. Localized habitat disruption would occur during construction.

2. Flow characteristics would be more efficient resulting in reduced localized backwater, flooding or erosive conditions. Analyses would be needed to ensure flow conditions are not worsened upstream or downstream.

3. Temporary localized disruption to fish habitat could occur during construction. Long term habitat provided for fish by trees.

4. The appearance of cabled trees would be preferred to structural measures using rock or concrete.

5. By protecting an erosion-susceptible bank, sediments discharged to the river would be reduced.

6. Temporary localized disruption to fish habitat and water quality would occur during construction.

7. Long term benefits to fish habitat and water quality by providing reduced erosive flow characteristics and associated generation of sediments.

8. Long term habitat would be provided for fish around the boulder.

9. Reduced erosive-flows would be anticipated associated with the energy dissipation provided by the boulders, thereby reducing sediment contributions to the river.

10. Placement may require removal/loss of habitat.

11. Property would be protected by confinement of flood on river side of dike/levee.

12. Flows would be redirected away from erosion-prone banks.

13. Riparian habitat lost to erosion would be restored.

14. The appearance of vegetation is preferred to concrete or rock erosion-protection.

Environmental impacts summary.
Source: Dungeness River Comprehensive Flood Control Management Plan

B. Consistency with Applicable Policies and Regulations

Each alterative should be examined in light of existing policies, regulations and permit requirements to insure that the proposed measure is feasible from a regulatory standpoint. Potential conflicts should be identified and noted, and where necessary, applicable regulatory agencies should be consulted. The chart below, excerpted from the *Dungeness River Comprehensive Flood Control Management Plan* presents an example of a method to summarize permit requirements for various structural measures.

STRUCTURAL FLOOD CONTROL MEASURE	REQUIRED PERMITS									
	SSDP	SCDP	BP	WQM	WQC	EC	EIS	HPA	NP	IP
APPROACH DIKES	●			●		●	○	●		●
CABLING TREES	✦	●						●		
FLOW REALIGNMENT	✦	✳					○	●		●
GRAVEL BAR SCALPING	✦	●						●		
INSTREAM BOULDERS	✦	●		●		●	○	●		●
LOW DIKES	●					●	○	●		●
SETBACK LEVEES	●					●	○			●
SPUR DIKES	●	●		●		●	○	●		●
REESTABLISH RIPARIAN VEGETATION	✦	●		●		●	○	●		●

● PERMITS REQUIRED

○ EIS REQUIREMENT DEPENDS ON FINDINGS OF PRELIMINARY REVIEW

✦ PERMIT REQUIRED IF FAIR MARKET VALUE OF PROJECT EXEEDS $2,500

✳ USE OF THIS MEASURE WOULD REQUIRE SMP REVISION

Matrix summarizing permit requirements.
Source: Dungeness River Comprehensive Flood Control Management Plan.

C. Cost and Method of Payment

Cost estimates for structural and non-structural solutions should be made in sufficient detail to estimate preliminary planning level project budgets. Estimates for construction budgets should indicate the contingency factors, and land costs, design fees, costs of mitigation measures, taxes and, in some cases, the monitoring or evaluation costs.

Beyond the direct costs of construction and/or land acquisition, the ongoing operations and maintenance costs should also be identified. For example, if a dike requires periodic maintenance every 10 years, then an estimated amount should be entered into the cost analysis. Administrative costs for non-structural alternatives should also be identified. If additional dikes, district actions or building permit

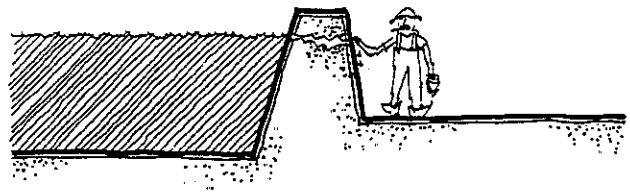
personnel are needed, for example, the cost for these items should be considered. The planning team should also indicate how potential projects are to be funded. For example, if a levee maintenance project is to be accomplished with an FCAAP grant combined with diking district assessments, this combination should be noted so that the public has a clear understanding "who pays how much for what."

Special Tip

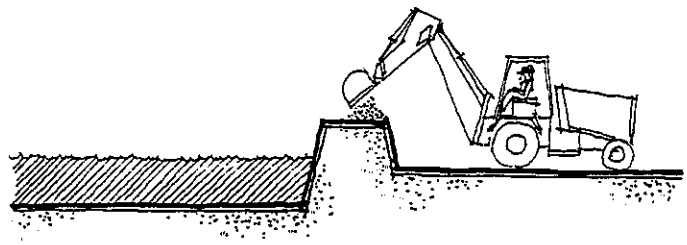
***Guidelines for Establishing Economic and Engineering Flood Criteria* by P.W. Barkley et.al. includes a useful section on the cost/benefit economics of flood damage reduction.**

D. Scheduling and Term of Benefit

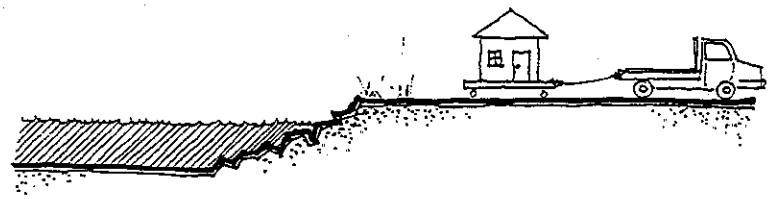
Strategic planning is often a matter of timing. This is especially true in flood hazard management where some solutions are remedial and solve intricate problems for a short-term while other solutions are more far reaching and long-term. The issue of short-term versus long-term benefit must be carefully addressed. In fact, the question of timing is twofold, involving both the scheduling of the proposed measures and the time period for which the measure will provide a benefit. For example, raising a dike may be an immediate solution for protecting a low, flood prone district, but may require further elevation in the future due to projected runoff. On the other hand, land acquisition of that same flood prone area and construction of flood water storage areas may require more time to implement, but also presents a longer term solution that improves conditions in other parts of the watershed.



Short-term solution; high risk



Another solution; less risk; high cost



Permanent solution; good flood plain management

E. Public Goals and Objectives

The alternatives should be measured by the goals and objectives developed in Step 2. The obvious way to accomplish this is to ask the public participants to assist in this evaluation in a public workshop. Step 7 presents some suggestions for a workshop during which participants can indicate which measures most effectively meet the goals and objectives that they helped to develop earlier in the process.

Before the public workshop, the alternative evaluation results should be summarized briefly so that the information can be presented to the Planning Committee and the public. The example alternative measure comparison matrix on the following page summarizes the environmental impacts, related regulatory requirements, cost, and timing benefits of the alternative measure. The alternative comparison matrix summarizes those parameters even more succinctly so that the alternatives can be compared. The format and content of these examples may vary widely, and the examples presented here are only one approach.

Step 7: Hold Public Alternative Evaluation Workshop(s)

A public workshop to present the alternative measures analysis and solicit the public's opinion is an effective way to incorporate public participation for three reasons. First, it provides the planning team the opportunity to present the result of the technical evaluation and to answer questions. Second, it allows the public the opportunity to compare all chosen alternatives among different options. Experience has shown that it is easier for public participants to deliver informed input when they are presented clear choices with the implications of each choice. Finally, it is an opportune time to reaffirm the commitment to public involvement, because it demonstrates that the public goals and objectives developed earlier are incorporated into the decision making process. The workshop should be well publicized to insure that all members of the community are invited to participate.

As in the case of the goals and objectives workshop, there are several different participation exercises that can be used. One format is to take the whole group through each of the alternatives one by one and ask each individual to fill out an evaluation sheet indicating their preferences at the end of the session. Another format is to divide the participants into smaller groups and have each group evaluate the individual alternatives one at a time and then compile the smaller group responses at the end of the workshop. Various scoring systems can be used or the comments can be made qualitatively. One technique is to let individuals vote on their preferred measures using sticky back dots as in the first workshop. Often it is helpful to array the alternatives and the objectives in a matrix format for easy comparison. (see example on page 36).

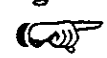
Alternative Measures Comparison Matrix (Hypothetical Example)

Criteria	Alternative		
	Raise Levees (Sec 1.1)*	Increase Flood Proofing Standards (Sec. 2.1)	Acquire Designated Flood Prone Properties in Valley (Sec 3.1)
Impacts	Reduces habitat significantly (requires mitigation), potential sedimentation downstream (Sec. 1.2).	Slight reduction in development pressure on flood plain (Sec 2.2).	Relocation of 8 homes; loss of 32 acres of pasture land.
Costs	$1,500,000 construction $10,000 maintenance annually (Sec 1.5)	Approx. 10% increase in foundation costs for new development $10,000 annual local administration costs (Sec. 2.5)	$700,000 acquisition costs $1,000 management costs annually (Sec 3.5)
Implementation Strategy	Diking district takes lead coordinating with county; applies for FCAAP matching grant (Sec. 1.6).	County Building Department administers program through permit process coordinated w/NFIP.	County purchase w/ FCAAP and IAC matching grants (Sec. 3.6).
Benefits	Would address local flooding problems of 14 property owners (Sec. 1.8).	Allows additional development space w/out reducing flood plain capacity.	Provide enhanced wildlife and recreation opportunities; reduces flood hazard potential (Sec 3.8).

* Section numbers refer to descriptions in text.

Alternatives evaluation matrix.

Special Tip: EIS Scoping Meeting



If a formal SEPA checklist or EIS process is used in the planning process, it may be advantageous to hold two public workshops during the alternative evaluation. During the first workshop, the planning team would just present the alternative measures and ask the participants what potential impacts or consideration they feel should be considered. This workshop would then serve as a "scoping meeting" within the EIS process. The second workshop, held after evaluation analysis is substantially complete would then allow participants to evaluate the alternatives and indicate their preferences.

Step 8: Develop Flood Hazard Management Strategy

After the public input has been compiled and evaluation analysis completed, the planning team can work with the Project Committee to assemble the preferred alternative measures into a management strategy which serves as the basis for the Comprehensive Flood Hazard Management Plan. The strategy should include a list of actions, the priority, cost and time frame for each, and the coordination activities with adjacent governments, related agencies, and associated programs. There are no strict procedures for this step which involves fitting various alternative measures into a coordinated course of action.

The *City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville, and Meadowdale* prepared by R.W. Beck and Associates, presents a useful example of one way to present a recommendation for particular alternative measures. That plan identified measures for each individual problem and then discussed the pros and cons of each recommendation.

A recommendation for a single problem area is included below. In discussing the final recommendations, the example describes the costs and benefits of each alternative that is required by Chapter 86.12 RCW as amended by ESSB 5411 Section 3(2a) (see the section on Washington State statutes in the Introduction).

Example of Alternative Selection Recommendation

c. Problem No. 3

Problem No. 3 is the insufficient capacity of both the Perrinville Creek culvert under Talbot Road and the downstream channel to the BNRR tracks.

Alternative A:

Pipe replacement with a 60-inch-diameter culvert incorporating the fish passage design criteria discussed in the fisheries inventory (Appendix E), is recommended for the Talbot Road culvert crossing. Downstream from the channel between Talbot Road and the BNRR tracks, installation of a pipe

parallel to the existing BNRR culvert would prevent water from backing up at the existing culvert which causes the upstream channel to flood (10-year event). It should be noted that the two culvert crossings were sized to carry the 100-year storm, however, the stream channel would not contain the 100-year storm.

Widening the stream channel to carry the 100-year event was not preferred because several property owners had previously improved the channel with landscaped and rockery channel side slopes.

Estimated Cost: $115,000

Potential Environmental Impacts:

Impacts would include the reduced incidence of flooding, and provide fish passage through the Talbot Road crossing. Temporary disruption of traffic will result during construction. Temporary disruption of the creek would result from installation of the culverts.

Alternative B:

Pipe replacement with a 60-inch-diameter culvert incorporating the fish passage design criteria discussed in the fisheries inventory (Appendix E), is recommended for the Talbot Road culvert crossing. To solve the stream channel flooding problem, peak flows could be diverted through a new 48-inch-diameter drainage pipe to Puget Sound. This pipe would cross under the BNRR tracks. The diversion was sized to pass all flows above the existing capacity of the stream channel.

Estimated Cost: $135,000

Potential Environmental Impacts:

Include the reduced incidence of flooding, and provide fish passage through the Talbot Road crossing. Temporary disruption of traffic will result during construction. Installation of diversion pipe will result in temporary disruption of lawn and landscaped areas. Temporary disruption to the creek would result from installation of the culverts.

Recommended Solution:

Alternative B is recommended because, for a relatively small increase in cost, flooding can be eliminated from the stream channel between Talbot Road and the BNRR for up to a 100-year storm.

Source: City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale

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The individual projects were then assembled into a list of capital improvements and non-structural solutions. Chapter 86.12 RCW as amended by ESSB 5411 Sections 2 and 3(e) calls for identifying sources of revenue sufficient to finance the comprehensive scheme of

the flood protection improvements. Table IX-3 (below) from the *City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale* summarizes the cost sharing breakdown for the different jurisdictions involved with the program. The source of funds should also be identified as well.

TABLE IX - 3

CAPITAL IMPROVEMENT PROGRAM

Priority Number	Problem Number	Description	1990 Estimated Cost
1	SB - 5a	6th Avenue W	$58,300
2	SH - 2a	96th Avenue W	$150,000
3	LB - 1	242nd Place (Lake Ballinger)	$120,000
4	SB - 7	5th Avenue	$57,000
5	TP - 2	Fruitdale-on-the-Sound Creek	$267,300
6	EW - 1	Willow Creek Outfall	$105,000
7	P - 3b	Talbot Road	$52,650
8	TP - 4	92nd Avenue W	$180,400
9	FC - 1	Good Hope Pond	$77,000
10	P - 2b	Perrinville Creek Bank Stabilization	$117,450
11	TP - 5b	88th Avenue W	$484,000
12	NS - 5	88th Avenue W	$205,700
13	M - 1	Meadowdale Seepage Collection System	$135,000
14	SB - 5b	Alder	$41,800
15	CL - 7	Chase Lake Elementary	$46,800
16	M - 13	171st Street SW	$85,000
17	SH - 12	Glen Street	$97,200
18	P - 1c1	Perrinville Pond	$144,000
19	SH - 2b	95th Avenue W	$65,000
20	FC - 2	Sierra Drive Collection facilities	$35,200
21	FC - 3	Sierra Drive Collection facilities	$30,800
22	FC - 6	80th Avenue W	$71,500
23	EW - 2c	Edmonds Way Trunk Sewer	$107,600
24	EW - 4	100th Avenue W	$75,000
25	EW - 3	Birch Street	$60,000
26	NS - 3a	Olympic Avenue	$322,300
27	NS - 3b	Olympic Avenue	$28,600
		Total	$3,220,600

Key:

(CL) - Chase Lake
(EW) - Edmonds Way
(FC) - Five Corners
(LB) - Lake Ballinger
(M) - Meadowdale
(NS) - North Stream
(P) - Perrinville
(SB) - Shellabarger
(SH) - Shell Creek
(TB) - Talbot Park

Cost summary and breakdown.
Source: City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale.

Special Tip: Non-structural Recommendations

In past years, the plans submitted as comprehensive flood control management plans have given little emphasis to non-structural solutions. Non-structural measures should be described in sufficient detail to clearly define a course of action, identify the regulatory tool to be used and, if possible, outline policies and regulatory language to be pursued. Nebulous statements like, "Revise comprehensive plan to insure better flood hazard management practices," are not acceptable unless supported by more specific direction. One way to provide greater specificity is to provide model ordinances from agencies. For example, the *City of Edmonds Drainage Basin Studies, Edmonds Way, Perrinville and Meadowdale* listed the recommendation to adopt an illegal dumping ordinance and then included examples of illegal dumping ordinances in an appendix.

Step 9: Complete Draft CFHMP and SEPA Documentation

Once the overall management strategy is determined, the plan's recommendations and supporting information must be compiled into a draft plan for review. The most prominent element, of course, should be the recommended actions, along with their time frame, participants, impact mitigation measures, costs and funding sources. The recommendations should also indicate priorities for the various actions. Chapter III outlines the elements that should be in the draft report. Also, completing the draft SEPA assessment (draft EIS or environmental checklist) at this time is also useful, so that the two documents can be distributed and reviewed together.

The draft plan and SEPA documentation should be distributed to agencies and special interest groups who have participated in the planning process and the public for review. Comments received on draft plans should be incorporated into the final plan and SEPA documentation. In addition to advisory committee meeting(s) to review the plan, a third public workshop may be advisable at this point to present the plan and solicit comment. The plan must also include certification from the Washington State Department of Community Development that the local emergency management organization is administering an acceptable comprehensive emergency plan. Once these steps have been taken, 5 copies of the draft plan and the SEPA documentation should be submitted to Ecology.

Ecology staff will disseminate the copies for review by other Ecology sections as well as consult with the State Departments of Fisheries and Wildlife, the State Department of Natural Resources, and affected Native American tribes. Other affected parties may comment on the draft plans as well (WAC 173-145-070(2)). Ecology staff will consolidate review comments and arrange a meeting with the submitting government to discuss the submittal. After receiving the

review comments it is recommended that the grantee write a letter to Ecology indicating how they will respond to the comments. Once Ecology and the local jurisdiction are in agreement on the proposed plan revisions, the local planning staff and/or consultant should revise the draft into the final CFHMP and submit to Ecology.

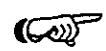
Step 10: Submit Final CFHMP to Department of Ecology

After comments from the public and regulatory agencies have been incorporated into the final plan and SEPA documentation, the plan is ready for submittal to Ecology.

At least 5 copies of the completed plan must be submitted to Ecology. It is helpful to submit copies of SEPA documentation as well. Ecology FCAAP review staff will review the plan for conformance to WAC-173-145-040 and the grant agreement scope of work.

If all review comments on the draft plan have been adequately addressed and the final CFHMP is in compliance with state statutes and grant agreement, Ecology will approve the plan, in consultation with the Departments of Fisheries and Wildlife.

Special Tip



The checklist on the following page lists some of the major elements the plan should include.

Step 11: Hold Public Hearing and Adopt the CFHMP

After the CFHMP has been approved by Ecology, it should be presented to the adopting governmental body at a public hearing, along with the project committee's recommendation for adoption. Where a plan encompasses more than one participating governmental jurisdiction (e.g. county and a city within the county) both governments should adopt. If there is a dispute, it must be resolved in accordance with ESSB 5411.

Step 12: Notify Ecology that the Final CFHMP is Adopted

Once the plan is adopted a letter should be sent to Ecology formally notifying them that the CFHMP is adopted.

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Comprehensive Flood Hazard Management Plan Submittal Checklist

- ☐ 1. Does the plan meet the grant's scope of work?
- ☐ 2. Is the planning area large enough to address flood damage prevention issues on a comprehensive basis?
- ☐ 3. Have adjacent jurisdictions, local, state and federal resource agencies and affected Native American tribes been invited to participate in the plan's development?
- ☐ 4. Does the plan outline a process-oriented examination of flood hazard management issues?
- ☐ 5. Are short- and long-term goals and objectives clearly identified?
- ☐ 6. Are problems and solutions clearly identified?
- ☐ 7. Does the level of detail of the inventory of existing conditions and planning analysis meet the grant's scope of work (if applicable) and is it appropriate to the nature of the problem?
- ☐ 8. Does the plan identify the regulations that apply within the watershed?
- ☐ 9. Has an effort been made to adopt a comprehensive balanced multi-objective approach?
- ☐ 10. Have non-structural flood hazard management measures been adequately considered? Are they as well-defined as the in-stream measures?
- ☐ 11. Have the potential impacts to the following uses and resources been identified?
  - o Fisheries resources
  - o Wildlife resources
  - o Scenic, aesthetic and historic resources
  - o Navigation
  - o Water quality
  - o Hydrology
  - o Existing recreation
  - o Other
- ☐ 12. Have the costs and benefits of the alternatives been thoroughly evaluated in both short- and long-term objectives?
- ☐ 13. Is the rationale for the recommended solutions based on comparative evaluation of the alternatives and is the rationale clearly documented?
- ☐ 14. Are the implementation step priorities and funding measures identified?
- ☐ 15. Is there certification from the State Department of Community Development indicating that an acceptable emergency operations plan is in effect?

- ☐ 16. Is evidence included indicating that the county engineer, the Washington Department of Fisheries or Wildlife and any affected Native American tribes been consulted?
- ☐ 17. Is the SEPA documentation included?
- ☐ 18. Have copies of the plan been sent to the Departments of Fisheries and Wildlife?
- ☐ 19. Has the plan been thoroughly edited?
- ☐ 20. Have 5 copies of the plan been sent to Ecology?

Appendix A: Regulatory Programs

Introduction

Federal, state and local regulatory programs directly affect flood hazard management. For the purpose of sorting out the numerous jurisdictions that have a role in flood hazard management, this appendix has grouped the many regulations into four major types listed below.

1. Land Use Management
2. Resource Management
3. Environmental Protection
4. Flood Hazard Management

There will be a brief discussion concerning their individual rationale, the regulatory mechanisms that drive them, and how the jurisdictions are responsible. Each regulation will be discussed in greater detail, exploring the individual tools available and how they relate to a Comprehensive Flood Hazard Management Plan (CFHMP).

Land Use Management

The purpose of land use management is to provide guidance for growth and development and the associated physical improvements that coincide with it. Both the State of Washington and federal agencies require counties to adopt specific regulations concerning land use issues and as such, many of the county regulations are very similar. Within most cities/counties, development regulations will include a comprehensive plan, zoning ordinance, building code, subdivision ordinance, shoreline master program and possibly a flood plain management ordinance. Those land use management regulations that effect flood hazard management plans are discussed briefly below.

Comprehensive Plan

The purpose of a city/county comprehensive plan is to give long range direction and guidance for systematic growth and development. The plan should emphasize immediate local concerns that can range from land use, transportation, utilities, water resources, open space, environmentally sensitive areas, drainage and others. Typically, these plans are non-regulatory, lacking the enforcement mechanisms to ensure compliance. Their purpose is to provide goals, objectives, and policy statements that are met through various ordinances set by the jurisdiction.

Within the past year, the State of Washington passed the Growth Management Act (GMA). The intention of the GMA is to manage growth in the state's fastest growing counties through the adoption of local comprehensive land use plans and development regulations. Although comprehensive planning is a common tool used by many local governments, the legislature found that too often growth occurred in an uncoordinated and unplanned manner, lacking common goals that expressed the public's interest in conservation and wise use of lands. The citizenry of the state saw the effects of undirected growth as a threat to their quality of life. Growth without direction was seen as posing a threat to not only the environment, but to the sustainability of economic development across the state. The GMA attempts to bring consistency and coordination to long range planning by reforming the decision-making processes that have been often unpredictable and disjointed.

The planning goals of the GMA range from economic land use issues such as urban growth, transportation, housing, economic development, and others to resource/environmental issues dealing with open space, conservation, and cultural resources. The resource/environmental planning goals specifically address critical areas (which include the following areas and ecosystems: wetlands, critical recharge areas affecting aquifers used for potable water, fish and wildlife habitat, frequently flooded areas, and geologically hazardous areas), requiring effected counties to adopt development regulations that preclude land uses or development deemed incompatible with those critical areas. The protection given these critical areas is intended to cross over jurisdictional boundaries in a coordinated manner.

It is at the comprehensive plan level, whether defined by the GMA or through a local effort, that communities are able to set a direction for regulations. For example, some comprehensive plans identify special flood hazard areas and include a set of guidelines to direct growth within those areas. These areas are typically designated by the United States Department of Housing and Urban Development using maps developed by the Federal Emergency Management Agency (FEMA). Using the FEMA maps to designate special flood hazard areas in a comprehensive plan is one of several steps needed to be taken.

Zoning Ordinance

The purpose of a zoning ordinance is to implement the growth management policies of the Comprehensive Plan. Typically, the zoning code assigns use and density requirements that guide land use in either a city or county. The major tools are a zoning map that identifies specific land use zones accompanied by a zoning code book that defines each zone and provides specific regulations. Zoning codes have the ability to grant variance and conditional uses as well as enforce the code if they are not complied with.

Land use zones are determined by environmental constraints and infrastructure. The availability of water, sewer, fire protection and transportation sets limits to densities. Environmental constraints include: geology, soils, slopes, drainage, earthquake potential, avalanche danger, flooding, as well as wildlife protection for fisheries and endangered species.

Employing zoning regulations is a useful tool in flood hazard management. Zoning sets the density and standards of development and has the ability to direct growth in such a way as to minimize the impact on flood plains. Development diminishes the ability of soils to absorb precipitation and recharge groundwater. This removal of pervious soil increases the loads on drainage systems and elevates the frequency and extent of flooding. Similarly, development constructed on fill intended to withstand a 100-year storm reduces the flood plain's capacity to carry the increased flow by displacing volume. Setting zoning regulations that address the impacts of development assist in the management of flood plains.

Building Code

Building codes are meant to regulate the safety and quality of a structure. The Uniform Building Code (UBC) is often used to set those standards. The building code is intended to be used in conjunction with other regulations such as the zoning ordinance.

When used in consort with flood hazard management planning, the building code ensures proper flood proofing of new construction in flood hazard areas.

Subdivision Ordinance

A Subdivision Ordinance prescribes procedures and conditions for dividing land into smaller parcels. The definition of a subdivision may vary among jurisdictions but is usually determined by some specified amount of parcels, usually five or more. Typically, subdivisions must conform to zoning regulations in effect at the time of the proposed subdivision.

Subdivisions influence flood hazard management planning by their intrinsic nature of increasing density. Because they are tied to zoning, subdivision are often limited by environmental constraints including flood hazards.

Washington State Shoreline Management Act

The purpose of the Washington State Shoreline Management Act (SMA) is to protect the public's interests in preserving natural resources such as water, fish and wildlife and their habitat by regulating public and private development in shoreline areas. Through an innovative administrative framework that involves joint, state and

local jurisdiction, management of shoreline resources, the SMA provides an effective tool for protecting, utilizing and enhancing shorelines within SMA jurisdiction. The Department of Ecology (Ecology) is the agency mandated to oversee the development of local Shoreline Master Programs and their subsequent implementation.

The legal basis for SMA regulatory documents is through the Washington Administrative Code (Chapter 173-14, 16, 17, 18, 19, 20 and 22). The WAC defines several shoreline designations including shorelines of state-wide significance; provides guidance to both Ecology and local jurisdictions for developing procedures and rules for shoreline uses, activities, and modifications; establishes time lines for the development of local shoreline master programs; and identifies uses and activities generally exempt from certain shoreline permits.

The SMA requires permits for any "substantial development" within the two hundred foot (200') shoreline jurisdiction. A substantial development is defined as any development where the total cost of fair market value is equal to or exceeds two thousand five hundred dollars ($2,500), or any development which materially interferes with the normal public use of the water or shorelines of the state; except as specifically exempted pursuant to RCW 90.58.030(3)(e) and WAC 173-14-040. Permits can be issued on a "conditional use" or on a "variance" basis. Permits are issued through the local Shoreline Master Programs and are reviewed by Ecology.

The Shoreline Management Act and local shoreline master programs are extremely useful in flood hazard management planning. The SMA requires local governments to define their shoreline jurisdictions along rivers in one of two ways:

1. The area 200' from the ordinary high water mark (OHWM) or floodway, whichever is greater, plus all wetlands in the 100-year flood plain associated with them; or

2. All or any portion of the 100-year flood plain as long as it includes all of those areas falling within the area describe in option 1 above.

There are advantages to using the entire 100-year flood plain to define the shoreline jurisdiction. One advantage is that it accommodates the complete meandering river ecosystem so that changes in the river bed itself will not effect jurisdictional boundaries, it also automatically places shoreline management protection on lands surrounding wetlands in the flood plain eliminating an extensive inventory, and finally allows more comprehensive shoreline management planning of the entire flood plain. This is a strong tool for flood hazard management planning, as well as shoreline management because it carries the legal and administrative status associated with a state regulation.

Using the second option for defining the shoreline jurisdiction (200' of floodway plus associated marshes, bogs and swamps in the 100-year flood plain) demands that wetlands in the flood plain be inventoried and recorded. Once the shoreline jurisdiction has been established,

permit applications can then be evaluated quickly as to whether or not a wetland will be affected by the proposed development. The major advantage of this option is that proposed developments that do not include wetland areas and which are not within 200' of the floodway do not require a shoreline permit. These developments, however, may still be required to attain local flood permits and go through a State Environmental Policy Act (SEPA) review process.

Sometimes a diked floodway is used as the boundary from which the 200' shoreline jurisdiction is measured. In order to qualify under FEMA requirements, the dike must extend at least as high as the 100-year flood elevation plus three feet.

Another important element of the SMA and local Shoreline Master Programs is shorelines of state-wide significance. Designated by the SMA, Chapter 173-16 WAC, these shorelines have a set of prioritized policies that first and foremost "recognize and protect the state-wide interest over local interest" and secondly, "preserve the natural character of the shoreline." The consequences of these policies is a strong shoreline management policy that provides another layer of protection to particularly unique shorelines within our state.

The SMA recognizes our states' shorelines as an important public natural resource which should be protected from degradation. The SMA authorizes local jurisdictions to develop local Shoreline Master Programs that reflect a community's goals and values in keeping with the SMA. The local regulations are used as an overlay to zoning and as such can guide future development within the flood plain and its watersheds.

Shoreline Master Program

The Shoreline Master Program (SMP), developed at the local, city or county level, is mandated by the state's SMA for the purpose of protecting the public's shoreline resources. Local governments develop SMP's, guided by the Department of Ecology, the SMA and the WAC's pertaining to it as briefly discussed above.

As a regulatory tool, the SMP provides local government a strong means by which to manage the effects of development on shorelines, including flood plains. All streams with a mean annual flow of 20 cubic feet per second (cfs) or more, and associated wetlands, are included within the shoreline management jurisdiction. Development can be regulated around these streams, reducing urban runoff effects by creating buffers, ensuring property containment of runoff and reducing densities. Wetlands can be retained to perform one of their major functions, absorbing excess water thereby reducing storm surge effects down stream. If the more inclusive method of defining a floodway is chosen by a jurisdiction, development can sensibly proceed, reducing potential damage, loss of life and property, and increasing the capacity of the flood plain to absorb water volumes during periods of flooding. Upstream in watersheds, baseflow can be increased by increasing vegetation in both forested wetlands and wet meadows. These habitats

have a great capacity to absorb and retain water, reducing storm surges, and releasing water slowly during low flow periods. Often times such systems fall under the jurisdiction of the SMA, providing the opportunity to manage the resource.

The SMP is an excellent tool to be used in consort with a flood hazard management plan because it directs land use and activities along shorelines, sets design criteria to ensure best management practices, and provides the enforcement mechanism that will be backed by Ecology.

Resource Management

The purpose of resource management is to preserve and protect our nation's natural resources from degradation. Resource management emphasizes sustainability of natural resources, and the industries based on their exploitation, as the timber, agricultural and fisheries industries. To this end, resource conservation and best management practices of productive forest and agricultural lands, and habitats associated with fisheries is the direction resource management regulations has taken. Various state and federal agencies are involved in resource management. All cities/counties must comply with these state and federal regulations depending on the type of project. Resource management regulations affecting flood hazard management include the Washington State Hydraulic Code (Hydraulic Code), Sections 404 and 401 of the Federal Clean Water Act, Section 10 of the Rivers and Harbor Act, and other local ordinances developed to reflect the needs of the particular community.

Hydraulic Code

The purpose of the Washington State Hydraulic Code, RCW 75.20.100-103, is to preserve fish and wildlife habitat by regulating activities within the state's salt and fresh waters. Any construction that will use, divert, obstruct, or change the natural flow or bedding of any of our state's waters within high water areas, including many wetlands, will require a Hydraulic Project Approval (HPA) permit. Such activities include, but are not limited to, streambank protection, dredging, culvert installation, pile driving, construction of bridges, piers and docks, pond construction, log jam or debris removal, mineral prospecting and extraction, and alteration or realignment. Within the code, specific technical provision for hydraulic projects are provided by the administrating agencies; the Department of Fisheries (WDF) and the Department of Wildlife (WDW).

The administration of the Hydraulic Code is split between the two agencies along fish use lines. WDF has jurisdiction over food fish (salmon, sturgeon, marine fish, etc.) while WDW has jurisdiction over "game fish" (trout, bass, perch, etc.). The Department of Fisheries takes the lead in all marine and estuarine waters of the state, and whenever salmon are present in either salt or fresh waters. In fresh

waters where salmon are not present, the Department of Wildlife takes the lead. Some jurisdictions within the state will be dealing with both agencies depending on where the project is located. An application may be denied when the administrating agency determines that the project will be directly or indirectly harmful to fish life and acceptable mitigation cannot be assured.

The Hydraulic Code provides city/county jurisdictions a tool to ensure that no harm to fish and wildlife habitat will occur during the construction of any structural or bioengineering modifications of shorelines. The provision given to assist in the design and construction of shoreline modification structures can also be useful to evaluate proposed projects.

Section 404 - Clean Water Act

Section 404 of the Clean Water Act is one of three federal laws that expanded the regulatory authority of the Army Corps of Engineers (COE) during the 1970's from regulating navigable waters of the United States to maintaining the biological integrity of the nation's waters. Section 401 is the most relevant to structural flood control measures, although Section 401 of the Clean Water Act ensures that federally permitted activities comply with the federal Clean Water Act, state water quality laws, and any other appropriate state laws.

Section 404 requires a COE permit for any project that alters or degrades the waters of the United States, ranging from the openwater disposal of dredge or fill material to the filling of nearshore areas. This includes adjacent wetland and tributaries to navigable waters, and any degradation or destruction of which could affect interstate or foreign commerce. Guidelines for permit approval have been developed by the Environmental Protection Agency (EPA). There are two types of permits issued: an individual permit and a general, or nationwide, permit. The following details each.

1. Individual Permit - This permit is generally issued for a single proposed activity, unless it falls under a blanket authorization for a general permit or if the project involves an especially valuable ecological area such as a wetland. The determination is based on whether the benefits of the project outweigh the predicted environmental impacts. Known as public interest review, the evaluation process entails:

    - o Pre-application meeting with the COE and other resource agencies (optional).
    - o Submittal of a permit application to the COE.
    - o Public notice for a 30-day review period by federal, state, and local permitting agencies, tribes, interest groups and the general public.
    - o Consideration of all comments received from public review process.
    - o Additional information from the applicant may be required.

- o COE decides on whether to prepare an Environmental Assessment and Finding of No Significance, or to prepare a National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS).
- o Public hearing is held, if needed.
- o COE prepares the appropriate decision documentation
- o The District Engineer approves or rejects the permit application.
- o The applicant's permit is advised of the decision.

2. General Permit - The General Permit, also called the Nationwide Permit 26, provides blanket authorization on a nationwide, state, or regional level for actions which have minimal adverse impacts on the environment. Such actions would include, but are not limited to, bank stabilization projects, navigation markers, utility line structures, minor road crossings and bridges, boat docks, minor dredge and fills involving less than 10 cubic yards, or fills involving one to ten acres of isolated wetland or adjacent wetlands located above the headwaters of a stream with an average annual flow of less than 5 cfs. The process involves the following:

   - o Notify the COE, EPA, and other permitting agencies for a review of the potential environmental impacts.
   - o Based on feedback from other agencies, COE accepts or denies permit.
   - o If denied, the applicant may appeal the decision by applying for an Individual Permit.

Section 401 - Clean Water Act

Section 401 is closely tied to Section 404 with the difference being that it is a certification process issued through the Washington Department of Ecology. Whenever there is an activity requiring a federal permit, the applicant must obtain certification as a prerequisite. The state essentially certifies the materials discharged into a water body, ensuring compliance with discharge limitations, water quality standards and any other applicable conditions of state law (Chapter 173-201 WAC). This certification also applies to the eventual operation of the facility. If Ecology denies the certification, then the federal permit must be denied. If the state imposes any conditions on a certification, those conditions become part of the federal permit.

The certification process begins with notification of Ecology at the time a Section 404 permit is filed with COE. Ecology becomes the clearinghouse for all state agency responses to Section 404 with the Environmental Review Section (ERS) reviewing all documents. The ERS prepares a state comment letter based on the responses from various state agencies along with the 401 certification or denial. Ecology has the authority to override any state agency recommendation, unless a violation of state law would result. All state 401 certifications are exempt from the State Environmental Policy Act (SEPA) requirements.

As Section 401 applies to flood hazard management measures, the application often requires what is called a "modification." Typical structural flood control measures such as stream bank protection and instream gravel removal have the potential of temporarily creating excess instream turbidity during the construction phase. This will require a Temporary Modification of Water Quality Criteria from Ecology before a water quality certification will be issued. This is an additional step projects will need to take if water quality is deemed in jeopardy.

Structural shoreline modification or bioengineering techniques have the potential to affect water quality due to the proximity of construction to the shoreline. Section 401 certifications are an important part of the permitting process required through Section 404 of the Clean Water Act and in fact takes precedence over it.

Section 10 - Rivers and Harbors Act

Enacted in 1989 to preserve the navigability of the nation's waterways, Section 10 prohibits the unauthorized obstruction or alteration of those navigable waters without a permit from the COE. The provisions apply to all structures or activities associated with a structure located "in, over, or affecting" navigable waters below the mean high water mark of tidal waters or ordinary high water mark of fresh waters.

This law pertains to navigable waters that are presently, historically, or have a reasonable potential to be navigable and all waters subject to the ebb and flow of the tide up to mean higher high tide or ordinary high water mark. The permit process includes consideration of navigational waters, flood control, fish and wildlife management, and environmental impacts. Section 10 review often occurs simultaneously with the Section 404 permitting process and includes compliance with NEPA.

Special Districts

A special district is a quasi-governmental body that is formed by an agreement of the effected property owners and maintained by special assessment on those property owners to provide particular services. The services vary depending on the districts (i.e. diking and drainage, water, sewer, public utilities districts, and flood control zone districts). Each district has an elected governing body that is empowered to ensure that the needs of the district are met. Any of these districts have the authority to engage in flood control activities.

For illustration purposes, the structure of a flood control district will be used to represent what is typical for a special district. The flood control district is designed to protect life and property, to preserve public health, and to conserve and develop the natural resources of the state. They are authorized to acquire, purchase, sell, lease and manage real and personal property either inside or outside the district's boundary. They also have the right to maintain and operate flood

control works, including their scoping, planning, construction, improvement, replacement, repair and or acquisition of flood control works. These flood control works can include, but are not limited to dams, dikes, levees, ditches, channels, canals, banks, revetments, and other techniques convenient and necessary to reduce floods and lessen their danger. It also has the right to enter into contracts, the right to sue and be sued, the right to eminent domain, and the right to do any and all lawful acts necessary to achieve their purposes.

Environmental Management

Environmental management concerns the natural resources of our state, including fish and wildlife, their habitats, along with recreational resources. Landmark legislation at the federal and state levels have provided a strong foundation for management of our environment. These laws are not strictly preservation or conservation oriented, but rather attempt to link our natural resources (i.e. air, water, public access, and wildlife) to provide rigorous examination of proposed projects to minimize adverse environmental impacts.

These regulations consist of the National Environmental Policy Act, State Environmental Policy Act, Shoreline Management Act and its Shoreline Master Programs, and other local ordinances developed to reflect the needs of the particular community.

National Environmental Policy Act

With the passing of the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et. seq.) a process was initiated requiring federal agencies to consider the environmental impacts of both development projects sponsored by the agency and those privately sponsored projects that require agency permits and approval. Concerned with project impacts, the NEPA process stresses full disclosure of environmental impacts along with technical and economic considerations of a development project, prior to an agency decision.

The Council on Environmental Quality (CEQ) provides the guidance to implement NEPA, however, most federal agencies have adopted their own regulations for implementation. The CEQ Regulation (40 CFR 1500-1508) emphasizes the consideration of alternatives, including ways to mitigate harmful environmental effects through reducing or avoiding those effects. The NEPA process generally occurs concurrently with Section 404.

Any major federal action that would have significant adverse environmental impacts is required by NEPA to prepare an environmental impact statement (EIS). The EIS must thoroughly evaluate any negative environmental impacts caused from the proposed action and its alternatives. Privately sponsored projects may also be required to perform an EIS if any federal monies are a part of the project or if anyone recommends to the permitting federal agency that

an EIS be performed. Such a recommendation should be based on evidence that indicates a proposed action would result in significant adverse environmental impacts.

To determine whether a proposal would produce significant adverse environmental impacts an environmental assessment (EA) must be performed. Typically the permit applicant provides much of the information and analysis used to prepare the EA. If it is determined that an EIS is not required, a Finding of No Significant Impact (FONSI) document is prepared, explaining why an EIS is not needed.

Generally, all structural and bioengineering flood control projects are federally funded and as such must comply with NEPA requirements. Even when grants are appropriate for operations and maintenance, those funds trigger the NEPA process and must comply with the rules. Private projects are also subject to preparing an EIS when, during review by state or federal agencies, the project is seen as potentially detrimental to the environment.

Washington State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) was passed by the legislature in 1969 for the purpose of providing a process to analyze the environmental impacts of development. SEPA is not a permit but rather a process of information gathering for the purpose of helping agency decision-makers and the general public understand how a project would affect the environment. SEPA requires a full disclosure of likely significant adverse environmental impacts of a proposed action and a mitigation plan for identified impacts to either the natural or built environment. Proposed actions with possible significant adverse environmental impacts are required to prepare an EIS. Many agency decisions can only be made after the SEPA process has been completed which may include: Hydraulic Project Approval, Shoreline Substantial Development permit and many other local permits (clearing and grading, utility, street use etc.).

There are a variety of actions that are "categorically exempt" from the SEPA process. For example, size is used as the criteria to differentiate between an exempt or nonexempt action. Exempted projects include most single-family homes, commercial buildings under 4,000 square feet, parking lots for 20 cars or less, and any landfill or excavation of 100 cubic yards or less. SEPA rules allow cities and counties to set their own size criteria based on a specific range for five categories of exemptions. The criteria cannot be more restrictive than those of SEPA unless the action affects an environmentally sensitive area.

One of the first steps in the SEPA process is the analysis of alternatives. Funds are available through FCAAP to assist in the EIS process and can actually be extended up to the time of implementation.

Flood Hazard Management

This section is concerned with policies and programs relating directly to issues surrounding flood hazard management and the protection of life and property. A primary regulatory tool is the National Flood Insurance Program (NFIP) which provides low cost insurance to communities that have adopted approved flood plain management regulations.

National Flood Insurance Program

The U.S. Congress initiated the National Flood Insurance Program (NFIP) in 1968 for the purpose of relieving the national Treasury and local jurisdictions from the burden of disaster relief. This program is administered by the Federal Insurance Administration (FIA) which is part of the Federal Emergency Management Agency (FEMA). The thrust of the program is to make affordable flood insurance available to communities. To qualify, the community must adopt approved flood plain management regulations. In 1973 Congress expanded the NFIP to require that funding for structures related to government programs within the 100-year flood plain be permitted only if the structure is covered under a flood insurance policy and the community participates in the NFIP.

The NFIP administers two separate programs, the emergency program and the regular program. Each has their own process within FIA and each provides for the community differently.

- Emergency Program - The process begins with the identification by FIA of flood prone communities. Notification comes in the form of a Flood Hazard Boundary Map (FHBM) which is a preliminary delineation of flood hazard areas. Along with the FHBM, the community receives an application from the FIA for the purpose of attaining limited amounts of flood insurance. Based on the FHBM, the community is required to adopt minimum flood plain management regulations. They are also encouraged to use any additional information available to establish flood elevations.

- Regular Program - The regular program provides communities full flood insurance once that community adopts a local flood plain management ordinance approved by FEMA. The ordinance is based on a detailed technical flood insurance study involving hydrologic and hydraulic analyses culminating in the Flood Insurance Rate Map (FIRM), and a report. Data on floodway width, cross sectional area and flood water velocity are provided at various points along the water-course. The purpose is to determine the flood risk and thereby the insurance rates for areas adjacent to the river. The floodway map defines the areas along the river channel where encroachment is disallowed.

The flood plain management ordinance is a local ordinance which is intended to satisfy the FEMA requirement for participating in the NFIP. Washington State requirements for flood plain management ordinances are contained in Chapter 86.16 RCW. Typically flood plain management ordinances contain the floodway designation, special flood hazard areas identified by the FIMA and establish specific development regulations for the purpose of minimizing losses due to flooding. Specific regulations concern building codes for on-site disposal systems, the use of flood resistant materials, flood proof design of on-site disposal systems, special designs for RV parks; and land use regulations limiting subdivision for residential or commercial use, permitting agricultural, recreational and business uses in the flood plain and or other uses which may impact the flood plain. Variances and conditional use permits are often allowed for hardship situations which demonstrate need, or actions which will not increase flood levels or *result in the habitable portion of a structure being below the base flood elevation.* Variances should have to maintain the minimum requirements of FEMA to continue participation in the NFIP.

State Flood Plain Management

Chapter 86.16 RCW - Flood Plain Management forms the core of the state's regulatory program. WAC 173-158 are the rules developed by Ecology to administer the provisions of Chapter 86.16 RCW. The state's regulatory program has aodpted the NFIP minimum standards as the state minimum standards for flood plain management. Washington exceeds the minimum federal standards in one area - Chapter 86.16 RCW- which has a provision prohibiting new or substantially improved residential development in any designated floodway. Other provisions of the state's program include the provision of technical assistance to localities in determining flood plain boundaries and the ability to assist localities in the development of additional standards that exceed the minimum federal requirements.

List of Abbreviations

FPA	Forest Practices Act
DNR	Department of Natural Resources
COE	Army Corps of Engineers
NEPA	National Environmental Protection Acts
FEMA	Federal Emergency Management Agency
FIA	Federal Insurance Administration
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries
NOAA	National Oceanographic & Atmospheric Agency
NPDES	National Pollutant Discharge Elimination System
EPA	Environmental Protection Agency
USFW	United States Fisheries and Wildlife
DOT	Department of Transportation (Washington)
PSWQA	Puget Sound Water Quality Authority
PSWQMP	Puget Sound Water Quality Management Plan
Ecology	Washington Department of Ecology
SMA	Shoreline Management Act (Washington)
SMP	Shoreline Master Program
FCAAP	Flood Control Assistance Account Program
DCD	Department of Community Development (Washington)
WDF	Washington Department of Fisheries
WDW	Washington Department of Wildlife