CHAPTER 9
FLOOD ACTION ALTERNATIVES & PRIORITIES

Comprehensive flood hazard management emphasizes selecting a mix of approaches to minimize flooding impacts and considers an adequate reach of river to capture impacts. Options for addressing flooding concerns include engineered projects, channel conveyance measures, public information programs, flood warning, planning measures, and floodplain enhancement measures. This chapter presents the process that was used by the Combined Committee to evaluate and select alternatives that were considered for recommendations in Chapter 11.

TYPES OF FLOOD HAZARD SOLUTIONS

Flood hazard management measures are commonly classified as structural or nonstructural. *Structural measures* involve physical activities in or near the stream, such as excavation, placement of bank protection materials, and other engineering and construction activities, these measures pertain primarily to existing flood prone development. *Nonstructural measures* include stormwater and land use regulations, flood preparedness programs, public awareness programs, floodproofing, and maintenance programs, which are intended to minimize flood impacts on future development and redevelopment. Nonstructural methods are also expected to minimize the possible affect of future development upon existing development.

Due to rising damage costs from over-reliance on structural approaches prior to the 1960's, the federal government began to encourage the use of cost-effective, long-term nonstructural alternatives instead. A very effective federal example of the movement towards non-structural approaches was the provision of Federal Flood Insurance in 1968 through the National Flood Insurance Program. Summaries of typical structural and nonstructural solutions are provided Tables 9-1 and 9-2, respectively.

TABLE 9-1
TYPICAL STRUCTURAL FLOOD HAZARD MANAGEMENT SOLUTIONS

Measure	Description	Typical Activities
Alignment Control	Measures designed to accommodate discharge along a course that allows the channel to develop without eroding adjacent property	• Barbs (spur dikes) • Flow realignment
Bank Protection	Measures designed to produce a stable, durable streambank that can withstand floodwaters up to the predicted 100-year flood	• Reestablishing riparian vegetation (bioengineering) • Reducing bank slope • Constructing standard trench fill revetment (riprap)
Conveyance Capacity	Increasing channel bed slope or cross-sectional area or decreasing channel roughness in order to increase the amount of flow that a stream can carry before water spills over the bank; increasing off-channel storage or floodplain storage	• Constructing overflow/secondary channels • Widening or deepening the channel • Increasing floodplain storage by removing levees or moving roads • Replacing multi-span bridges with single span bridges (no interior piers) • Installing culverts through embankments to minimize obstructions to flow.
Floodplain Protection	Measures that reduce flood hazards for property, structures, and occupants in the 100-year floodplain; protection from inundation, floating debris, sediments, and the force of water flowing in the floodplain	• Constructing setback levees • Constructing ring levees • Elevating roads • Redesigning and replacing bridges • Constructing/expanding storage reservoirs • Changing the configuration/alignment of headgate structures at diversions

TABLE 9-2
TYPICAL NONSTRUCTURAL FLOOD HAZARD MANAGEMENT SOLUTIONS

Measure	Description	Typical Activities
Open Space	Maintain and increase open space in floodplains to provide conveyance, storage capacity and minimize flood hazards to structures	• Provide incentives for developers • Provide incentives for agricultural lands • Land acquisition • Purchase of flood easements • Encourage parks and trails in floodplains • Meet Growth Management requirements for open space & shoreline/habitat protection
Public Information	Public information activities to advise people of the risks associated with flood hazards and about flood insurance and ways to reduce flood damage	• Map determinations/technical assistance • Public outreach projects • A flood protection library • Flood preparedness programs • Hazard disclosure • Elevation certificates
Regulation and Mapping	Regulatory and mapping measures to provide protection for existing structures and new development through land use regulation and the collection of accurate floodplain information	• Higher regulatory standards • Low-density zoning • Open-space preservation • Ordinance consistency • Interagency agreements • Accurate floodplain and floodway mapping, and migration hazard mapping
Planning, Evaluation & Data Collection	Activities to develop accurate floodplain information and flood data, analyze alternative feasibility, and increase the understanding of the river's flood characteristics	• Flood data maintenance (GIS, databases) • Floodplain audits • Flood gage installation/improvements • Engineering studies & mapping products • Provide FEMA hydraulic models to project proponents
Flood Damage Reduction	Measures addressing flood damage to existing structures (buildings, roads, bridges, levees, canals, ditches etc.)	• Acquiring, elevating or relocating flood-prone structures • Wet or dry floodproofing • Developing repetitive loss plans • Management of interconnected irrigation and natural drainage systems
Flood Preparedness	Actions to minimize the effects of flooding on people, property, and the contents of buildings	• Localized action and access plans • Comprehensive response planning • Flood warning systems • Flood facility maintenance programs
Maintenance	Activities to maintain stream conveyance	• Removing vegetation and debris • Controlling growth of vegetation in the channel

FLOOD MITIGATION APPROACH ANALYSIS

Table 9-3 provides guidance on how well common alternatives address a particular type of flooding problem and their likely environmental impacts. These considerations along with the goals and objectives for this plan were utilized to select and prioritize recommendations

TABLE 9-3.
PROBLEM ADDRESSED AND ENVIRONMENTAL IMPACT
ASSOCIATED WITH FLOOD HAZARD MANAGEMENT MEASURES

Alternative	Problem Solved[a]							Impact[b]					
	Channel Migration	Bank Erosion	Conveyance Capacity	Property Protection	Streambed Degradation/ Aggregation	Public Knowledge	Long-term Flood Control Expenditures	Fisheries	Wildlife	Scenic/ Aesthetic/ Historic	Water Quality	Hydrology	Recreation
Nonstructural													
Open space	+	+	+	+	0	0	+	+	+	+	+	+	+
Public Information Program	0	0	0	+	0	+	+	+	0	0	+	+	0
Regulatory Measures	+	0	+	+	0	0	+	+	+	+	+	+	+
Vegetation & Debris Removal	0	–	0	0	– or +	0	–	–	–	–	–	0	– to 0
Flood Damage Reduction for Existing Structures	0	0	0	+	0	0	+	+	+	+	+	+	+
Floodproofing of Structures	0	0	0	+	0	0	+	0	0	0	0	0	0
Flood Preparedness/ Emergency Management	0	0	0	+	0	+	–	0	0	0	0	0	0
Structural													
Barbs (Spur Dikes)	+	+	–	+	–	0	–	+	0	0	+	0	0
Flow Realignment	+	+	–	+	–	0	–	–	–	–	–	–	–
Bioengineering	+	+	0	+	0	0	+	+	+	+	+	0	0
Cabling Trees	+	+	–	+	0	0	0	+	+	+	+	0	0
Reducing Bank Slope	+	+	+	0	0	0	0	0	0	0	0	0	0
Standard Riprap	+	+	–	+	0	0	–	–	–	–	+	0	0
Overflow Channels	+	+	+	+	0	0	–	+	0 to +	0	0	0	0
Channel Widening or Deepening	+	+	+	+	+	0	–	–	–	0	– to 0	0	– to 0
Setback Levees	+	0	–	+	0	0	–	+	+	+	+	0	+
Ring Levees	+	–	–	+	–	0	–	0	0	– to 0	–	0	0
Storage Reservoirs	+	+	0	+	0	0	–	–	–	– to 0	– to 0	+	0 to +

a. + = problem solved; 0 = problem not addressed; – = problem aggravated
b. + = positive impact; 0 = no impact; – = negative impact

in Chapter 11.

ALTERNATIVE GENERATION

Based on problems identified in Chapter 8, Flooding Issues, input and discussions at committee meetings, the primary flood issues identified included:

- accurate mapping of flood hazards and overflow paths,
- agricultural modifications to channels and floodplains,
- irrigation infrastructure and "ditched" stream channels,
- bridge capacity and road alignment/elevation impacts,
- reduced channel capacity due to sediment,
- abnormal growth of hybrid willows and other riparian vegetation,

- wildlife management of beavers;
- flood risk awareness; and
- future development pressure in the floodplain.

Brainstorming Exercise

Flood problems were grouped in Table 9-4 based on their nature, cause or geographic location. The Committee then developed alternatives using these group numbers as identifiers.

TABLE 9-4 FLOOD PROBLEMS	
1.	Instream Debris
2.	St. Joseph's Mission at Ahtanum
3.	Emma Lane
4.	Inundation
5.	Irrigation Infrastructure
6.	Spring Creek East in Union Gap
7.	Vegetation
8.	Shaw Creek
9.	Fish and Wildlife
10.	Flood Fight - Flood Response
11.	Union Gap
12.	Transportation Infrastructure (Roads and Bridges) Note: North Fork Ahtanum problems was merged into this group before individual alternative numbers were assigned
13.	Land Use
14.	Regulatory Issues
15.	Channel Issues

Problem statements, shown in Table 9-5 below, were generated for each problem group in Table 9-4 and sent to Committee members. The Committee then went through a brainstorming process using Table 9-5, Tables 9-1 and 9-2, and site specific knowledge obtained during the plan to generate Plan alternatives.

TABLE 9-5 PROBLEM / ALTERNATIVES WORKSHEETS

Process for Developing Alternatives:

1. **Problem** - What is the problem? (Problem Statement)
2. **Causes** - What is causing the problem?
3. **Alternatives** - What Alternative solutions will address the problem?
    a. What has *already been proposed* to address the problem?
    b. Are there any *new solutions* that have not already been proposed?
    c. What *still needs to be studied*?
    d. Do these proposals address the causes of the problem?
4. **List Alternatives** - Proposals that address the causes of the problem are listed as Alternatives, as well as instances where further study is required.

The completed Problem Statements / Alternatives Worksheets generated during the committee meetings are contained in Appendix F.

Nomenclature Key

Alternatives generated by the committee on the problem worksheets were assigned a unique individual alternative number which was retained through-out the formation of this plan. The numbering convention is based on the group numbers in Table 9-4 and follows a number letter-number format, placed in parentheses (i.e. 8E-6). Some alternatives were not assigned a letter (i.e. 15 or 4-7).

The "Alternatives Discussion" beginning on page 9-12 and summarized in the Alternatives Summary Table 9-8, follow this parentheses format. These individual alternative numbers, generated from the worksheets can be used to track a specific alternative through-out Chapters 9 and 11, and Appendix G.

Alternative Analysis and Selection

Over 300 alternatives were generated in the Problem Worksheet meetings. The large number of alternatives created difficulties in determining the best method to group or eliminate alternatives, so that the committee would have a manageable number to consider. An objective rating method was sought to reduce the number and facilitate the analysis of the alternatives.

Accordingly, alternatives were initially evaluated and scored with regard to *importance* (severity & benefits), *feasibility* (impacts, cost & acceptance) and their meeting *multi-objectives* from the plans objectives in Table 1-2. This differentiation recognizes the need and degree of expected success for alternatives.

It was found after several iterations on this approach using scoring methods that each attempt retained too many alternatives of low priority and also dropped some important alternatives. Staff then presented the results to the committee which dropped the alternatives listed in Table 9-6.

Alternatives considered and not included

The Committee reduced alternatives by dropping several and consolidating some of the remainder for review.

Pine Hollow Reservoir considerations

The potential for the proposed Pine Hollow Reservoir to reduce flood peaks was explored at the beginning of the CFHMP committee process and this alternative did not receive an alternative number. The Ahtanum Creek Watershed Assessment (Ecology, 2004) investigated various options for increasing water storage and restoring natural habits in the Ahtanum drainage, including the Pine Hollow Reservoir. The project consists of a diversion to an off channel storage site.

In June 2005 Ecology released the Final Programmatic Environmental Impact Statement for the Ahtanum Creek Watershed Restoration Program (Ecology Publication #05-06-016). The

use of the proposed Pine Hollow Reservoir to help mitigate flooding was addressed in several locations in the EIS. In the discussion of Alternatives on page 6-10 the document states, "None of the alternatives would significantly reduce flooding". Later in the Public Services section (page 6-58) of the same chapter, additional flood information is provided:

> "The proposed Pine Hollow Reservoir would provide storage for surface water to be used for irrigation and augmentation of instream flows. The reservoir would not provide a drinking water supply and would not generate hydroelectricity. The reservoir would not provide significant flood control to the project area, but could provide a small reduction of flood flows during non-peak events. The reservoir would be an off-stream reservoir and would not be designed to provide storage of flood waters. The diversion and enlarged John Cox Ditch would operate during winter and spring high flows, and could divert up to 160 cfs. That could reduce flood flows during non-peak events. Peak flows during major flood events have exceeded 1,000 cfs. The reservoir and smart diversion would have to be operated for flood control in order to provide any such benefits."

A somewhat more detailed explanation is included in the EIS as a response to a letter (Comment Letter No. 12) received during the public process. The first part of the EIS response to the comment was:

> "12-4 Flood control has not been included as a primary feature of the proposed diversion and reservoir. As noted in the EIS, the ability of the proposed reservoir to reduce flooding would be limited by the size of the diversion from the Ahtanum Creek and maintenance of channel-forming flows. The proposed diversion would have a capacity of 160 cfs. For comparison, the flood flows on the North Fork of Ahtanum Creek are approximately 600 cfs (10-year flood), and 860 cfs (100-year flood). Providing capacity to divert a significant portion of these flood flows to the reservoir would require a much larger diversion and ditch."

Since the proposed Pine Hollow Reservoir project does not include flood control in its design and estimated cost, it was not viewed as a viable alternative for this CFHMP.

The dropped alternatives listed in Table 9-6 were reviewed and discussed several times by the Committee and staff. The discussion and basis for dropping the specific alternatives follow Table 9-6.

Table 9-6.
Dropped alternatives identified during Alternative Tracking process

Alt. No.	Alternative Text
1A-4	Utilize heated irrigation gates to prevent ice buildup (most gates are closed in the winter)
1B-6	Put standards or policies in Critical Areas Ordinance addressing fences across streams
1C-1	Reconsider closing solid waste dumps near streams
1C-6	Jurisdictions should remain cognizant that they are liable to enforce laws related to known public hazards

Table 9-6.
Dropped alternatives identified during Alternative Tracking process

Alt. No.	Alternative Text
1D-4	Utilize corrections crew for roadside cleanup
2A-4	Tribe is working with Herkes to do some stream restoration work- cooperation with the Yakama Nation
2A-9	Define acceptable level of flooding relative to headcuts
2B-1	Construct levees along Hatton to redirect flow
3-4	Re-mapping of FEMA flood maps at Emma Lane
4-1	Adhere to rules of the National Flood Insurance Program
4-2	Adhere to rules under the Critical Areas Ordinance
4-5	Create more stringent subdivision standards in flood prone areas
4-14	Coordinate with City of Yakima on checking old regulations against Comprehensive Plan updates
4-16	Engage in "Full Build-out Mapping" exercise
5A-3	Create hard structures in ditches and diversions, preserving natural drainages - involves designating some channels as "artificial" and some as "natural"
5D-6	Develop a water conservation plan that includes designation of fish habitat and other uses
6B-3	Coordinate with WDFW's Restoration Plan for Spring Creek (WDFW)
6D-1	Culverts under Hwy. 97 either need to be plugged and repaired or sealed. WSDOT has plugged or repaired culverts in the past. Recent observations indicate they are once again backwatering.
7B-1	Enforce regulations that protect or encourage restoration of riparian vegetation (Critical Areas Code)
7D-1	Utilize riparian setbacks and buffers
7D-2	Respond to log jams in a site-specific manner
8A-1	Classify Shaw Creek (or parts of it) as a ditch or stream
8D-2	Model the Shaw Creek watershed at full build-out
9A-4	Beaver-proof culverts (don't normally function well during floods). And provide alternatives for water passage through beaver dams.
9A-8	Consider establishing areas where beavers should not be allowed. (i.e. dense urban areas, irrigation, artificial ditches).
9A-9	Identify protocols for beaver management. Who is responsible?
10C-6	Provide open contract for aerial observation during floods for event documentation
11B-2	Limit extension of services to flood prone areas
12A/B-9	Limit/restrict/reduce the number of bridges and bridge crossings, especially small private bridges and culverts.
12C-4	Study the level of service standard for designing roads in floodplains in flood-prone watersheds
12D-4-9	Potential hole- contact with private landowners- driveways, culverts, etc.
12E-6	Build private driveways at grade, where culverts generate flooding.
12G-4	County utilize existing and amended floodplain and critical areas codes to reduce flood hazard.
12H-1	Apply stormwater management standards for new and reconstructed roads
12H-5	For roads in floodplains in flood prone watersheds develop special standards by road functional type and private road classification.
12H-9	County (and Cities) evaluate access needs on a case by case basis
12H-10	Use Unnumbered A-zones (Regulatory Parking Lot) on maps
13A-1	Rely on Existing zoning (status quo)
13A-2	Continue to implement NFIP standards (regulatory standards)
13A-6	Use Critical Areas update policies to establish open space

Table 9-6.
Dropped alternatives identified during Alternative Tracking process

Alt. No.	Alternative Text
13A-8	Focus lower-intensity development within the floodplain corridors, while focusing higher intensity developments to the sides of the flood corridor. Lower density for subdivisions in the floodplain. (repeat)
13A-12	Establish land use standards within flood hazard zones
13A-14	Establish policies for retrofitting and re-development of stormwater facilities and flood water routing in existing urbanized areas
13B-1	As per Code new developments must meet development standards and go through the planning process.
14A-1 (part)	Build road bed at grade? Implement standard for access, and Define "island" size (other elements of alternative were retained)
14C-6	Create policies for areas of existing dense development within the floodplain (such as Ahtanum and Wiley City) *(From Land Use)* (repeat)
14D-2	Provide incentives or bonuses for developers who actively protect flood hazard areas. (10% density bonus). Specific development standards in zoning ordinance. *(From Land Use)* (repeat)
14D-3	Focus lower-intensity development within the floodplain corridors, while focusing higher intensity developments to the sides of the flood corridor. Lower density for subdivisions in the floodplain. *(From Land Use)* (repeat)
14E-2	Use Critical Areas update policies to establish open space *(From Land Use)*
15	Open space taxation policies (repeat)
15C-5	Levees, armor, buffers, CMZ (channel migration zones) (repeat)
15C-6	"Softer" solutions for bank stabilization (plantings, etc.) (repeat)
15C-7	Buyouts/relocation/easements and flood-proofing for areas threatened by meandering and erosion.
15C-8	Agricultural subsidies allowing flooding on some farmland. Depends on erosion verses sheet flow. Compensation program for productive ag. land lost to erosion. Linked to property loss protection program (?). (repeat)
15G-3	Model flood effects of build-out
17	Better system of checks and balances within local government for agencies to buy in.

Shaw Creek Classification

Alternative 8A-1 "Classify Shaw Creek (or parts of it) as ditch or stream" received a great deal of discussion at several committee meetings. This alternative arose due to difficulties managing the channel as both a creek and as an artificial irrigation and drainage facility. Shaw Creek is not unique in this respect; there are other stream reaches both within and outside the Shaw Creek area that have similar classification issues.

While everyone in the committee acknowledged the difficult management issues regarding Shaw Creek, agreement on this alternative was not obtained. The committee decided to drop this classification alternative at the February 26, 2008 meeting since a consensus could not be reached.

Several other alternatives were generated that address the overall issue of channels that have some current or historic irrigation function. These alternatives will be discussed at the beginning of the Channel Issues/River Function section.

Miscellaneous Dropped Alternatives

Six alternatives were dropped early in the process when the committee reviewed alternatives for Bridges and Roads.

Alternative 1D-4 is not directly related to flooding and at best would only help reduce risks for the smallest flood events. Alternative 12D-4-9 was not required since it was created to cover a perceived "hole" in the alternatives that did not exist.

Alternatives 12G-4, 12H-1, and 13B-1 are either already being implemented or don't indicate a specific action that could be implemented. All six of the above alternatives were reviewed at several committee meetings and also received detailed review by the staff before being dropped. Alternative 12E-6 relates to private development and would probably not significantly reduce flooding in the few locations where it might apply. For new road access in the unincorporated county, the required driveway culvert is sized according to the depth of the pre-existing ditch that is part of the road system.

Seven Alternatives were duplicates of other alternatives, so they were dropped: 13A-8, 14C-6, 14D-2, 14D-3, 15, 15C-5, 15C-6, 15C-7, and 15C-8. One alternative, 2B-1, though not an exact duplicate was determined to be redundant since other alternatives adequately cover preventing an avulsion of Ahtanum Creek into Hatton Creek. Another redundant alternative is 9A-9 since responsibility for management of beavers lies with the Washington State Department of Fish and Wildlife. During recommendation review alternative 10C-6 was determined to be included within 15D-5, so 10C-6 was dropped as redundant.

During the alternative tracking process additional Alternatives were identified that were not included in earlier alternative review discussions. Approximately half of these were either "status quo" alternatives, are already being done, were too general, or did not have a clearly identified action that could be implemented: 1C-6, 2A-4, 3-4, 4-1, 4-2, 4-14, 7B-1, 7D-1, 7D-2, 12H-10, 13A-1, 13A-2, 13-A-6, 13A-12, 14E-2 and 17. During the recommendation review process one alternative (4-5) was dropped due to lack of specificity and because other recommendations already address subdivision standards.

Three Alternatives (4-16, 8D-2, and 15G-3) proposed modeling "full build-out" conditions in specific locations or the entire FEMA study area. FEMA refers to this type of mapping as "Future-Conditions Hydrology". When this type of mapping is requested by a community, FEMA will identify the future-conditions floodplains on the official maps in addition to the usual floodways and floodplains, but it is up to the community to enact an ordinance to regulate to this higher standard. Since the likely outcome (wider floodplains) of implementing these alternatives was not thoroughly discussed and analyzed by the committee, these alternatives were dropped.

Several alternatives did not receive support from the committee and were dropped. Alternative 1B-6 for regulation of fences through Critical Areas Ordinances was felt to be unwanted regulation of something that is not believed to be a widespread problem. The committee suggested it was more appropriate to include the issue of fences in floodplains in public outreach to property owners. The next alternative in this group, 11B-2, proposed

limiting extension of services. The committee decided this was not the proper method to reduce density in floodplains and dropped this alternative. During this discussion the committee also decided to reinstate the floodplain overlay alternative which had previously been dropped (13B-3).

For Alternative 14A-1 the committee decided to drop two elements related to "islands" of non-floodplain areas surrounded by overland floodplain. The remaining elements of this alternative were retained.

One dropped alternative, 5A-3, was similar to the classification of Shaw Creek as a ditch or stream (8A-1). Though 5A-3 does not identify a specific stream to be reclassified, the committee expressed no interest in addressing this topic. Eight dropped alternatives appeared to be impractical, unlikely to produce flood reduction benefits, or are not identified as a serious problem in the CFHMP area, 1A-4, 1C-1, 2A-9, 6D-1, 9A-4, and 9A-8. Two dropped alternatives were beyond the scope of this plan or funding has been removed for the project, 5D-6 and 6B-3. One alternative, 13A-14, was dropped because the flood concerns were adequately covered in other alternatives and it also had considerable overlap with the new stormwater program.

Four alternatives (12H-5, 12H-9, 12A/B-9, 12C-4) grouped together were dropped by the committee at the end of the alternative review process. These alternatives were grouped together since they all involve consideration of new roads and bridges in the floodplain, and determining the appropriate standards for roads in floodplains. The committee felt these alternatives were redundant since they are already included in other alternatives or in current regulations.

Alternative Consolidation

Staff deleted alternatives common to more than one worksheet and combined like alternatives as noted above. As part of this process the *flood problem groups* (Table 9-4) were also consolidated and renamed *flood issue categories*. A new category titled "Monitoring and Inventories" was created for alternatives aimed primarily at data collection that is not site-specific. The final flood issue categories are shown in Table 9-6.

TABLE 9-7 FLOOD ISSUE CATEGORIES	
1.	Channel Issues / River Function
2.	Watershed
3.	Bridges and Roads
4.	Irrigation
5.	Land Use
6.	Development Standards / Enforcement
7.	Union Gap
8.	Information / Outreach
9.	Flood Response
10.	Shaw Creek
11.	St. Joseph's Mission at Ahtanum
12.	Emma Lane Area
13.	Monitoring / Studies / Inventories (added during alt. review process)

The approved alternatives table (Tale 9-8) includes all alternatives, which were not prioritized at this stage of the process. The combined Committee felt the alternatives in this list were worthy of further discussion before final recommendations were made.

ALTERNATIVES DISCUSSION BY FLOOD ISSUES CATEGORIES

The alternative descriptions in the section below are summarized in Table 9-8 and organized based on the 13 flood issue categories in Table 9-7, not the 15 flood problem groups in Table 9-4. The original alternative numbering scheme, using the groups from Table 9-4, is maintained in parentheses. For additional background regarding alternative generation, see Chapter 4 Floodplain Characteristics, Chapter 5 Development in Basin Floodplains, Chapter 6 Planning and Regulatory Environment, Chapter 7 Basin Flooding Characteristics, and Chapter 8 Flooding Issues.

Dropped alternatives from Table 9-6 are not carried forward into Table 9-8 or the discussion below. However, alternatives that were dropped later in the process of developing recommendations are retained in Table 9-8 and the discussion below. They are noted as being dropped within Table 9-8.

The discussion of the alternatives below is brief if the alternative listing on the table is largely self-explanatory or if the alternative is a minor component of other alternatives. Greater discussion is reserved for alternatives that received a great deal of attention from the committee or required additional explanation to address concerns generated during committee meetings about their scope.

TABLE 9-8
Alternatives Summary by Flood Issue

1. CHANNEL ISSUES / RIVER FUNCTION

1. Stream Management - Natural vs. Irrigation Ditch or Urban Stream	
A.	Separate irrigation conveyances from natural streams based on studies where it is shown this would be effective as flood control. (15B-3, 5D-7) ▪ Reduce operational spill of irrigation water into streams (7A-2) ▪ As part of mitigation for piping of irrigation waters, create a more normative conveyance schedule (7A-4) *Consideration- A non normative hydrograph results in overgrowth of species such as Pacific willow, which contribute to flooding, particularly in the Wide Hollow basin. Lower Wide Hollow and Ahtanum Creek are influenced by the water table of the Yakima River, which also has a non-normative hydrograph*.
B.	Establish work groups to clarify technical & regulatory measures and options for natural, artificial and shared drainages effected by irrigation: ▪ *Consideration- This may involve distinguishing between areas that should retain natural functions and processes (e.g. Ahtanum Creek), as opposed to areas that should be managed within the context of high intensity uses, such as irrigation conveyance or drainage ditches.* (7B-7, 15E-5, 15E-6, 5D-2, 5D-3, 5D-4, 5D-5, 5D-8, 5F-4, 15E-1, 2-2, 8A-3)
2. Riparian Protection / Restoration	
A.	Utilize existing federal, state and local policies and programs to: ▪ Preserve/restore riparian areas- Acquisition/legal protection of riparian zones: o Easements, o Agreements, (Fee Simple, etc.). o *Consideration- This is most often done with multiple objectives-Fish and Wildlife habitat protection, (Open Space, parks, trail and other)* ▪ Protect riparian vegetation: o Conservation Reserve Enhancement Program o YTAHP (Yakima Tributary Access and Habitat Program) o Open Space taxation incentives ▪ Limit rates of habitat loss: o Endangered Species Act, o Growth Management Act, Critical Areas Ordinance o Hydraulic Code ▪ Maintain watershed and channel processes (i.e. Clean Water Act, In-stream flow rules (9C-1, 7B-2, 7B-3)
B.	Coordinate/cooperate with currently in-place habitat protection and restoration programs (i.e. Salmon Recovery Funding Board, Northwest Power and Conservation Council), as well as other programs and funding sources that encourage habitat protection. (9C-2)
C.	Work with private habitat restoration organizations (e.g. Land trusts, Greenway, other non-profit programs) to protect riparian areas. (9C-4)
3. Elk	
A.	Move elk feeding stations to other areas away from streams. (9B-3)
B.	Apply similar management standards to elk confined feeding operations as livestock operations & incorporate watershed management principles when managing elk. (9B-2, 9B-4)
C.	Develop a Coordinated Resource Management Group (e.g. Wenas working group). (9B-1)

4. Dumping and Pollution in Streams	
A.	Investigate funding for enforcement and cleanup of illegal dumps on private ground. (1C-9, 1C-10) FCZD would not be the lead
B.	Initiate/Encourage Stream cleanup programs (1C-2) Committee decision not to carry this forward as a recommendation 3-16-09
5. Private Landowner Assistance	
A.	Utilize fence designs that allow for prevention of floodwaters from backing up on fences, such as: ▪ Breakaway fence panels in locations that flood frequently. ▪ Suspension fences, which consist of steel pipe or cable hung high above the creek, and hanging lighter materials down from the cable. This works as a fence, but is not lost during floods. ▪ Fence setbacks - hold fences back some distance from the creek (loss of traditional land usage) (1B-1, 1B-2, 1B-3, 1B-4, 1B-5) (note: this is a problem in site specific locations & doesn't apply to entire CFHMP area)
B.	Work with landowner assistance programs (i.e. Conservation Districts) for establishing or re-establishing vegetation and information about flood resistant fencing (7B-4, 1B-7, 1B-8).
6. Vegetation	
A.	Utilize natural solutions for in-stream flooding issues: ▪ In some locations, add wood to stream to "catch" wood debris- this accomplishes multiple objectives- would benefit habitat as well as reduce the volume of woody debris that accumulates on bridges, diversions, and other structures. (7D-4) ▪ Utilize plantings (such as Red osier dogwood, etc.) solutions for bank stabilization (15C-2).
B.	Control or Replace Undesirable Plant Communities (e.g. hybrid willows) ▪ Utilize other types of vegetation that can be substituted for Pacific Willow over the long term- may include non-native plant communities. Research appropriate plant communities for denuded riparian areas (7A-5 & 7B-8, moved alt #'s to associate with correct alt, 5-19-10) ▪ Utilize regulations or region-wide permits for management of the undesirable riparian plant communities (7A-3,) Committee decision not to carry this forward as a recommendation 3-16-09 ▪ Create program for removal and long term management of hybrid Willow- (may be at different scales- site specific or throughout the watershed, i.e. for some distance upstream and downstream of bridges on Wide Hollow, have a more aggressive Willow control program). (7A-1)
C.	Increase evergreen riparian vegetation at known ice jam locations to reduce the formation of anchor ice (1A-5). First step is to inventory locations where this occurs. Committee decision not to carry this forward as a recommendation 3-16-09
7. Channel Relocation/Reconfiguration	
A.	Relocate modified streams away from high-intensity uses, or restore incised stream channels to allow for natural riparian/flood function ▪ **Channel reconfiguration and reconstruction at Emma Lane, Shaw Creek, lower Wide Hollow in Union Gap, and the Mission (15A-1, 15B-1, 7B-6).**
B.	Flood overflow channels/conveyances where channels are perched (15B-9)

8. Channel Maintenance	
A.	Perform periodic channel maintenance (Stream clean out) (15A-2) at identified problem areas. *Consideration- more effective when done on a small scale (site specific near bridges and other problem spots).Not as effective for large flood events* ▪ Convene technical work group to assess gravel management options in upper Wide Hollow watershed (Ellensburg formation geology) ▪ Develop coarse sediment budget through empirical monitoring or modeling. ▪ Implement options to increase channel stability based on information generated in alternatives A & C above. ▪ (gravel/sediment alternatives added from 2-26-08 committee meeting, so no alt. #)
9. Beavers	
A.	Establish regulatory measures (buffers, setbacks, etc.) to allow for localized flooding/changes in water surface level or the channel (9A-5, 9A-7)
B.	Deal with beavers on a case by case basis- use discretion based on situation ("is the floodplain function provided by the beaver a good thing or a bad thing?") (9A-1) ▪ Remove "problem" beaver dams, under permits from Department of Fish and Wildlife. (9A-3, 9A-6) ▪ Establish policies for lethal trapping or relocation of "problem beavers." (9A-2) ▪ Encourage beavers in areas where their presence could restore degraded watershed function. (9C-5)
10. Flood Protection	
A.	Natural changes in the channel become a problem when they threaten homes, businesses, agricultural land, or infrastructure therefore the following alternatives may be considered, where appropriate. ▪ Levees, armor, buffers, CMZ (channel migration zones) (15C-1) ▪ Structural flood control measures either by individuals or government (4-7) ▪ Utilize "softer" solutions for bank stabilization, bio-engineering (15C-2) ▪ Levees constructed along perched channels (i.e. Cottonwood Grove) (15B-2)

2. WATERSHED FLOOD ISSUES

1. Non-Stormwater Watershed Issues	
A.	Alter DID management over the long term as land use changes (15E-4) Committee decision not to carry this forward as a recommendation 3-16-09
B.	Consider environmental benefits in funding processes (i.e. Benefit-Cost Analysis). (9C-9) Committee decision not to carry this forward as a recommendation 3-16-09
C.	Include habitat goals in disaster response and post disaster mitigation (9C-8.) Committee decided (6-15-09) to keep this as an alternative but not carry it forward as a recommendation.
D.	Preserve natural drainage including draws that provide flood protection (new from 2-26-08, so no alt code)
E.	Planning for the joint needs of fish and wildlife in floodplain development. (9C-6) Committee decision not to carry this forward as a recommendation 3-16-09
F.	Design bridges and irrigation diversions to reduce potential for debris and bedload (sediment) accumulation. (5B-1, 7D-3, 7D-5) (see also debris alternatives under irrigation and bridges/roads and channel maintenance under channel issues)
2. Stormwater	
A.	Utilize NPDES stormwater programs to retain site runoff and reduce overland flow for Yakima urbanized area. (1D-5) Committee decision not to carry this forward as a recommendation 3-16-09
B.	Develop stormwater standards for detention and retention on site and regional; abide by and enforce

	stormwater design standards; and incorporate flood issues into stormwater programs (4-4, 13C-4, 1D-6, 14C-7, 15G-1, 13C-1)
C.	Establish a relationship between stormwater standards and development standards in floodplains with regard to flooding (high water table and low gradient) (13C-3)
D.	Preserve natural drainage including draws that provide flood protection (new from 2-26-08, so no alt code) (same as 1.D above)
E.	Size drainage facilities for future build-out and flood flows – including ability to pass upland drainage of 100-yr flow (15E-2, 15F-1, 15G-2).
F.	Limit new connections to existing undersized drainage systems, ie. DIDs, storm drains, and resolve the runoff issues presented by the Drainage Improvement Districts (DIDs) that may act as stormwater drainage systems although designed for subsurface flows. (13C-2, 15E-3)
G.	Implement an effective Stormwater Management Program that reduces basin flooding (4-15)

3. BRIDGES AND ROADS FLOOD ISSUES

1. Design	
A.	Adequate Bridge & Road Crossing Standards: ▪ Develop bridge design and freeboard standards to account for backup from ice and other debris. ▪ Develop new floodplain width and function standards and policies for bridges in the floodplain to account for effect of the structure relative to floodplain function. Includes consideration of upstream and downstream beyond usual right-of-way (This will require public involvement.) ▪ Consider additional flow capacity to account for additional habitat permit requirements for new bridges beyond the State hydraulic code requirement of 100. ▪ For new structures, include in-stream actions to maintain conveyance as part of the design and construction (such as grade control) where needed. ▪ Design new bridges to allow natural channel processes where they occur. Take into consideration natural channel processes that have been lost or altered, or where natural processes are highly unpredictable. (1A-1, 12A/B-1, 12A/B-5, 12A/B-6, 12A/B-7, 12G-7)
B.	Improve bridge conveyance at 16th Ave. on Ahtanum Creek (3-13).
C.	Consider lowering existing roads where they act as dams and cause flooding (ponding) (12D-5).
D.	Provide armoring of roads which act as levees (Cottonwood Canyon Rd., etc.)(12D-1).
E.	New and reconstructed roads should be evaluated. New roads that are not intended to be passable to a certain standard (10, 25, or 100 year flood), should be built at grade (12F-6, 12H-8). *Coordinate with 2A. (below)* ▪ Consider designing new roads at grade in FEMA identified overflow areas. (12D-4)
F.	Armor road ditches where road fill is going to contribute to excess bedload (new alternative) (12E-3).
G.	Provide better floodplain mapping and modeling to allow for better infrastructure design, including current Ahtanum-Wide Hollow remapping. (12C-2, 12A/B-2).
H.	Modify drainage standards for roads in overflow areas (i.e. Emma Lane area) (3-12)
I.	Recognize the limitations of culverts as flood conveyance structures (12E-2)
2. Monitoring / Maintenance	
A.	Decide upon, designate and maintain critical access routes at 10, 25 and 100 year events *Coordinate with 1D and 1E above (12F-3, 12H-7).
B.	Actively monitor and manage channels adjacent to bridges to improve and maintain bridge capacity (Armor or sediment removal in poorly functioning bridges, and management of vegetation debris). Monitor channel and floodplain conditions post bridge construction. If significant unforeseen problems develop, after the stabilization period, respond to them (12A/B-4, 12A/B-8). ▪ Institute a policy of more maintenance at known problem bridges (12F-2)
C.	Replace old culverts with higher capacity culverts based on level of risk (12E-7a).

D.	Investigate and recommend increased maintenance and debris cleanout of culverts and ditches on public roads (coordinate with road maintenance crews to optimize ditch cleaning for flood purposes) (1D-1,12D-2, 12E-1).
E.	Assess the cumulative effect of new road policies and standards regarding roads acting as dams or conveyances. (12C-3.) ▪ Take larger scale affects to the watershed into account when designing new transportation systems: Minimize number of roads- maximize efficiency. (12H-4a)
3. General Planning	
A.	Inventory and rank problem bridges throughout the watershed and coordinate with Capital Improvement Plans of local and state jurisdictions. (12A/B-3) *Considerations*: [(County Roads currently has an inventory, Surface Water is currently working on as part of FEMA re-mapping). The rate of replacement of infrastructure is limited by funding, and to some extent standards in the funding programs.]
B.	Integrate existing or new funding programs into strategic program for addressing problem bridges (12A/B-10).
C.	Explore ways to take better advantage of Federal and state funding programs to reduce or mitigate the environmental effects (including flooding) of existing road systems (12G-6).
D.	Work with landowners upstream and downstream of new infrastructure to design access to property to mitigate flood impacts (12G-9).
E.	Replace flood damaged transportation infrastructure in a manner that reduces vulnerability to future flood hazard (12G-5).
F.	Identify and map overflow paths and relationship to road crossings. (12G-3)
G.	Minimize negative flood effects of accessing major arterials esp. when adjacent to or across floodplains (12H-4.c)

4. IRRIGATION FLOOD ISSUES

1. Conversion of Irrigation Systems	
A.	Consolidate irrigation diversions to minimize stream impacts, consider upgrades like piping, and consider converting irrigation systems to a pressure-based system, i.e. Pine Hollow (5C-1, 5C-2, 5D-1)
2. Infrastructure Maintenance and Inventory	
A.	Develop a program of proactive debris removal and maintenance on irrigation structures (1D-2, 5B-4) ▪ Install temporary or sacrificial debris capture structures adapted to existing channel conditions to reduce debris problems, esp. Wide Hollow. (5B-2)
B.	Conduct an inventory of existing irrigation infrastructure (working or abandoned) and flooding impacts. Identify problem locations and old drainage and irrigation systems that are affecting flooding in the irrigation system, ie. gate at Wiley City (2C-1, 5A-1, 5E-1) ▪ Install removable structures, such as irrigation pumps, weirs, gates, etc. (potential problem with ice), e.g. JM Perry Tech. (5B-3)
C.	Identify sources of funding for removal of abandoned irrigation structures (5E-2)
D.	Investigate the possible use of flood gates or siphons to reduce flood flow routing by irrigation infrastructure, if needed, identify locations of most benefit: ▪ Stationary or removable flood gates for use at diversions or in channel (5A-2, 5A-5) ▪ Install undershots in some locations- siphons through gulleys and depressions under the ditch (5A-4)

5. LAND USE FLOOD ISSUES

1. Subdivisions / Housing Developments	
A.	Minimize new homes/structures etc. in harms way (15C-11). ▪ Effectively integrate protection of floodplain functions/flood hazard reduction in individual subdivision platting process. (See also regulatory) (8C-5.) ▪ Create more stringent develop standards in some flood prone areas and jurisdictions (4-5.) ▪ Work toward common development standards (added at 4-7-08 mtg, so no alt. code #)
B.	Work for consistency in zoning standards for developments and buildings within floodplains. Determine gaps in the regulatory scheme. ▪ Recognize that in some places, the issues associated with larger scale proposed developments are not adequately addressed by current standards. (13A-9) (13B-7).
C.	Establish or maintain standards for subdivision in the floodplain- at the minimum require a buildable area outside of the floodplain. Standards for lot size and housing location. (14D-1)
2. Incentives / Taxation	
A.	**Provide special incentives- (clustering, density bonuses, Transfer of Development Rights) for retention of floodplain function in development design (13B-4).** ▪ Provide incentives or bonuses for developers who actively protect flood hazard areas. (i.e. 10% density bonus). Specific development standards in zoning ordinance. (From Land Use)- *could probably be moved into Regulations category.* (14C-2, 13A-7). ▪ Utilize landowner incentive programs (i.e. Conservation District, Cost- Shares, Open Space taxation and other tax breaks) (9C-3). *(These programs can provide significant restrictions, which may discourage participation*) ▪ Utilize existing agricultural subsidies or programs to allow for flooding on some farmland. *Consideration- Depends on water velocity- erosion verses sheet flow*. Develop a compensation program for productive ag land lost to flood induced erosion. C*onsideration*- could be linked to property loss protection program (15C-4)
3. Open Space / Parks	
A.	Encourage the retention of open space in floodplains through: ▪ Open space taxation policies (specifically including these problem areas in the public benefit rating) (13B-6) ▪ The development of walking paths / trail systems (12H-4d). ▪ Develop policies and standards for open space retention within expanding UGA's, and within individual developments. (14E-3) ▪ Incorporate open space/floodplain retention into site plans (e.g. La Salle High School)(11A-3) ▪ Include flood hazard reduction goals in Open Space Planning (13C-5) ▪ Encourage local governments to establish specific comprehensive plan policies to use floodplains and other critical areas to meet their GMA requirements for Parks and Open Space. This may substitute for designating some blocks of private land as open space. (13A-5, 14E-4) ▪ Maintain open areas near the mouth of Ahtanum creek for inevitable flooding (i.e. Fulbright Park and adjacent areas).(11A-2) ▪ Encourage parks (County and City) in frequently flooded areas (i.e. Fulbright Park) (13A-3).

4. Large Scale Retention of the Floodplain	
A.	Reduce density in the floodplain through various methods-(14C-3). ▪ Preserve and restore natural floodplain in places that retain some of the floodplain function. Prioritization- allow for flexibility while identifying critical locations, based on CFHMP and mapping (4-12). ▪ Make changes to comprehensive planning and zoning documents and maps to focus lower intensity development within floodplain corridors and focus higher intensity development outside floodplain corridors (14C-4, 14C-5). ▪ In certain high risk locations, consider development moratoriums or high standards of proof in place where development is outpacing knowledge or tools available to keep the public safe (i.e. the area has not been mapped, or conditions have changed since the last mapping) (13A-15). ▪ New major arterials and new traffic-generating developments should be located outside of floodplains (See also Bridges & Roads). (12H-4b)
B.	Incorporate principle of floodplain planning into infrastructure & similar facilities plans (8C-2, 12H-2)
5. Acquisitions / Easements / Incentives	
A.	Acquisition/easements of land surrounding flood problem areas (4-13, 15B-4, 15D-4) ▪ Acquire land- fee simple or easement, for a variety of purposes consistent with floodplain function (13B-5). ▪ Address maintenance of drainage easements-establish who is going to enforce maintenance (9C-12) ▪ Develop a program/policy guidelines for areas threatened by meandering and erosion, or frequent inundation, including: ▪ Buyouts ▪ Relocation ▪ Easements ▪ Flood-proofing (15C-3, 15C-7, 15C-9, 15C-10)
B.	Utilize tools such as floodplain easements to preserve off-site storage of water and sediment in farmland (existing pastures, alfalfa), while preserving use as farmland. Consideration: This could accomplish two goals: preservation of use of land for agriculture, and preservation of floodplain. (15B-5, 15B-8). Link to Farmland preservation programs.
C.	Encourage organizations (neighborhoods, County/City/Yakama Nation or others) to purchase floodplain areas (9C-10).
D.	Provide incentives for landowners and developers who provide floodplain storage (4-6).
6. Standards for Development in High-Risk Areas	
A.	Establish Flood Overlay Zones in affected jurisdictions. These overlay zones would have legal status (i.e. in a zoning code) and contain development standards, objectives, and review/process criteria for the broad suite of land uses that occur in floodplains. (13B-3) ▪ *Consideration- The Flood Overlay Zone exists within the Yakima Urban Area Zoning Ordinance.*
B.	Develop policies for areas of existing dense development within the floodplain (such as Ahtanum and Wiley City) (14A-4, 13A-13) Design better drainage, especially in Wiley City and Ahtanum. Consideration: In the past, overflow water used a ditch along the railroad, which has been filled in. Resulting lack of drainage causes sheet flow (14A-4) Establish areas such as Wiley City & Ahtanum as special study areas
C.	Establish policies in flood prone and flood hazard areas for directing preferred locations for the siting of new infrastructure such as major and minor arterials, water and wastewater distribution mainlines, regional stormwater facilities, parks and greenbelts. (13A-11)

7. Miscellaneous Policies	
A.	Ensure flood policies in the Yakima Urban Area Comprehensive Plan are implemented through ordinances and land use decisions. Planning for flooding is supported in Objective E7 (13A-4).
B.	Develop special land use and flood-proofing standards for industrial uses relating to hazardous materials, storage, use, disposal (11B-1)

6. DEVELOPMENT STANDARDS/ENFORCEMENT FLOOD ISSUES

1. NFIP Related	
A.	Consider increased elevation above BFE of new structures in the floodplain. 14A-2
B.	Require Flood-proofing ▪ Flood-proof utilities ▪ Flood proof structures- elevate, make existing structures less flood damage-prone (4-8)
2. Special Zones	
A.	Based on flood risk studies, consider stricter ordinances for flood zones in Union Gap (6C-4, 14A-3).
B.	Consider use of the Zero or 0.1 foot rise practice from International Building Code (14C-8)
C.	Identify areas with floodplain "islands" and develop standards that: 1. Limit density to provide flood passage 2. Provide emergency access 3. Transportation networks in these areas (even if they are zoned as low density) should be planned to take into account surrounding properties, rather than a standard site-specific approach (12H-6).
3. Miscellaneous	
A.	Enforcement- Adequately fund enforcement activities. More effective code enforcement, especially for blatant disregard of the law. (1C-4, 1C-3, 18)
B.	Coordinate between jurisdictional procedures in place for expedited permit issuance during and period after a flood event under State and County regulations (10D-1).

7. UNION GAP FLOOD ISSUES

(No Sub-categories for Union Gap Issues)	
A.	Modify Wapato Dam (4-11, 6C-7) to decrease flood risk (See Upper Yakima CFHMP)
B.	Sediment Transport on the Yakima River ▪ Studies: ▪ Study how changes on the Yakima River adjacent to Union Gap may affect water tables in Union Gap (4-18). (6C-9). ▪ Causes and rates of channel aggradation in the Yakima River (4-17) ▪ Identify future flood impacts that may occur as a result of aggradation (6C-1, 6C-2, 6C-3, 6C-8) ▪ Improve sediment transport along the Yakima River (Refer to the Upper Yakima CFHMP) (4-10). (Wapato Dam and upstream reach)
C.	Relocation of Wide Hollow Creek below 3rd Ave. (6C-6, 11A-4) ▪ Construct floodgates on Wide Hollow culverts if Wide Hollow is diverted into Ahtanum Creek (abandoned culverts at/near the mouth if creek relocated) (6C-5)
D.	Bypassing the Mill structures. (11A-5)
E.	The Spring Creek floodgate should generally be closed except for habitat or flow enhancement for a limited time period (see alternative F below also) (6B-1)
F.	Install a remotely controllable floodgate that could be opened some times of year, closed at others (on Spring Creek floodgate) (6B-2)

G.	Improve conveyance downstream of the culverts on the Spring Creek irrigation channel by increasing grade – this would help in most flood events, possibly not in large-scale flooding. (6D-2)
H.	Retain overflow path along the railroad right of way. (11A-1)

8. INFORMATION / OUTREACH FLOOD ISSUES

1. Mapping	
A.	Use improved flood mapping and modeling to assess risk to new and existing infrastructure and for designing new infrastructure (12G-1).
B.	Re-map the floodplain for NFIP rate maps, to allow for up-to-date accuracy and application of land use regulations. (8D-1, 4-3, 15B-6) ▪ Consider the contribution of high ground water to flooding (4-9). (4-19). ▪ Complete floodway mapping in the region (15D-1, 15C-13) ▪ Regularly scheduled updates (15D-2) *Consideration: the re-mapping process for Ahtanum-Wide Hollow is currently underway*
C.	Map Channel Migration Zones (and other hazards) (15G-4 15D-3) ▪ Identify areas that are at risk for channel migration in addition to identified CMZ, ie. N.F. Ahtanum, below the Narrows, at the Mission, Shaw Creek, etc. (15C-12).
D.	Supply Better/Different mapping products ▪ For example, identify where hollows overflow, upland flood channels are located and (aside from the formal FEMA mapping process) disclose when purchasing or developing property. 1D-8. 15F-2 *Consideration - (would be difficult for the County to produce in some locations)*
2. Landowner Assistance	
A.	Provide public education about potential flood hazards and responses on individual properties including keeping debris sources out of known flood channels (10B-2, 1D-3, 1D-7).
B.	Encourage residents who are at high risk for flooding to purchase flood insurance even if they are not in a mapped floodplain (8D-3.)
C.	Create pamphlets for new landowners i.e. pamphlet put out for small landowners in Kittitas County by the Kittitas Conservation District (fence debris) [responsible party] (1B-9.)
D.	Prepare a program to educate landowners about riparian function and health before and after a flood event (9C-7.)
E.	Provide information about properties up-front in public services (no surprises) (13A-10, 14B-1)
F.	Public education about maintaining driveway culverts, and correct sizing and maintenance of culverts. (12E-5)
3. General Public Outreach	
A.	Cooperate with others to support or develop public education programs, such as stream cleanup programs and volunteer monitoring (9C-13).
B.	Encourage citizens to report dumping in streams (public outreach) (1C-5).
C.	Cooperate with others to engage in public education regarding the values and esthetic appeal of riparian corridors/open space for purpose of preservation of floodplain corridors (7B-5).
D.	Public education about how riparian and flood hazard management goals complement each other. Inform people about the importance of the functions of streams, rivers, and natural drainage ways. (9C-11).
E.	Provide public education directed to residents, farms and businesses to increase individual preparation for floods (10A-3).
4. Outreach/Information Related to Flood Projects	
A.	Flood Control Zone District to provide technical assistance and comments regarding flood hazards and infrastructure design (12G-2).
B.	Public notice/disclosure/consultation when flood projects are planned (19).

5. Realtor, Lender, etc. Outreach	
A.	Provide information about flood history to realtors, lenders, etc. in proposed new developments (15C-14) (15C-15)
B.	Put on workshops and other outreach for realtors (15C-16)

9. FLOOD RESPONSE FLOOD ISSUES

1. General Flood Response Planning	
A.	Participate in and support Flood Response planning efforts (as part of the Emergency Response Plan) (10A-1, 10A-2, 12F-5).
B.	Implement Emergency Response Plan (Get Ready- Set- Go- Recover) procedures, from the Emergency Response Plan (10C-1).
2. Planning/Mapping	
A.	Identify and map problem spots throughout the watershed so flood responders know where to look first (5F-5).
B.	Designate emergency response access routes and incorporate into transportation planning (12F-4). Designation of evacuation routes and notification of the public and first responders (10B-3).
C.	The Flood Control Zone District will develop databases of parcels affected by different level flood events, corresponding to upcoming Ahtanum-Wide Hollow FEMA re-map (10C-5).
3. Coordination	
A.	Provide infrastructure or technology for better communication between agencies (EOC) (10C-2)
B.	Coordination between Emergency Management and the Irrigation Districts such as AID and Yakima Valley Canal, for management during floods. Include Irrigation Districts in communications with the EOC (emergency operations center) and FCZD (5F-1, 5F-3, 2B-3).
C.	Interagency coordination of flood information and response, including WDFW, Irrigation Districts and Yakama Nation Natural Resources, Fisheries and Engineering (10C-4, 10C-9).
D.	Flood responders concentrate patrol and response on known problem bridges and roads - (12F-1).
E.	Public and agencies coordinate flood fight and post flood actions with recommendations identified in the Ahtanum-Wide Hollow CFHMP, since they require approval by WDFW and Ecology (so will be consistent with regulations), and provide a good basis for deciding whether to take emergency actions. (10D-2)
4. Outreach	
A.	Recognition and dissemination of knowledge about potential flood hazards during a flood event in coordination with the EOC (10C-3).
B.	Develop warning systems including mass media (10B-1) ▪ Investigate reverse 911 system
C.	Encourage volunteer flood-watchers program to provide information (10C-8).
D.	Provide special flood phone line for public to call in and provide information about current flooding (10C-7). (EOC & FCZD cooperate/coordinate)
5. Irrigation Gates	
A.	Improve access to Bachelor diversion during floods without diverting flood waters or making flood problems worse (2C-3).
B.	Coordinate opening gates for flood relief, based on flood forecasts, channel maintenance needs, and impact to diversion facility (5F-6).
6. Monitoring/Documentation	
A.	Install a North Fork gage including telemetry (5F-2).

B.	Provide open contract for aerial observation during floods for event documentation (10C-6).
7. Ice Jams	
A.	Inventory of locations where ice jams are known to occur- identify them in the Flood Response Plan (1A-7).
B.	Outline emergency response to ice jams in the Flood Response Plan (1A-3). ▪ Alert residences at risk. (added by staff so no alt #) ▪ Blast ice jams- (normally only done on very stable ice jams) (1A-6). ▪ Facilitate regulatory approval by Ecology and Fish and Wildlife and local jurisdictions.
8. Regulatory	
A.	Facilitate involvement of permitting agencies as a component of the Emergency Management Plan, and are present in the EOC during a declared emergency. General guidelines for taking action during a declared or non-declared emergency are: A. permitting personnel do a site visit (10D-3, 10D-3a). ▪ choose minimum flood fight action, or action that will meet the intent of the regulations- i.e. better protect/enhance the resources (10D-3b) ▪ follow up- 6 months after a declared disaster to come into compliance for flood fight actions (10D-3c)

10. SHAW CREEK FLOOD ISSUES

1. Structural Response for Shaw Creek Flooding	
A.	Relocate Shaw Creek to the low point in the drainage to allow for more natural stream and floodplain function, and less maintenance. Consider a potential for a larger solution that includes concurrent considerations on Wide Hollow Creek ▪ Nob Hollow Road possibly a problem, possibly remove two Wide Hollow bridges, which would help with conveyance on Wide Hollow ▪ Shaw Creek overflow Bridge added as part of Nob Hollow construction. ▪ Move Wide Hollow Creek South of Wide Hollow Road (if Nob Hollow is not constructed). ▪ Investigate ways to keep certain properties undeveloped (for flood protection, and for possible relocation of Shaw Creek channel). Address Zeigler's property ▪ School owns property, and may be amenable to relocation. ▪ Consider downstream impact of changing Shaw Creek's confluence with Wide Hollow west. (If all creeks diverge on Wide Hollow during a major flood, it may cause problems at 80th and West Valley Park.) ▪ Recommend quick actions which allow us to keep options open: o Keep at-risk areas undeveloped and, o Require drainage easements, o Allow for high density development in areas that are not at risk Consider purchase of property or property interest (i.e. option, easement, etc.) needed for relocation soon before development prevents this alternative (new from 2-26-08, so no alt code) (8B-1, 8E-1.a-e, 8E-4, 8E-6.b-d)
B.	Reconfigure Shaw Creek to function as floodplain and fish and wildlife habitat (8A-2).
C.	Expand diking along Shaw Creek to protect new and existing development (8B-2, 8E-2, 15B-2)
D.	Consider developing regional retention upstream of Tieton Drive (8C-6, 8E-3)
E.	Consider overflow channel – addition from FCZD so no alt # (8-20-08)
2. Information and Outreach	
A.	Notify developers and prospective residents of flood hazard on the property (8E-6.a)
B.	Hold neighborhood meeting for residents living near Shaw Creek (public outreach). (8D-4, 8D-5).

3. Floodplain Designation	
A.	Change zoning code/amend the Comprehensive Plan to allow for restrictions on development in flood-prone areas around Shaw Creek, and protection of floodplain function (8C-3). ▪ Request an administrative designation of floodplain on Shaw Creek, based on historic flood patterns in the Shaw Creek area, prior to updating of the FIRM maps. (8C-4, 8C-7, 8E-5).
B.	Protect natural floodplain functions in Shaw Creek's watershed, especially before it is mapped (8C-1).

11. ST. JOSEPH'S MISSION AHTANUM FLOOD ISSUES

1. Study	
A.	Continue Surface Water's study, which is predicting flood flow patterns at Ahtanum Mission, based on surveys and modeling. Modifications to infrastructure management may result in relation to headcuts (2A-1).
B.	Determine the effects of flooding at the Mission on irrigation structures and of irrigation infrastructure on flooding patterns (2C-6)
C.	Verify if there is room for Ahtanum Creek to occupy old floodplain channels on the tribal land adjacent to Ahtanum Mission. Determine if the tribe/allotment owners may be amenable to that (2-3).
D.	Define the sensitive historical and cultural issues at Ahtanum Mission site (2-1).
2. Hatton	
A.	Recreate a flood overflow channel back to Ahtanum Creek from Hatton Creek (natural overflow channel blocked in the 1930s) (2A-5. 2B-2)
B.	Modify the old Hatton ditch channel below the diversion. Intent would be to block/armor channel to prevent opportunity for formation of headcuts (2A-7).
C.	Remove the old Hatton Diversion (Ahtanum Mission Headcuts) (2A-6).
3. Levees/Armor	
A.	Armor stream channel to prevent migration of Ahtanum Creek to the North (Soft levees on North side would not be sufficient- river would cut through) (2A-8).
B.	Utilize Ring dikes to protect St. Joseph's Mission property (2A-3).
C.	Major levee construction on Mission property to alleviate headcuts (2A-2).
4. Bachelor	
A.	Modify the Bachelor Diversion to improve functionality and decrease flood hazard (e.g. upstream of 90- degree turn on Ahtanum Creek) (2C-2, 2C-4) ▪ During floods, close Bachelor diversion and create a new high flow diversion channel from Ahtanum creek (2C-5)
B.	Identify potential future downstream impacts from any proposed changes in the Ahtanum Mission area, and establish acceptable level of flooding along the entire reach (2B-4).

12. EMMA LANE AREA FLOOD ISSUES

1. Study	
A.	Perform an Emma Lane flood study, and develop design guidance on acceptable flood protection levels. (3-2) ▪ Address Ahtanum Creek flood conveyance downstream of 42nd and Ahtanum Rd. (3-18).
B.	Perform a Cost-Benefit analysis of stream relocation at Emma Lane (3-19).

2. Relocation	
A.	Move Ahtanum creek to a lower point in the floodplain (requires cooperation with Yakama Nation, acquisition of at least two homes, and a new bridge) (Emma Lane) (3-1). ▪ If Ahtanum Creek is relocated, consider a design that does not include filling in the old Ahtanum Channel- looking at the existing channel as habitat (3-15). ▪ *Examine Constructing* a controlled side channel to bypass Emma Lane, rather than moving the creek (3-14).
3. Development in Emma Lane Area	
A.	Limit future development in the Emma Lane area (3-3). ▪ Place controls on building in the flood-prone areas in and around Emma Lane (3-17).
B.	Adopt and implement more strict building standards in Emma Lane area- flood-proofed homes, buildings (3-11, 3-3).
4. Channel and Drainage Capacity	
A.	Improve drainage throughout the entire Emma Lane area- culverts, roads, etc. (3-8). ▪ Reconfigure the Bachelor Creek Bridge on Ahtanum Road to increase capacity and reduce backwater flooding (3-6). ▪ Alter drainage systems and easements, based on Emma Lane floodplain remap study (3-10). ▪ Eliminate the Shropshire ditch or other irrigation ditch remnants (i.e. remove irrigation ditch that directs flow and inundates Emma Lane- area pastures and residents) (3-7). ▪ Improve stormwater system on Ahtanum Road to limit Emma Lane overflows into the airport area, and downstream to 16th (which floods the intersection at Ahtanum Road) (3-9).
B.	Widen bridge at 42nd Ave. (3-5).
C.	Remove old fill on Ahtanum at the Yakama Nation land just south of Emma Lane (3-16).

13. MONITORING/STUDIES/INVENTORIES FLOOD ISSUES

By Alternative Number	
1C-7, 1C-8, 1C-11	Investigate methods for the following: ▪ Research how other communities deal with dumping, particularly concrete, fill, etc. ▪ Research measures to deal with illegal/contaminated dumps (meth labs, etc.) ▪ Examine statewide laws relating to dumping and streams
12D-3	Inventory roads acting as levees. Design site-specific solutions based on the inventory and current and future road classification; solutions may include armoring or changes to road configuration, or elimination of the road and selection of alternate route. Incorporate findings into transportation planning.
12C-1	Inventory channel process problems in relation to existing and proposed roads
12D-6	Inventory of private roads acting as levees
12E-4	Identify road ditches that serve as flood conveyance, thus placing them at a high priority for maintenance (i.e. Rutherford Rd and Shaw Creek at 80th).
12E-7b	Continue private road culvert inventory
12G-8	Investigate funding sources or incentives for private drainage infrastructure
12H-3	Monitor the effects of urbanization and land use intensification to the characteristics (runoff, time of concentration, water quality) of the watershed over time. Take action to mitigate for negative watershed scale effects.
13B-8	Seek land use examples from other similar areas.
14E-1	Investigate standards associated with geologic hazard areas to see if they would be applicable for flood risk causes such as channel migration zones and alluvial fans.
15A-3	Identify areas where man-made alterations are affecting flooding (i.e. upstream of 64th on

	Hatton, Diversion #14, and The Narrows) to allow for cooperative projects.
15B-7	Identification of areas that are near perched channels (disclosure that the area is at risk for flooding). *Identify areas that are* of *particular concern.* ▪ Identify other perched stream locations (15B-10)
15D-5	Documentation of floods (air photos, etc.) Open contract with flights.
15F-3 & 15F-4	Identify critical hollows through risk assessment and through flood benefit (for protection measures) ▪ Identify special flood protection measures for hollows

1. CHANNEL ISSUES / RIVER FUNCTION FLOOD ISSUES

This category includes all general channel issues that are not specific to a particular location and are not included in the bridges and roads or other categories. The first section of this category relates to Stream Management and the unique problems presented by streams that are/were used for irrigation conveyance, especially those areas experiencing conversion to urban characteristics.

1. Stream Management – Natural versus Irrigation Ditch or Urban Stream

These alternatives were generated from the committee meetings on the flood problems related to: Irrigation Infrastructure, Vegetation Issues, Ahtanum Mission, and Channel Issues. Four alternatives (15B-3, 5D-7, 7A-2, 7A-4) were merged into the alternative, **"A. Separate irrigation conveyances from natural streams"**. The alternative refers to a physical separation between irrigation conveyances and streams. This would alleviate the following causes of flood problems: perched ditches that convey flood flows, unnatural vegetative growth due to the artificial hydrograph, and management difficulties related to stream versus ditch needs and regulations. When this alternative was discussed, it was not expected that a wholesale separation of ditches and streams could be done or financed through this CFHMP. If particular small problem spots are identified the stream and ditch could be separated in coordination with the specific irrigation district involved. This could also include coordination with irrigation districts to seek funding for reregulation ponds. However, the greatest value of including this alternative in the plan may be to provide a local vision for irrigation districts or others to seek funding to separate ditches and streams in this watershed.

Some of the small streams that are used for irrigation conveyance may not contain flowing water most of the year if irrigation flows are removed. Regulatory agencies, environmental stakeholders, and some property owners would likely be concerned about loss of riparian habitat and amenity values.

The second alternative, **"B. Establish work groups to clarify regulatory measures and options for natural, artificial and shared drainages effected by irrigation"** merges six alternatives - 15E-5, 15E-6, 5D-2, 15E-1, 2-2, 8A-3. This alternative generated a great deal of discussion in several meetings. Originally the alternative sought re-definition of regulatory measures for artificial drainages. This approach and wording was deemed too aggressive by several committee members and included concerns about the ability to implement the alternative. The wording in the final alternative to establish "work groups to clarify regulations regarding these channels" was considered to be both needed and something that could be implemented.

Membership in the work groups will be determined during formulation of the CFHMP recommendations or the implementation phase, but are expected to include WDFW, FCZD, effected property owners, applicable irrigation district, and CAO/SMP regulatory officials. Streams that should be reviewed first include Bachelor Creek, Hatton Creek and Spring Creek (west).

2. Riparian Protection / Restoration

The three alternatives in this section all encourage protection, rehabilitation and restoration of riparian areas through utilization of existing regulatory and habitat restoration programs. The first alternative is **"A. Utilize existing federal, state and local policies and programs to:"** preserve, protect, limit habitat loss and maintain channel processes (9C-1, 7B-2, 7B-3). Examples for this alternative are listed on the Alternatives Summary Table (9-8).

The other two alternatives encourage interactions and partnerships with conservation programs and organizations: "**B. Coordinate/cooperate with currently in-place habitat protection and restoration programs** (9C-2)"; and "**C. Work with private habitat restoration organizations** (9C-4)". Examples of programs and organizations are included on Table 9-8 for each of these alternatives.

3. Elk

Three alternatives were generated that apply to elk management in the headwaters of the Wide Hollow drainage. Alternative "**A. Move elk feeding stations to other areas away from streams** (9B-3)" refers to occurring or potential negative effects on streams when concentrations of elk are fed at a feeding station during the winter. The second alternative, "**B. Apply similar management standards to elk confined feeding operations as livestock operations & incorporate watershed management principles when managing elk** (9B-2, 9B-4)" applies to the feeding stations and also any other range issues that could contribute to increased erosion or run-off changes. The Washington Department of Fish and Wildlife (WDFW) maintain a winter elk feeding station off Winchester Road, near the end of Tieton Drive. WDFW submitted a letter when the alternatives were being reviewed that objected to treating elk similarly to livestock. Additional discussion about this alternative did not occur during subsequent committee meetings.

Alternative "**C. Develop a Coordinated Resource Management Group (e.g. Wenas working group)** (9B-1)" was suggested based on positive results seen for several local CRM groups (a grazing group in the Ahtanum area and one that was started in the Wenas). Coordinated Resource Management (CRM) is a process that creates a voluntary group to address complicated or controversial resource issues to develop collaborative solutions. A Memorandum of Understanding (MOU) for the CRM process in Washington State includes many agency stakeholders, including the Washington Association of Conservation Districts, USDA Natural Resources Conservation Service, USDA Forest Service and the Washington State Departments of Natural Resources, Fish and Wildlife, and Agriculture. To initiate a CRM, a person or organization presents their request to one of the stakeholders (MOU agencies). The group is frequently coordinated by the local Conservation District, in this case it would be the North Yakima Conservation District.

The WDFW management plan for elk (Yakima Herd, 2002) includes concerns voiced by the USDA Forest Service, Washington State Department of Natural Resources, and the Yakama Nation that there may be more elk in the Yakima Herd than the habitat can carry. The WDFW draft 2009-2015 Game Management Plan includes objective #25 to evaluate and if possible, reduce winter feeding based on data from a research project gathering data on the Yakima herd. The Yakima herd is one of the largest in the state.

4. Dumping Pollution in Streams

The two alternatives for this section are, "**A. Investigate funding for enforcement and cleanup of illegal dumps on private ground**. (1C-9)", and "**B. Initiate/Encourage Stream cleanup programs** (1C-2)". Illegal dumps are not known to be a large problem in these watersheds and clean-up programs typically deal with water quality not flooding. For these reasons, the FCZD would not be the lead for implementing these alternatives.

5. Private Land Owner Assistance

The first alternative is, "**A. Utilize fence designs that allow for prevention of floodwaters from backing up on fences**". There are examples listed on the table. This is primarily a site or area specific problem and may not be wide-spread across the plan area. The second alternative, "**Work with landowner assistance programs for establishing or re-establishing vegetation** (7B-4)" could be coordinated with alternatives in the next section relating to vegetation.

6. Vegetation

Abnormal growth patterns of native and introduced plant species have been widely identified as causing flooding problems in the Ahtanum and Wide Hollow watersheds, as discussed in the Channel Routing of Flood Waters section of Chapter 7 of this plan (additional background - Vegetation section of Chapter 4). The Committee discussed a wide variety of options but also recognized several potential difficulties. First was the anticipated high cost of watershed-wide vegetation management by one or several agencies. The second was the possibility that private land owners would remove necessary riparian plants if vegetation management was implemented on an as-needed parcel by parcel basis. The FCZD and the City of Yakima conducted a pilot project in the winter of 2009-2010 to increase channel conveyance. Additional information about this project is located in Appendix I.

The first alternative, "**A. Utilize natural solutions for in-stream flooding issues:**" contains two sub-alternatives. The first is to add wood to selected stream reaches between bridges so it will catch woody debris to decrease the amount that gets hung up on the bridge and also improve habitat diversity. Identifying locations where this would be beneficial while not adding an unacceptable increase in out of bank flooding may be difficult. The second refers to utilizing native plant species – esp. shrubs – for erosion control and bank stabilization. Revegetation is already a mitigation component in permits for other bank stabilization methods like rip rap, but is not widely promoted or used to increase bank stability by itself.

The second alternative, **"B. Control or Replace Undesirable Plant Communities"** contains three sub-alternatives. The first includes researching plants and plant communities that can

be substituted for hybrid willow, including non-native species. This would require input from-and coordination with-regulatory agencies such as state Fish and Wildlife Department (WDFW) and local jurisdictions that regulate Shorelines and Critical Areas habitats. The next sub-alternative refers to using regulations or regional permits to control undesirable species. A regional permit would likely only be possible for WDFW hydraulic permits, but policies added by amendment to the Comprehensive Plans of the jurisdictions may provide a comparable function at the local level. The last sub-alternative proposes a program for long-term management of hybrid willow. This would be fairly expensive and would need to occur into the future. This may not be feasible without an agency stepping forward or a long-term funding source.

After further investigation of the status of hybrid willows, the FCZD added a new recommendation to **"Petition State Noxious Weed Control Board to list hybrid willows as invasive species as designated in other states"**. This would provide a clear regulatory framework for vegetation management in problem locations of the CFHMP area. Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). The FCZD submitted an application to add three willow species to the state noxious weed list (C class) in March 2011. The species submitted are either non-native willows or hybrids derived from non-native species. The Washington State Noxious Weed Control Board (Board) will decide whether to add the submitted species of willow to the Noxious Weed List in September 2011. The entire list is then open for comment at a public hearing. After consideration of any testimony the Board will make final decisions on the new weed list which will become effective January 2012.

The third alternative, **"C. Increase evergreen riparian vegetation at known ice jam locations"** was identified as a site specific problem. Locations known to have frequent anchor ice build-up are also frequently deficient in riparian cover, esp. evergreens that would provide microclimate effects even in the winter. The first need for this alternative would be an inventory to identify locations where this kind of vegetation would reduce ice formation.

7. Channel Relocation/Reconfiguration

This section includes two alternatives. The first, **"A. Relocate modified streams away from high-intensity uses, or restore incised stream channels to allow for natural riparian/flood function"**, refers to streams that are highly modified and are usually closer to urban or commercial/industrial areas. Several creeks are identified as examples on the alternative summary table. One assumption included in this alternative is that channels perched above their floodplain experience flooding that is less predictable than stream channels in the lowest portion of their floodplain. The more predictable a flood is, the less likely it will be to cause personal or property risks. Greater predictability also makes flood hazard mitigation more straightforward to design and more effective.

Alternative **"B. Flood overflow channels/conveyances where channels are perched"** was not included in further committee discussions after it was generated. This was due to a preference to relocate streams to the bottom of their floodplain whenever possible.

Relocation is generally preferred because flood response would be more predictable and there would be no design or maintenance needed for a diversion structure. However, there may situations where relocation is not possible, so overflow channels would provide some reduction of flood risk.

8. Channel Maintenance

This section includes one alternative, **"A. Perform periodic channel maintenance (Stream clean out) at identified problem areas"**. This alternative refers to gravel accumulation in stream channels, especially where this decreases bridge conveyance. This is especially a concern in the upper Wide Hollow drainage. Separate components of this alternative include a need to explore policy options, model sediment transport in the drainage and selecting options that will increase longer-term stability in the channels. This topic will require a solid scientific background to help form a consensus on possible solutions. The FCZD began analysis of a sample number of bridges to investigate sediment deposition and options for sediment removal in and near bridges. More information about this analysis is located in Appendix G. The FCZD also began pilot channel sediment and vegetation removal projects, one of which is provided in Appendix I.

9. Beavers

There are three alternatives regarding beavers that range from the flood problems they cause to their benefits for watersheds. The first alternative, **"A. Establish regulatory measures (buffers, setbacks, etc.) to allow for localized flooding/changes in water surface level or the channel"**, considers allowing beneficial beaver activities where possible. The largest difficulty for this alternative will be identifying locations where this will not create local or downstream flooding that is unacceptable. Once potential locations are identified, policy and regulatory changes would need to be proposed and implemented.

Alternative B, **"Deal with beavers on a case by case basis- use discretion based on situation (is the floodplain function provided by the beaver a good thing or a bad thing?)"** includes the status quo permitting by WDFW and other regulatory authorities for beavers causing local problems. It also includes developing policies for relocation and use of beavers to help restore degraded stream reaches. Some of the policy portions of this alternative will require knowledge gained from the last beaver alternative, **"C. Who is responsible? Identify protocols for beaver management"**. A necessary step for beaver management is to determine all of the various regulatory and responsible agencies and governments. Once all of the stakeholders and regulators are identified (and their authorities), the first two alternatives can be addressed.

10. Flood Protection

The alternative tracking process-to account for every alternative-turned-up three alternatives that didn't fit easily into the other categories, so the Flood Protection section was created in the channel issues/river function category. The first of these alternatives, **"A. Natural changes in the channel become a problem when they threaten homes, businesses, agricultural land, or infrastructure"** refers to structural flood protection measures. The first sub-alternative lists alternatives that have already been suggested when channels change: levees, armor, buffers, channel migration zones (CMZ). The second also includes measures

already being done and suggested (structural measures). Comments raised when these alternatives were generated included defining "threaten" and whether there is a threshold level of risk. Discussion of the term "threaten" identified it with erosion and potential for land and buildings lost. A risk threshold was not determined. While the possibilities described above may not be the preferred method to address channel changes, it may be the only alternative in some locations.

The second alternative, **"B. Utilize "softer" solutions for bank stabilization, bio-engineering"**, expresses a preference for using bio-engineering methods when possible. The use of vegetation for bank stabilization is included in the vegetation section already discussed. Other possibilities included in this alternative are use of large woody debris and reconfiguring the slopes of the stream bank so they are more easily revegetated.

The last alternative in this section is, **"C. Levees constructed along perched channels (i.e. Cottonwood Grove)"**. This alternative applies to perched channels used in the past for irrigation conveyance or other agricultural practices. If channel relocation or overflow channels are not possible in a specific location, construction of a levee would help reduce the flood risk for existing properties or infrastructure. Due to anticipated high maintenance and construction costs, permitting difficulties and residual risk for properties behind the levee, this is not likely to be a preferred alternative unless other options do not exist.

2. WATERSHED FLOOD ISSUES

This category is divided into stormwater related and non-stormwater sections. It includes items that are broader than the channel issues and that are generally a factor in the entire watershed.

1. Non-Stormwater Watershed Issues

There are six widely varied alternatives included in this section. The first, **"A. Alter DID management over the long term as land use changes"**, deals with issues related to conversion of land from agricultural to urban use. DIDs (Drainage Improvement Districts) were originally created by groups of farmers to drain high ground water and/or to remove excess irrigation flows. Any DID that becomes inactive (does not elect boards of directors) reverts to management by the County Engineer. There are currently seven DIDs within the CFHMP area, all of which are managed by Yakima County. Due to annexation by the cities over time, most of these DIDs are now within cities of Yakima and/or Union Gap. Yakima County has recently begun studies to determine whether there is a current need for the DIDs. This will include how they do - or could - play a role in stormwater management. For purposes of this plan, any future plans for the DIDs should include a criterion that any conversions not increase flooding. Considerations would include high ground water influences on flooding, removing private connections, and the sizing of run-off facilities (discussed later in stormwater section).

Alternative "**B. Consider environmental benefits in funding processes**" refers to including environmental benefits in cost benefit analysis for projects and grant applications. While determining and directly including these costs is relatively new and not well defined, the inclusion of habitat mitigation costs are already included in projects. One method is to offset

mitigation with the actual benefits. The next alternative, "**C. Develop pre and post-disaster program for implementation of habitat goals in flood hazard reduction/recovery projects/programs**", proposes that habitat goals be included as a component of flood hazard reduction activities. This would require development of the habitat goals, their dissemination to jurisdictions or agencies who could implement them, a commitment to implement them when possible, and perhaps a funding source separate from those funding the flood reduction/recovery project. There are several recent plans that include relevant habitat goals, the Yakima Sub-basin Plan, and the Yakima Basin Salmon Recovery Plan. Grant funding is also available for projects that implement goals identified in these plans.

The next alternative, "**D. Preserve natural drainage including draws that provide flood protection**" was added to this section and the next section (Stormwater) by the committee during the alternative review meetings. It was added in recognition of the flooding role played by draws and intermittent streams that are typically not included as FEMA identified floodplains. Type 5 streams are no longer regulated as streams in the 2007 Yakima County Critical Areas Ordinance (under appeal as of November 2008). These topographic features may still fall under regulation through grading or development permits or as floodplains or geographic hazards.

Alternative "**E. Planning for the joint needs of fish and wildlife in floodplain development**", encourages a more proactive approach for habitat needs when floodplain development is considered. How this would be implemented (for example, as a mitigation for development) will need to be addressed when recommendations are formulated from the alternatives. Alternative, "**F. Design bridges and irrigation diversions to reduce potential for debris and bedload (sediment) accumulation**", is placed in this more general category (Watershed) since it refers to planning for both infrastructure types and includes sediment. Because accumulation of debris and sediment is such a problem in this watershed, additional alternatives related to design, maintenance and monitoring were also developed in more specific categories such as roads and bridges.

2. Stormwater

This section contains eight alternatives, many of which refer to recent (2007) initiation of a regional stormwater program in response to federal EPA requirements (NPDES – National Pollutant Discharge Elimination System). These requirements apply to both cities and the unincorporated county within the urbanized area of the City of Yakima (Sunnyside and Selah are also included, but are outside the plan area).

The first alternative, "**A. Utilize NPDES stormwater programs to retain site runoff and reduce overland flow for Yakima urbanized area**", acknowledges the contribution of urban runoff to flooding. The regional stormwater manual and ordinances for the jurisdictions are currently being developed so the timing allows an ideal opportunity to provide input regarding flooding. The adopted ordinances for these flood-prone basins require on site detention of the 25 year event which also means no incremental peak increase for the 100 year flow. This is a significant change to peak runoff from urbanization for all future development. The second alternative, "**B. Develop stormwater standards for detention and retention on site and regional; abide by and enforce stormwater design standards;**

and incorporate flood issues into stormwater programs", will require implementation through a variety of mechanisms ranging from the manual mentioned above to the overall stormwater programs.

Alternative, "**C. Establish a relationship between stormwater standards and development standards in floodplains with regard to flooding (high water table and low gradient)**", refers more specifically to the connection between stormwater, development and flooding. How this relationship is identified and then incorporated into stormwater and development regulations has not been determined. Some of these considerations may be included development of the Stormwater Manual and Ordinances referred to above. Alternative, "**D. Preserve natural drainage including draws that provide flood protection**", is the same as the alternative listed above. It was included in stormwater also since recognition of natural drainage is a significant component of stormwater programs.

The next two alternatives deal with sizing of drainage facilities, "**E. Size drainage facilities for future build-out and flood flows – including ability to pass upland drainage of 100-yr flow**", and, "**F. Limit new connections to existing undersized drainage systems, i.e. DIDs, storm drains, and resolve the runoff issues presented by the Drainage Improvement Districts (DIDs) that may act as stormwater drainage systems although designed for subsurface flows**". The first alternative could be addressed by modeling future build-out and then including the sizing requirements in stormwater standards and guidelines. The second points out there will be increased runoff problems if developers and jurisdictions try to incorporate existing DID systems that were not designed for stormwater purposes. Yakima County currently evaluates every request by new developments or cities to connect to the DIDs, but it's likely that additional inventory, modeling, and retrofitting would be required for any significant increase in their use for stormwater. This alternative also includes consideration of existing stormwater facilities that were constructed for smaller design storms (10-year), no upland pass-through conveyance, and less impervious surface.

Alternative "**G. Implement an effective Stormwater Management Program that reduces basin flooding**", specifically identifies stormwater management as a method to reduce flood in the CFHMP area. This alternative may be more appropriate as the main stormwater alternative with the other alternatives included in this section as sub-alternatives within it. Alternative "**H. Establish policies for retrofitting and re-development of stormwater facilities and flood water routing in existing urbanized areas**", would create the policy framework necessary to implement many of the other alternatives in this section. DIDs, the county and cities would be involved in creation of the policies which would likely include funding sources and responsibilities for construction, maintenance and management. This alternative was found to be redundant and already included in stormwater programs so committee decided to drop it.

3. BRIDGES AND ROADS FLOOD ISSUES

Bridges and roads was one of the most discussed categories for this flood plan. Primary flood problems identified included: bridge conveyance and orientation; roads interaction with flood flows; roads acting as dams; roads over-topped during flooding; and, roads in "islands" surrounded by flooding. Most of the emergency response alternatives related to

over-topped roads are located in Flood Response (Category 9). Topics in this category are split between existing infrastructure and future infrastructure.

1. Design

Nine alternatives are included in this section. The first alternative, "**A. Adequate Bridge & Road Crossing Standards**", includes five sub-alternatives. Many of these require increased standards which would likely need additional funding, public participation and expanded design parameters. The first sub-alternative requires additional free-board to convey debris and ice. Free-board in this instance refers to additional clearance included in bridge design to prevent ice and debris from catching on the bridge. The fourth sub-alternative also refers to increased conveyance but achieves it by in-channel designs, such as orienting large rocks in the channel in such a way as to maintain stream depth and velocity. The second sub-alternative would allow transportation planners and designers more flexibility to include floodplain effects or flood reduction designs, including extended review of upstream and downstream areas. The first step needed would be to determine the function standards and policies. Currently design considerations are limited to a standard right-of-way area around a project. The third sub-alternative also requires an increase in conveyance, but in this case, to account for habitat requirements such as the large woody debris frequently required for mitigation. The last sub-alternative promotes conservative design where channels are unpredictable or where natural channel processes have been lost.

A new recommendation was added to "A" in the Bridges and Roads category in the Design section, **"Design of bridges and bridge footings should incorporate long-term erosion and scour conditions that do not impede flood conveyance"**. Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). The need for this recommendation became apparent as bridges were being cleaned on Wide Hollow Creek and during review of the new draft flood maps. The purpose is to ensure bridge footings are deep enough to prevent erosion problems and ensure the design will convey the flows expected at the bridge site for up to 100-yr flood events.

Alternative "**B. Improve bridge conveyance at 16th Ave**", refers to a specific bridge and was originally generated during the Emma Lane area discussion. The next alternative, "**C. Consider lowering existing roads where they act as dams and cause flooding (ponding)**", would first require identification of these road segments. Review for whether they are needed for emergency response (alternative E below) would also be required before deciding to decrease the road elevation.

A new recommendation was added to the Bridges and Roads category in the Design section, "**Also investigate installing culverts in currently undrained artificially ponded areas if this would help mitigate risks from smaller 5 – 25 year floods**". Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). This was merged with recommendation "C" regarding roads acting as dams and creating ponding. This was added to mitigate inundation with relatively minor structural projects in locations where even smaller floods can cause damage and reduce access to

property. These locations would need to be identified first and coordinated with the other recommendation proposing lowering road elevations in specific areas.

Alternatives "**D. Provide armoring of roads which act as levees (Cottonwood Canyon Rd., etc.)**" and "**F. Armor road ditches where road fill is going to contribute to excess bedload**" acknowledge that ditches conveying flood flows and roads acting as levees need additional protection to allow emergency access (see E below), reduce repairs, and prevent delivery of road prism material to streams during floods. Also see Alternative #12D-3 in the Monitoring / Inventories category (last alternative category).

Alternative "**E. New and reconstructed roads should be evaluated. New roads that are not intended to be passable to a certain standard (10, 25, or 100 year flood), should be built at grade**" requires that access standards during floods be included in road design requirements. While the preference is to build roads at grade to prevent damming or redirecting flood flows, there is also a need for access as part of an emergency flood response (such as evacuation). Alternative A in the next section contains the first step which is to decide on and designate critical access routes. Input sources for making these determinations would include first responders, county emergency management, transportation, planners and flood control. These two alternatives would likely be combined to generate the recommendation for this topic. (Also see alternative 2.B. in the Flood Response category).

Alternative "**G. Provide better floodplain mapping and modeling to allow for better infrastructure design, including current Ahtanum-Wide Hollow remapping**" refers to current and anticipated future floodplain mapping products. In addition, models generated for specific projects may have additional utility for other infrastructure projects in the area. This alternative could include distribution of products and/or notification of product availability to jurisdictions and engineering consultants with projects in the watershed. The next alternative, "**H. Modify drainage standards for roads in overflow areas (i.e. Emma Lane area)**", requires special consideration of drainage design in areas that have flood flows, but no identified stream channel. Considerations could include designs that would be less likely to add to flooding or prevent redirecting flows to unexpected locations. The last alternative in this section, "**I. Recognize the limitations of culverts as flood conveyance structures**", may primarily be relevant for jurisdictions considering private road and driveway access proposals. The vast majority of culverts in the CFHMP area are for private access, minor natural drainage channels or irrigation related conveyance.

2. Monitoring / Maintenance

Five alternatives are included in this section. A few similar topics are included in the Monitoring / Inventories category (the last alternatives category).

The first alternative, "**A. Decide upon, designate and maintain critical access routes at 10, 25 and 100 year events *Coordinate with 1D and 1E above**", was already discussed in Alternative E above. Alternative "**B. Actively monitor and manage channels adjacent to bridges to improve and maintain bridge capacity**" is similar to conveyance alternatives at the beginning of the previous section, but it deals with existing bridges rather than design.

This could be described as an adaptive management approach that includes additional targeting of problem bridges.

Alternative "**C. Replace old culverts with higher capacity culverts based on level of risk**" is currently thought to be a relatively minor problem. Additional information may be needed to see how extensive this problem is. Only two culverts are currently known to have capacity problems in the public transportation system for this area. It's also possible this was viewed as a problem due to blockage of culverts used to convey irrigation waters or located on intermittent drainages. The next alternative is similar, "**D. Investigate and recommend increased maintenance and debris cleanout of culverts and ditches on public roads (coordinate with road maintenance crews to optimize ditch cleaning for flood purposes)**". The first step would be to identify locations where this is a recurring problem. Implementation of alternatives C and D are unlikely to reduce damage caused by large floods.

The last alternative in this section, "**E. Assess the cumulative effect of new road policies and standards regarding roads acting as dams or conveyances**" includes a similar sub-alternative to include watershed flooding considerations when planning transportation infrastructure. The overall approach would be to maximize transportation efficiency and minimize roads in floodplains.

3. General Planning

Eight alternatives are included in this last section for Bridges and Roads. These alternatives deal primarily with program level planning and funding considerations. Alternatives "**A. Inventory and rank problem bridges throughout the watershed and coordinate with Capital Improvement Plans of local and state jurisdictions**" and "**B. Integrate existing or new funding programs into strategic program for addressing problem bridges**" both refer to developing and seeking funding for problem bridges. One funding difficulty that has been identified is the definition of a bridge. Short-span bridges are not considered to be bridges for some common funding sources. Bridge information from the jurisdictions and recent data collected for flood map restudies could provide initial information to start the inventory. Alternative "**G. Identify and map overflow paths and critical bridges**" would also include overflow paths in this inventory. The last funding alternative in this section includes not just bridges but also road systems, "**C. Explore ways to take better advantage of Federal and state funding programs to reduce or mitigate the environmental effects (including flooding) of existing road systems**".

Alternatives D and H both limit roads in the floodplain: "**D. Limit/restrict/reduce the number of bridges and road crossings, especially small bridges and culverts**", and "**H. Limit access to major arterials where they cross or are adjacent to floodplains**". This can be accomplished through road standards, combining existing access points or limiting development density. Both of these alternatives were created to prevent additional road related flooding problems, including loss of access.

Alternative "**E. Work with landowners upstream and downstream of new infrastructure to design access to property to mitigate flood impacts**" is related to the right-of-way sub-

alternative in the Design Alternative A above. These two alternatives could be combined when recommendations are created. The last alternative in this section is, "**F. Replace flood damaged transportation infrastructure in a manner that reduces vulnerability to future flood hazard**". A first step for this alternative would include investigating whether FEMA's Public Assistance program would fund additional replacement costs if it was needed to reduce future vulnerability.

4. IRRIGATION FLOOD ISSUES

1. Conversion of Irrigation Systems

The only alternative for this section is, "**A. Consolidate irrigation diversions to minimize stream impacts, consider upgrades like piping, and consider converting irrigation systems to a pressure-based system, i.e. Pine Hollow**". This alternative differs little from those listed in first Channel Issues alternative above, and they may be combined in the recommendations. The three combined alternatives here place the emphasis on conversion of irrigation infrastructure primarily to reduce flood damage risks to the irrigation structures. The alternatives in the Channel Issues section address flood problems caused by the irrigation hydrographs and infrastructure.

2. Infrastructure Maintenance and Inventory

Three alternatives are included in this section. The first alternative, "**A. Develop a program of proactive debris removal and maintenance on irrigation structures**", would probably be most helpful to mitigate small to moderate sized flood events. The sub-alternative is a more specific debris related alternative that suggests use of temporary or sacrificial structures to catch debris or prevent it from damaging permanent irrigation structures. Further discussion with the irrigation districts to identify and quantify the problem could be the first step for these alternatives.

The next alternative is, "**B. Conduct an inventory of existing irrigation infrastructure (working or abandoned) and flooding impacts**". The inventory would also provide valuable information useful for other irrigation related alternatives. The sub-alternative suggests removable irrigation structures such as large pump and pipe systems that may be prone to icing problems. It is currently unknown if ice forming on this type of irrigation structure contributes significantly to flooding. The other major component of this alternative is identification of abandoned infrastructure that is adding to flood problems. This is a known problem at some of the site specific locations identified in this plan (Emma Lane area and the near the Mission) and is expected to contribute to flooding in other locations as well.

Once the inventory listed above is complete the next alternative would seek funding for removal of the abandoned structures, "**C. Identify sources of funding for removal of abandoned irrigation structures**". This would involve discussions with irrigation districts, North Yakima Conservation District and other agencies that may have funding available. Who would apply for funding and implement projects will depend in part on whether there is still an active irrigation district with a connection to the structure.

The last irrigation alternative involves possible new infrastructure, "**D. Investigate the possible use of flood gates or siphons to reduce flood flow routing by irrigation**

infrastructure, if needed, identify locations of most benefit". The siphons (or undershots) referred to are intended to pass upslope flows from natural drainages (gulleys or low spots) under the canals. It is unknown whether, or how much, a lack of siphons contributes to flooding. Some use of flood gates or boards is already occurring, such as the Yakima Valley Canal Company inserting boards in one canal each fall to prevent ditch-conveyed flooding. Additional discussions with irrigation districts in the area, especially in the Wide Hollow basin, may identify additional locations for new siphons or flood gates.

5. LAND USE FLOOD ISSUES

Alternatives in this category focus on the decreasing amount of land available for flood conveyance and storage. This decreasing flood capacity endangers current and future development and makes flooding less predictable. For these reasons, most of the alternatives generated involve the following: increasing areas available for flooding; decreasing the density of new structures in the floodplain; decreasing the number of existing structures in especially dangerous locations; and increasing the potential for public use of areas with the multiple purposes of flood capacity, recreation and open space. Chapter 6 includes information about broader planning frameworks, the Growth Management Act, regulations from the federal to local, permitting and how it is expected to fit together.

1. Subdivisions / Housing Developments

Three alternatives are included in this section with the first also providing some over-arching policy guidance, "**A. Minimize new homes/structures etc. in harm's way**". The first sub-alternative is to effectively integrate flood functions and risks into individual subdivision platting processes. The second is creation of more stringent development standards for some flood prone areas and jurisdictions (note – this alternative was dropped during recommendation review since it was not specific about what was included). This would require either criteria or an inventory to identify these potential flood prone locations. The last sub-alternative is to work toward common development standards. This was a frequently voiced concern through-out the flood plan process. A wide variety of stakeholders stated that development projects would be quicker and easier to conceive and implement if the development standards were more similar for all jurisdictions within the CFHMP area.

The second alternative, "**B. Work for consistency in zoning standards for developments and buildings within floodplains. Determine gaps in the regulatory scheme**", continues the flood theme but addresses zoning standards. One gap noted in Chapter 8 is that not all jurisdictions have a zone identified that allows a reduced development density or Open Space. The last alternative in this section is, "**C. Establish standards for subdivision in the floodplain- at the minimum require a buildable area outside of the floodplain. Standards for lot size and housing location.**" This alternative was proposed to decrease flood risk for new structures by ensuring a building envelope outside the floodplain.

2. Incentives / Taxation

The four sub-alternatives were grouped into an overall alternative for this section, "**A. Provide special incentives- (clustering, density bonuses, Transfer of Development Rights)**

for retention of floodplain function in development design (13B-4)". The first sub-alternative provides bonuses for developers who protect flood hazard areas. These could include allowing increased density which could be specified in zoning ordinances. The next sub-alternative suggests utilizing property owner incentive programs for maintaining flood capacity. One method would be to provide property owners with a central information resource about these programs.

The last sub-alternative applies only to agricultural land. To take advantage of the open nature of agricultural land the first part of the sub-alternative would utilize existing programs to provide benefits for farmers allowing some flooding on their property. To prevent erosion, this would be most applicable to land with traits that encourage sheet flow type flooding. The last part of this sub-alternative would develop a compensation program for loss of productive farm land from erosion. Either of these would require more investigation to determine what options are possible and if there are already existing programs that could be utilized.

A new recommendation "**B**" was added to the Land Use category in the Incentives/Taxation section, "**Encourage jurisdictions to join FEMA's Community Rating System (CRS) to reduce property owners' flood insurance premiums**". Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). Unincorporated Yakima County is the only community that is a member of the CRS program. Communities in this program implement activities that earn points to reduce flood insurance rate premiums for property owners. The County has a classification of 8 which reduces flood insurance premiums by 10% for those inside and 5% for those outside the regulatory floodplain. The Yakama Nation would need to join the NFIP (National Flood Insurance Program) before they could join the CRS.

3. Open Space / Parks

This category includes one alternative that has eight sub-alternatives, "**A. Encourage the retention of open space in floodplains through:**" One way to provide adequate flood conveyance and storage and decreased risk is to ensure there are open areas in the floodplain. Parks permit multiple uses of floodplains for flooding as well as recreation.

Several of the sub-alternatives refer to the requirements for parks and open space in long range planning for the Growth Management Act (GMA). The jurisdictions could include floodplains in their planning for these GMA elements with the added benefit of reducing flood risk. The sub-alternatives also include adding floodplains or flood problem criteria to existing programs and activities. This includes the Open Space taxation program and developing policies and standards for open space retention as part of the Urban Area expansion process.

One sub-alternative calls for inclusion of open space in site plans: "Incorporate open space/floodplain retention into site plans". The UAZO (Urban Area Zoning Ordinance) requires a class 2 or 3 review for all development permits containing floodplains. Provisions are also listed for projects where the developer proposes - or the reviewing official requires -

Common Open Space for the development. Union Gap also contains requirements related to Common Open Space for class 2 or 3 developments, but does not utilize a floodplain overlay zone trigger for higher than a class 1 review. Yakima County outside the UAZO is subject to a regulation stating the board of county commissioners may require plats to designate up to 5% of their land area as public or private parks or recreation areas. To date, this option has rarely been successfully utilized. Yakima County outside the UAZO also does not have a floodplain trigger that automatically moves a development in the floodplain above a type 1 review (comparable to class 1). Further discussion of a floodplain overlay zone alternative is included below in section 6, "Standards for Development in High-Risk Areas".

A slightly different approach incorporates walking paths or trails into floodplain retention. This alternative would require planning and funding over a larger area and would need to address any adjacent property owners concerns. Several large area trail systems have been implemented or proposed in recent years, so this alternative may be more possible now than in prior years.

4. Large Scale Retention of the Floodplain

This section contains two alternatives; the first has four sub-alternatives that deal with development density in floodplains, "**A. Reduce density in the floodplain through various methods**" (14C-3). The first sub-alternative (4-12) provides flexibility when reviewing proposed developments in the floodplain. This would place a higher priority on preserving and restoring floodplains in areas where floodplain functions have not already been significantly modified. For example, a lower priority would be placed on floodplain preservation and restoration in areas with substantial diking or development of the floodplain.

The second sub-alternative (14C-4, 14C-5) proposes changes to zoning and comprehensive planning documents to permit lower intensity development in high risk areas. These floodplain corridors will be identified in the flood map restudies currently under contract (see the Information/Outreach category). Implementation of this alternative could be coordinated with the proposed floodplain overlay zone discussed in section 6 below.

The third sub-alternative (13A-15) addresses the use of development moratoriums or high standards of proof in high risk areas. No specific areas were identified by the committee. This alternative is only intended to be used in circumstances such as, unmapped areas and locations with known significant changes since it was last mapped. Since this would be an exceptional action, it is anticipated it would be used rarely and only for limited lengths of time with clear documentation of the flood risk.

The last sub-alternative (12H-4b) in this group specifies that new major arterials and traffic generating developments should be located outside the floodplain. Other similar alternatives such as those mentioned above in the Bridges and Roads category (12H-5, 12H-9, 12A/B-9, 12C-4, 12H-4c) also address the potential increase in risk and development density connected to road system development. Alternative 12H-4b, however, is the only

one that specifically states this type of development should be located outside of the floodplain.

The next alternative in this section, "**B. Incorporate principle of floodplain planning into infrastructure & similar facilities plans (8C-2, 12H-2)**", combines two alternatives to ensure capital facilities improvements and expansion of the transportation network are consistent with applicable CFHMPs. This includes integrating protection of floodplain function for a range of projects from new roads such as the proposed "Nob-Hollow connector"**,** to routine bridge replacement, and to larger planning efforts like the proposed north-south connector route. Incorporation of floodplain principals would be done through Growth Management and Capital Facilities planning processes. This would ensure floodplain options and constraints are incorporated into the planning process earlier, which will reduce overall costs and produce a more flood resistant outcomes.

A new recommendation "**F**" was added to the Land Use category in the Large Scale Retention of the Floodplain section, "**When developing floodplain planning, zoning, and development standards or use designations, the jurisdictions should consider increased costs created by floodplain risk**". Because this item was added when the recommendations were being developed, it will be in the Recommendations table, but not the Alternatives tables (and does not have an alternative number). These additional costs include future land owner costs for flood damage, NFIP insurance costs, and construction costs for flood prevention. To minimize these costs consider urban land use preferences in the following order from most to least preferred: open space, trails, parks and recreation, light industrial, commercial, low density R1 (one lot per acre), and clustered residential. The purpose of this recommendation is to encourage communities to include secondary costs in their consideration of floodplain development. Additional information is included in the Economics of Floodplain Development section of Chapter 5.

5. Acquisitions / Easements / Incentives

This section includes four groups of alternatives that compensate property owners for maintaining or increasing floodplain capacity and conveyance. Though the cities, county and FCZD can legally acquire land to reduce flood risk through condemnation, acquiring land or easements would likely require assistance by grant funding. Grants available for these purposes require willing sellers, which may reduce the effectiveness of this approach or greatly increase the length of time needed to implement a specific project.

The first alternative, "**A. Acquisition/easements of land surrounding flood problem areas**", includes a total of eight merged sub-alternatives. The first group of three sub-alternatives (4-13, 15B-4, 15D-4) refers to properties in areas at risk for inundation. Known risk locations include the specific areas identified in this plan: Emma Lane, Shaw Creek, St. Joseph's Mission at Ahtanum, and portions of Union Gap. The next sub-alternative (13B-5) is somewhat more general and provides for fee simple or easement acquisition of land for a variety of purposes consistent with floodplain functions. This alternative would be applicable when floodplain function and inundation risk reduction was the driving motive.

The next sub-alternative (9C-12) addresses maintenance of drainage easements and asks who will enforce maintenance. This alternative touches on several issues: who pays for and does maintenance; does maintenance include planting, irrigating and mowing vegetation; what enforcement is necessary if property owner obstructs the easement; and, might enforcement be needed if property owner removes more or different species of plant than is called for. Easements that support riparian vegetation may require a vegetation management plan to ensure the easement remains open for flood conveyance.

The last group of alternatives (15C-3, 15C-9, 15C-10) refer to buyouts, relocations, easements, and flood-proofing, and differ from the previous alternatives in several ways. They include risks from erosion; they were generated with natural channel changes in mind; and are grouped to specifically address the policy and/or program guidelines necessary for implementation. Also, alternative 15C-9 specifically includes buyouts for property lost due to flooding (also see 15C-8 in Taxation/Incentives above). While the wording in the original alternatives don't specifically address guidelines, any jurisdiction or agency trying to implement them will need to have a program and/or policy basis allowing them to make these types of purchases.

A new recommendation was added to "A" in the Land Use - Acquisitions / Easements / Incentives section, "Make acquisition of FEMA identified Repetitive Loss properties a high priority". Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). The Ahtanum and Wide Hollow watersheds contains six of the nine FEMA identified Repetitive Loss properties in the county. Five of these six are in either the Emma Lane or Shaw Creek areas. One of these houses was mitigated by acquisition in 2010 through an FCAAP grant. One of the difficulties in mitigating these properties is that most FEMA grant funding is only available if the property still carries a flood insurance policy. FEMA's Repetitive Loss strategy targets insured property that experienced:

- Four or more paid flood losses of more than $1,000 each; or
- Two paid flood losses within a 10-year period that, in the aggregate, equal or exceed the current value of the insured property; or
- Three or more paid losses that, in the aggregate, equal or exceed the current value of the insured property.

The second alternative, "**B. Utilize tools such as floodplain easements to preserve off-site storage of water and sediment in farmland (existing pastures, alfalfa), while preserving use as farmland**" merges two individual alternatives (15B-5, 15B-8) to take advantage of the unique attributes of farm land occurring in floodplains. This includes encouraging maintenance of existing farm use of floodplains including possible floodplain easements and links to programs for preservation of farm land. Maintaining farm use can reduce flood risk by providing additional flood storage and conveyance on open land where buildings will not be at risk. It would also more be more effective to coordinate vegetation management and other flood related activities with one property owner versus multiple owners if the land converted to more urban uses.

The third alternative, "**C. Encourage organizations (neighborhoods, County/City/Yakama Nation or others) to purchase floodplain areas (9C-10)**", is another land purchase method aimed at increasing flood storage and conveyance. This could be considered the purchase component of alternatives proposed above in the Open Space section. Encouragement could be in the form of: providing draft policy guidance; connecting organizations to grant opportunities; and forming partnerships for acquisition as opportunities arise.

The last alternative, "**D. Provide incentives for landowners and developers who provide floodplain storage (4-6)**", originally included buyouts also which duplicates the other buyout alternatives listed above in the "A. Acquisitions…" section. The remaining portion of this alternative (incentives for storage) appears to be the same topic as alternative 9C-3 in the Taxation/Incentives section above and may not be needed.

6. Standards for Development in High-Risk Areas

The first alternative for this section, "**A. Establish Flood Overlay Zones in affected jurisdictions. These overlay zones would have legal status (i.e. in a zoning code) and contain development standards, objectives, and review/process criteria for the broad suite of land uses that occur in floodplains. (13B-3)**", was initially dropped and later added back to the list of alternatives. The alternative was dropped at an April 2008 meeting when a planner on the committee explained this alternative was unnecessary due to zoning changes and CAO-SMP updates. In February 2009 when it became clear there was a regulatory gap since zoning and CAO-SMP regulations vary a great deal between jurisdictions, this alternative was reinstated. There was also a request to modify the original wording of the alternative, so staff clarified the overlay zones' status and connection to ordinances. Currently the only floodplain overlay zone exists in the City of Yakima and the Yakima Urban Area Zone portion of unincorporated Yakima County. Several benefits may be possible through a floodplain overlay zone. One is the greater potential consistency of floodplain regulations between jurisdictions. Another benefit from this alternative could be a regulatory requirement for jurisdictions to do at least a Type 2 review for any development proposed in a floodplain overlay zone.

The next alternative group is, "**B. Develop policies for areas of existing dense development within the floodplain (such as Ahtanum and Wiley City)**", also includes drainage improvements. Though both sub-alternatives (13A-13, 14A-4) use Ahtanum and Wiley City as examples, they are not limited to these geographic areas. The final sub-alternative in this group does not have an alternative number since it was added during a committee meeting (April 7, 2008) about Land Use. The proposal for this alternative to make Ahtanum and Wiley City a special study area occurred when it became clear these are unique areas with serious flooding problems. Details about the alternatives in this group (B) were not identified.

The next alternative in this section is, "**C. Establish policies in flood prone and flood hazard areas for directing preferred locations for the siting of new infrastructure such as major and minor arterials, water and wastewater distribution mainlines, regional stormwater facilities, parks and greenbelts (13A-11)**". This alternative proposes including flood risks in long range planning done by the jurisdictions. There are several other

alternatives that address specific aspects of this topic, but this is the most broad policy statement that includes all long range infrastructure planning.

The last alternative in this section was added back into the alternatives during the tracking process and was then moved from the Bridges and Roads category to Land Use. This alternative groups a number of sub-alternatives created initially during work on transportation infrastructure, "**D. Limit/restrict/reduce the number of bridges and road crossings, especially small bridges and culverts. [This can be accomplished through road standards, combining existing access points or limiting development density] (12H-5, 12H-9, 12A/B-9, 12C-4)**". This group of alternatives triggered much discussion, in part questions about whether this is already included in CAO, SMP and other regulations. The Committee decided to keep this alternative in part to reinforce the importance of this topic and also because this plan includes several jurisdictions.

7. Miscellaneous Policies

There are two alternatives in this section, with the first, "**A. Ensure flood policies in the Yakima Urban Area Comprehensive Plan are implemented through ordinances and land use decisions (13A-4)**", calling for implementation of policies in this plan by adopting ordinances by the applicable jurisdictions. Planning for flooding is supported in Objective E7 of the Urban Area Comprehensive Plan. The jurisdictions currently included in the urban area plan that would need to adopt implementing ordinances are Yakima County and the City of Yakima. This alternative does not address whether or not Union Gap's Comprehensive Plan would also benefit from an implementation alternative such as this one. At the time this alternative was discussed by the committee, there was uncertainty about whether Union Gap is a party to the Urban Area plan. It is unknown if a comparable planning document has been created by the Yakama Nation.

The next alternative in this section and this category is, "**B. Develop special land use and flood-proofing standards for industrial uses relating to hazardous materials, storage, use, disposal (11B-1)**". This alternative was originally proposed in relation to the conversion of flood prone areas in Union Gap to higher intensity uses in recent years. Committee members suggested that adoption of the IBC Appendix G (International Building Code) would mitigate these concerns. More information about the International Codes is included in Chapter 6.

In reference to hazardous materials, Appendix G of the IBC includes requirements for underground and aboveground tanks; new and replacement sewer systems; and some site work. The appendix references ASCE 24 (American Society of Civil Engineers) for engineering standards including classifying structures according to the nature of their occupancy. Structures containing sufficient quantities or types of hazardous materials considered to be dangerous to the public if they are released are classified in category III or IV. For these types of hazards there may be increased elevation or flood proofing required. Beyond this, does not appear to be any specific requirements or standards regarding hazardous materials, storage, use or disposal in Appendix G. Additional discussion with each jurisdiction would be required to determine what additional land use or flood proofing standards would be desired and what the appropriate regulatory tool would be.

A new recommendation "**C**" was added to the Land Use category in the Miscellaneous Policies section, **"Provide 10 and 25 year flood extent maps for two creeks to indicate vulnerable economic areas to abate or prevent chronic "nuisance" flooding and to provide a design guideline for maintenance and improvement of channel capacity, vegetation management and guide the location of structural improvements in the floodplain"**. Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). The range of flood events is included since it is unknown which flood level will provide the most benefit until maps are produced and reviewed. The intent is to reduce nuisance flooding caused in large part by loss of conveyance combined with unusual flow paths due to valley topography. This nuisance flooding - 10 to 25 year recurrence interval floods that inundate relatively large areas – can produce inordinate amounts of structural and economic damage due to inundation of crawl spaces or foundations of buildings, and road closures or road damage. Additional information is included at the end of Chapter 8, Flooding Issues.

6. DEVELOPMENT STANDARDS / ENFORCEMENT FLOOD ISSUES

This category contains three sections aimed specifically at code enforcement, compliance with the NFIP (National Flood Insurance Program) and possibilities for special zones for specific identified problems. Chapter 6 includes information about broader planning frameworks, the Growth Management Act, regulations from the federal to local, permitting and how it is expected to fit together.

1. NFIP Related

This section contains two alternatives that would decrease flood risk to structures by requiring floodproofing or elevating the building above NFIP and Washington State minimum regulations. For purposes of this chapter, floodproofing refers to minimizing damage from flooding but does not include elevating the building.

The first alternative, "**A. Consider increased elevation above BFE of new structures in the floodplain (14A-2)**", generated discussion when the committee was finalizing the alternatives. Planning staff in attendance from the jurisdictions did not believe their elected officials would be willing to increase building elevation requirements in their communities. So as not to lose the alternative completely, the wording was changed to read "consider" rather than the original "require". Currently Washington State require at least one foot of freeboard above the BFE (Base Flood Elevation) through the IBC (see Chapter 6) for all non-residential structures. The City of Yakima and Yakima County meet the minimum IBC freeboard requirements for non-residential buildings, but Union Gap does not. This is not the case for residential buildings which are only required to be constructed at or above the BFE. None of the jurisdictions in the CFHMP area currently exceed these minimum NIFP and state IRC requirements, although the City of Yakima required one foot above the BFE for residential structures until their CAO ordinance was updated in 2008.

There are many reasons this alternative was proposed. The first is that FEMA flood maps with floodways allow activities in the floodplain that can raise flood level up to one foot. This means home owners could find themselves with flooding in their ductwork or above

their properly elevated floor. Another reason for additional elevation above the BFE is because flood elevations rise as a watershed is built-out. For this area, this occurs as land is converted from agriculture to urban land uses. One of the most important reasons to require additional elevation are studies by the Army Corps of Engineers demonstrating significant damage occurs when flood flows are still one foot below the BFE. In addition, if people choose to remain in their homes when flooding is occurring, additional elevation above the BFE may keep them safer in floods up to the 1% annual chance flood (100-yr flood). The FCZD welcomes the opportunity to present research to the jurisdictions regarding additional elevation requirements above the BFE for structures in floodplains.

The second alternative, "**B. Require Floodproofing - Floodproof utilities and Floodproof structures- elevate, make existing structures less flood damage-prone (4-8)**", combines the floodproofing language from alternative 14A-2 described above with alternative 4-8. NFIP and Washington State regulations allow new non-residential structures to use floodproofing instead of the elevation requirement for residential structures. No mechanism was discussed for how to apply this requirement to existing structures. Since substantial improvements or repairs would already require any flood mitigation measures not already included when the structure was built, implementation of this would be more valuable if it were an incentive or other program to assist retrofitting rather than a requirement.

A new recommendation "**C**" was added to the Development Standards/Enforcement – NFIP Related section, "**Utilize available flood data in accordance with FEMA's definition**". Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). This recommendation was added for any jurisdiction where the CAO's "Best Available Science" might not apply to the FEMA requirement to utilize available flood data. The intent is to encourage jurisdictions to clarify whether flood map data-such as draft and preliminary maps-will be used for NFIP regulations or CAO-SMP regulations or both.

2. Special Zones

The alternatives in this section deal with less common topics or situations that are specific to these watersheds or particular types of locations. The first alternative, "**A. Based on flood risk studies, consider stricter ordinances for flood zones in Union Gap (6C-4, 14A-3)**", combined an alternative generated in the Spring (Chambers) Creek in Union Gap meeting with one developed in the meetings regarding regulations. This alternative was placed in this category since it is regulatory in nature (the draft Recommendations list moved it to the Union Gap category).

The alternative addresses the reality of aggradation of the Yakima River and the potential for deeper flooding than people expect. The aggradation increases the likelihood of flood waters upwelling west of I-82, flood flows seeping around or through the flood gates, and the decreased ability of flood flows from Wide Hollow and Spring (Chambers) Creeks to empty out into the Yakima River. Potential ordinances that would help mitigate the increased risk in this area include requiring increased elevation of 2 or 3 feet above BFE for new construction. If recommendations such as changes to Wapato Dam are implemented and effective, this alternative may no longer be needed.

The second alternative, "**B. Consider use of the Zero or 0.1 foot rise practice from International Building Code (14C-8)**", required further definition by the committee and was not carried forward as a recommendation since it is not clear what was desired. This alternative was created in reference to using zoning and floodplain overlay zone regulations to reduce flood risk. FCZD staff was asked to research connections of zero-rise or 0.1 ft rise to the IBC. The zero rise requirements in the IBC apply only to development in floodways, and are comparable to current FEMA regulations. The only other place this is referred to in the IBC is for a floodplain designation that has not been used so far in Yakima County – a floodplain that determines BFEs but does not identify a floodway. If the new flood maps include any of this type of floodplain they will also fall under zero rise requirements. Again, these IBC regulations are comparable to FEMA minimum requirements.

There is also zero rise language in the current County CAO regulations, so the committee may have been suggesting similar language be included for the proposed floodplain overlay zone. The County Code (16C.05.28.010(1)(c)) specifies using zero rise methods when elevating structures that will be within 100 ft of the floodway or 100 ft of the ordinary high water mark if no floodway is identified. This ordinance applies to new construction and improvements outside the existing structure footprint. The no rise methods given as examples include piers, posts, or columns. This is required unless it can be demonstrated that other construction methods will not impede the movement of floodwater or displace a significant volume of water. As mentioned above, the committee's desires need to be clarified before this alternative could be successfully implemented. One option the committee could consider is to drop the IBC language and pursue the recommendation as the zero or 0.1 ft rise currently existing in the County CAO Code 16C.05.28.010(1)(c).

The next alternative, "**C. Identify areas with floodplain "islands" and develop standards (12H-6, 14A-1 (part was dropped), 14C-1)**", merges several alternatives to improve safety in locations that would become islands of dry ground in large floods. These "island" areas are caused primarily by the unusual topography of the flatter portions of the valley, especially in the Ahtanum drainage. The occurrence of interconnecting overflow paths between the streams creates "island" areas that are surrounded by, but not include in the identified floodplain.

The merged alternatives include limiting density to allow flood passage (limiting density was added at the May 2008 meeting), ensuring transportation networks take into account the surrounding area, and multiple possibilities related to putting roads at grade to reduce flood impacts as well as considering emergency access. The over-riding concern expressed by the committee is there needs to be a mechanism to allow inclusion of factors outside the site specific project area when a project includes or influences one of these "island" areas.

3. Miscellaneous

This section contains two alternatives aimed at increased coordination and support of enforcement activities. The first, "**A. Enforcement - Adequately fund enforcement activities. More effective code enforcement, especially for blatant disregard of the law (1C-4, 1C-3, 18)**", recognizes the key role enforcement plays in floodplain management. These three merged alternatives include making enforcement more effective, providing

needed resources for enforcement and ensuring that existing policies and regulations are enforced. So while the merged title seems to focus on funding, this merged alternative is broader. Discussion with jurisdiction building officials would likely point to additional actions that would aid code enforcement.

The second alternative, "**B. Coordinate between jurisdictional procedures in place for expedited permit issuance during and the period after a flood event under State and County regulations (10D-1)**", highlights the need for rapid response during flood emergencies. Additional coordination could include: annually updated state and local permit contact lists for jurisdictions and fact sheets for emergency permitting for jurisdictions and the public.

The last alternative described in this section is, **"C. Ensure floodplains and floodways are identified on final plat maps – included would be text identifying effective map date and disclosure regarding fact that the maps will change over time. Also consider including identification of riverine Critical Areas buffer on plats".** Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). Identifying floodplains and floodways on construction maps is required through the International Codes (Chapter 6) but is not consistently applied. Some jurisdictions allow delineation of a building envelope outside the floodplain instead the floodplains themselves. The Critical Areas buffer would be a new requirement for some or all jurisdictions. Some jurisdictions require their delineation on new plat maps on a project by project basis. Requirements to include floodways, floodplains and Critical Area riverine buffers on final plats would reduce inconsistency and ensure these areas which have special regulatory requirements are identified for future property owners.

7. UNION GAP FLOOD ISSUES

Discussions about flood risks specific to Union Gap focused on various ways to reduce impacts from aggradation of the Yakima River and flooding from Wide Hollow Creek. A review of flood risks related to Spring (Chambers) Creek was also included, especially as they pertain to Yakima River aggregation and flood gate management. Some of these alternatives may not be required if others are done and several of them are dependent upon previous alternatives. All of the Union Gap alternatives are grouped into one section.

The first alternative, "**A. Modify Wapato Dam (4-11, 6C-7) to decrease flood risk (See Upper Yakima CFHMP)**", refers to the dam's contribution to increased aggradation of the Yakima River near Union Gap. A thorough discussion of this alternative begins in Chapter 8, on page 8-30 of the Upper Yakima River CFHMP, June 2007 Update, so it will not be duplicated here. Since this alternative will likely be included in three different CFHMPs (the Ahtanum-Wide Hollow, Upper Yakima River, and upcoming Lower Yakima River), it is anticipated any requests for funding or studies will reference all of these documents. In addition to studies and CFHMPs initiated by the FCZD, the Yakama Nation has conducted studies and projects that include the dam. One Yakama Nation project has been completed to reduce flood elevation and improve flood flow alignment at the dam.

The second alternative, "**B. Sediment Transport on the Yakima River (4-10, 4-17, 4-18, 6C-1, 6C-2, 6C-3, 6C-8, 6C-9)**" groups eight alternatives proposing studies and sediment transport improvements. Studies already in process include geomorphic studies and a sediment model for the Gap-to-Gap Levee Pull Back Study (an Upper Yakima River CFHMP project). Additional studies currently in the planning stage for the lower Yakima River reach will also add valuable information about the river conditions and trends at Union Gap. Results from current and future studies will be used to determine methods and projects to improve sediment transport in the Yakima River.

The next alternative, "**C. Relocation of Wide Hollow Creek below 3rd Ave (6C-6, 11A-4)**", also includes a sub-alternative (6C-5) to add flood gates to Wide Hollow culverts if this project is implemented. This alternative proposes to relocate Wide Hollow Creek so it would empty into Ahtanum Creek somewhere east of S. 3rd Avenue. This would move the flooding caused by Wide Hollow Creek out of the heavily developed urban portion of Union Gap to currently undeveloped agricultural fields. Relocation would abandon the current artificial 90 degree bends in the stream channel and the constriction at the former grist mill. The sub-alternative would add a new culvert and flood gate where Wide Hollow flows underneath either I-82 or the US 97 on ramp.

The pre-settlement location of the mouth of Wide Hollow Creek has been the subject of some debate. What is known at this time is Wide Hollow Creek was straightened in several locations in the mid to late 1800's for farming purposes and also to power a grist mill at the southern end of Union Gap. The mill was established in 1869 and continued using water power from the creek into the late 1900s. Original surveys show the presence of Spring (Chambers) Creek in the mill location, but no mention is made of Wide Hollow Creek in the original surveys of this area. A 1901 soils map shows Wide Hollow Creek emptying directly into Ahtanum Creek, Figure 4-12 in Chapter 4. This map was produced by the U.S. Department of Agriculture.

This alternative has received support from some resource staff at various agencies and the Yakama Nation since it was initially proposed as part of a sports development in 2001. More recent discussions in the committee brought up some reservations due to water quality concerns in Wide Hollow Creek. Improvement of water quality in the creek and resolution of any remaining fish habitat issues would increase the likelihood this alternative could be implemented (also see Alternative H below).

A new recommendation "**D**" was added to the Union Gap category, "**Encourage the appropriate parties to develop Operations and Maintenance agreements for the flood gates and fish passage structures at the Mill to ensure coordinated and effective management for flooding**". Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). This recommendation was added when it became clear during the flood mapping project that there is some disconnect between land ownership, flood gate designers and owners, and fish screen owners and managers. The purpose of this recommendation is to clarify the various roles and responsibilities to promote maintenance implementation and effective actions during flood events. The FCZD could organize and coordinate these discussions, but any agreements would be up to the relevant participants.

Alternative **"E. Bypassing the Mill structures (11A-5)"** addresses the constriction at the mill diversion, the steep pass for fish passage and erosion occurring at the site. If alternative C is implemented this alternative will not be needed. The fact that the mill no longer uses the creek for power eliminates one possible complication for this alternative. Any bypass located near the existing mill may run into a difficulty due to a lack of space. In addition to the close proximity of the mill building, there is a house on the adjacent parcel that would constrain the design of a bypass channel. Elimination of the structures would also improve fish passage. If this project includes re-grading or down-cutting of the creek upstream of the bypass location it would also increase channel capacity at the S. 1st Street Bridge and reduce flooding west of S. 1st Street.

The next three alternatives involve Spring (Chambers) Creek and the flood gate for the creek at Interstate Highway 82. The first, **"E. The Spring** (Chambers) **Creek floodgate should generally be closed except for habitat or flow enhancement for a limited time period (6B-1)"**, identifies changes to management of the flood gate that have occurred as the Yakima River has aggraded. Because of the river's proximity and elevation in relation to Spring (Chambers) Creek, the flood gate was closed several years ago and has not been reopened. Water right needs have been able to be met without opening the flood gate. The FCZD through County Roads Maintenance Division is responsible for management of this flood gate. As long as the configuration of the Yakima River in this location is not improved to lower flood risks, the gate would only be open for limited amounts of time. These circumstances could include allowing some flow for temporary scouring of the channel to improve stream flow through this area.

The second Spring (Chambers) Creek alternative, **"F. Install a remotely controllable floodgate that could be opened some times of year, closed at others (on Spring** (Chambers) **Creek floodgate) (6B-2)"**, would allow remote control of the gate. This technology is used to control irrigation flows in some districts, but has not been used for flood gates in the Yakima area. Improvement in Yakima River channel conditions or specifically defined beneficial temporary flows mentioned in the previous alternative would likely be needed to justify the expense of this alternative. The last Spring (Chambers) Creek alternative addresses improved conveyance, **"G. Improve conveyance downstream of the culverts on the Spring** (Chambers) **Creek irrigation channel by increasing grade – this**

would help in most flood events, possibly not in large-scale flooding (6D-2)". This alternative would include work with the ditch owner to eliminate or decrease the height of the irrigation diversion structure to increase the stream grade. Because flooding also occurs in this area from surfacing ground water and flows from Wide Hollow Creek, this alternative would likely only improve flooding for smaller events.

The last Union Gap alternative identifies the flood capacity along the railroad embankment, **"H. Retain overflow path along the railroad right of way (11A-1)"**. The committee did not discuss how this would be done, but it could include purchase of a floodplain easement (also see Alternative C above). The recent FEMA flood re-mapping project points out the importance of this flood overflow path in reducing hazard to urban Union Gap. Modifications to the railway embankments that constrain this path would require significant changes to the proposed new flood maps.

A new recommendation "**J**" was added to the Union Gap category, "**Coordinate with agencies planning large infrastructure projects – such as WSDOT – to look for opportunities to reduce flood hazards for Union Gap**". Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). This recommendation was added to ensure that opportunities to reduce flood risk have a higher priority when large infrastructure projects are planned and designed. Current identified projects include two by WSDOT: I-82 – Valley Mall Blvd Interchange Rebuild (currently under construction); and I-82 – South Union Gap Interchange Improvements (developing design alternatives). Union Gap and the FCZD have already been involved in planning and design for these projects, so this recommendation would continue that participation and elevate the goal of reducing flood risks where opportunity allows.

8. INFORMATION / OUTREACH FLOOD ISSUES

1. Mapping

This section contains four grouped alternatives that pertain to keeping flood maps current and creating additional map products. The first alternative, **"A. Use improved flood mapping and modeling to assess risk to new and existing infrastructure and for designing new infrastructure (12G-1)"**, reinforces using the new flood maps and models to improve design of new roads, bridges and other structures. For example, the new models allow engineers to try various designs to evaluate a new structure's effects on flood flows and susceptibility to damage.

Alternative **"B. Re-map the floodplain for NFIP rate maps, to allow for up-to-date accuracy and application of land use regulations (8D-1, 4-3, 15B-6)"** groups several alternatives and also includes three sub-alternatives. A majority of the mainstem of Ahtanum Creek is currently under contract with FEMA for a flood map restudy and is expected to be finished in 2012. The FCZD has contracted a restudy for the remaining portions of Ahtanum Creek including both forks and all of the Wide Hollow drainage. This restudy is also scheduled to be finished in 2012 and will include the first flood maps for Shaw Creek. Additional sub-alternatives (15D-1, 15C-13, 15D-2) include mapping floodways

and regularly updating the maps to keep them current. The restudies mentioned above include identifying floodways in areas that are already densely developed or expected to be in the near future. The last sub-alternative proposes identifying areas that produce flooding due to high ground water (4-9, 4-19). After the restudies are completed the FCZD will check to see if there are areas that are not classified as floodplains but still have flood problems from high ground water ponding. The new FEMA RISK Map program may offer additional flexibility to identify these kinds of risks.

The next alternative includes one sub-alternative, **"C. Map Channel Migration Zones (and other hazards) (15C-12, 15G-4 15D-3)"**, all of which relate to identification of CMZ locations and other risk areas including avulsions. A CMZ was identified for Ahtanum Creek as part of the Yakima County Shoreline Master Program update in 2007. This update has not been approved (as of July 2009) by the Washington Department of Ecology and is not known to have been adopted by Yakima or Union Gap. The communities in Yakima County are required to update their SMPs (including the new CMZ requirement) by 2013. Avulsion or other hazardous areas are not currently included on FEMA flood maps. It is possible they could be included in the new FEMA map program mentioned above.

The last mapping alternative provides the opportunity to develop additional map products to identify risks not currently included in FEMA flood maps, **"D. Supply Better/Different mapping products (1D-8, 15F-2)"**. Examples of possible maps include flooding in and from hollows and flooding in flat terrain where small changes can redirect flows, such as debris in channels, flood fight actions by neighbors, etc. The alternatives also refer to notification about the risk to potential property purchasers and developers. An additional note from the meetings indicates it would be difficult for the County (FCZD) to produce these types of maps. To implement this alternative would first require determining which flood risks are not currently adequately identified, then determining mapping methods, and finally deciding on the funding priority. After the flood map restudies are completed there will be a better indication whether some risks remain unidentified.

2. Land Owner Assistance

All of the alternatives in this section include active outreach to property owners especially as pertains to risks on their property. Alternative **"A. Provide public education about potential flood hazards and responses on individual properties including keeping debris sources out of known flood channels (10B-2, 1D-3, 1D-7)"**, could be included with alternatives C and F in this section. The outreach could include brochures, posting on web sites, presentation at community meetings, or fliers. The topics that would be valuable include: maintenance of private culverts, possible flood fight responses on private property, responsible parties for various flood related topics, and fence management in floodplains. Related alternatives are, **"C. Create pamphlets for new landowners- i.e. pamphlet put out for small landowners in Kittitas County by the Kittitas Conservation District (1B-9)"**, and **"F. Public education about maintaining driveway culverts, and correct sizing and maintenance of culverts (12E-5)"**. Another related alternative is described in the next section (Alternative E).

Alternative **"B. Encourage residents who are at high risk for flooding to purchase flood**

insurance even if they are not in a mapped floodplain (8D-3)", was included in part because of wide-spread misconceptions about flood insurance. This could be as simple as providing a FEMA flood insurance or Frequently Asked Questions brochure to property owners or key contact organizations, such as title companies and lending institutions.

Alternative **"D. Prepare a program to educate landowners about riparian function and health before and after a flood event (9C-7)"**, is pretty straight-forward. First step could be a brief review to see if there is already a publically available presentation that could be used. Whether produced locally or acquired outside the area, a presentation also be made available through the county web site. Also see alternatives C and D in the next section which contain similar alternatives.

The last alternative in this section is a more general proposal to inform property owners and prospective buyers about flood risks, **"E. Provide information about properties up-front in public services (no surprises) (13A-10, 14B-1)"**. It appears the "public services" text was accidentally added since the term only applies to a Yakima County Department. Discussions about this alternative did not include specifics about methods to use to get this information to current and prospective property owners.

3. General Public Outreach

Though there is some overlap with alternatives in the previous section, these alternatives are more general and do not target current and prospective property owners specifically. The first alternative, **"A. Cooperate with others to support or develop public education programs, such as stream cleanup programs and volunteer monitoring (9C-13)"** focuses on participating with others who are doing public outreach related to streams and flooding. This alternative, especially as regards clean-up programs, is related to the next alternative, **"B. Encourage citizens to report dumping in streams (1C-5)"**. For example, both of these efforts could be led by a non-profit stream stewardship organization or Ecology.

The next two alternatives have some possible overlap with alternative D in the previous section, **"C. Cooperate with others to engage in public education regarding the values and esthetic appeal of riparian corridors/open space for purpose of preservation of floodplain corridors (7B-5)"**, and **"D. Public education about how riparian and flood hazard management goals complement each other. Inform people about the importance of the functions of streams, rivers, and natural drainage ways (9C-11)"**. Outreach regarding flood storage, habitat values and the amenity value of riparian corridors could also be coordinated with alternatives in the land use category urging jurisdictions to include floodplains when planning for open space and parks. Floodplain and habitat values outreach materials for riparian areas are available from other organizations and jurisdictions. Local amenity value examples include increased property values for parcels in Suncadia in Kittitas County (Tom Ring, Yakama Nation). The Smart Growth organization may also have examples available (http://www.smartgrowth.org/default.asp).

The last alternative, **"E. Provide public education directed to residents, farms and businesses to increase individual preparation for floods (10A-3)"**, is more narrowly focused on flood safety. The emphasis for this alternative is pre-flood actions people can

take to reduce their risks. This alternative is similar to the flood preparation alternative described in the previous section (Alternative A) and they could probably be combined.

4. Outreach / Information Related to Flood Projects

This section contains two alternatives. The first, **"A. Flood Control Zone District to provide technical assistance and comments regarding flood hazards and infrastructure design (12G-2)"** proposes utilizing technical expertise housed in the FCZD. Though the FCZD already provides comments on infrastructure projects when notice arrives at the County, not all of the jurisdictions seek this technical support early in the design process. Early technical input can reduce design and construction costs by reducing revisions and contract amendments, and prevent unnecessary difficulties for project permitting. Other government agencies or districts such as the Bureau of Reclamation and irrigation districts have generally not contacted the FCZD for technical expertise early in the design process for their riverine infrastructure projects. Some agencies such as the WSDOT have periodically contacted the FCZD early in the design process. The committee did not discuss specific ways to implement this alternative.

The other alternative refers to outreach to the public and neighboring property owners for flood risk reduction projects, **"B. Public notice/disclosure/consultation when flood projects are planned (19)"**. The committee did not discuss how much outreach should occur, or specifics for notice vs. disclosure vs. consultation, or what timeframe, or by which methods.

5. Realtor, Lender, etc. Outreach

Two alternatives are proposed for this section. The first, **"A. Provide information about flood history to realtors, lenders, etc. in proposed new developments (15C-14, 15C-15)"** does not include suggestions for how this should occur. This information (when flood history is known for a property) is likely already available by request from the jurisdictions, so more details from the committee would be useful to define their intent with this alternative. The second alternative **"B. Put on workshops and other outreach for realtors (15C-16)"** is self-explanatory.

9. FLOOD RESPONSE FLOOD ISSUES

1. General Flood Response Planning

The two alternatives in this section refer to planning at a broad level that includes implementation of the Flood Emergency Response Plan and coordination with the Yakima Valley Office of Emergency Management. The two alternatives are, **"A. Participate in and support Flood Response planning efforts (as part of the Emergency Response Plan) (10A-1, 10A-2, 12F-5)"**, and **"B. Implement Emergency Response Plan (Get Ready- Set- Go- Recover) procedures, from the Emergency Response Plan (10C-1)"**. The Flood Response Plan was completed and incorporated into the county response plan in 2008. This included a multi-jurisdiction Flood Exercise in December 2007. Because the flood plan is now completed, the committee may prefer to edit these alternatives to incorporate all or part of Purpose B.8. from the Flood Emergency Response Plan:

(8) Providing for a flood response planning team comprised of representatives from jurisdictions as identified and utilized through this plan development for: continuing review and revision of the plan; exercise planning and evaluation; reviewing and offering recommendations on flood emergency management initiatives.

The last alternative was added, **"C. Determine where large numbers of animals may be kept during a flood event and distribute information to the public. Work with Emergency Management and Red Cross to establish animal food and shelter contingencies - discussions may include Central Washington State Fairgrounds, farm feed stores, veterinarians, and animal rescue organizations."** Because this item was added when the recommendations were being developed, it will be on the Recommendations table, but not the Alternatives tables (and does not have an alternative number). Though farmers and ranchers with large acreages may be able to move animals to higher ground away from flooding, people with pets and those with small acreage "hobby farms" may have fewer options. It became clear during Hurricane Katrina that some people even in severe flooding situations will resist evacuation if it means leaving their pets behind. Even if large animal owners were more willing to evacuate without their livestock, it would be preferable to avoid the loss, heartache and post flood clean-up. It is likely other communities have developed contingencies for animals that could be used as a starting point for discussions in our area.

2. Planning / Mapping

The three alternatives in this section propose increased mapping and other products to assist first responders and emergency responses during a flood. The first alternative **"A. Identify and map problem spots throughout the watershed so flood responders know where to look first (5F-5)"**, would utilize information gathered from jurisdictions and people experienced with flood response in this drainage as well as identifying possible new locations indicated changed conditions or by the new flood map models. This alternative includes identifying draws that may be prone to flash flooding.

The next alternative combines two similar alternatives, **"B. Designate emergency response access routes and incorporate into transportation planning (12F-4) and Designation of evacuation routes and notification of the public and first responders (10B-3)"**. The first part of this alternative will require coordination and cooperation with transportation planning organizations at both the jurisdictional and regional/metro levels. The second part of the alternative would utilize data from flood models and interaction with first responders to determine safe access routes. Notification to the public could be accomplished in a variety of ways. (Also see alternatives 1.E. and others in the Roads and Bridges category).

The last alternative in this section is, **"C. The Flood Control Zone District will develop databases of parcels affected by different level flood events, corresponding to upcoming Ahtanum-Wide Hollow FEMA re-map (10C-5)"**. The FCZD has already done this for the Naches River flood restudy area and plans to provide this information for first responders after each restudy is completed.

3. Coordination

The first alternative has already received some work on implementation, **"A. Provide infrastructure or technology for better communication between agencies (EOC) (10C-2)"**. As a result of the Flood Response exercise mentioned previously and the accompanying after action report, several communication gaps were identified. The Yakima Valley Office of Emergency Management (YVOEM) subsequently purchased communication equipment and improved communication process. Discussion with the emergency management office will be needed to determine whether this alternative has been implemented.

The next merged alternative addresses the importance of including irrigation districts during flood emergencies, **"B. Coordination between Emergency Management and the Irrigation Districts such as AID and Yakima Valley Canal, for management during floods. Include Irrigation Districts in communications with the EOC (emergency operations center) and FCZD (5F-1, 5F-3, 2B-3)"**. Included in these alternatives (5F-2) is a proposal for the FCZD to communicate potential flood risks to the irrigation districts. Discussion with the irrigation districts and Emergency Management will be needed to determine the most effective method to coordinate and communicate during floods. One aspect of this alternative that may be valuable would be a listing of flood operations currently used by the irrigation districts.

Alternative **"C. Interagency coordination of flood information and response, including WDFW, Irrigation Districts, and Yakama Nation Natural Resources, Fisheries and Engineering (10C-4, 10C-9)"** addresses the more broad coordination effort. The after action plan for the 2007 Flood Exercise would again be a good place to start for implementation of this alternative. The next alternative, **"D. Flood responders concentrate patrol and response on known problem bridges and roads - (12F-1)"**, is dependent on alternative A in the previous section to first identify known potential problem areas.

The last alternative in this section stimulated a great deal of discussion in the committee, **"E. Public and agencies coordinate flood fight and post flood actions with recommendations identified in the Ahtanum-Wide Hollow CFHMP, since they require approval by WDFW and Ecology (so will be consistent with regulations), and provide a good basis for deciding whether to take emergency actions (10D-2)"**. The intent of the alternative is to reduce permitting difficulties, reduce post-flood costs, minimize resource damage, prevent increased flood risk, and increase implementation of alternatives of this CFHMP. Since CFHMPs must be approved by WDFW and Ecology at the state level, flood response actions that are consistent with recommendations in the CFHMP will likely be more easily permitted. This approach could also reduce costs since it would be costly for agencies, jurisdictions, or property owners to have to remove or reconstruct projects in order to receive permits after the flood emergency is past. It is most likely this alternative would be implemented through coordination with public agencies during large flood events and through post-flood permitting review for actions during smaller floods. The FCZD already reviews floodplain developments in these watersheds though the inclusion of consideration of the CFHMP recommendations for these drainages would be new.

4. Outreach

Alternative **"A. Recognition and dissemination of knowledge about potential flood hazards during a flood event in coordination with the EOC (10C-3)"** did not develop specific suggestions about how this should occur (Note: the EOC is the Emergency Operations Center - coordinated by staff of the YVOEM). The second alternative in this category is very specific, **"B. Develop warning systems including mass media (10B-1) - Investigate reverse 911 system"**. Implementation of this alternative would be coordinated with or led by YVOEM. The specific suggestion to investigate a reverse 911 system was added to this alternative after committee members heard about this being used during recent emergencies to contact community members by phone. This software program is used during emergencies to alert them to the danger and issue guidance. Other jurisdictions in Washington State have used this product so information on the pros and cons from their experiences could help determine if this is one of the mass notification methods that would work for Yakima County.

The next alternative is more of a grass roots type of approach, **"C. Encourage volunteer flood-watchers program to provide information (10C-8)"**. No additional information about this alternative was discussed by the committee. A national program called CERT (Community Emergency Response Team) may provide a way to implement this alternative. The last alternative in this section is self-explanatory, **"D. Provide special flood phone line for public to call in and provide information about current flooding (10C-7) (EOC & FCZD cooperate/coordinate)"**.

5. Irrigation Gates

The first alternative, **"A. Improve access to Bachelor diversion during floods without diverting flood waters or making flood problems worse (2C-3)"**, addresses the problem of access to the diversion being cut-off by flooding. This prevents irrigation district staff from having safe access for removing debris that accumulates on the diversion during floods. Any diversion access improvements implemented in the near-term would need to consider potential changes to the channel alignment or flood routing alternatives in the Bachelor section of the St. Joseph's Mission at Ahtanum category (11.4. below).

The last alternative in this section proposes possible flood relief assistance that may be provided by irrigation systems, **"B. Coordinate opening gates for flood relief, based on flood forecasts, channel maintenance needs, and impact to diversion facility (5F-6)"**. While this would not be likely to help reduce flooding during major flood events, it may be valuable for more frequent smaller floods.

6. Monitoring / Documentation

The first alternative would increase stream monitoring capabilities, **"A. Install a North Fork gage including telemetry (5F-2)"**. The FCZD has been investigating cooperative arrangements and grant opportunities for several years. Including this alternative as a recommendation in the CFHMP will increase the odds of being able to install and maintain this stream gage. During recommendation creation Wide Hollow was added to this alternative due to the lack of gages in this drainage and because it has different hydrologic characteristics than the Ahtanum.

The other alternative in this section would be valuable for many purposes, **"B. Provide open contract for aerial observation during floods for event documentation (10C-6)"**. The possible uses for this data include: validation for FEMA flood mapping efforts, public outreach, and information for first responders during future flood events. The FCZD has begun implementation of this alternative through discussions with WSDOT to do aerial observations for floods exceeding a predefined flow. The aerial observations proposed in this alternative are included in alternative 15D-5 (Monitoring / Inventory category) so during recommendation review alternative 10C-6 was dropped and 15D-5 was retained to reduce redundancy.

7. Ice Jams

The first alternative, **"A. Inventory of locations where ice jams are known to occur-identify them in the Flood Response Plan (1A-7)"**, is necessary in part to determine whether icing problems are a widespread problem or are uncommon. In recent years the FCZD has received calls related to minor ice problems in the lower reach of North Fork Ahtanum Creek and west of Wiley City. The property owner on the N. F. Ahtanum reported the ice jam was broken up in 2007 using a backhoe to break up the ice on the stream bank.

The second alternative also contains several sub-alternatives, **"B. Outline emergency response to ice jams in the Flood Response Plan (1A-3)"**. The first sub-alternative was added by the FCZD (so there is no alternative number) and proposes alerting residences at risk as part of a flood response. Specific methods to accomplish this were not discussed. The next sub-alternative calls for blasting (1A-6) the ice jam. It's was also noted during discussions that this method typically only works on very stable jams. Another comment included in this group of alternatives was added at some point after the alternative worksheets were completed so it does not have an alternative number, "Facilitate regulatory approval by Ecology and Fish and Wildlife and local jurisdictions".

8. Regulatory

This section contains one alternative with several sub-alternatives, **"A. Facilitate involvement of permitting agencies as a component of the Emergency Management Plan, and are present in the EOC during a declared emergency (10D-3)"**. This alternative is similar to 10D-1 and 10D-2 contained in other alternative categories described above (6.3.B and 9.3.E). All of these alternatives came under the broad title "Expedited actions taken during a flood" when the alternatives were first generated. The primary rationale for this group of alternatives is that coordination with permitting agencies during and immediately following the flood fight will reduce difficulties securing permits for the actions and reduce unnecessary resource damage. These concepts are contained in the sub-alternatives:

- permitting personnel do a site visit (10D-3a);
- choose minimum flood fight action, or action that will meet the intent of the regulations- i.e. better protect/enhance the resources (10D-3b); and
- follow-up - 6 months after a declared disaster to come into compliance for flood fight actions (10D-3c).

10. SHAW CREEK FLOOD ISSUES

Shaw Creek has been a source of concern and discussions since before this CFHMP was initiated. It is the only flood prone basin in the CFHMP area that was not included in the initial flood studies done for the unincorporated portion of Yakima County, so it has no FEMA identified floodplains. Whether this was due to it being identified as a ditch in the past or because the lands were largely rural with little development expected in the immediate future doesn't change the fact that this drainage is rapidly converting to urban land uses while having unidentified flood risks. Some of the alternatives listed below will be unnecessary after FEMA floodplains are identified for Shaw Creek as part of the Wide Hollow Creek flood map restudy which is currently underway. Yakima County has submitted grant applications for relocating the creek or construction of a flood bypass channel.

1. Structural Response for Shaw Creek Flooding

Many specific proposals are grouped under the first alternative, **"A. Relocate Shaw Creek to the low point in the drainage to allow for more natural stream and floodplain function, and less maintenance. Consider a potential for a larger solution that includes concurrent considerations on Wide Hollow Creek (8B-1)"**. Note: for flood overflow channel option see Alternative E below. The most important sub-alternatives are those that require quick actions so future mitigations are not eclipsed by current development patterns. The first of these sub-alternatives was added by the committee to reinforce the urgency felt as more agricultural lands were proposed for development (therefore, no alternative number), **"Consider purchase of property or property interest (i.e. option, easement, etc.) needed for relocation soon before development prevents this alternative"**. Another sub-alternative aimed at maintaining options for reducing flood risk as urbanization continues is, **"Investigate ways to keep certain properties undeveloped (for flood protection, and for possible relocation of Shaw Creek channel) (8E-4)"**. Though this sub-alternative does not contain the sense of urgency of the previous sub-alternative, there is enough overlap between them to suggest they might be consolidated to create the recommendation for this topic.

Another group of sub-alternatives include several land use approaches related to the concern about rapid urbanization, **"Recommend quick actions which allow us to keep options open:**

- **Keep at-risk areas undeveloped (8E-6.c)**,
- **Require drainage easements (8E-6.b)**,
- **Allow for high density development in areas that are not at risk (8E-6.d)"**

The FCZD has applied for a grant to provide a Shaw Creek overflow channel to Wide Hollow Creek at this location. Once a grant is obtained, likely in late 2011, the necessary public process on routes can be completed. When these sub-alternatives were proposed, specific mechanisms that could be used to implement them had not been detailed.

As part of the discussions about land required for a channel relocation, two of the parcels that have been proposed for a portion of the relocated channel were specifically named and

listed as sub-alternatives, **"Address Zeigler's property (8E-1.d)"** and **"School owns property, and may be amenable to relocation (8E-1.a)"**. The FCZD entered into discussions with the West Valley School District and applied for the grant noted above.

The remaining sub-alternatives deal with design issues. **"Consider downstream impact of changing Shaw Creek's confluence with Wide Hollow west (if all creeks diverge on Wide Hollow during a major flood, it may cause problems at 80th and West Valley Park) (8E-1.c)"**. The FCZD contracted West Consultants to create hydraulic models for investigating changes to flood patterns by either the stream relocation or an overflow channel project (see Figure 9-1 in alternative E below). These models will be used to ensure that any changes to flood patterns on Wide Hollow Creek are identified and mitigated.

The last three sub-alternatives all deal with various aspects of a proposed new section of road and how it would affect the Shaw Creek channel relocation (note: these issues would be similar or identical if an overflow channel is implemented instead of the relocation). Yakima County transportation planning is calling the proposed road segment Nob-Hollow since it would connect west Nob Hill Blvd. to Wide Hollow Road. Two items identify design considerations related to current and future bridge placement, **"Nob Hollow Road possibly a problem, possibly remove two Wide Hollow bridges, which would help with conveyance on Wide Hollow (8E-1.b)"**, and **"Shaw Creek overflow Bridge added as part of Nob Hollow construction"**. The overflow bridge was added to ensure road project planning includes the potential need for a new bridge to allow the relocated Shaw Creek (or overflow channel) to continue south to its new confluence with Wide Hollow Creek. The FCZD has communicated information about the proposed Shaw Creek project to both Yakima County Roads and the City of Yakima as planning proceeds. The proposed Nob-Hollow road project will be modified by development and annexation.

The last sub-alternative proposes, **"Move Wide Hollow Creek South of Wide Hollow Road (if Nob Hollow is not constructed) (8E-1.e)"**. This proposal is aimed at reducing flooding at two county bridges (recently annexed into City of Yakima) that are approximately 1000 ft apart. If the Nob-Hollow Road project is implemented and the existing bridges are removed or otherwise mitigated, this alternative will not be necessary. If Nob-Hollow is not constructed this will still be considered.

The next alternative in this section, **"B. Reconfigure Shaw Creek to function as floodplain and fish and wildlife habitat (8A-2)"**, incorporates a draft CFHMP Goal # 3 Objective: "Protect existing, or enhance where possible, fish and wildlife habitat". Though there is some debate about whether Shaw Creek was a fish bearing creek in the recent past, the riparian habitat would be of value to a number of aquatic and animal species. This alternative would not be possible as intended if the flood mitigation alternative implemented is the flood overflow channel rather than the stream relocation alternative.

Alternative **"C. Expand diking along Shaw Creek to protect new and existing development (8B-2, 8E-2, 15B-2)"** would likely be more extensive than was originally envisioned. Flood history and draft hydraulic models show most flood overflows leaving the existing stream channel well west of the Cottonwood Grove development. Additional

diking in this area would confine high flows in the channel to the east of 87th Avenue which could increase the need for diking to the east and perhaps along 80th Avenue where the creek is ditched along the road. The hydraulic modeling will allow analysis of this alternative to see if and where it would be most feasible.

The next alternative in this section deals with reducing flood flows, **"D. Consider developing regional retention upstream of Tieton Drive (8C-6, 8E-3)"**. The committee did not provide any details about this alternative. The only similar proposal in the past involved preliminary plans for stormwater detention ponds in the northwestern Shaw Creek drainage when Summitview Avenue was widened (from Gene Soules, former Yakima County Bridge Engineer). The stormwater ponds were not included in the Summitview road improvement project.

The last alternative in this section was added by the FCZD when land conversion issues called into question the possibility of being able to relocate Shaw Creek, **"E. Consider overflow channel (no alternative number)"**. Though overflow channels are included as a possible mitigation for perched channels in the Channel Issues category (1.7.B), the FCZD staff felt it should be specifically identified as a possibility for Shaw Creek. See Figure 9-1 for reduction in floodplain extent if a bypass channel is implemented. Other analyses in the "Shaw Creek High-Flow Bypass Channel" report (contracted by the FCZD) modeled alternatives including one with both the bypass channel and Wide Hollow Creek mitigation actions. This modeled alternative further predicted a reduction in floodplain extent. The main benefits to an overflow channel as opposed to stream relocation are a reduced width of land required; existing property owners would retain the amenity value of the creek in its current location; and possible foot paths or trails along the overflow channel. The cons for an overflow channel include: no improvement to habitat in and along the creek; operation and maintenance of the diversion structure would be needed; and continued concerns about widening 80th Avenue because of existing Shaw Creek critical area permitting. Alternative A above discusses relocation of Shaw Creek.

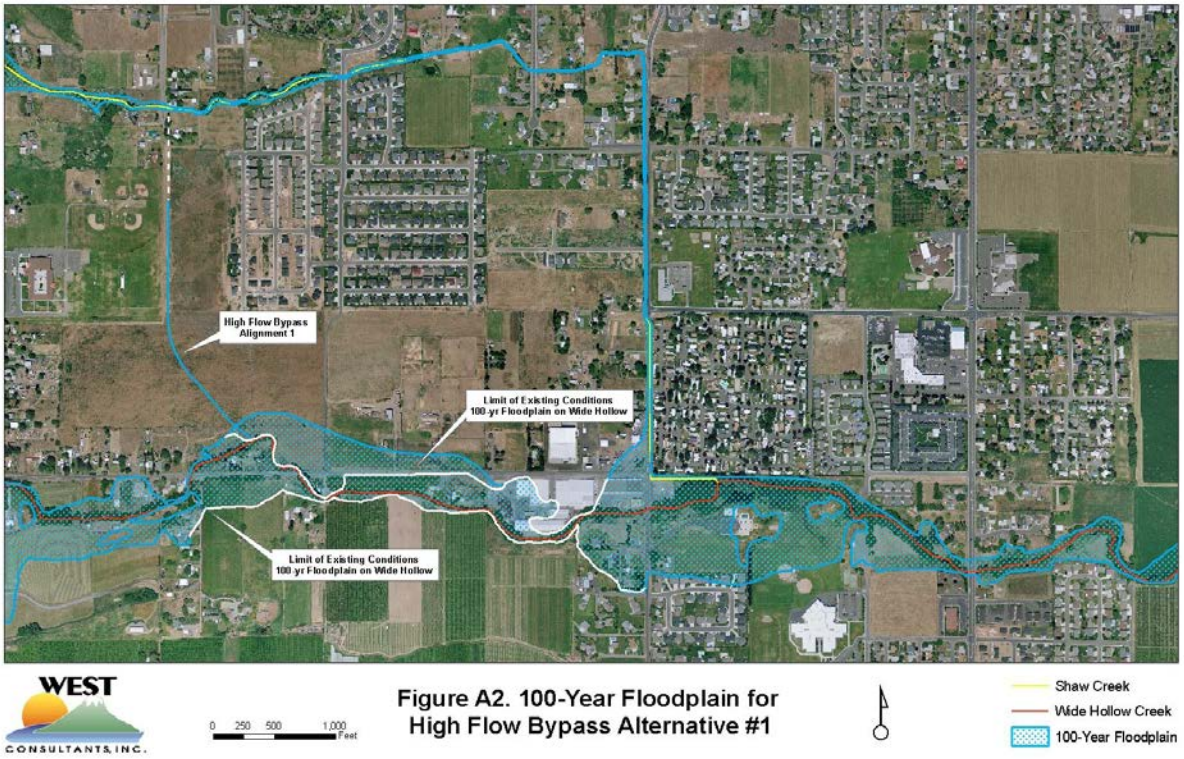


Figure 9-1

2. Information and Outreach

The first alternative is similar to one in the Public Outreach category, **"A. Notify developers and prospective residents of flood hazard on the property (8E-6.a)"**. Developers are notified by the jurisdictions about flood hazards during the permitting process. Currently there is no formal method identified to notify prospective residents about flood risks unless it is identified on the Sellers Disclosure Statement.

The other alternative in this section is aimed at current property owners, **"B. Hold neighborhood meeting for residents living near Shaw Creek (8D-4, 8D-5)"**. The committee did not provide specific for this alternative. As part of the public outreach process for a FEMA grant application, the FCZD held two public meetings at West Valley Jr. High School in June 2008. The meeting announcements were mailed to residents in the area and the meetings were well attended. Further meetings will be held upon project conceptual design.

3. Floodplain Designation

The first alternative, **"A. Change zoning code/amend the Comprehensive Plan to allow for restrictions on development in flood-prone areas around Shaw Creek, and protection of floodplain function (8C-3)"**, also includes a sub-alternative. This alternative could be considered in conjunction with the land use alternatives included in the first Shaw Creek alternative section, "Structural Response for Shaw Creek Flooding". The sub-alternative specifically addresses the situation before the FEMA maps are completed, **"Request an administrative designation of floodplain on Shaw Creek, based on historic flood patterns in the Shaw Creek area, prior to updating of the FIRM maps (8C-4, 8C-7, 8E-5)"**. The

committee decided not to submit this as an emergency request to the jurisdictions during discussions finalizing the alternatives.

The last alternative, **"B. Protect natural floodplain functions in Shaw Creek's watershed, especially before it is mapped (8C-1)"**, has some overlap with some alternatives in the first Shaw Creek section, but its emphasis is on protection of natural functions rather than just trying to keep flood mitigation options available.

11. ST. JOSEPH'S MISSION AT AHTANUM FLOOD ISSUES

The flood hazards at and downstream of this location include: head-cuts through fields at the Mission that threaten to capture the flow of Ahtanum Creek; flood flows directed to the communities of Ahtanum, Wiley City and other developments downstream; and, damage or loss of irrigation infrastructure.

The head-cuts are primarily due to low banks and the stream's location on the alluvial fan which contains three creeks/ditches proceeding downstream from this point in the valley. For this reason, there is a high avulsion risk for Ahtanum Creek, which presents a particular hazard for Hatton Creek. Flood flows that leave Ahtanum Creek at this point continue downstream towards Wiley City and Ahtanum by way of creeks and irrigation and roadside ditches. Existing bridges and culverts further direct flows to sometimes unexpected locations. Flooding causes damage to these two communities and other buildings and developments downstream.

Flood hazards both to and from irrigation infrastructures are also a concern. Due to the agricultural basis of much of the Ahtanum valley, any damage to irrigation headgates, ditches or other structures could affect the valley's economy. There are also a number of abandoned diversions and other structures that may redirect flood flows or increase channel changes such as erosion.

Due to the potential of Ahtanum Creek channel change and flow redirection northward into irrigation passageways with limited capacity, this scenario is considered the largest single threat to new flooding within the CFHMP area. If this were to occur, the new 100-year mapping would be significantly altered and produce more basin flooding.

1. Study

Alternative **"A. Continue Surface Water's study, which is predicting flood flow patterns at Ahtanum Mission, based on surveys and modeling. Modifications to infrastructure management may result in relation to head-cuts (2A-1)"**, refers to the FCZD study of flood flows at the Mission (the Surface Water Management Division of Yakima County Public Services manages the FCZD). The completed FEMA models are now available. Studies are scheduled for 2011 and 2012.

The second study alternative involves effects from existing structures, **"B. Determine the effects of flooding at the Mission on irrigation structures and of irrigation infrastructure on flooding patterns (2C-6)"**. This area will be modeled in late 2011 to determine design scenarios.

The next alternative, **"C. Verify if there is room for Ahtanum Creek to occupy old floodplain channels on the tribal land adjacent to Ahtanum Mission. Determine if the tribe/allotment owners may be amenable to that (2-3)"**, will require information from hydraulic modeling and communication with tribal property owners. Current communications with Yakama Nation staff and allotment owners about the Emma Lane project may provide a framework for future discussions about proposals for the Mission reach of Ahtanum Creek.

The last alternative in this section identifies the rich cultural and historical background of the Mission area, **"D. Define the sensitive historical and cultural issues at Ahtanum Mission site (2-1)"**. The committee did not propose additional details about this alternative.

2. Hatton Creek

The first Hatton Creek alternative, **"A. Recreate a flood overflow channel back to Ahtanum Creek from Hatton Creek (natural overflow channel blocked in the 1930s) (2A-5. 2B-2)"**, would help mitigate flood risks two ways. This alternative restores some lost flood capacity and would help reduce the risk of head-cuts from Hatton Creek capturing Ahtanum Creek. Again the 2011 and 2012 studies should clarify options.

The next alternative, **"B. Modify the old Hatton ditch channel below the diversion. Intent would be to block/armor channel to prevent opportunity for formation of head-cuts (2A-7)"**, may be used in addition to or instead of other alternatives to reduce the risk of head cutting. The last alternative in this section deals with abandoned irrigation structures, **"C. Remove the old Hatton Diversion (2A-6)"**. Flood events the last several years resulted in down-cutting of the main Ahtanum Creek channel in this area so the risk of head cuts capturing the creek has been reduced but not eliminated. These recent channel changes may be significant enough to have reduced the time pressure to remove this abandoned diversion. This appears to be an outstanding requirement of the Hydraulic Approval Permit to construct the new diversion.

3. Levees / Armor

The first alternative for this section, **"A. Armor stream channel to prevent migration of Ahtanum Creek to the North (Soft levees on North side would not be sufficient- river would cut through) (2A-8)"**, describes the need for this structural alternative. In addition to concerns that "soft" levees would not be resistant enough to erosion, is the question of how and where to key-in the foot and ends of a levee so it would be resistant to erosion.

The next alternative is aimed at protection of existing structures, **"B. Utilize Ring dikes to protect St. Joseph's Mission property (2A-3)"**. During committee discussions there was some skepticism about this alternative providing adequate protection during floods.

The third alternative in this section, **"C. Major levee construction on Mission property to alleviate head-cuts (2A-2)"**, appears similar to the alternatives listed above. It was not clear during committee discussions whether there are additional locations where head cuts are a concern or whether this is just a broader proposal for structural mitigation.

4. Bachelor Creek

The alternatives in this section were all generated under the heading, "Damage or loss of irrigation infrastructure could affect the economy of the Ahtanum Valley". Though the focus is on protecting the irrigation infrastructure, modifications based on these alternatives will also reduce flood risks downstream. The first alternative concerns channel modification near the diversion, **"A. Modify the Bachelor Diversion to improve functionality and decrease flood hazard (e.g. upstream of 90 degree turn on Ahtanum Creek) (2C-2, 2C-4)"**. The 90 degree corners stack the flood stage and increase the chances of blow out and by-pass for flood events. A small amount of debris caught on the diversion will also kick high flows out of the channel. For larger floods the primary concern is damage to the structure. Also recall the alternative in the Flood Response category regarding access to this diversion. This alternative also contains a sub-alternative, **"During floods, close Bachelor diversion and create a new high flow diversion channel from Ahtanum creek (2C-5)"**. The hydraulic models will provide more information to help determine the feasibility and possible location of this alternative.

The last alternative, **"B. Identify potential future downstream impacts from any proposed changes in the Ahtanum Mission area, and establish acceptable level of flooding along the entire reach (2B-4)"**, reinforces the need to broadly evaluate potential effects from any project in this area. Regardless of which alternatives are implemented, the streams will continue to require room for their floodplains. Identifying floodplain areas that will still be available for flood conveyance and storage after any flood reduction projects will mitigate undesirable potential effects from projects in this area on lands downstream.

12. EMMA LANE AREA FLOOD ISSUES

Recurrent flooding in the Emma Lane area was one of the "poster children" that prompted the Board of Yakima County Commissioners to form the County-wide Flood Control Zone District in 1998. This area is larger than just Emma Lane and at a minimum includes lands from upstream of S. 42nd Ave. to the parcels east of S. 34th Ave. It includes the Ahtanum Creek and Bachelor Creek floodplains and overflow paths in this area south of Ahtanum Road, though alternatives in this category include mitigations that may also reduce flooding on the south portion of the airport and east to S. 16th Ave. Yakima County received approval for a FEMA hazard mitigation grant for the stream relocation project (section 2 below). In winter of 2010-2011 the project was undergoing federal NEPA analysis as required for the grant process.

1. Study

The first alternative, **"A. Perform an Emma Lane flood study, and develop design guidance on acceptable flood protection levels (3-2)"**, focuses on the need for additional detailed information. The FCZD will use models created as part of the FEMA map restudy to examine potential projects and any additional effects. The sub-alternative also discusses information that will be available from the hydraulic models, **"Address Ahtanum Creek flood conveyance downstream of 42nd and Ahtanum Rd. (3-18)"**. This would be done as part of 3-2 and include all potential benefits.

The second alternative, **"Perform a Cost-Benefit analysis of stream relocation at Emma Lane (3-19)"**, was required as part of the FEMA grant award. A cost-benefit analysis is a requirement for FEMA mitigation grants and was submitted and approved by FEMA for a 2007 HMGP (Hazard mitigation Grant Program) grant awarded to the FCZD. An additional update about the grant is in the next section.

Relocation

The alternative, **"A. Move Ahtanum creek to a lower point in the floodplain (requires cooperation with Yakama Nation, acquisition of at least two homes, and a new bridge) (3-1)"** suggests one of the various means to reduce flooding at this location. Ahtanum Creek at the 42nd road crossing was ditched to the north side of the valley wall between 1911 and 1948 based on surveys. The resulting channel perched almost seven feet and the resulting 90 degree corners permits high flows to leave the stream channel and head off in unexpected directions, prior to reaching the bridge even during minor flood events. Channel relocation was also proposed in a federal grant application by Yakima County in 1997 following the extensive flooding at this location and downstream through flow redirection in 1996. In 2007 the FCZD obtained a federal Hazard Mitigation Grant for this location. Channel relocation, among several other alternatives are being considered within the grant for flood hazard mitigation. (See Figures 9-2 and 9-3).

Figure 9-2 Emma Lane - January 2010 Draft Options

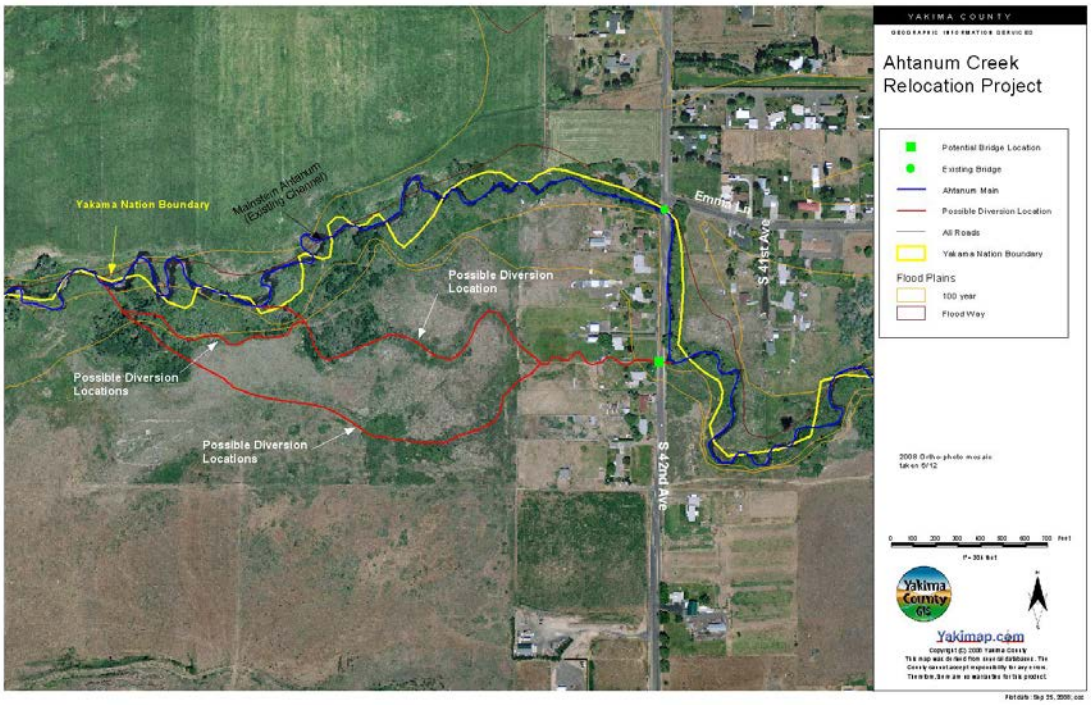
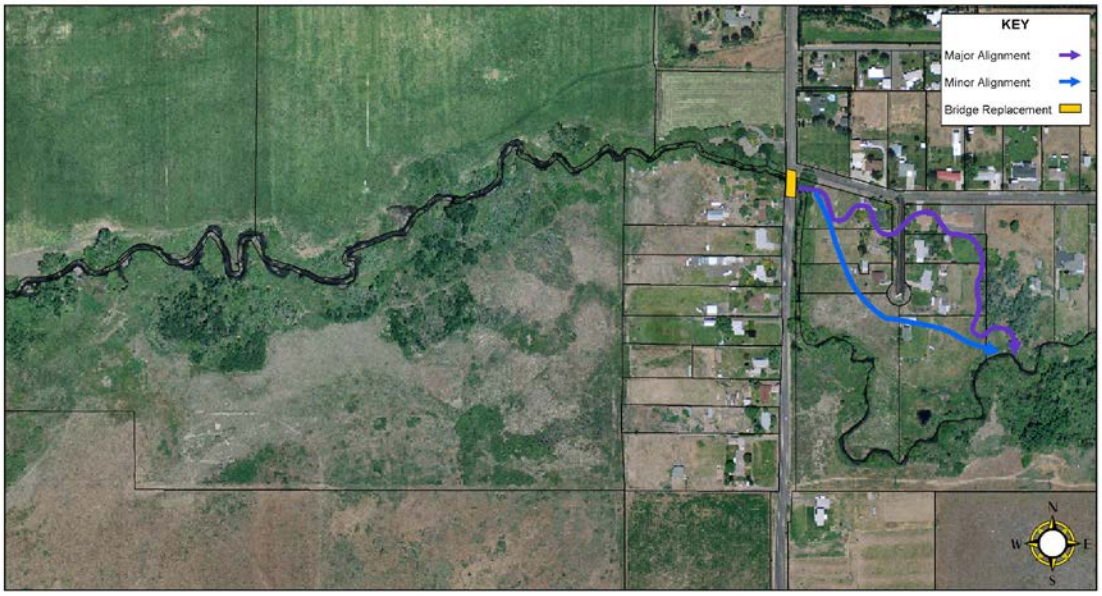


Figure 9-3 Emma Lane - January 2010 Draft Options



Yakima County Roads Division has agreed to rebuild the bridge on 42nd Ave. in a new location if that alternative is selected. This funding commitment was proposed as part of the match for the HMGP grant awarded by FEMA for the project. The required federal environmental review (NEPA) for this FEMA grant is currently in process awaiting input from the Yakama Nation and allotment owners. FEMA discussed with the Yakama Nation other concerns including the Yakima Reservation boundary line (which by treaty is Ahtanum Creek) and any cultural or historical concerns. The alignment in Figure 9-2was dropped by FEMA in 2011. Yakima County Right-of-Way staff has been in discussion with the property owners of the likely parcels to be purchased for the stream relocation. Implementation of this alternative is in process, but may not be completed should irresolvable problems arise.

Two sub-alternatives for this alternative involve design possibilities. The first, **"If Ahtanum Creek is relocated, consider a design that does not include filling in the old Ahtanum Channel- looking at the existing channel as habitat (3-15)"**, proposes converting the old channel to a side channel. The hydraulic models will provide more information to determine if this is feasible. The second sub-alternative proposes an overflow channel approach, **"Examine constructing a controlled side channel to bypass Emma Lane, rather than moving the creek (3-14)"**. These aspects will be considered in the project.

3. Development in Emma Lane Area

This section contains two alternatives, the first **"A. Limit future development in the Emma Lane area (3-3)"**, also has one sub-alternative. The sub-alternative is similar, **"Place controls on building in the flood-prone areas in and around Emma Lane (3-17)"**. Few specific methods were discussed beyond the examples listed of using zoning and utility hook-ups to limit development density. The new FEMA flood map restudy may decrease the desire for

this alternative if more of the risk area is identified as 1% annual chance floodplain (a.k.a. 100-year floodplain).

The second alternative, **"B. Adopt and implement more strict building standards in Emma Lane area- flood-proofed homes, buildings (3-11, 3-3)"**, did not include additional suggestions besides those included in the alternative title. FEMA only allows elevation as a method for flood-proofing residential structures (as far as receiving an insurance rate reduction is concerned).

4. Channel and Drainage Capacity

This section contains three alternatives. The first alternative, **"A. Improve drainage throughout the entire Emma Lane area- culverts, roads, etc. (3-8)",** provides the big picture view with several sub-alternatives contributing the details. These sub-alternatives range from improving existing infrastructure to improving stormwater management. The first, **"Reconfigure the Bachelor Creek Bridge on Ahtanum Road to increase capacity and reduce backwater flooding (3-6)"**, includes improvements to alignment of the existing bridge. Another sub-alternative that addresses infrastructure improvements is, **"Eliminate the Shropshire ditch or other irrigation ditch remnants (i.e. remove irrigation ditch that directs flow and inundates Emma Lane- area pastures and residents) (3-7)"**. Until the hydraulic analysis is completed it is unknown if this proposal would provide a benefit primarily for smaller floods or would also be useful for larger floods.

The next two sub-alternatives deal with drainage mitigations a somewhat more urban focus. The first is, **"Alter drainage systems and easements, based on Emma Lane floodplain remap study (3-10)"**. This area was developed before 1968 and is currently in the unincorporated portion of Yakima County. All roads in the area are public county roads with some roads having ditches and culverts for driveways and others allowing sheet flows across the road. The major roads in the development are paved, with the loop and cul-de-sac roads having a gravel surface. None of the roads have curb and gutter drainage. If the flood map restudy indicates locations that could use improved drainage, easements would be possible, but changes to the "drainage system" would require more effort.

The last sub-alternative, **"Improve stormwater system on Ahtanum Road to limit Emma Lane overflows into the airport area, and downstream to 16th (which floods the intersection at Ahtanum Road) (3-9)"** refers to run-off from the main Emma Lane area. Widening to four lanes, curbs, gutters, and other improvements to this stretch of Ahtanum Road is listed on the county 6-year transportation improvement plan and is slated to begin preliminary engineering in 2012. Coordination of the CFHMP recommendations with this roads capital improvement project may solve some stormwater problems. The addition of curbs and gutters to a short stretch of Ahtanum Road west of S. 16th Ave. received a drainage test during a minor flood event in February of 2003. Flooding down Ahtanum Road was captured by the drainage system and conveyed to the intersection at S. 16th Ave. where it then flowed up and out of the man holes. The flooding in the intersection took several days to dissipate and at least one of the property owners sandbagged around their house. The intersection of Ahtanum and 16th Ave. is further complicated by being located at the corner of three jurisdictions.

The next alternative, **"B. Widen Bridge at 42nd Ave. (3-5)**, is somewhat in doubt. Several committee members are skeptical that this alternative by itself would do much to reduce the flooding problems in this area. When the hydraulic model is finished it can be used to try this alternative to see if it would reduce flood problems.

The last alternative, **"C. Remove old fill on Ahtanum at the Yakama Nation land just south of Emma Lane (3-16)"**, regards removing illegally place fill. Information from local residents states a person leasing Yakima Reservation land filled in a large area at the end of S. 42nd Road. Removing this fill would increase floodplain capacity and the restored area could possibly be used to enhance habitat.

MONITORING & INVENTORIES FLOOD ISSUES

Some studies, inventories and monitoring alternatives are located in specific categories described above. This category typically contains activities that would be of value across the CFHMP area, rather than for a specific geographic area or stream reach. These are listed by their original alternative number; they were not grouped into sections and labeled by their location on the table, in contrast to labeling for the previous alternatives.

From a risk standpoint, the alternatives (15B-7, 15B-10, 15F-3 and 15F-4) for identification of perched stream channels and flood risks related to hollows stand out. The FEMA flood map restudies for this area will provide valuable information about perched streams so disclosure of the flood risk will be possible and quantifiable. While the identification of risk for larger hollows may also be aided by the restudies, smaller hollows not evaluated for flood maps will require additional risk assessment.

Five alternatives (12D-3, 12C-1, 12D-6, 12E-4 and 12E-7b) in this category involve gathering information about public and private roads and bridges that may contribute to flood risks. This is a good indicator of the level of concern about transportation infrastructure and flooding, as well as confirming there is still a lot that is not known. The current FEMA flood map restudies being conducted will provide valuable information that will be aid these inventories, though additional work will need to be done. Alternative 12D-3 also includes a future development aspect to utilize information that is gathered for transportation planning.

Several alternatives (1C-7, 1C-8, 1C-11, 12G-8 and 13B-8) call for investigating specific methods to reduce flood risks or seek potential funding sources. These range from illegal dumping in floodplains to funds for incentives for private drainage infrastructure. If suitable methods were found, these land use, code enforcement and funding alternatives would require ordinance changes or, in the case of private drainage infrastructure, a mechanism to connect the financial sources to applicants.

The remaining four alternatives cover a wide range from specific site identification to broad monitoring activities. Beginning with the most specific is alternative 15A-3. It is anticipated that identifying locations where streams have been changed in ways that increase flooding will allow cooperative flood reduction projects. This alternative would capture any man-made changes that are not already identified in inventories of transportation and irrigation infrastructure. Another specific site alternative (15D-5) in this category involves

documentation of flooding using methods such as aerial photos and recording high water marks. The greatest challenge for this alternative is determining the most efficient way to have the needed contracting ready to go when significant flooding occurs. This alternative includes the aerial observations also found in alternative 9.6.B in the Flood Response category (10C-6). Because alternative 15D-5 is broader, it was retained and 10C-6 was dropped.

The last two alternatives are much broader and will likely require some background research to determine the best approach to use. The first (12H-3) calls for watershed monitoring to track urbanization and land use intensification effects that add to flood problems over time. Determining which parameters to track and setting thresholds for negative effects would likely be the first step.

Alternative 14E-1 would investigate the possibility of using geologic hazard areas to identify channel migration zones and alluvial fans. Though there is a FEMA map process available for mapping certain types of alluvial fans, there is currently no established method for including channel migration risks into FEMA flood maps. It is also anticipated that some alluvial fan areas may be under the size requirement for FEMA mapped drainages. In Washington State, geologic hazards are regulated through local Critical Areas Ordinances and channel migration zones (for identified larger streams only, such as Ahtanum Creek) are regulated through local Shorelines Programs.

COMMITTEE SELECTION OF ALTERNATIVES

As noted above the Committee finalized, through discussion, the Table 9-8 alternatives by dropping and merging those alternatives. The revised alternatives selected for implementation are contained in Table 9-9.

Prioritization

Committee members' top alternatives were selected as high priority at a meeting on April 19, 2010. Based on the plan goals and objectives the FCZD selected some additional high priority actions to cover gaps and these were presented again to the Committee.

Alternatives were selected as medium priority if they had been chosen by any committee member and were rated high by the FCZD when rated at an earlier step in the process. The remaining alternatives were considered lower priority. Table 9-9 contains all the recommended alternatives for implementation.

Table Notation Notes

As part of the merging of like alternatives, the original alternative numbering was retained. This is the best way to obtain more detail and to track an alternative through the steps in this CFHMP creation. The numbers reference directly to the alternatives in Chapter 9 and the appendices.

TABLE 9-9 SELECTED FLOOD ALTERNATIVES AND PRIORITIES

	Priority - High, Medium, Low **Crosswalk # - reference to Tables 11-1, 11-2, 11-3 in Chapter 11**	**Priority**	**Crosswalk #**
1. CHANNEL ISSUES / RIVER FUNCTION			
1. Stream Management - Natural vs. Irrigation Ditch or Urban Stream			
A.	Separate irrigation conveyances from natural streams based on studies where it is shown this would be effective as flood control. (15B-3, 5D-7) · Reduce operational spill of irrigation water into streams (7A-2) · As part of mitigation for piping of irrigation waters, create a more normative conveyance schedule (7A-4) *Consideration- A non normative hydrograph results in overgrowth of species such as Pacific willow, which contribute to flooding, particularly in the Wide Hollow basin. Lower Wide Hollow and Ahtanum Creek are influenced by the water table of the Yakima River, which also has a non-normative hydrograph*	High	MM-9
B.	Establish work groups to clarify technical & regulatory measures and flood routing and management options for natural, artificial and shared drainages effected by irrigation: ▪ *Consideration- This may involve distinguishing between areas that should retain natural functions and processes (e.g. Ahtanum Creek), as opposed to areas that should be managed within the context of high intensity uses, such as irrigation conveyance or drainage ditches. (7B-7)* (15E-5, 15E-6, 5D-2, 5D-3, 5D-4, 5D-5, 5D-8, 5F-4, 15E-1, 2-2, 8A-3)	High	PR-9
2. Riparian Protection / Restoration			
A.	Utilize existing federal, state and local policies and programs to protect the natural function of the system to reduce flood hazard: Preserve/restore riparian areas using acquisition/legal protection of riparian zones - · Easements, · Agreements, (Fee Simple, etc.). *Consideration- This is most often done with multiple objectives - Fish and Wildlife habitat protection, Open Space, parks, trail and other* Protect riparian vegetation - · Conservation Reserve Enhancement Program · YTAHP (Yakima Tributary Access and Habitat Program) · Open Space taxation incentives · Limit rates of habitat loss: · Endangered Species Act, · Growth Management Act, Critical Areas Ordinance · Hydraulic Code	High High	MM-4 PR-6

	· Maintain watershed and channel processes (i.e. Clean Water Act, In-stream flow rules (9C-1, 7B-2, 7B-3)		
B.	Coordinate/cooperate flood efforts with currently in-place habitat protection and restoration programs (i.e. Salmon Recovery Funding Board, Northwest Power and Conservation Council), as well as other programs and funding sources that encourage riparian habitat protection. (9C-2)	High	MM-4
C.	Work with private habitat restoration organizations (e.g. Land trusts, Greenway, other non-profit programs) to protect riparian areas for flood hazard reduction. (9C-4)	High	MM-4
3. Elk			
A.	Relocate elk feeding stations to other areas away from stream corridors to lessen compaction, erosion, and pollution impacts. (9B-3)	High	MM-6
B.	Apply similar management standards to elk in confined feeding operations as in livestock operations & incorporate watershed management principles when managing elk. (9B-2, 9B-4)	High	MM-6
C.	Develop a Coordinated Resource Management Group to develop joint priorities for resource management (e.g. Wenas working group). (9B-1)	Low	IS-20
4. Dumping and Pollution in Streams			
A.	Investigate funding for enforcement and cleanup of illegal dumps on private ground. (1C-9, 1C-10)	Low	MM-18
5. Private Landowner Assistance			
A.	Utilize fence designs that prevent floodwaters from backing up on fences, such as: · Breakaway fence panels in locations that flood frequently. · Suspension fences, which consist of steel pipe or cable hung high above the creek, and hanging lighter materials down from the cable. This works as a fence, but is not lost during floods. · Fence setbacks - hold fences back some distance from the creek (loss of traditional land usage) (1B-1, 1B-2, 1B-3, 1B-4, 1B-5).	Low	MM-21
B.	Work with landowner assistance programs (i.e. Conservation Districts) to establish or re-establish vegetation and provide information about flood resistant fencing (7B-4, 1B-7, 1B-8).	Medium	PO-6
6. Vegetation			
A.	Utilize natural solutions for channel related flooding issues:		heading
	▪ In some locations, add wood to stream to "catch" wood debris- this accomplishes multiple objectives- would benefit habitat as well as reduce the volume of woody debris that accumulates on bridges, diversions, and other structures. (7D-4)	Low	ST-18
	▪ Utilize plantings (such as Red osier dogwood, etc.) solutions for bank stabilization (15C-2).	High	MM-1
B.	Control or Replace Undesirable Plant Communities that can contribute to flooding (e.g. hybrid Willows):		heading

	▪ Utilize other types of vegetation that can be substituted for Pacific or hybrid Willows over the long term- may include non-native plant communities. Research appropriate plant communities for denuded riparian areas (7A-5 & 7B-8)	High	MM-1
	▪ Create program for removal and long term management of hybrid Willow, may be at different scales: site specific or throughout the watershed, e.g. for some distance upstream and downstream of bridges on Wide Hollow (7A-1)	High	MM-1
	▪ Petition State Noxious Weed Control Board to list hybrid willows as invasive species as designated in other states (new)	High	PR-2
7. Channel Relocation / Reconfiguration			
A.	Relocate modified streams away from high-intensity uses, or restore incised stream channels to allow for natural riparian/flood function ▪ Channel reconfiguration and reconstruction at Emma Lane, Shaw Creek, lower Wide Hollow in Union Gap, and the Mission (15A-1, 15B-1, 7B-6). Note: main title for 15B is, "Perched irrigation conveyances are not compatible with natural flooding patterns and development"	Medium	ST-14
B.	Create or maintain Flood overflow channels/conveyances where channels are perched (15B-9)	Medium	ST-14
8. Channel Maintenance			
A.	Perform periodic channel maintenance (stream clean-out of sediment, woody debris and invasive vegetation) at identified flood hazard areas. (15A-2) · Convene technical work group to assess gravel management options in upper Wide Hollow watershed (Ellensburg formation geology) · Develop coarse sediment budget through empirical monitoring or modeling. · Implement options to increase channel stability based on information generated in alternatives above.	High	IS-1
9. Beavers			
A.	Deal with beavers on a case by case basis- use discretion based on situation (determine "is the floodplain function provided by the beaver a good thing or a bad thing?") (9A-1) ▪ Remove "problem" beaver dams, under permits from Department of Fish and Wildlife. (9A-3, 9A-6) ▪ Establish policies for lethal trapping or relocation of "problem beavers." (9A-2) ▪ Encourage beavers in areas where their presence could restore degraded watershed function. (9C-5)	High	MM-2
B.	Establish regulatory measures (buffers, setbacks, etc.) to allow for localized flooding/changes in water surface level or the channel (9A-5, 9A-7) *Consideration – would first need to identify locations where this would be appropriate or likely*	High	MM-2

10. Flood Protection			
A.	The following structural alternatives can be considered where changes in the channel threaten homes, businesses, agricultural land, or infrastructure. ▪ Levees, armor, buffers, CMZ (channel migration zones) (15C-1) ▪ Structural flood control measures either by individuals or government (4-7) ▪ Utilize "softer" solutions for bank stabilization, bio-engineering. (15C-2) ▪ Levees constructed along perched channels (i.e. Cottonwood Grove) (15B-2)	Low	ST-16
2. WATERSHED			
1. Non-Stormwater Watershed Issues			
A.	Review DID management in relation to flood hazard over the long term as land use changes (15E-4)	Low	MM-17
B.	Preserve natural drainage including draws and hollows that provide natural flood paths. (new, so no alternative number)	Medium	PR-24
C.	Design bridges and irrigation diversions to reduce potential for localized debris and bedload (sediment) accumulation and from creating un-natural overflow channels/paths (5B-1, 7D-3, 7D-5)	Medium	IS-16
2. Stormwater			
A.	Utilize NPDES stormwater programs to retain site runoff and reduce overland flow for the Yakima urbanized area (1D-5)	High	PR-14
B.	Develop stormwater standards across the basins for detention and retention on site; abide by and enforce stormwater design standards; and incorporate flood issues into stormwater programs (4-4, 13C-4, 1D-6, 14C-7, 15G-1, 13C-1)	Medium	PR-1
C.	Establish a relationship between stormwater standards and development standards in floodplains with regard to flooding (high water table and low gradient) (13C-3)	Medium	PR-1
D.	Size drainage facilities for future build-out and flood flows – including ability to pass upland drainage of 100-yr flow (15E-2, 15F-1, 15G-2).	Medium	PR-1
E.	Limit new connections to existing undersized drainage systems, i.e. DIDs, storm drains, and resolve the runoff issues presented by the Drainage Improvement Districts (DIDs) that may act as stormwater drainage systems although designed for subsurface flows. (13C-2, 15E-3)	Medium	IS-13
F.	Implement an effective Stormwater Management Program that reduces basin flooding (4-15)	High	PR-14
G.	Modify drainage standards for roads in overflow areas to minimize flood impacts (i.e. Emma Lane area) (3-12)	Medium	MM-13

3. BRIDGES AND ROADS

1. Design

A.	**Adequate Bridge & Road Crossing Standards:** Build new bridges & roadways in agreement with the hydraulic model to optimize flow passage in bridge/culvert design. • Develop the following bridge design standards and policies for implementation by the jurisdictions such as: o freeboard to account for ice and debris (1A-1) o include floodplain functions and natural channel processes, including expanded up and downstream right-of-way where needed to account for these functions (12A/B-7 & 12A/B-6) o include in-stream actions to maintain conveyance (such as grade control) where needed to reduce erosion and flooding (12A/B-1) o place priority on infrastructure flooding issues at the federal, state, tribal and local level (12G-7) o design of bridges and bridge footings should incorporate long-term erosion and scour conditions that do not impede flood conveyance (new, so no alternative number)	High	PR-15 IS-5 IS-5 IS-5 PR-3 OR 23 IS-5
B.	Improve bridge conveyance at S.16th Ave. at Ahtanum Creek (3-13).	High	ST-3
C.	Consider lowering existing roads where they act as dams and cause flooding (ponding) (12D-5). Investigate installing culverts in currently artificially ponded areas if this would help mitigate risks from 5 – 25 year floods. (new, so no alternative number)	High	IS-3
D.	Armoring: • Provide armoring of roads which act as levees (Ahtanum/Cottonwood Canyon Rd., etc.)(12D-1). • Armor road ditches where road fill is going to contribute to excess bedload and to protect road prism (12E-3).	Low	ST-19
E.	New and reconstructed roads should be evaluated; roads that are not intended to be passable to a certain standard (10, 25, or 100 year flood), should be built at grade (12F-6, 12H-8). Coordinate with 2A (below) • Consider designing new roads at grade in FEMA identified overflow areas. (12D-4)	High	IS-12 & PR-7
F.	Culverts: • Recognize the limitations of culverts as flood conveyance structures (12E-2) • Replace old culverts with higher capacity culverts based on flood risk (12E-7a).	Low	ST-20

2. Monitoring / Maintenance			
A.	Decide upon, designate and maintain critical access routes at 10, 25 and 100 year events. Coordinate with 1E above (12F-3, 12H-7).	High	IS-12 & PR-7
B.	Actively monitor and manage channels adjacent to bridges to improve and maintain bridge capacity (armor or sediment removal in poorly functioning bridges, and management of vegetation debris). Monitor channel and floodplain conditions post bridge construction. If significant unforeseen problems develop, after the stabilization period, respond to them (12A/B-4, 12A/B-8). ▪ Institute a policy of more maintenance at known problem bridges (12F-2)	High	MM-3
D.	Investigate and recommend increased maintenance and debris cleanout of culverts and ditches on public roads (coordinate with road maintenance crews to optimize ditch cleaning for flood purposes) (1D-1, 12D-2, 12E-1).	Low	IS-21
E.	Assess the cumulative effect of road policies and standards for new roads that act as dams or conveyances. (12C-3.) · Take larger scale affects to the watershed into account when designing new transportation systems: Minimize number of roads-maximize efficiency. (12H-4a)	Low	PR-32 PR-31
3. General Planning			
A.	Inventory and rank problem bridges throughout the watershed and coordinate with Capital Improvement Plans of local and state jurisdictions. (12A/B-3)	High	IS-3
B.	Integrate existing or new funding programs into strategic program for addressing inventoried problem bridges (12A/B-10).	High	IS-3
C.	Explore ways to take better advantage of Federal and state funding programs to reduce or mitigate the environmental effects (including flooding) of existing road systems (12G-6).	Medium	MM-15
D.	Work with landowners upstream and downstream of new infrastructure to design access to property to mitigate flood impacts (12G-9).	High	PR-16
E.	Replace flood damaged transportation infrastructure in a manner that reduces vulnerability to future flood hazard (12G-5).	Medium	MM-14
4. IRRIGATION			
1. Conversion of Irrigation Systems			
A.	Consolidate irrigation diversions to minimize stream impacts, consider upgrades like piping, and consider converting irrigation systems to a pressure-based system, e.g. Pine Hollow (5C-1,5C-2,5D-1)	High	MM-10

2. Infrastructure Maintenance and Inventory			
A.	Develop a program of proactive debris removal and maintenance on irrigation structures (1D-2, 5B-4) · Install temporary or sacrificial debris capture structures adapted to existing channel conditions to reduce debris problems, esp. Wide Hollow. (5B-2)	High	MM-3 ST-18?
B.	Conduct an inventory of existing irrigation infrastructure (working or abandoned) and flooding impacts. Identify problem locations and old drainage and irrigation systems that are affecting flooding in the irrigation system, i.e. gate at Wiley City (2C-1, 5A-1, 5E-1) · Install removable structures, such as irrigation pumps, weirs, gates, etc. (potential problem with ice), e.g. JM Perry Tech. (5B-3)	High	IS-4 TBD
C.	Identify sources of funding for removal of abandoned irrigation structures (5E-2)	Low	ST-21
D.	Investigate the possible use of flood gates or siphons to reduce flood flow routing by irrigation infrastructure, if needed, identify locations of most benefit: · Stationary or removable flood gates for use at diversions or in channel (5A-2, 5A-5) · Install undershots in some locations- siphons through gulleys and depressions under the ditch (5A-4)	Medium	MM-12
5. LAND USE			
1. Subdivisions / Housing Developments			
A.	**Minimize new homes/structures etc. in harm's way** (15C-11). ▪ Effectively integrate protection of floodplain functions/flood hazard reduction in individual subdivision platting process. (See also other regulatory recommendations) (8C-5.) ▪ Create more stringent subdivision standards in flood prone areas (4-5.) Note: dropped due to lack of specifics during recommendation review. ▪ Work toward common development standards. (new, so no alternative number)	Medium	PR-28 PR-28 ----- PR-27
B.	Work for consistency in zoning standards across jurisdictions for developments and buildings within floodplains. Determine gaps in the regulatory scheme. (13A-9) ▪ Recognize that in some places, the issues associated with larger scale proposed developments are not adequately addressed by current standards. (13B-2) Note: was moved to high in Chapter 11 & added SEPA & Comp Plans text.	Medium	PR-27 PR-13
C.	Establish or maintain standards for subdivision in the floodplain- at the minimum require a buildable area outside of the floodplain. Standards for lot size and housing location. (14D-1)	Medium	PR-28

2. Incentives / Taxation			
A.	Provide special incentives- (clustering, density bonuses, Transfer of Development Rights) for retention of floodplain function in development design (13B-4).	High	PR-6
	▪ Provide incentives or bonuses for developers who actively protect flood hazard areas. (i.e. 10% density bonus). Specific development standards in zoning ordinance. (14C-2, 13A-7).	High	PR-6
	▪ Utilize landowner incentive programs (i.e. Conservation District, Cost- Shares, Open Space taxation and other tax breaks) (9C-3).	High	PR-6
	▪ Utilize existing agricultural subsidies or programs to allow for flooding on some farmland. Note: Will depend on water velocity-erosion verses sheet flow. Develop a compensation program for productive agricultural land lost to flood induced erosion. (15C-4)	High	PR-6
B.	Encourage jurisdictions to join FEMA's Community Rating System to reduce property owners' flood insurance premiums. (new, so no alternative number)	High	MM-11
3. Open Space / Parks			
A.	**Encourage the retention of open space in floodplains through:**		heading
	▪ Open space taxation policies (specifically including these problem areas in the public benefit rating) (13B-6)	High	PR-5
	▪ The development of walking paths / trail systems (12H-4d).	High	PR-5
	▪ Develop policies and standards for open space retention within expanding UGAs, and within individual developments. (14E-3)	High	PR-5
	▪ Incorporate open space/floodplain retention into site plans (e.g. La Salle High School)(11A-3)	High	PR-5
	▪ Include flood hazard reduction goals in Open Space Planning (13C-5)	High	PR-5
	▪ Encourage local governments to establish specific comprehensive plan policies to use floodplains and other critical areas to meet their GMA requirements for Parks and Open Space. This may substitute for designating some blocks of private land as open space. (13A-5, 14E-4)	High	PR-5
	▪ Maintain open areas near the mouth of Ahtanum creek for inevitable flooding (i.e. Fulbright Park and adjacent areas).(11A-2)	Medium	PR-26
	▪ Encourage parks (County and City) in frequently flooded areas (i.e. Fulbright Park) (13A-3).	High	PR-6
4. Large Scale Retention of the Floodplain			
A.	Reduce density in the floodplain through various methods(14C-3):	High	PR-5
	▪ Preserve and restore natural floodplain in places that retain some of the floodplain function. Prioritization- allow for flexibility while identifying critical locations, based on CFHMP and mapping (4-12).	Low	ST-22
	▪ Make changes to comprehensive planning and zoning documents and maps to focus lower intensity development within floodplain	High	PR-5

	corridors and focus higher intensity development outside floodplain corridors (14C-4, 14C-5).		
	▪ In certain high risk locations, consider development moratoriums or high standards of proof in place where development is outpacing knowledge or tools available to keep the public safe (i.e. the area has not been mapped, or conditions have changed since the last mapping) (13A-15).	Medium	PR-25
B.	New traffic-generating developments should be located outside of floodplains (See also Bridges & Roads). (12H-4b)	Low	PR-36
C.	New major arterials should be located outside of floodplains where possible. If in floodplain, design to minimize flood impacts. (12H-4b)	High	PR-4
D.	Incorporate principle of floodplain planning into infrastructure & similar facilities plans (8C-2, 12H-2)	Medium	PR-23
E.	Minimize negative flood effects of accessing major arterials esp. when adjacent to or across floodplains (12H-4c)	High	PR-4
F.	When developing floodplain planning, zoning, and development standards or use designations, the jurisdictions should consider: • future land owner costs for flood damage, • NFIP insurance costs • construction costs for flood prevention. • urban land use preference in the following order from most to least preferred: open space, trails, parks and recreation, light industrial, commercial, low density R1 (one lot per acre), and clustered residential.	High	PR-3
5. Acquisitions / Easements / Incentives			
A.	Acquisition/easements of land surrounding flood problem areas, i.e. Emma, Shaw, Union Gap, Ahtanum Mission (4-13, 15B-4, 15D-4) • Acquire land- fee simple or easement, for a variety of purposes consistent with floodplain function (13B-5). • Address maintenance of drainage easements-establish who is going to enforce maintenance (9C-12) • Develop a program/policy guidelines for areas threatened by meandering and erosion, or frequent inundation, including (15C-3, 15C-9, 15C-10): · Buyouts · Relocation · Easements · Flood-Proofing • Make acquisition of FEMA identified Repetitive Loss properties a high priority (6 of the 8 properties with this FEMA designation are in the CFHMP area). (new, so no alternative number)	High	MM-5 MM-5 MM-5 PR-5 ST-1
B.	Utilize tools such as floodplain easements to preserve off-site storage of water and sediment in farmland (existing pastures, alfalfa), while preserving use as farmland. Consideration: This could accomplish two goals: preservation of use of land for agriculture, and preservation of floodplain. (15B-5, 15B-8). Link to Farmland preservation programs.	High	PR-6

C.	Encourage organizations (neighborhoods, County/City/Yakama Nation or others) to purchase floodplain areas (9C-10).	High	PR-5
D.	Provide incentives for landowners and developers who provide floodplain storage (4-6).	High	PR-5
6. Standards for Development			
A.	Establish Flood Overlay Zones in affected jurisdictions. These overlay zones would have legal status (i.e. in a zoning code or other ordinance) and contain development standards, objectives, and review/process criteria for the broad suite of land uses that occur in floodplains. (13B-3) Note: language substantially modified in final review.	Medium	PR-8
B.	Develop flood abatement policies for areas of existing dense development within the floodplain (such as Ahtanum and Wiley City) (13A-13) ▪ Design better drainage, especially in Wiley City and Ahtanum. In the past, overflow water used a ditch along the railroad, which has been filled in. Resulting lack of drainage causes sheet flow (14A-4). ▪ Establish areas such as Wiley City & Ahtanum as special study areas. (new)	Medium	PR-19
C.	Establish policies in flood prone and flood hazard areas for directing preferred locations for the siting of new infrastructure such as major and minor arterials, water and wastewater distribution mainlines, regional stormwater facilities, parks and greenbelts. (13A-11)	High	PR-4
D.	Limit/restrict/reduce the number of bridges and road crossings, especially small road capacity bridges and culverts for new development through subdivision standards. Also offer incentives for improvements or consolidation for existing crossings esp. post disaster. (12H-5, 12H-9, 12A/B-9, 12C-4).	High	PR-16
E.	Seek land use examples from other similar areas. 13B-8	Medium	PR-21
7. Miscellaneous Policies			
A.	Ensure flood policies in the Yakima Urban Area Comprehensive Plan are implemented through ordinances and land use decisions. Planning for flooding is supported in Objective E7 (13A-4).	Medium	PR-22
B.	Develop special land use and flood-proofing standards for industrial uses relating to hazardous materials, storage, use, disposal (11B-1). Jurisdictions should adopt Appendix G.	Medium	PR-29
C.	Consider 25-year flood as design and regulatory floodplain for future development to minimize frequent damages (new, so no alternative number). Note: language modified in final recommendation review.	High	IS-7
6. DEVELOPMENT STANDARDS/ENFORCEMENT			
1. NFIP Related			
A.	Consider increased elevation above BFE of new structures in the floodplain. 14A-2	High	PR-10

B.	Require Flood-proofing for non-residential structures: ▪ Flood-proof utilities ▪ Flood proof structures- elevate, make existing structures less flood damage-prone (4-8).	Medium	PR-29
C.	Utilize available flood data in accordance with FEMA's definition; this is may be valuable esp. for jurisdictions where NFIP compliance regulations are not affected by CAO's "Best Available Science" requirements. (new, so no alternative number)	High	PR-15
2. Special Zones			
A.	Identify areas with floodplain "islands" and develop standards that: 1. Limit density to provide flood passage 2. Provide emergency access 3. Transportation networks in these areas (even if they are zoned as low density) should be planned to take into account surrounding properties, rather than a standard site-specific approach (12H-6).	Medium	PR-20
3. Miscellaneous			
A.	Enforcement- Adequately fund enforcement activities. More effective code enforcement, especially for blatant disregard of the law.(1C-4, 1C-3, 18)	High	PR-11 & PR-18
B.	Coordinate between jurisdictional procedures in place for expedited permit issuance during and period after a flood event under State and County regulations (10D-1).	Low	FR-13
C.	Ensure floodplains and floodways are identified on final plat maps – included would be text identifying effective map date and disclosure regarding fact that the maps will change over time. Also consider including identification of riverine Critical Areas buffer on plats (new) Added during final recommendations review	Added	PR-17
7. UNION GAP			
A.	Modify Wapato Dam (4-11, 6C-7) to decrease flood risk (See Upper Yakima CFHMP)	High	IS-6
B.	Identify future flood impacts that may occur as a result of aggradation (6C-1, 6C-2, 6C-3, 6C-8). Sediment Transport on the Yakima River Studies: ▪ Study how changes on the Yakima River adjacent to Union Gap may affect water tables in Union Gap (4-18) (cont.) ▪ Causes and rates of channel aggradation in the Yakima River (4-17, 6C-9) ▪ Improve sediment transport along the Yakima River (Refer to the Upper Yakima CFHMP) (4-10). (Wapato Dam and upstream reach)	High	IS-6
C.	Relocation of Wide Hollow Creek below 3rd Ave. (6C-6, 11A-4) ▪ Construct floodgates on Wide Hollow culverts if Wide Hollow is diverted into Ahtanum Creek (abandoned culverts at/near the mouth if creek relocated) (6C-5)	High	ST-6

D.	Encourage the appropriate parties to develop Operations and Maintenance agreements for the flood gates and fish passage structures at the Mill to ensure coordinated and effective management for flooding. (new, so no alternative number)	Medium	ST-15
E.	Bypassing or modifying the Mill structures on Wide Hollow Creek. (11A-5)	High	ST-8
F.	The Spring Creek floodgate should generally be closed except for habitat or flow enhancement for a limited time period (6B-1)	Low	MM-16
G.	Install a remotely controllable floodgate that could be opened some times of year, closed at others (on Spring Creek floodgate) (6B-2)	Low	ST-23
H.	Improve conveyance downstream of the culverts on the Spring Creek irrigation channel by increasing grade – this would help in most flood events, possibly not in large-scale flooding. (6D-2)	High	ST-7
I.	Retain Wide Hollow overflow path along the railroad right of way. (11A-1)	Medium	ST-15
J.	Coordinate with agencies planning large infrastructure projects – such as WSDOT – to look for opportunities to reduce flood hazards for Union Gap. (new, so no alternative number)	High	ST-6

8. INFORMATION / OUTREACH

1. Mapping

A.	Provide and use improved flood mapping and modeling to assess risk to new and existing infrastructure and for designing new infrastructure, including current Ahtanum-Wide Hollow remapping. (12G-1, 12A/B-2, 12C-2, 12G-3).	High	PR-15
B.	Re-map the floodplain for NFIP rate maps, to allow for up-to-date accuracy and application of land use regulations. (8D-1, 4-3, 15B-6) ▪ Consider the contribution of high ground water to off channel flooding (4-9). (4-19). ▪ Complete floodway mapping in the region (15D-1, 15C-13) ▪ Regularly scheduled updates (15D-2)	High	PR-11 & PR-15
C.	Map Channel Migration Zones (and other hazards) (15G-4 15D-3) Identify areas that are at risk for channel migration in addition to identified CMZ, i.e. N.F. Ahtanum, below the Narrows, at the Mission, Shaw Creek, etc. (15C-12).	Low	IS-23
D.	Supply specific flood mapping products beyond NFIP. ▪ For example, identify where hollows overflow, upland flood channels are located (aside from the formal FEMA mapping process) and disclose when purchasing or developing property. 1D-8. 15F-2	High	IS-11 & PR-15

2. Landowner Assistance

A.	**Provide public education about potential flood hazards and responses** on individual properties including keeping debris sources out of known flood channels (10B-2, 1D-3, 1D-7).	High	PO-5
B.	**Encourage residents** who are at high risk for flooding **to purchase flood insurance even if they are not in a mapped floodplain** (8D-3.)	Medium	PO-8

C.	**Create pamphlets for new landowners**- i.e. pamphlet put out for small landowners in Kittitas County by the Kittitas Conservation District (fence debris) (1B-9.)	High	PO-5
D.	Prepare a **program to educate landowners about riparian function** and health before and after a flood event (9C-7.)	High	PO-5
E.	Provide flood risk and regulatory constraints at beginning of development process (no surprises) (13A-10, 14B-1)	High	PO-3
F.	Public education about maintaining driveway culverts, and correct sizing and maintenance of culverts. (12E-5)	Medium	PO-10
3. General Public Outreach			
A.	Cooperate with other agencies to support or develop public education programs, such as stream cleanup programs and volunteer monitoring (9C-13).	Low	PO-13
B.	Encourage citizens to report dumping in streams (public outreach) (1C-5).	Low	PO-14
C.	Cooperate with other agencies to engage in public education regarding the values and esthetic appeal of riparian corridors/open space for purpose of preservation of floodplain corridors (7B-5).	High	PO-5
D.	Provide public education about how riparian and flood hazard management goals complement each other. Inform people about the importance of the functions of streams, rivers, and natural drainage ways. (9C-11).	High	PO-5
E.	Provide public education directed to residents, farms and businesses to increase individual preparation for floods (10A-3).	High	PO-5
4. Outreach/Information Related to Flood Projects			
A.	Flood Control Zone District to provide technical assistance and comments regarding flood hazards and infrastructure design (12G-2).	Medium	PO-11
B.	Public notice/disclosure/consultation when flood projects are planned (19).	Medium	PO-9
5. Realtor, Lender, etc. Outreach			
A.	Provide information about flood history to realtors, lenders, etc. in proposed new developments (15C-14) (15C-15)	High	PO-4 & PO-5
B.	Put on workshops and other outreach for realtors (15C-16)	High	PO-4 & PO-5
9. Flood Response			
1. General Flood Response Planning			
A.	Participate in and support Flood Response planning efforts (as part of the Emergency Response Plan) (10A-1, 10A-2, 12F-5).	High	FR-2
B.	Implement Emergency Response Plan (Get Ready- Set- Go- Recover) procedures, from the Emergency Response Plan (10C-1).	High	FR-2
C.	Determine where large numbers of animals may be kept during a flood event and distribute information to the public. Work with	High	FR-4

	Emergency Management and Red Cross to establish animal food and shelter contingencies - discussions may include Central Washington State Fairgrounds, farm feed stores, veterinarians, and animal rescue organizations. (new)		
2. Planning/Mapping			
A.	Identify and map problem spots throughout the watershed so flood responders know where to look first (5F-5).	Medium	FR-9
B.	Designate emergency response access routes and incorporate into transportation planning (12F-4). Designation of evacuation routes and notification of the public and first responders (10B-3).	High	IS-12 & PR-7
C.	The Flood Control Zone District will develop databases of parcels affected by different level flood events, corresponding to upcoming Ahtanum-Wide Hollow FEMA re-map (10C-5).	Medium	FR-9
3. Coordination			
A.	Provide infrastructure or technology for better communication between agencies (EOC) (10C-2)	Medium	FR-12
B.	Coordination between Emergency Management and the Irrigation Districts such as AID and Yakima Valley Canal, for management during floods. Include Irrigation Districts in communications with the EOC (emergency operations center) and FCZD (5F-1, 5F-3, 2B-3).	High	FR-5
C.	Interagency coordination of flood information and response, including WDFW, Irrigation Districts, and Yakama Nation Natural Resources, Fisheries and Engineering (10C-4, 10C-9).	Medium	FR-12
D.	Flood responders concentrate patrol and response on known problem bridges and roads (12F-1).	Medium	FR-9
E.	Public and agencies coordinate flood fight and post flood actions with recommendations identified in the Ahtanum-Wide Hollow CFHMP to provide a good basis for decision whether to take emergency actions. (10D-2)	Medium	FR-6
4. Outreach			
A.	Recognition and dissemination of knowledge about potential flood hazards during a flood event in coordination with the EOC (10C-3).	Medium	FR-12
B.	Develop warning systems including mass media (10B-1) · Investigate reverse 911 system	Medium	FR-8
C.	Encourage volunteer flood-watchers program to provide information (10C-8).	Medium	PO-12
D.	Provide special flood phone line for public to call in and provide information about current flooding (10C-7).	Medium	FR-10
5. Irrigation Gates			
A.	Improve access to Bachelor diversion during floods without diverting flood waters or making flood problems worse (2C-3).	Medium	FR-11
B.	Coordinate opening gates for flood relief, based on flood forecasts, channel maintenance needs, and impact to diversion facility (5F-6).	High	MM-8

6. Monitoring/Documentation			
A.	Install North Fork Ahtanum & Wide Hollow gages including telemetry (5F-2).	Medium	FR-7
B.	Documentation of floods (air photos, etc.) Open contract with flights. (15D-5) Note: this replaced 10C-6 since they were near duplicates	Medium	IS-14
7. Ice Jams			
A.	Inventory of locations where ice jams are known to occur- identify them in the Flood Response Plan (1A-7).	Medium	FR-9
B.	Outline emergency response to ice jams in the Flood Response Plan (1A-3). · Alert residences at risk. · Blast ice jams - (normally only done on very stable ice jams) (1A-6) · Facilitate regulatory approval by Ecology and Fish & Wildlife and local jurisdictions due to short time frame (new)	Low	FR-14
8. Regulatory			
A.	Facilitate involvement of permitting agencies as a component of the Emergency Management Plan, and are present in the EOC during a declared emergency. General guidelines for taking action during a declared or non-declared emergency are: A. permitting personnel does a site visit (10D-3, 10D-3a). · Choose minimum flood fight action or action that will meet the intent of the regulations - i.e. better protect/enhance the resources (10D-3b) · Follow up - 6 months after a declared disaster to come into compliance for flood fight actions (10D-3c)	High	FR-3
10. Shaw Creek & Wide Hollow/80th Ave. Area			
1. Structural Response			
A.	Relocate Shaw Creek to the low point in the drainage to allow for more natural stream and floodplain function, and less maintenance. Consider a potential for a larger solution that includes concurrent considerations on Wide Hollow Creek. • Recommend quick actions which allow us to keep options open: · Keep at-risk areas undeveloped · Require drainage easements · Allow for high-density development in areas that are not at risk. • Consider purchase of property or property interest (i.e. option, easement, etc.) needed for relocation soon, before development prevents this alternative (new, so no alternative number) • Investigate ways to keep certain properties undeveloped (for flood protection and for possible relocation of Shaw Creek channel). Address Zeigler's property. • School owns property and may be amenable to relocation.	High	ST-5

	• Proposed Nob Hollow Road possibly a problem, possibly remove two Wide Hollow bridges, which would help with the conveyance on Wide Hollow • Shaw Creek overflow bridge added as part of Nob Hollow construction. • Move Wide Hollow Creek south of Wide Hollow Rd (if Nob Hollow is not constructed) • Consider downstream impact of changing Shaw Creek's confluence with Wide Hollow west. (8B-1, 8E-1.a through e, 8E-4, 8E-6.b through d)		
B.	Consider overflow channel (new)	High	ST-5
C.	Reconfigure Shaw Creek to function as floodplain and fish and wildlife habitat (8A-2).	Medium	ST-14
D.	Expand diking along Shaw Creek to protect new and existing development (8B-2, 8E-2, 15B-2)	Low	ST-17
E.	Consider developing regional retention upstream of Tieton Drive (8C-6, 8E-3)	High	ST-4
F.	Protect natural floodplain functions in Shaw Creek's watershed, especially before it is mapped (8C-1).	Low	ST-24
2. Information and Outreach			
A.	Notify developers and prospective residents of flood hazard on the property (8E-6.a)	Medium	PO-7
B.	Hold neighborhood meeting for residents living near Shaw Creek. (8D-4, 8D-5).	Medium	PO-7
11. St. Joseph's Mission at Ahtanum			
1. Study			
A.	Initiate hydraulic study to predict flood flow patterns at Ahtanum Mission, based on surveys and modeling. Modifications to infrastructure management may result in relation to head-cuts (2A-1).	High	IS-9
B.	Determine the effects of flooding at the Mission on irrigation structures and of irrigation infrastructure on flooding patterns (2C-6)	High	IS-9
C.	Verify if there is room for Ahtanum Creek to occupy old floodplain channels on the tribal land adjacent to Ahtanum Mission to reduce uncontrolled flow down Bachelor Creek and damage to AID diversion. Determine if the tribe/allotment owners may be amenable to that (2-3).	High	IS-9
D.	Define the sensitive historical and cultural issues at Ahtanum Mission site (2-1).	High	IS-9
E.	Identify potential future downstream impacts from any proposed changes in the Ahtanum Mission area, and establish acceptable level of flooding along the entire reach (2B-4).	High	IS-9

2. Hatton			
A.	Recreate a flood overflow channel back to Ahtanum Creek from Hatton Creek due to lack of flood capacity on Hatton and risk of avulsion from current flood routing/channel configuration (natural overflow channel blocked in the 1930s). (2A-5. 2B-2)	High	ST-9
B.	Modify the old Hatton ditch channel below the diversion. Intent would be to block/armor channel to prevent opportunity for formation of head-cuts (2A-7).	High	ST-9
C.	Remove the old Hatton Diversion to reduce flood stage at Mission and avulsion potential into Hatton Creek (Ahtanum Mission head-cuts) (2A-6).	High	ST-9
3. Levees/Armor			
A.	Armor stream channel to prevent migration of Ahtanum Creek to the North (Soft levees on North side would not be sufficient- river would cut through) (2A-8).	High	ST-9
B.	Utilize Ring dikes to protect St. Joseph's Mission property (2A-3).	Low	IS-17
C.	Consider major levee construction on Mission property to alleviate head-cuts, this would not be needed if Recommendations A & B in Hatton section are successfully implemented. (2A-2).	Low	IS-18
4. Bachelor			
A.	Modify the Bachelor Diversion to improve functionality and decrease flood hazard (e.g. upstream of 90- degree turn on Ahtanum Creek) (2C-2, 2C-4) (cont.) ▪ During floods, close Bachelor diversion and create a new high flow diversion channel from Ahtanum creek (2C-5)	High	ST-9
12. Emma Lane Area			
1. Study			
A.	Perform an Emma Lane flood study, and develop design guidance on acceptable flood protection levels. (3-2) · Address Ahtanum Creek flood conveyance downstream of 42nd and Ahtanum Rd. (3-18).	Low	IS-19
B.	Perform a Cost-Benefit analysis of stream relocation at Emma Lane (3-19).	Medium	ST-13
2. Relocation			
A.	Move Ahtanum creek to a lower point in the floodplain (requires cooperation with Yakama Nation, acquisition of at least two homes, and a new bridge) (Emma Lane) (3-1).	High	ST-2
	• If Ahtanum Creek is relocated, consider a design that does not include filling in the old Ahtanum Channel- looking at the existing	Medium	ST-12

	channel as habitat (3-15).		
	• Examine constructing a controlled side channel to bypass Emma Lane, rather than moving the creek (3-14).	Medium	ST-14
3. Development in Emma Lane Area			
A.	Limit future development in the Emma Lane area (3-3). - Place controls on building in the flood-prone areas in and around Emma Lane (3-17) (e.g. using zoning, utility hook-ups, etc.)	Low	PR-32 & PR-33
B.	Adopt and implement more strict building standards in Emma Lane area- flood-proofed homes, buildings (3-11, 3-3).	Low	PR-35
4. Channel and Drainage Capacity			
A.	Improve drainage throughout the entire Emma Lane area- culverts, roads, etc. (3-8).	Low	PR-37
	• Reconfigure the Bachelor Creek bridge on Ahtanum Road to increase capacity and reduce backwater flooding (3-6).	High	ST-3
	• Alter drainage systems and easements, based on Emma Lane floodplain remap study (3-10).	Low	IS-24
	• Eliminate the Shropshire ditch or other irrigation ditch remnants (i.e. remove irrigation ditch that directs flow and inundates Emma Lane- area pastures and residents) (3-7).	Medium	ST-11
	• Improve stormwater system on Ahtanum Road to limit Emma Lane overflows into the airport area, and downstream to 16th (which floods the intersection at Ahtanum Road) (3-9).	Low	MM-19
B.	Widen bridge at 42nd Ave. to reduce localized flooding and overflows (3-5).	Medium	ST-11
C.	Remove old fill that restricts floodplain capacity on Ahtanum Creek at the Yakama Nation land just south of Emma Lane (3-16).	Medium	ST-11
MONITORING – INVENTORIES (By Alternative Number)			
1C-7, 1C-8, 1C-11	Investigate methods for the following: · Research how other communities deal with dumping in floodplains, particularly concrete, fill, etc. · Research measures to deal with illegal/contaminated dumps (meth labs, etc.) · Examine statewide laws relating to dumping and streams to establish authorities	Low	MM-20
12D-3	Inventory roads acting as levees. Design site-specific solutions based on the inventory and current and future road classification; solutions may include armoring or changes to road configuration, or elimination of the road and selection of alternate route. Incorporate findings into transportation planning.	High	IS-3 & PR-4
12C-1	Inventory channel process problems in relation to existing and proposed roads	Medium	IS-15
12D-6	Inventory of private roads acting as levees	Low	IS-25
12E-4	Identify road ditches that serve as flood conveyance, thus placing them at a high priority for maintenance (i.e. Rutherford Rd and Shaw Creek at 80th).	High	

12E-7b	Private road culvert inventory	Low	IS-26
12G-8	Investigate funding sources or incentives for private drainage infrastructure	Low	IS-27
12H-3	Monitor the effects of urbanization and land use intensification to the characteristics (runoff, time of concentration, water quality) of the watershed over time. Take action to mitigate for negative watershed scale effects.	Low	IS-22
14E-1	Investigate geologic hazard areas standards for applicability to high flood risk hazard categories such as channel migration zones and alluvial fans to address potential regulatory gaps.	Low	PR-36
15A-3	Identify areas where man-made alterations are affecting flooding (i.e. upstream of 64th on Hatton, Diversion #14, and The Narrows) to allow for cooperative projects.	Medium	IS-15
15B-7	Identification of flood prone or high risk areas that are near perched channels (disclosure that the area is at risk for flooding).(15B-10)	Medium	IS-15
15F-3 & 15F-4	Identify critical hollows through risk assessment and through flood benefit (for protection measures) ▪ Identify special flood protection measures for hollows	High	IS-11

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