KING COUNTY FLOOD CONTROL DISTRICT

King County

King County Flood Hazard Management Plan Update
Citizen Committee Meeting

January 10, 2012

Protecting public safety, the regional economy and critical infrastructure.

GOALS, OBJECTIVES AND GUIDING PRINCIPLES

Goals of the King County Flood Hazard Management Plan

1. To reduce the risks from flood and channel migration.
2. To avoid or minimize the environmental impacts of flood hazard management.
3. To reduce the long-term costs of flood hazard management

"Objectives" are the set of flood hazard management actions that will lead to achieving the identified goals.

Key themes of the 14 plan objectives include:

- Evaluate risks and take management actions to mitigate risks
- Maintain and operate a flood warning program
- Maintain risk reduction structures and prioritize actions using cost-effective approach that sustains economic productivity
- Protect the environment
- Provide public education
- Coordinate actions within King County and other jurisdictions and organizations

"Guiding Principles " are the facts and technical understanding that direct flood hazard management.

Key themes of the 11 guiding principles include:

- The purpose of the plan is to reduce risk to people and property
- Flooding creates financial costs, working with natural processes reduces cost
- River corridors include a range of land uses
- Actions upland impact flooding and channel migration
- Biological productivity and diversity are sustained by natural processes, including flooding
- Communication and coordination with the public and other public and private agencies is essential
- Advances in knowledge calls for adaptive management

Key questions or comments about goals, objectives and guiding principles:

1. What are your initial thoughts about whether these are still relevant?

- NOTE: We will revisit these again at the end of the planning process.

Flood Hazard Information

Flood and Channel Migration Hazards

What they are

and

How they are illustrated

Hazards and Risks

- **Hazard** is the physical feature that is the source of risk
  - Understand characteristics, i.e. frequency of overbank flooding, flow paths, river ecology, habitats, sediment and wood movement, and built impediments, i.e. bridges
  - Apply our understanding to develop flood protection and habitat restoration projects, and to protect important features, i.e. flood conveyance and storage, rearing areas
- **Risk** is the possibility of suffering harm or loss from the exposure to a hazard
  - Evaluate effects of development proposals
  - Determine impacts to built or natural environments
  - Set flood insurance premiums

Flood Hazards

- Floodplains and Floodways

  Physical

  Channel and overbank areas shaped by flowing water

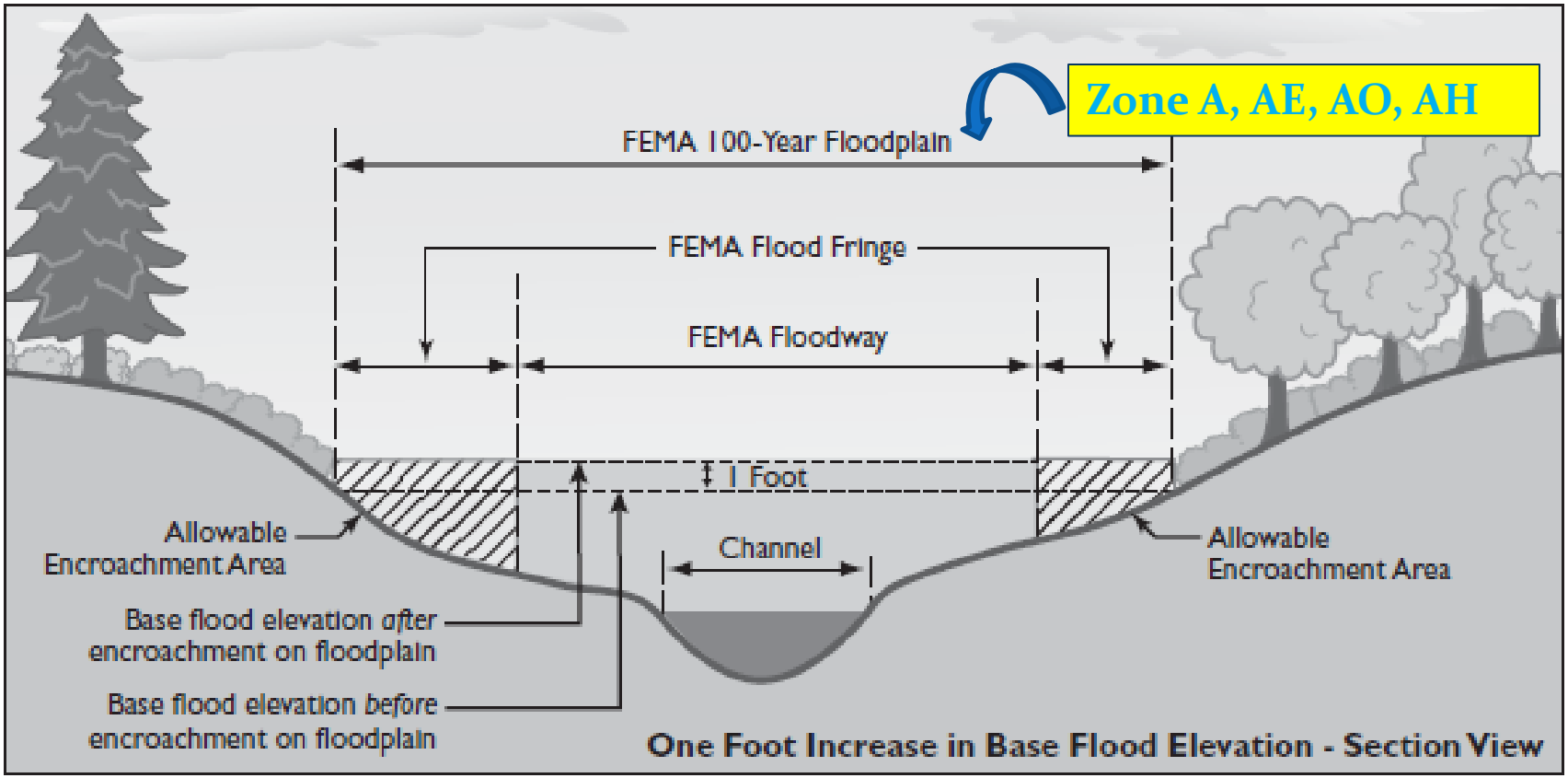
  Allows for water to be conveyed and stored

  Regulatory

  Apply mathematical computations to estimate hydrology (how much water) and hydraulics (extent of inundation) and to illustrate areas of flooding on a map

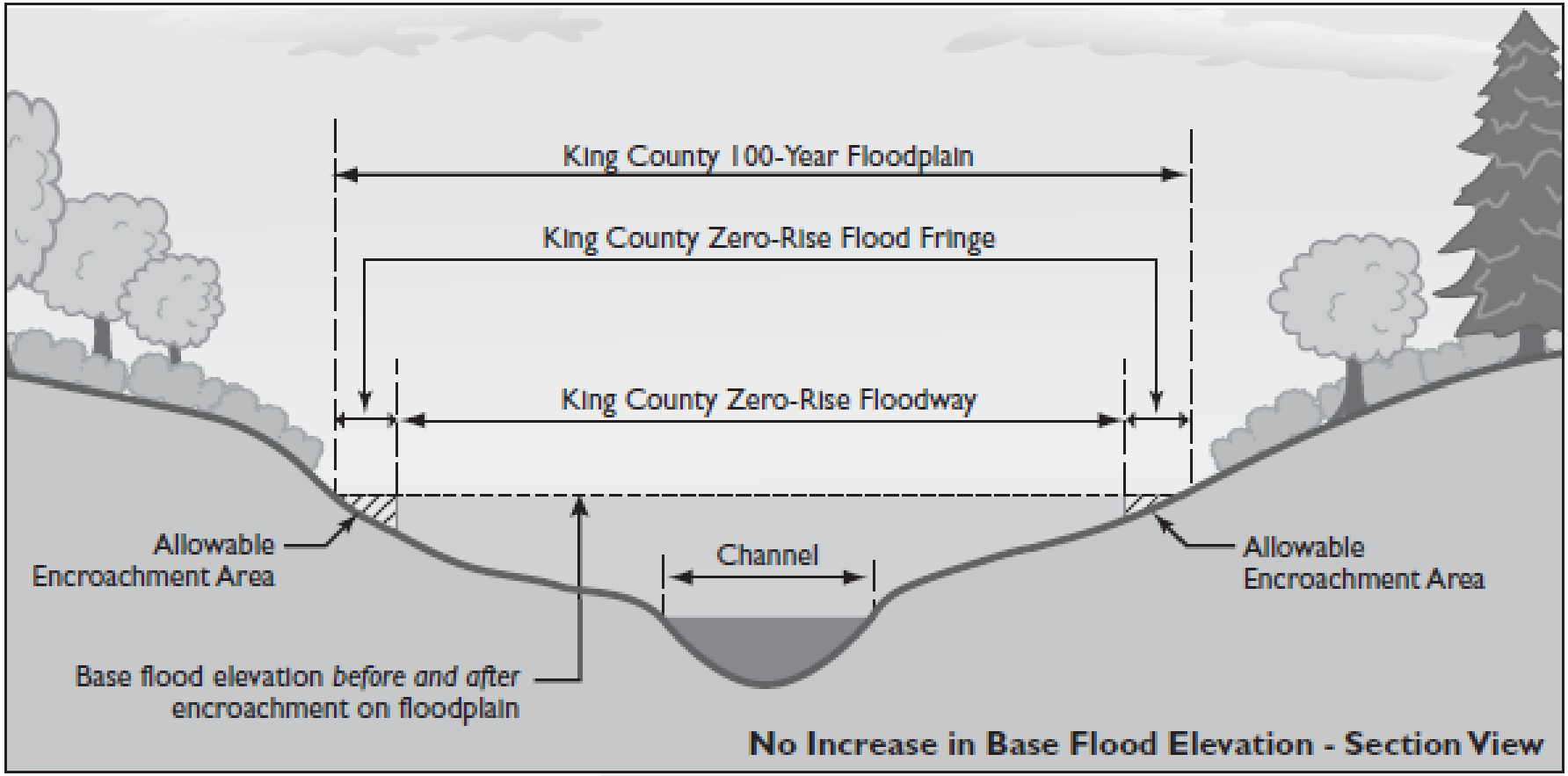
FEMA Floodplain and Floodway

2006 KING COUNTY FLOOD HAZARD MANAGEMENT PLAN



King County Floodplain and Floodway

2006 KING COUNTY FLOOD HAZARD MANAGEMENT PLAN



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Channel Migration Hazards

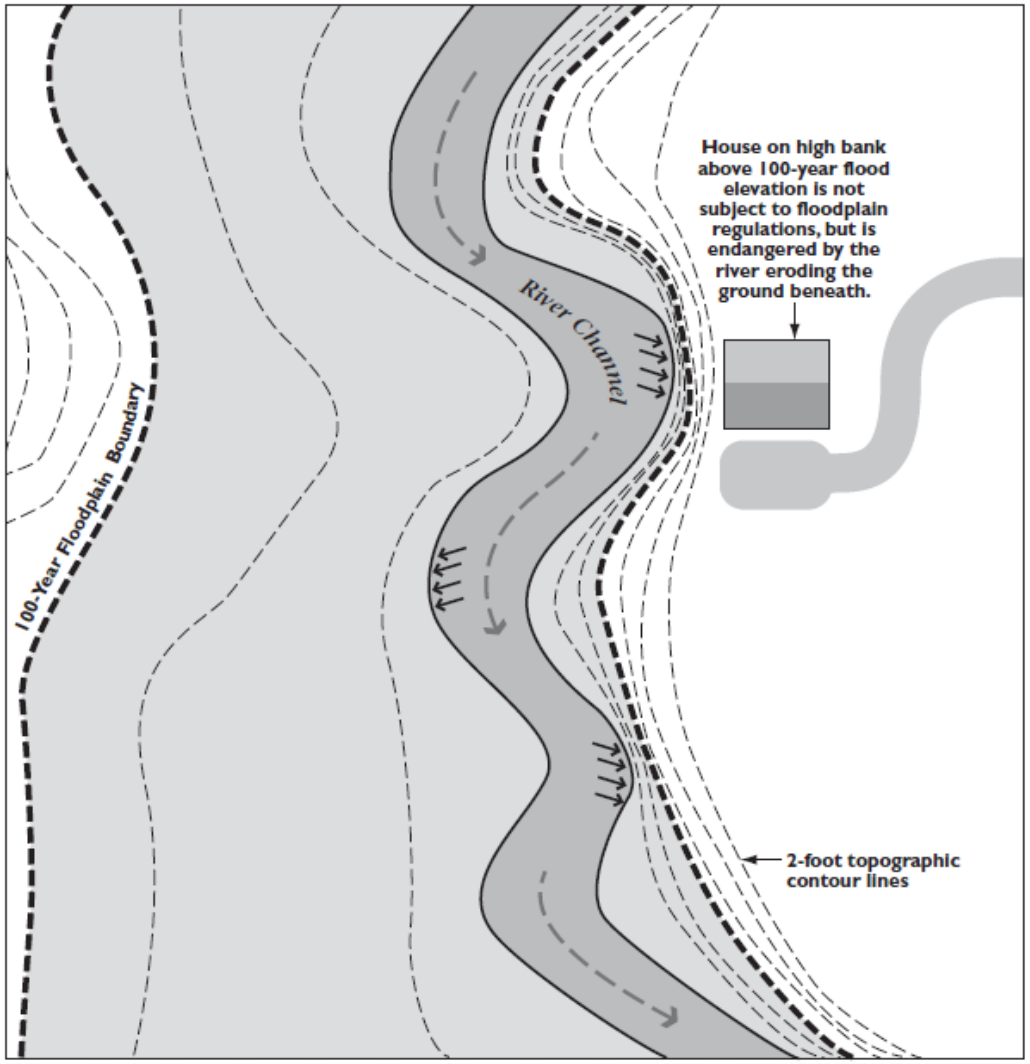
- Also physical and regulatory
  - <u>Physical</u>

    channel movement due to bank destabilization, rapid stream incision, bank erosion and shifts in the location of channel

  - <u>Regulatory</u>

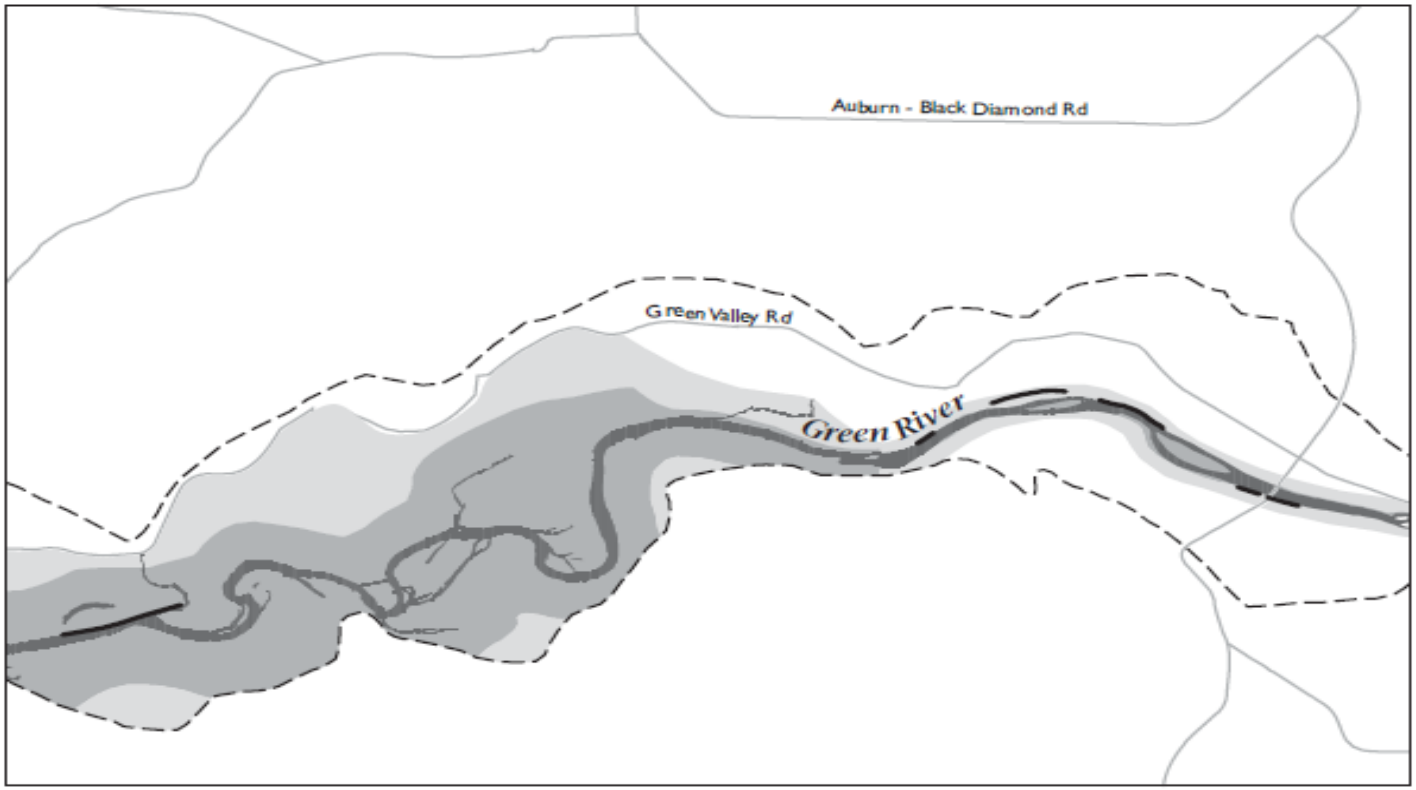
    Per King County Code, two hazard areas (Severe and Moderate)

2006 KING COUNTY FLOOD HAZARD MANAGEMENT PLAN



Green River Channel Migration Map

2006 KING COUNTY FLOOD HAZARD MANAGEMENT PLAN



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Channel Location
Severe Hazard Area
Moderate Hazard Area
Levees and Revetments
Valley Wall
Roads

N

0 1/4 1/2 Mile

King County Code Definitions of Channel Migration Hazard Areas

- **Severe --** The total width of the severe channel migration hazard area equals one hundred years times the average annual channel migration rate, plus the present channel width. The average annual channel migration rate as determined in the technical report, is the basis for each Channel Migration Zone map.

- **Moderate** – area that lies between the severe channel migration hazard area and the outer boundaries of the channel migration zone.

- **Channel Migration Zone** – refer to handout

Hazard Mapping Program

- Since 1993, new flood hazard studies on major rivers and recently along Vashon Maury Island and Incorporated marine shoreline
  - Priority based on areas having no detailed mapping (i.e. no estimates of flood elevations) or where available mapping was notably erroneous, or areas of consequence.
- Since 1991, channel migration studies and mapping on Tolt, Raging, Green Rivers and the Three Forks of Snoqualmie
  - Studies prepared in reaches known to have significant channel movement and erosion problems, or areas of consequence.

Other “flood” hazards

- Alluvial fans: river-scale (i.e. lower Tolt and White), and also tributary stream confluences with rivers
- Landslides: mass wasting along Cedar River
- Lahars: Mt. Rainier, along White and potentially affecting the Green River
- Seismic: Leveed reaches

What are the Needs??

- Updated flood studies for most major river reaches
  - Upper White and Greenwater are not yet updated (Zone A)
  - Continue checking for map accuracy to represent current day flood hazards, i.e. channel capacity or infrastructure changes.
  - Large streams (Soos, Boise and Newaukum Creeks) having approximate hazard mapping (Zone A)
- Several major river reaches remaining for CM studies
  - Cedar, SF Skykomish and White Rivers – studies started
  - Increased technical approaches to preparing CM mapping; allows for improved application to the variety of physical settings, i.e. braided, alluvial fan, avulsions

More needs, more questions…

- How should remaining flood mapping needs be prioritized? Continue to update unmapped river areas; start updating large streams? Should large stream updates within incorporated areas be addressed by cities?

- Should recent studies be prioritized to be revised per the newly proposed FEMA Levee Analysis and Mapping Procedures?

- How should channel migration mapping proceed? Continue with current county methodology or review all studies and reprioritize all river reaches?

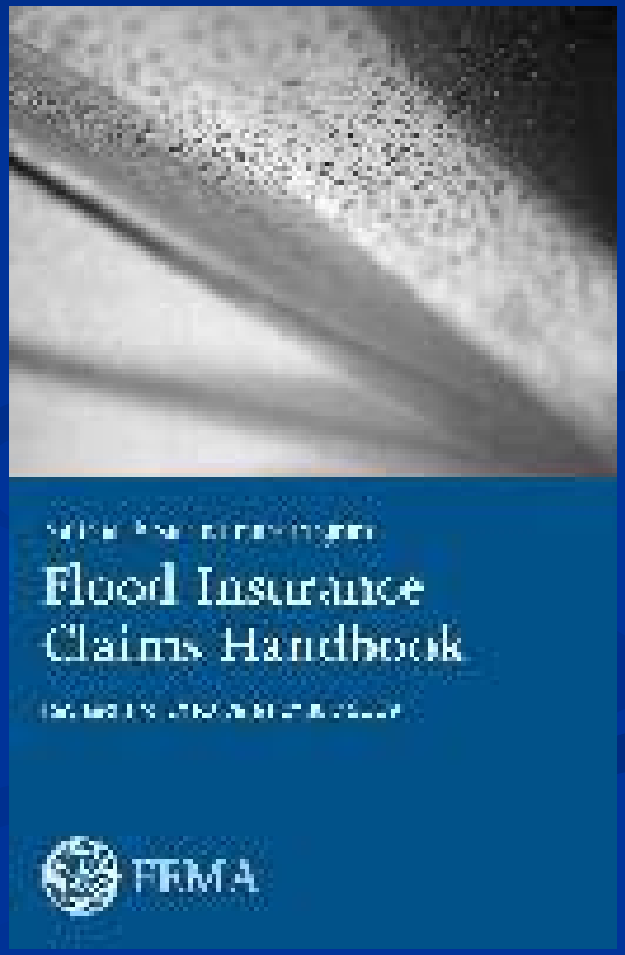
- Should assumed boundaries to migration, (i.e. levees, arterial roads, railroads or sole access roads), continue to be considered "boundaries"? Should the "overnight line" be considered?

- Should mapping of alluvial fans and lahars be prepared?

MANAGEMENT OF LAND USES

Minimum National Flood Insurance Program and State Standards

- Focus is on reducing risk to insurable buildings
- Building standards (lowest floor at or above the 100-year flood elevation, foundation openings, anchoring buildings, flood resistant materials, etc.)
- Encroachments in the floodplain that will cause a rise in the FEMA floodway
- State law addresses allowed uses and substantial improvements in the FEMA floodway



Additional NFIP Requirements for the Puget Sound Region Based on NFIP "Bi-Op"

- Requirements to address the impact of development on Endangered Species Act (ESA) listed species and habitat
- Recognition of the natural and beneficial functions of floodplains (future conditions mapping, compensatory storage, riparian buffer zone, low impact development methods, impervious surface limits, low density development, etc.)

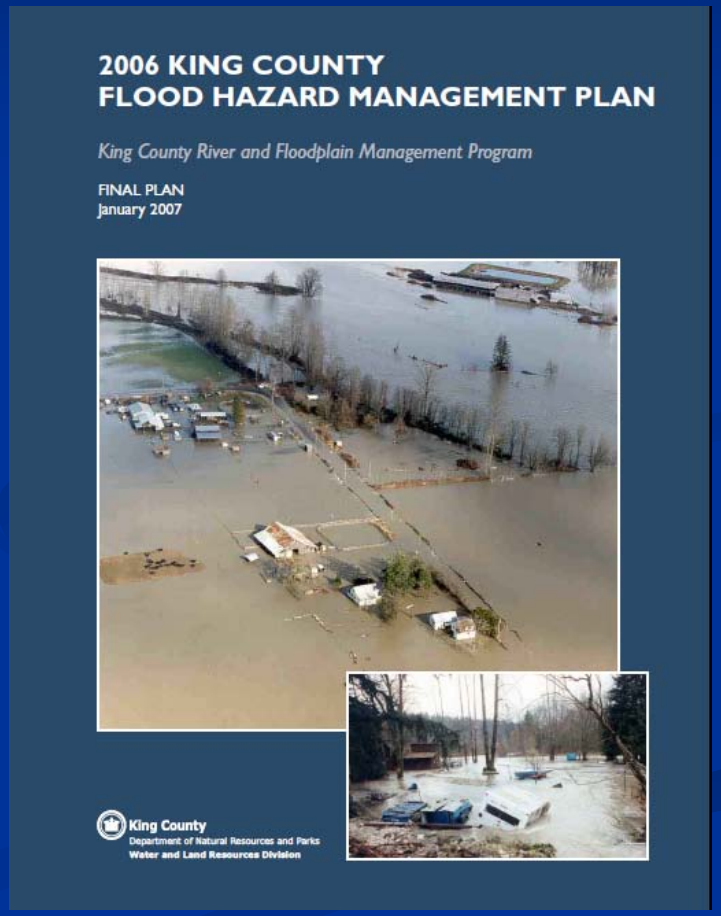
State Requirement for Comprehensive Planning

RCW 86.12.210

- Comprehensive flood plans developed by the county with "full participation" with cities and special purpose districts
- Once County adopts the plan it is "binding on each jurisdiction and special district" within the planning area
- Jurisdictions within the planning area must adopt the plan within 120 days
- Little enforcement of this state requirement

2006 Flood Hazard Management Plan

- Policy G-11: Cities must meet the minimum NFIP and state standards
- Policy G-12: Encourages cities to adopt higher standards
- Policy G-13: Encourages "No Adverse Impact Floodplain Management"



Non-Regulatory Actions to Address Impacts

- Current use taxation (282,151 acres)
- Transfer of Development Rights (TDR) (141,500)
- Farmland Preservation Program (13,200 acres)
- Open space charter amendment (154,393 acres)
- Capital improvement projects (170 levee repairs between 1990 and present, acquired 119 parcels and 284 acres of floodplain property since 2007, elevated 47 homes since 2000,

Options to Consider for the Plan Update

1. Maintain the existing policy direction
2. Require jurisdictions to adopt the same standards as unincorporated King County
3. Require a combination of regulations and floodplain management programs that meet the higher standards required by the FEMA NFIP Bi-Op

Key Input Questions:

1. The 2006 Flood Plan requires local jurisdictions to adopt the minimum standards under the National Flood Insurance Program (NFIP) and encourages adoption of higher standards recommended by FEMA Region 10. Should the Flood Plan require standards that are higher than the minimum NFIP?

2. Should use of Flood District resources be tied to jurisdictions regulatory and land use programs?

River Channel Maintenance

2006 Flood Plan Section 4.3: River Channel Maintenance

- Natural accumulations of sediment or large woody debris can result in increased flood risks.
- Modifying the river channel is one tool that King County may employ selectively to reduce flood risks.

2006 FHMP, page 60.

2006 Flood Plan Section 4.3.1: Sediment Management

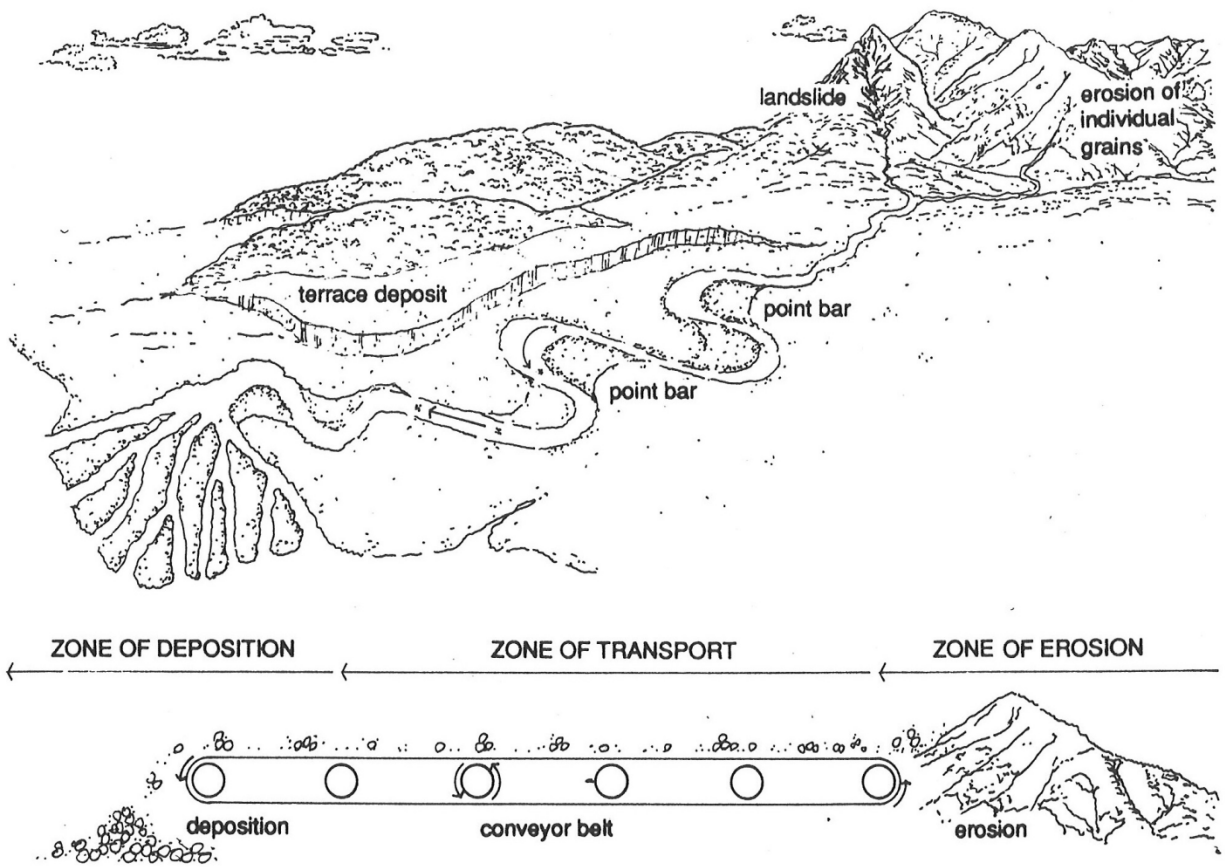
Sediment management can involve actions that:

- Alter the distribution of sediment within a channel to accommodate flows, or
- Alter the corridor within which the channel flows in order to accommodate the movement and deposition of sediment.

2006 FHMP, page 61.

Natural Factors Affecting Sediment in Rivers

- Geology, soils, climate, vegetation
- Channel gradient, channel confinement



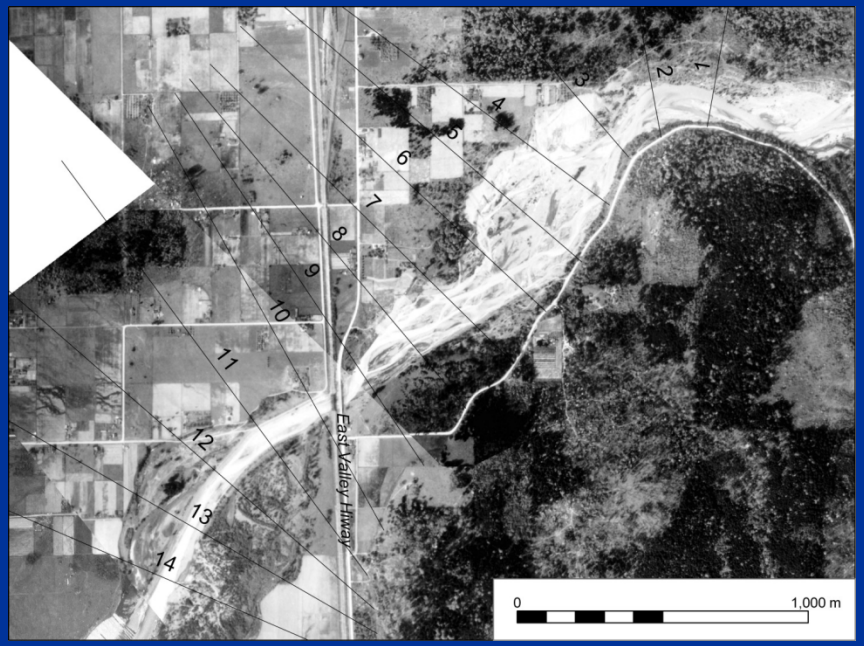
Kondolf and Matthews (1993)

Constructed Features Can Affect Sediment Movement and Deposition

Constructed Feature	Potential Effect
Bridges	Backwater conditions favor deposition.
Containment Levees	Disconnect channel from floodplain where sediments would have deposited in overbank areas.
Bank Armoring	Inhibit lateral channel migration, which is a natural response to sedimentation. Vertical sediment accretion may result.

Example:
Lower White River Alluvial Fan

1931



2000

King County Sediment Management Program: Two Main Components

- Channel Monitoring →
- Sediment Management Actions

Channel Monitoring in King County

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Use Channel Monitoring Results to:

Characterize Existing Conditions:

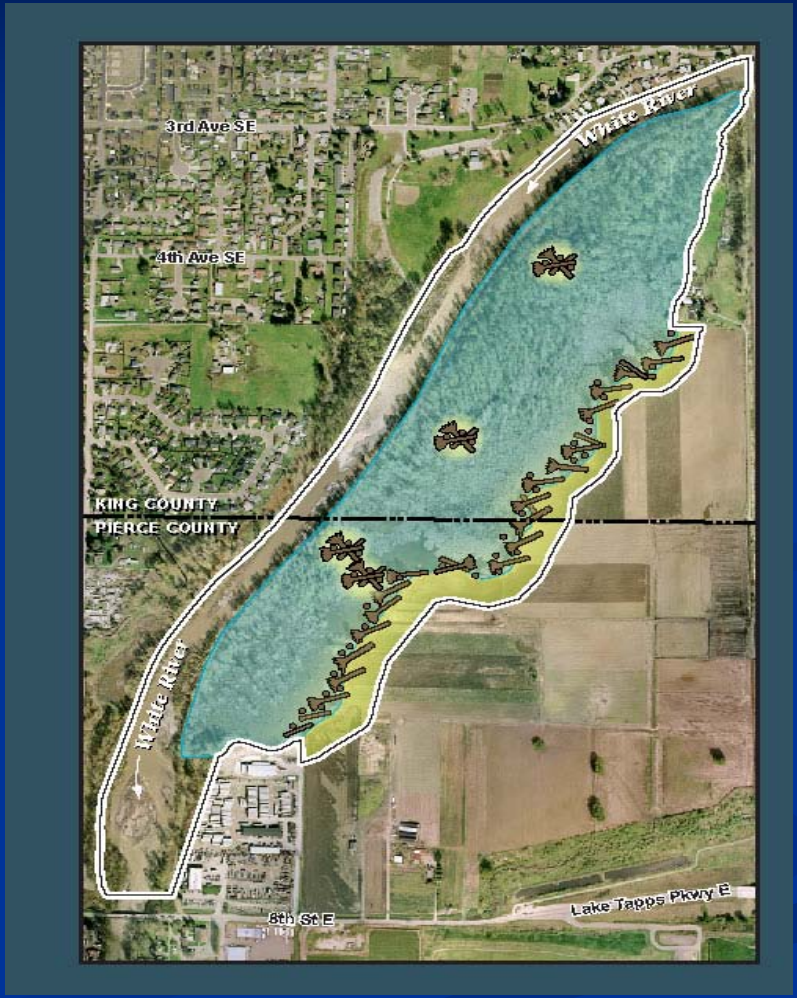
- Quantify in-channel sediment trends
- Quantify trends in floodwaters, flood hazards
- Consider effect of sediment on floodwater levels

Inform Sediment Management Decisions:

- Have flood hazards increased?
  - … beyond an identified acceptable threshold?
- Are such increases attributable to sedimentation?
- If so: Consider Sediment Management Actions

Sediment Management Actions: Alter Channel Corridor to Accommodate Sediment and Flows

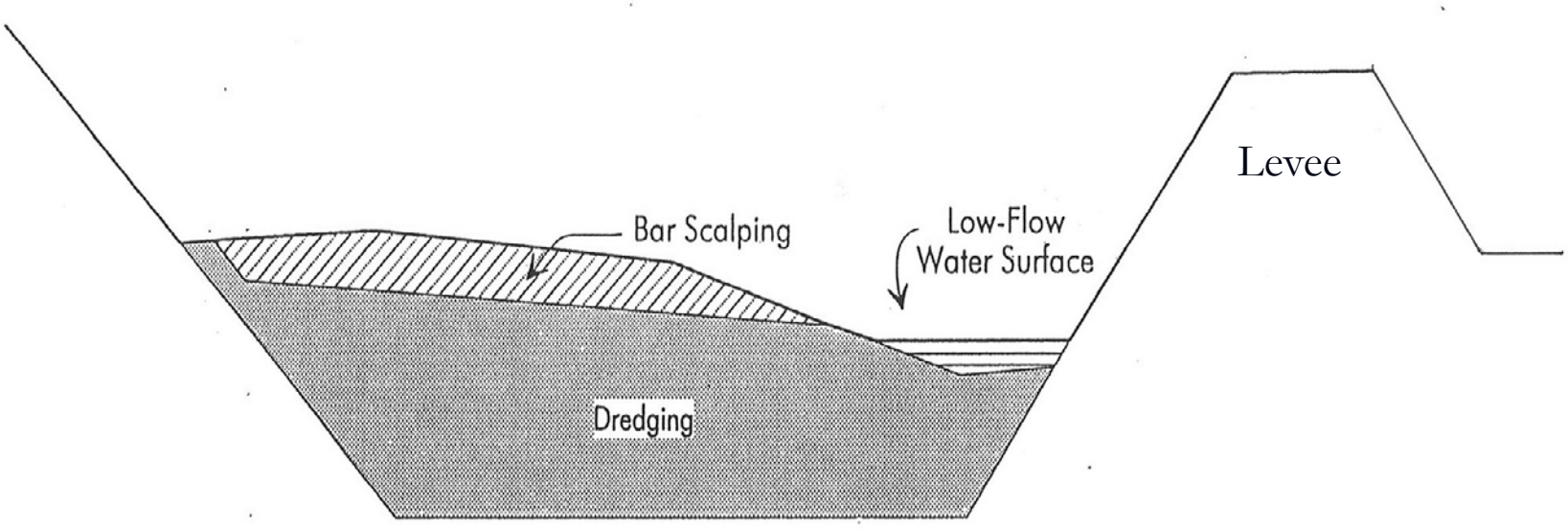
- Levee setback, flood-plain reconnection ➔
- Buy out and remove structures at risk
- Elevate structures at risk
- Temporary flood protection structures (e.g. supersacks, HESCOs)



Proposed Countyline Levee Setback & Flood-plain Reconnection Project; Lower White River, Left Bank

Sediment Management Action: Alter Sediment within a Channel to Accommodate Flows

Gravel Removal by Bar Scalping or by Dredging



Evaluate Sediment Management Action Alternatives

- Evaluate alternatives relative to:
  - Effectiveness in flood risk reduction
  - Avoid or minimize environmental impacts
  - Minimize long-term costs
  - Consistency with Flood Plan Policies
- Select a sediment management project
- Any potential sediment mgmt project would be rated for relative priority among all other flood risk reduction projects, via KCFCD processes.

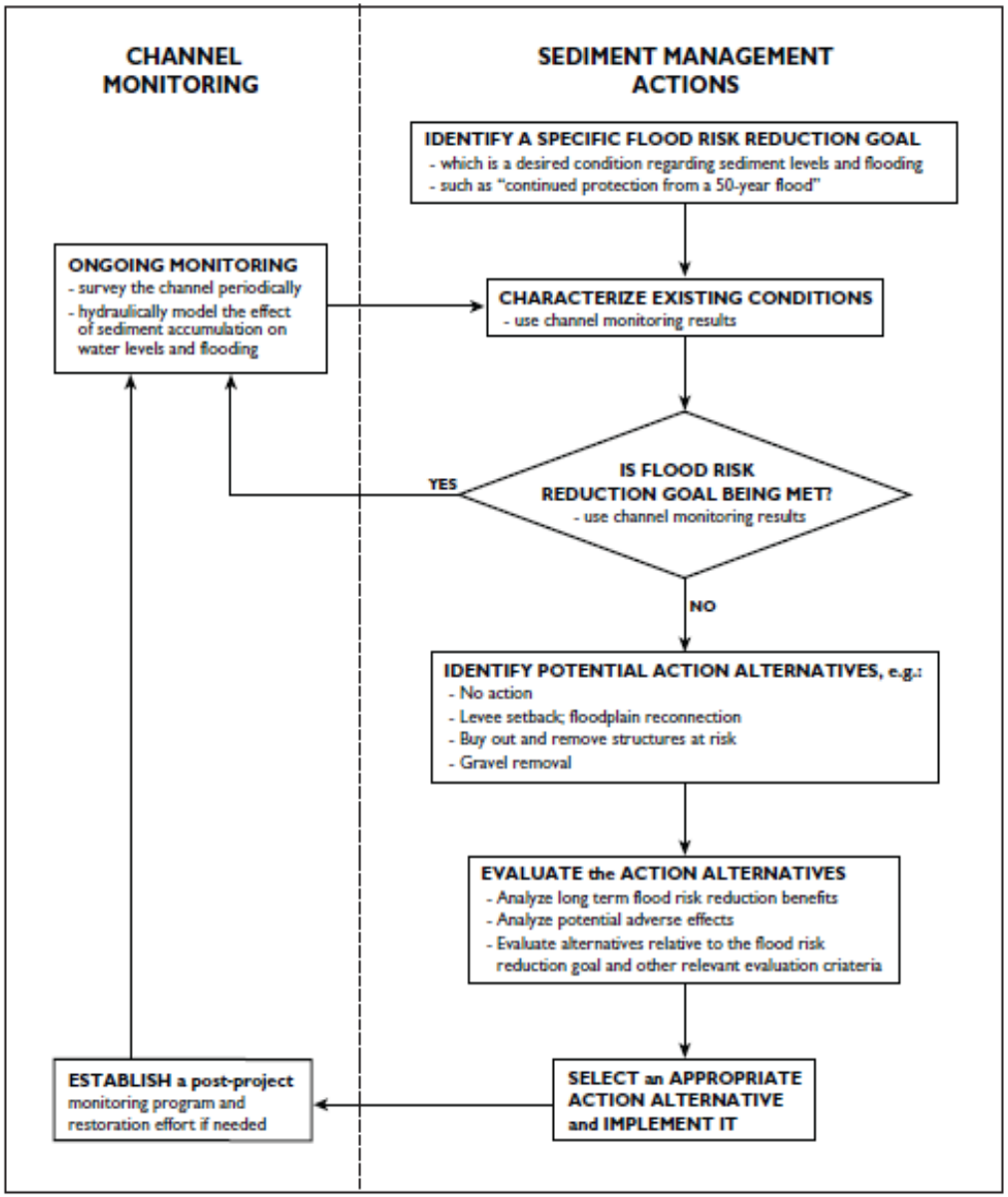
King County Sediment Management Program

- Flood Plan Figure 4-6, Section 4.3.1 →
- Flood Plan Policy RCM-3: Gravel Removal (page 21 of Flood Plan)

Figure 4-6

A SEDIMENT MANAGEMENT PROGRAM AND ITS COMPONENTS

2006 KING COUNTY FLOOD HAZARD MANAGEMENT PLAN



File name: 0604fhmpFIG46.ai wgab **Data source:** Adapted from Kondolf et. al. (2001) Figure 44

Channel Monitor/Sediment Mgmt Studies

- South Fork Snoqualmie River Gravel Removal Study (King County 2011).

http://www.kingcounty.gov/environment/waterandland/flooding/documents/south-fork-snoqualmie-gravel-removal-study.aspx

- Channel Conveyance Capacity, Channel Change, and Sediment Transport in Lower Puyallup, White, and Carbon Rivers WA (Czuba et al. 2010)

http://pubs.usgs.gov/sir/2010/5240/

- City of Renton analyses for the 1998 Cedar River dredging.
- In Progress: Lower White, Lower Raging &Tolt, Mainstem Snoqualmie (near Fall City & Carnation), MF Snoqualmie, Lower Cedar River (prepared by or for City of Renton)

2006Flood Plan Section 4.3.2: Naturally Occurring Woody Debris Management

- King County responds to requests to remove or reposition fallen trees from rivers and streams.
- That response includes an onsite assessment of channel dynamics and the level of risk created by the woody debris.
- In some cases, it is appropriate for King County to remove or alter large woody debris to reduce flood or channel migration risks.

See Flood Plan Policies RCM-1 and RCM-2 (page 21).

More discussion of Large Wood at March 2012 meeting.

Flood Plan Section 4.3: Key question

- What are your comments on the approach we are taking to sediment management?

Flood Risk Reduction Structures (aka Levees and Revetments)

Structural Approaches to Floodplain Management

! DISCLAIMERS !

1. ***Levees only reduce the risk to individuals and structures behind them. They do not eliminate the risk.***

2. ***To the extent that development and investments occur behind levees, risk may actually increase for higher magnitude, less frequent floods.***

3. ***Levees can help to reduce risk – and the community needs to make informed decisions about their tolerance for residual risk in the long-term, and clearly communicate the residual risks to those that live and work in the floodplain.***

Lowell, MA

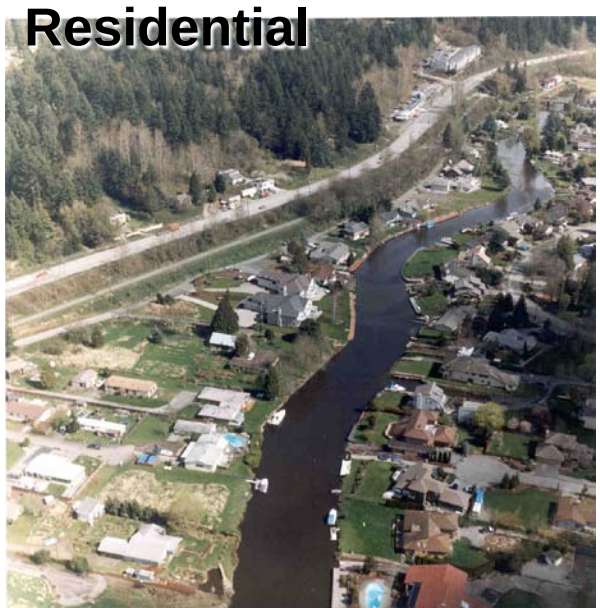
Pittsburgh, PA

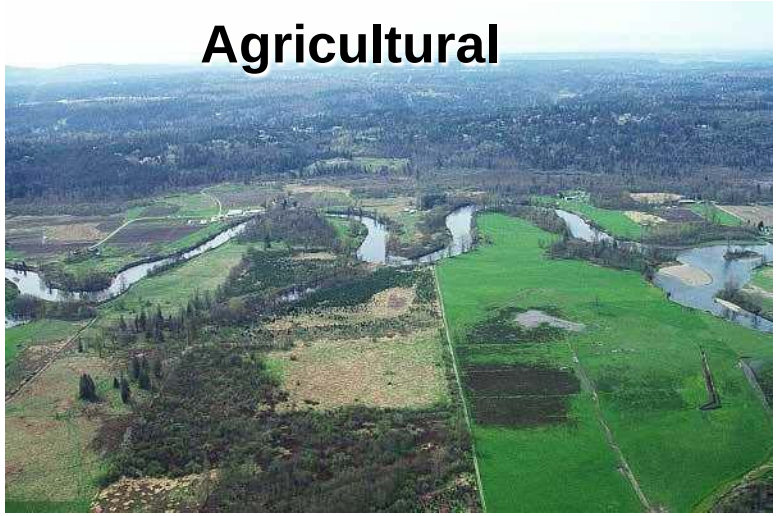
Johnstown, PA

C.P. CHOPHOUSE
Cedar Rapids Iowa, 2008

New Jersey, September 2011

Flood Risk Reduction Strategies in Context





Reconnect Floodplains through Levee Setbacks

Floodplain reoccupied, increased flood storage and conveyance

- Core strategy in 2006 Flood Plan
- Key element of federal salmon plans

Increased complexity, dynamic salmon habitat

Levee Setback examples include…

Chinook Bend
(Snoqualmie R.)

Pautzke (Green R.)

Lower Tolt River

Cedar Rapids Levee Setback Example

Project Goals

- Reduce flood hazards
- Re-establish river processes to restore habitat

Basic Project Approach

- Purchase at-risk homes
- Set levees back to edge of floodplain (30+ acres)
- Install stable wood structures in floodplain
- Allow river to migrate freely within setback levees

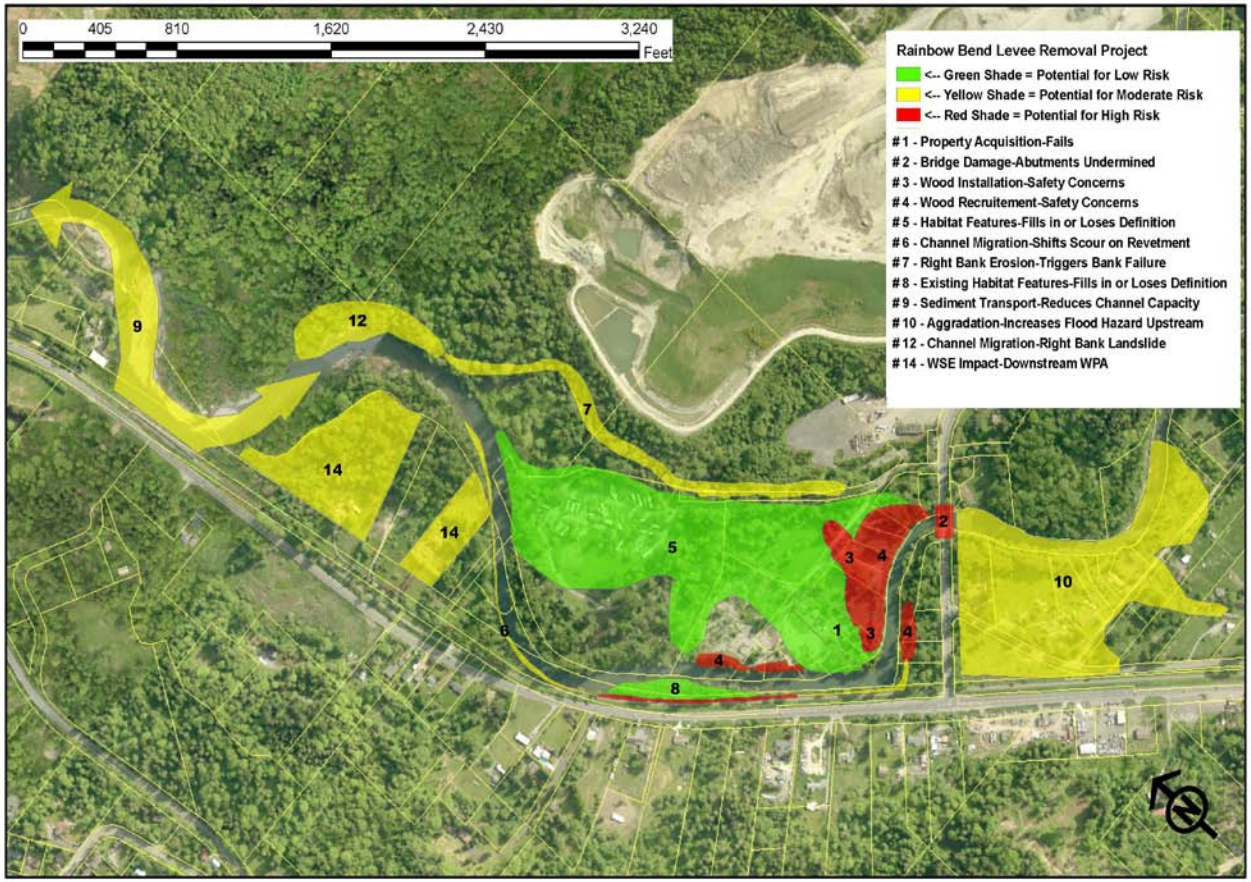
2008-09 Project History

- Original project construction fall 2008
- Two large floods that winter
- Setback levees worked well
  - Protected adjacent homes and roads
  - Provided storage and conveyance of floodwaters
  - Trapped sediment
- Major shift in river channel, habitat formation
- Chained log clusters mobilized

Challenges with both engineering approaches and recreational safety

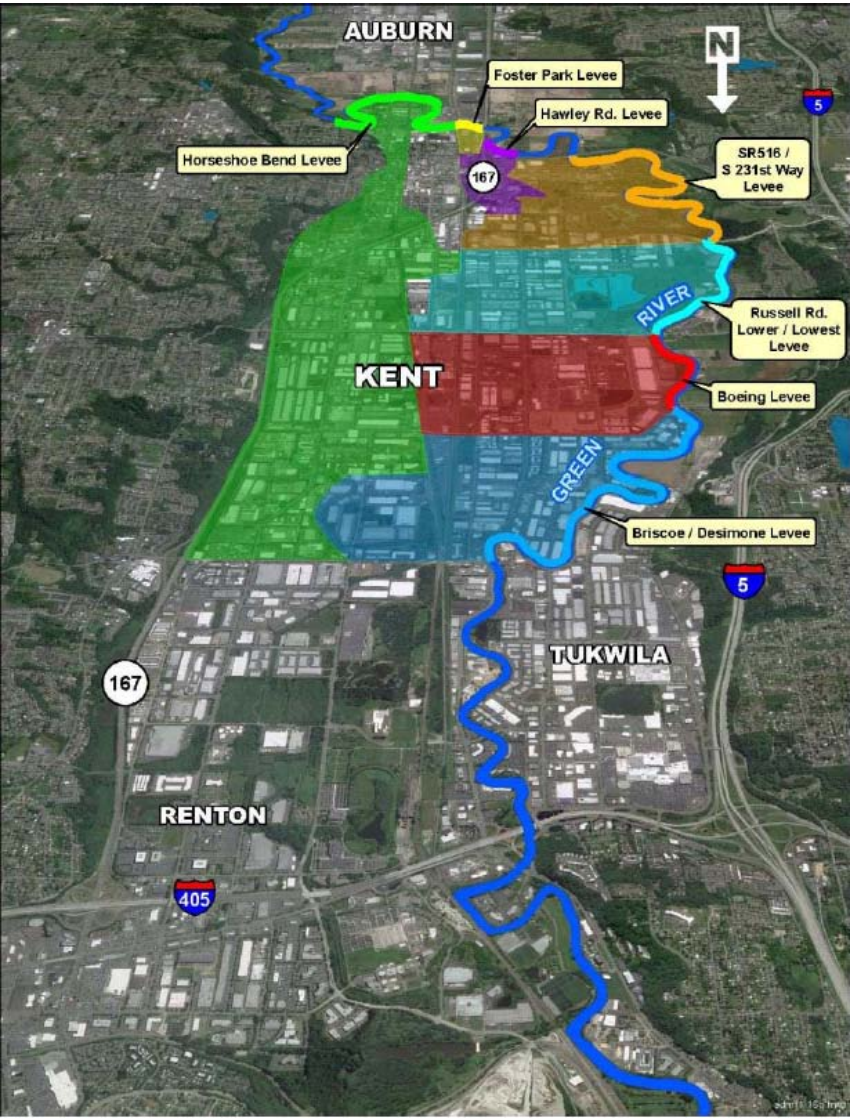
Lessons Learned: King County's engineering and procedural approaches

- Design review and approval by P.E.
- Evaluate and plan for range of geomorphic outcomes
- Construction oversight, record drawings
- Design redundancy, higher factors of safety, stable protection at site margins
- Better outreach: discussions with community about project goals and expected outcomes
- Recreational Safety Outreach? (part of future issue paper on large wood management)



Evaluating and Managing Risk: Proposed Rainbow Bend Levee Removal on the Cedar River

Levees in an Urban Context



Room to 'lay back' the levee in some areas….

…..but less room in others

Levee Challenges in an Urban Context

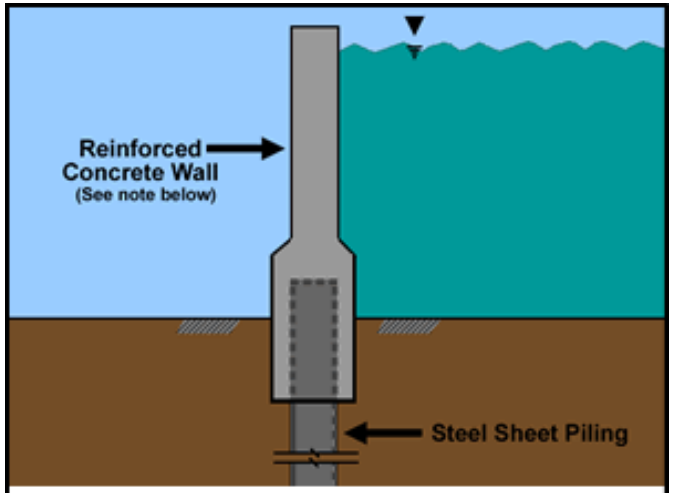
- Risks to:
  - Public safety
  - Listed species
  - Economic development
- Hedge your bets when it comes to dams and levees
- Above ground = existing land uses = $$!
- Below ground = Utilities = $$!
- 'Don't own the schedule 'til you own the land'
- How do we integrate short-term needs with long-term plans?

Green River External Advisory Panel

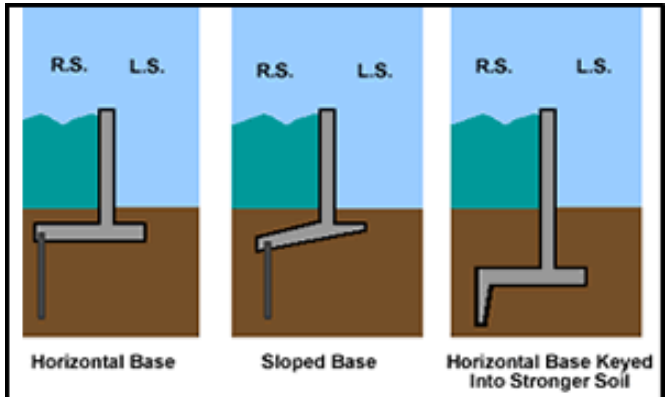
- External panel of engineers, scientists, and policy experts convened to review Green River Strategy
- Recommendations include:
  - Plan for larger flood events, and a wider (500-foot) corridor
  - Use a risk-based approach
  - Long-term strategy should be guided by reducing flood risk and achieving environmental benefit, cost effectiveness, and sustainability.
  - Lack of regulatory consistency across jurisdictions has resulted in significant increase in risk exposure
  - Convene forum of GRV cities to develop long-term strategy:
    - Potential sites for levee setbacks for the next 20-50 years
    - Identify land uses that may be compatible with 'inside-the-levee' locations
    - Restrict further development that is incompatible with periodic inundation on undeveloped lands
    - Do not miss opportunities in areas that have not been built out yet; do not repeat historical steps that led to current problem

USACE Performance Evaluation of New Orleans Hurricane Protection System under Hurricane Katrina

- The 100-year de-facto standard is ‘far too risky’
- Structures should be designed as an integrated system
- T-wall floodwalls performed well during Katrina
- Overtopping and erosion led to failure of I-walls
- Armoring and other approaches that provide resilience would significantly reduce the probability of breaching when overtopping occurs.
- Designs should consider resilience, adaptation, and redundancy



Basic I-Wall Configuration



Note: R.S. = River Side (or seaward, unprotected side)
L.S. = Land Side (or protected side)

Inverted T-Type Cantilever Walls

Key Questions

1. When should we pursue structural versus non-structural solutions?

2. In light of the ‘lessons learned’ regarding levee setbacks, what other changes are advisable to improve capital project design and delivery?

3. In constrained, urbanized environments, when should we pursue acquisitions necessary to rebuild levees and when should we consider alternatives such as floodwalls?

Flood Hazard Education and Preparedness

King County River and Floodplain Management
Public Education & Outreach Program

GOALS

- Increase flood awareness and preparedness
- Improve river and flood safety for the public
- Promote flood risk reduction projects and programs
- Engage the public's involvement
- Improve access to information for vulnerable populations
- Improve communication and measure success through research

King County River and Floodplain Management
Public Education & Outreach Program

AUDIENCE OVERVIEW

- Floodplain property owners
- People who live, work, go to school or regularly travel through a floodplain
- River recreational users
- King County residents/taxpayers
- Stakeholder groups

King County River and Floodplain Management
Public Education & Outreach Program

CHALLENGES

- Limited resources
- Competing messages
- Measuring success
- Defining and reaching vulnerable populations

King County River and Floodplain Management
Public Education & Outreach Program

RESEARCH

- Green River Flood Awareness (2009)
- King County Flood Awareness Study (2010)
- Cedar River Recreation Study (2010)
- *King County River Management Survey (2011)*
- *Cedar River "Focus Group" (2011)*
- *Snoqualmie River "Focus Group" (2012)*

King County River and Floodplain Management
Public Education & Outreach Program

Green River Flood Awareness Survey (2009) Findings

- 75% heard about the flood risks associated with the Howard Hanson Dam (HHD)
- After hearing about risks associated with the HHD, 82% feel it is somewhat or very important to prepare for flood season
- For those who are aware of the risk, 42% have heard about it because of direct mail
- 67% feel they know what to do in the event of an emergency
- 12% have flood insurance
- 26% feel their community is prepared for a flood emergency

King County River and Floodplain Management
Public Education & Outreach Program

King County Flood Awareness Survey (2010) Findings

- Increase in the proportion of respondents who feel their community is prepared for a flood emergency
- Significant increase in proportion reporting they have flood insurance
- Radio/TV top sources for info during a flood event
- Internet, mail and broadcast news are preferred sources about flood preparation and emergencies
- People prefer to receive county info via mail and internet

King County River and Floodplain Management
Public Education & Outreach Program

Cedar River Field Study (2010) Findings

- Recreation users, particularly inner tubers make decisions that could increase their risk for injury.
- They are not aware of the risks of river recreation and often come to the river unprepared.
- Feelings about large wood among river users span a broad spectrum of concern. Many floaters are accepting of large wood and recognize its ecological benefits.
- The primary wood concern among river users applies to spanning logs and sharp sticks.

King County River and Floodplain Management
Public Education & Outreach Program

Recommendation to improve communication program, continue to measure:

- Flood awareness and preparedness
- Public opinion on river management activities
- Outreach effectiveness
- River usage

King County River and Floodplain Management
Public Education & Outreach Program

Outreach to Vulnerable Populations

- Population segments identified to be especially at risk in a public health emergency
- We've initially focused on limited English or non-English proficient segment
- Case study: Print materials require literacy so we provided flood preparedness information via video in 21 languages

King County River and Floodplain Management
Public Education & Outreach Program

Outreach to Vulnerable Populations

- King County Executive Translation Policy
- King County 2010 census data floodplain maps for language
- Identified partners to convey messaging to these populations

King County River and Floodplain Management
Public Education & Outreach Program

Recommendation to improve outreach to vulnerable populations:

- Develop an assessment of where outreach is needed most.
- Develop a way to assess the effectiveness of the outreach efforts.
- Broaden the spectrum of emergency outreach partnerships.

King County River and Floodplain Management
Public Education & Outreach Program

DISCUSSION

- What other ways should we do outreach to the public?
- How can we enhance our outreach "toolbox"?
- Suggestions or feedback?

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