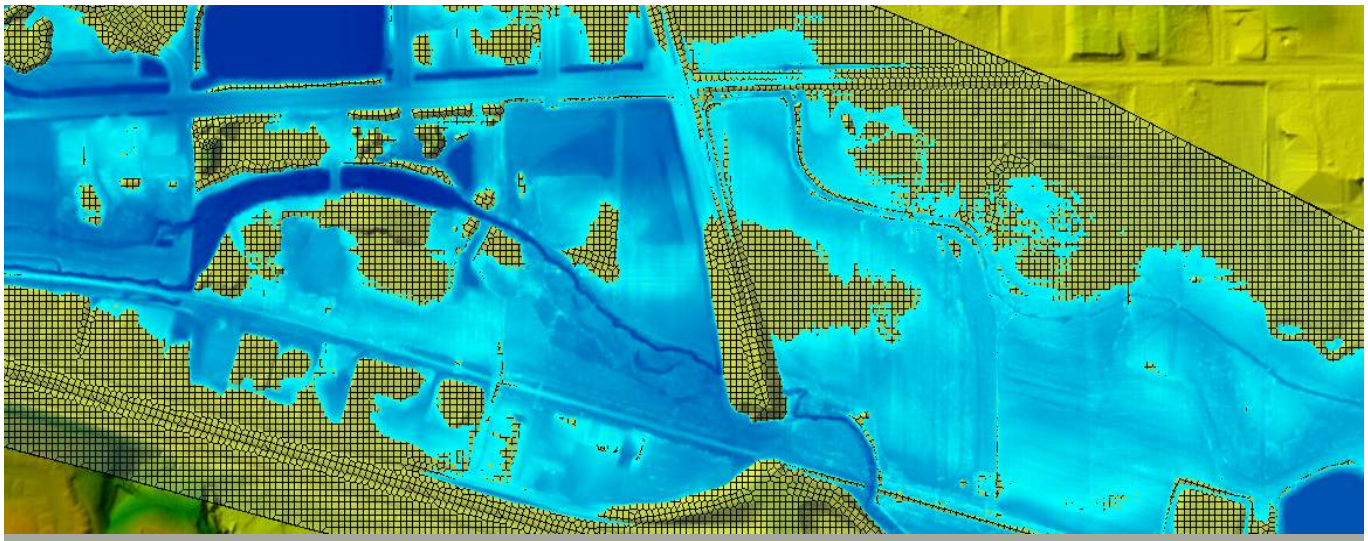


Applying Rapidly-Changing Technologies to Floodplain Regulations and Management

Mike Schubert, P.E.
HDR Engineering, Inc.

March 27,2019

01 **Floodplain Regulation and Management**

02 **Evolution of Flood Modeling**

03 **Challenges in Regulations and Management**

Objectives

- Understand concepts in NFIP regulations
- Understand recent advancements in hydraulic modeling and climate science
- Identify challenges and strategies in managing flooding risk within existing regulatory framework with recent advancements

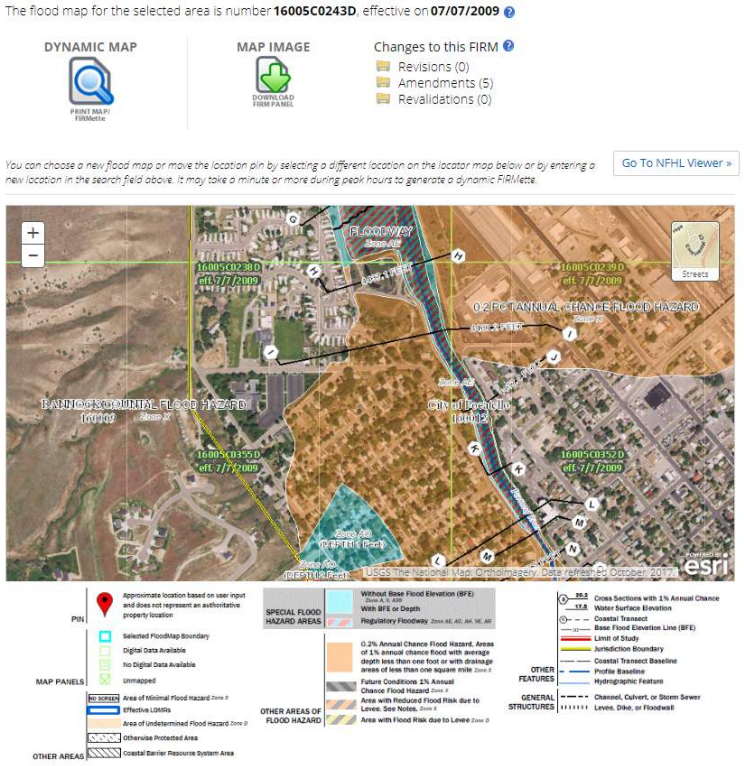
01 Floodplain Regulation and Management

National Flood Insurance Program

- Created by congress in 1968
- Allows property owners in participating communities to by government-administered flood insurance
- Requires participating communities to adopt and enforce a floodplain management ordinance that meets standards
- FEMA uses Flood Insurance Rate Maps to identify flood risk premium zones
- Minimum criteria spelled our in Chapter 44 of Code of Federal Regulations Part 59 and 60

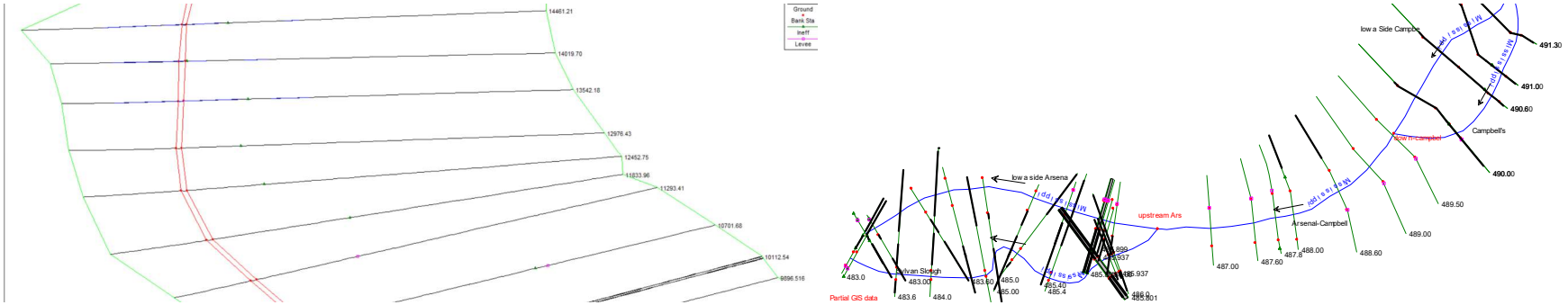
Summary of Minimum Federal Regulations

- Use the latest flood maps and data published by FEMA to administer ordinance
- A permit it required for all development in a Special Flood Hazard Area on the FIRM
- Development must not increase flood hazard on other properties
- New or improved buildings must be protected from damage by the base flood
- Coastal zone require additional protection

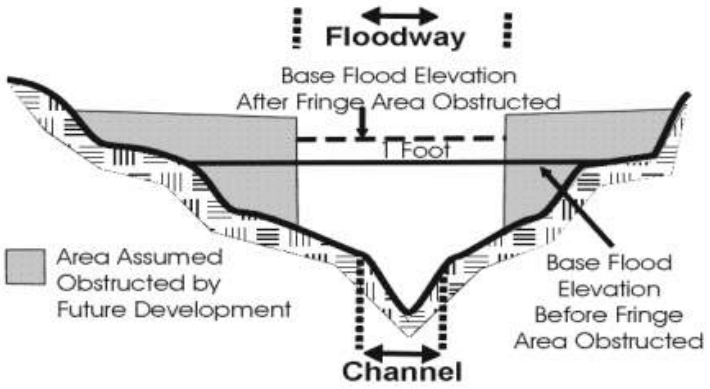


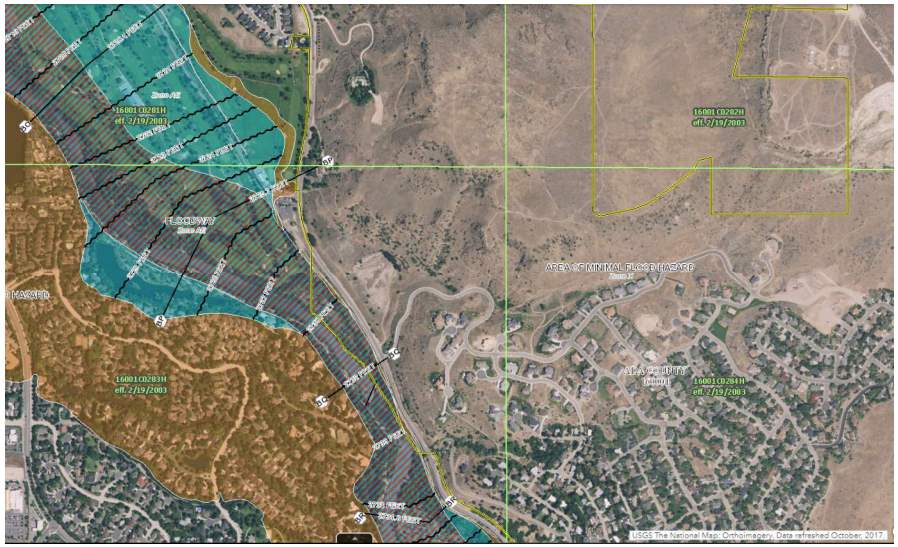
Common Application Based on 70s Technology

- Base flood, 100-year flood, 1% ACE flood
  - Gage evaluation
  - Regional regression
- Rivers are modeled as a series of cross sections
- Water level change between cross sections area calculated to determine flood elevation
- Areas in the “floodway” are managed to allow flood conveyance
- Development in floodplain needs to be flood proofed for the base flood



What is the floodway?

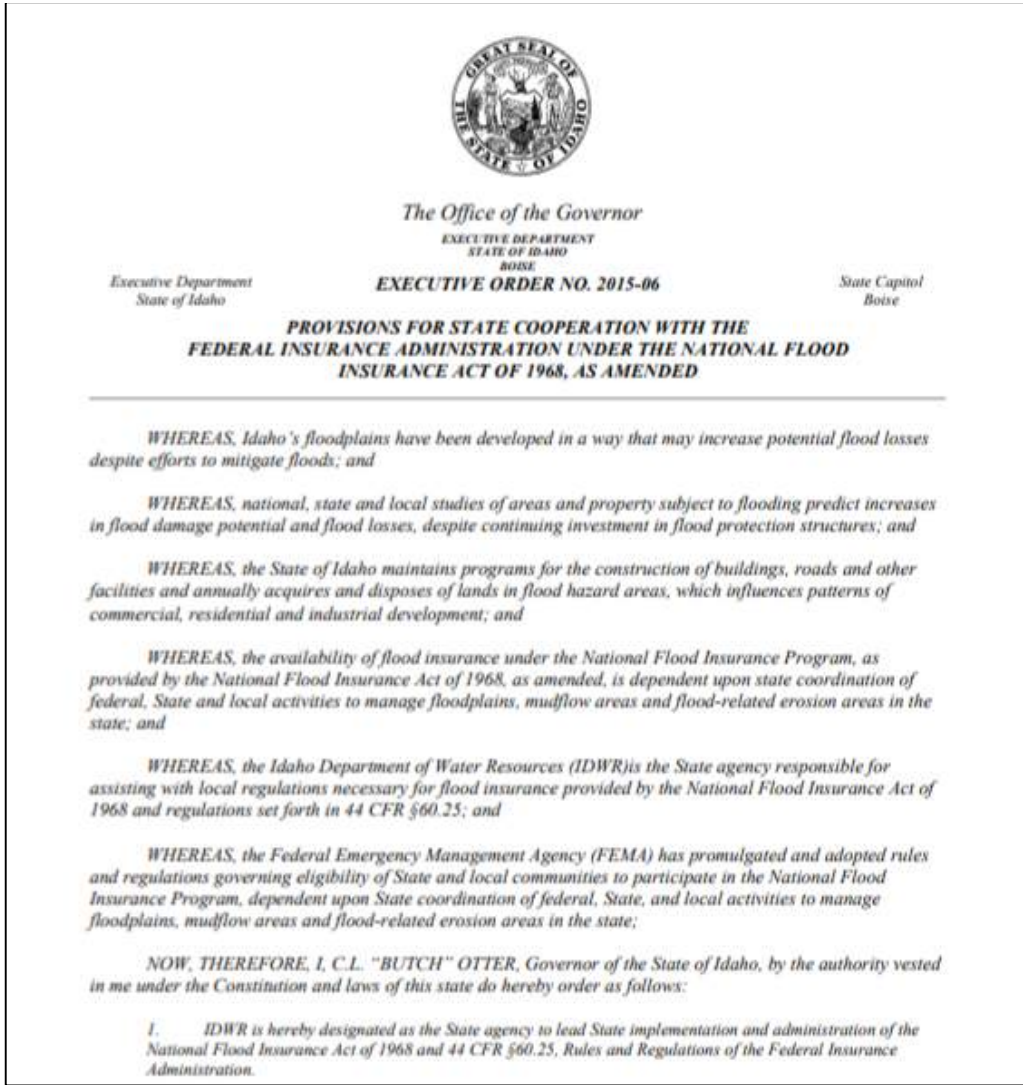




***44 CFR 59.1** Definitions: "Regulatory floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.*

Executive Order No 2015-06

- Provisions for State Cooperation Under the National Flood Insurance Act of 1968
  - https://idwr.idaho.gov/files/floodplain-mgmt/Executive-Order-2015-06.pdf
- Preclude unsafe or unnecessary use of floodplains
- Account for flood Hazard in planning to encourage appropriate land use
- Ensure that the most up-to-date data and/or methods of analysis are utilized



The Office of the Governor

EXECUTIVE DEPARTMENT
STATE OF IDAHO
BOISE

Executive Department
State of Idaho

EXECUTIVE ORDER NO. 2015-06

State Capitol
Boise

PROVISIONS FOR STATE COOPERATION WITH THE FEDERAL INSURANCE ADMINISTRATION UNDER THE NATIONAL FLOOD INSURANCE ACT OF 1968, AS AMENDED

WHEREAS, Idaho's floodplains have been developed in a way that may increase potential flood losses despite efforts to mitigate floods; and

WHEREAS, national, state and local studies of areas and property subject to flooding predict increases in flood damage potential and flood losses, despite continuing investment in flood protection structures; and

WHEREAS, the State of Idaho maintains programs for the construction of buildings, roads and other facilities and annually acquires and disposes of lands in flood hazard areas, which influences patterns of commercial, residential and industrial development; and

WHEREAS, the availability of flood insurance under the National Flood Insurance Program, as provided by the National Flood Insurance Act of 1968, as amended, is dependent upon state coordination of federal, State and local activities to manage floodplains, mudflow areas and flood-related erosion areas in the state; and

WHEREAS, the Idaho Department of Water Resources (IDWR)is the State agency responsible for assisting with local regulations necessary for flood insurance provided by the National Flood Insurance Act of 1968 and regulations set forth in 44 CFR §60.25; and

WHEREAS, the Federal Emergency Management Agency (FEMA) has promulgated and adopted rules and regulations governing eligibility of State and local communities to participate in the National Flood Insurance Program, dependent upon State coordination of federal, State, and local activities to manage floodplains, mudflow areas and flood-related erosion areas in the state;

NOW, THEREFORE, I, C.L. "BUTCH" OTTER, Governor of the State of Idaho, by the authority vested in me under the Constitution and laws of this state do hereby order as follows:

1. IDWR is hereby designated as the State agency to lead State implementation and administration of the National Flood Insurance Act of 1968 and 44 CFR §60.25, Rules and Regulations of the Federal Insurance Administration.

Stream Channel Alteration Act- Section 42- 3806

- Permit shall not be required to do work to prevent inference of a water right
- Does not exempt compliance with floodplain ordinance
- Does this conflict with FEMA's minimum standards

TITLE 42
IRRIGATION AND DRAINAGE — WATER RIGHTS AND RECLAMATION

CHAPTER 38
ALTERATION OF CHANNELS OF STREAMS

42-3806. EXISTING RIGHTS UNAFFECTED — WHERE PERMIT NOT REQUIRED. This act shall not operate or be so construed as to impair, diminish, control or divest any existing or vested water rights acquired under the laws of the state of Idaho or the United States, nor to interfere with the diversion of water from streams under existing or vested water right or water right permit for irrigation, domestic, commercial or other uses as recognized and provided for by Idaho water laws.

No permit shall be required by the state or any agency or political subdivision thereof, from a water user or his agent to clean, maintain, construct in, or repair any stream channel, diversion structure, canal, ditch, drain or lateral. No permit shall be required by the state or any agency or political subdivision thereof, from a water user or his agent to remove any obstruction from any stream channel, if such obstruction interferes with, or is likely to interfere with, the delivery of, or use of, water under any existing or vested water right, or water right permit.

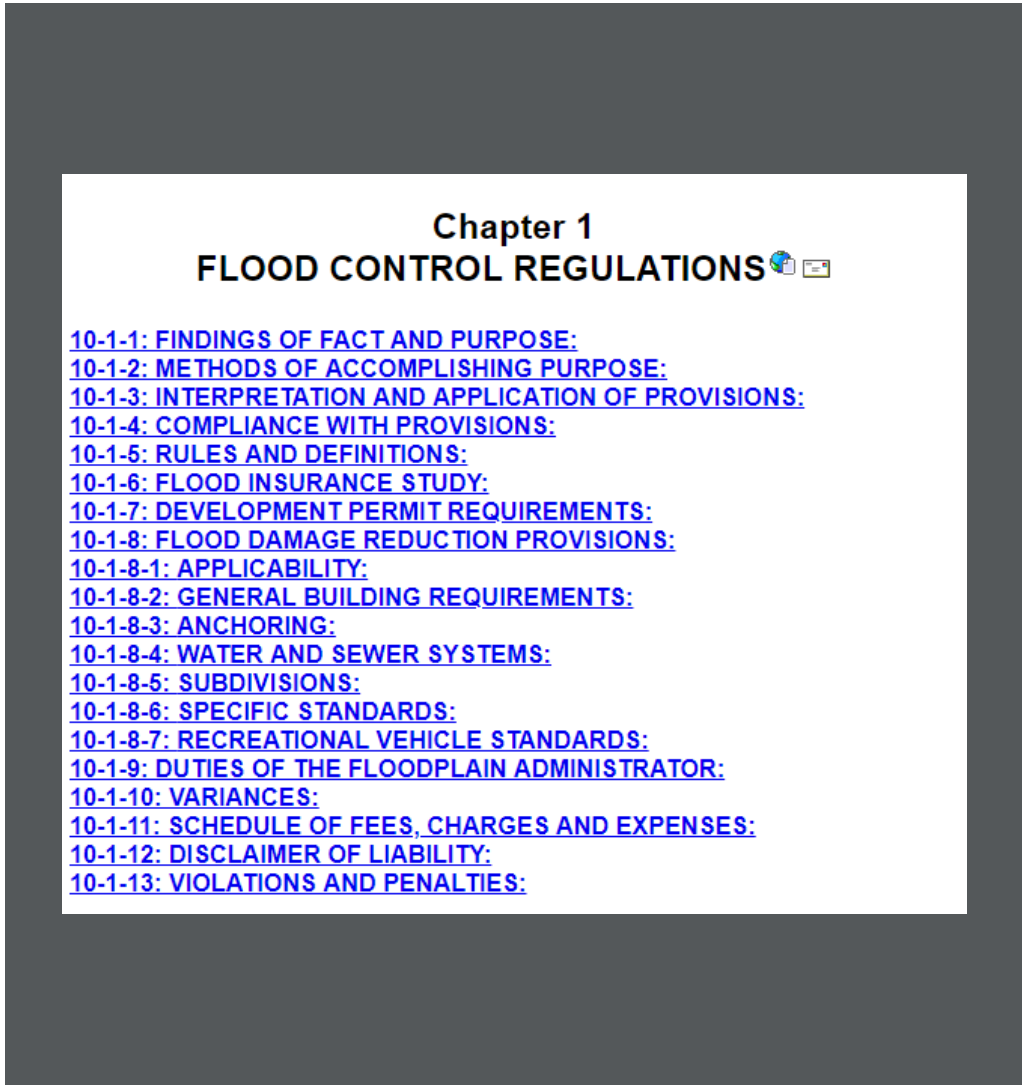
Nothing in this section shall be construed to affect the provisions of chapter 10, title 46, Idaho Code, or to exempt a water user or his agent from compliance with any applicable local flood plain ordinance adopted pursuant to section 46-1022, Idaho Code.

History:

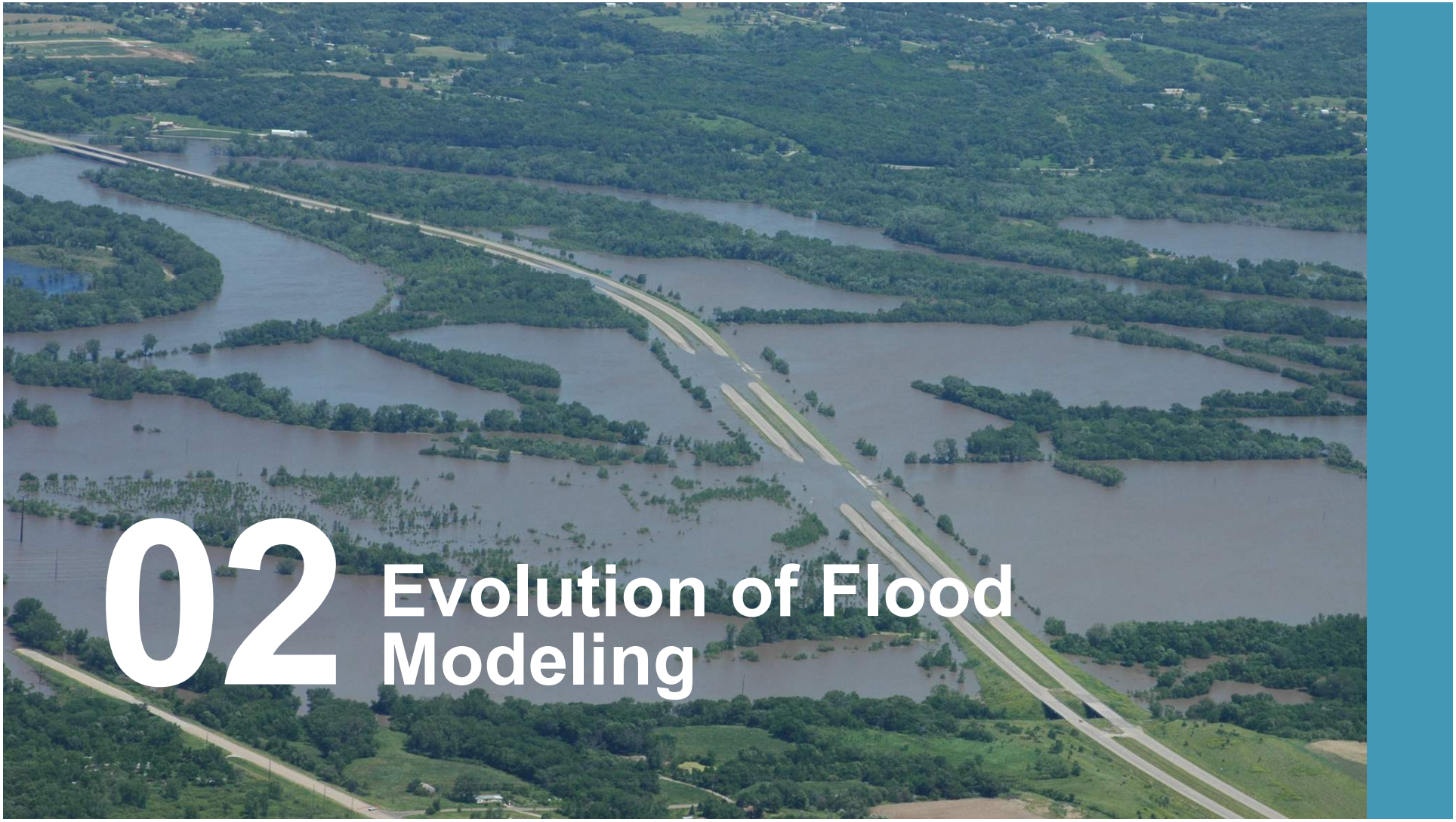
[42-3806, added 1971, ch. 337, sec. 6, p. 1304; am. 2004, ch. 191, sec. 3, p. 602; am. 2011, ch. 261, sec. 1, p. 707.]

Local Ordinances

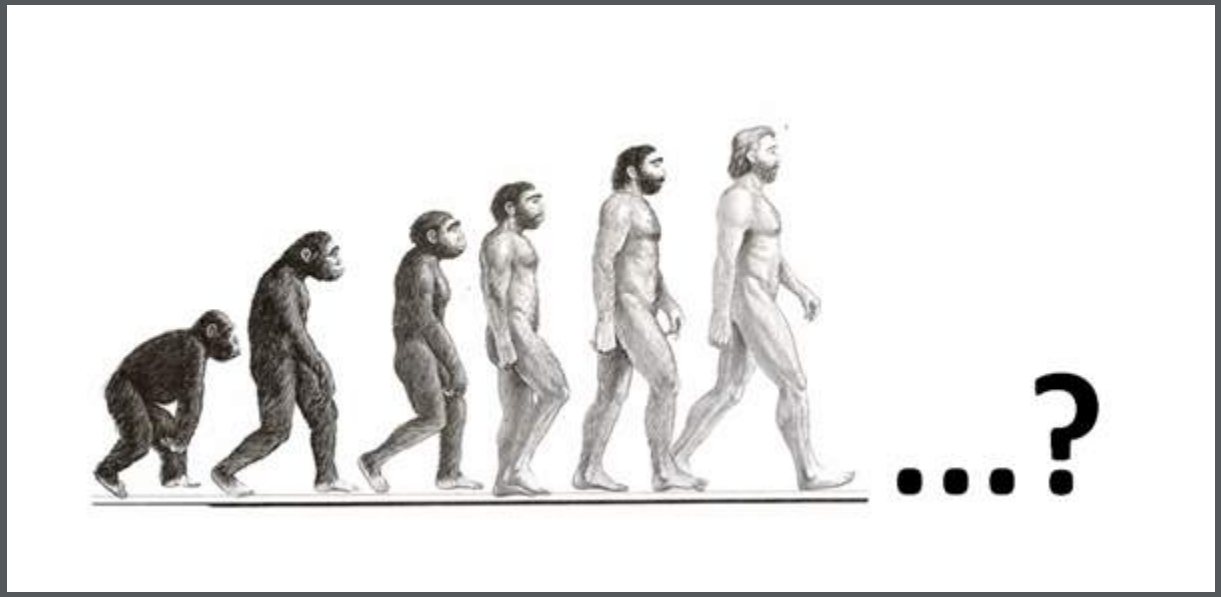
- Required by NFIP
- May go above minimum requirements
  - Additional freeboard above base flood
  - Land use and parking provisions of different flood zones
  - Compensatory storage
  - Public comment opportunities
- Communities that do this can help residents get lower insurance rates – Community Rating System
- Examples
  - Boise River Ordinance
  - Eagle



Chapter 1
FLOOD CONTROL REGULATIONS



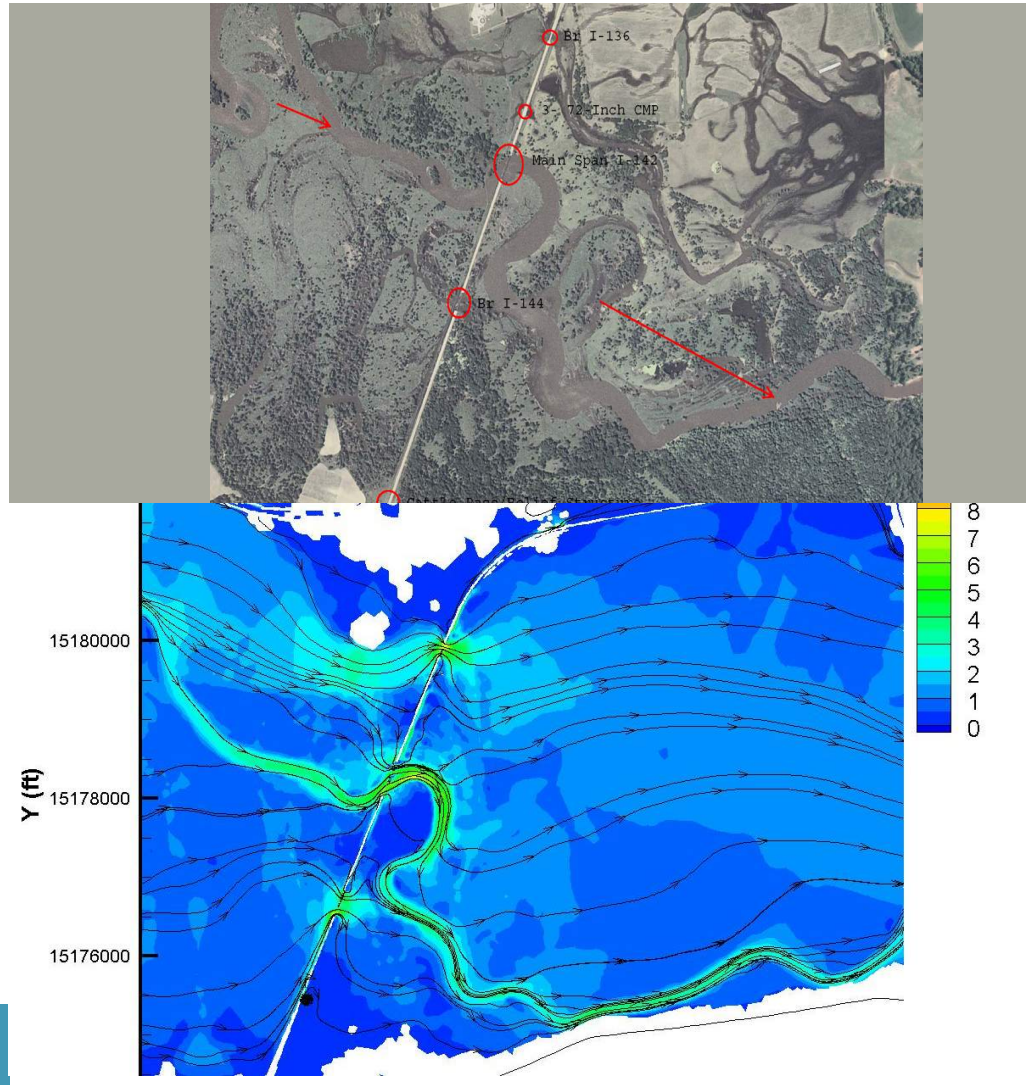
02 Evolution of Flood Modeling



Knowing where we have been

What is a Flood Model?

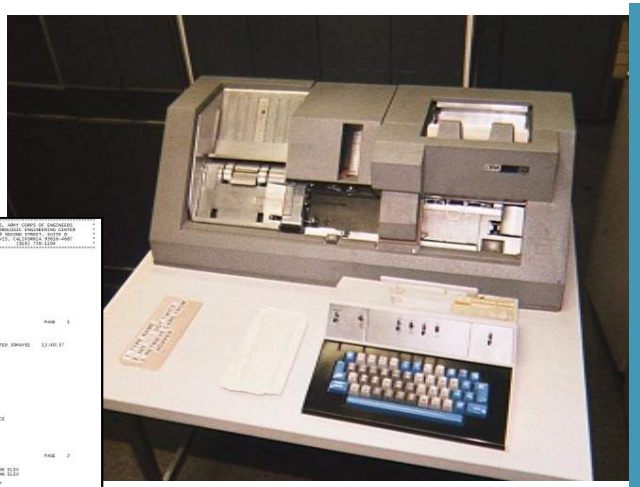
- Computer-based tool to predict flooding conditions
  - Hydrology
    - Flow rate (cubic feet per second)
  - Hydraulics
    - Inputs- Elevation Data, roughness, flow rate
    - Outputs – Depth, Velocity

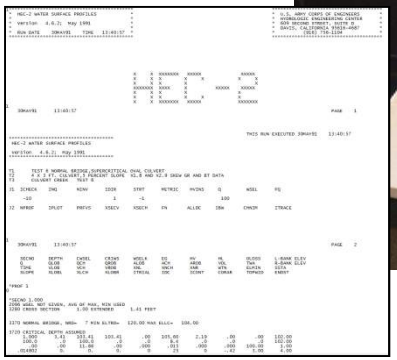


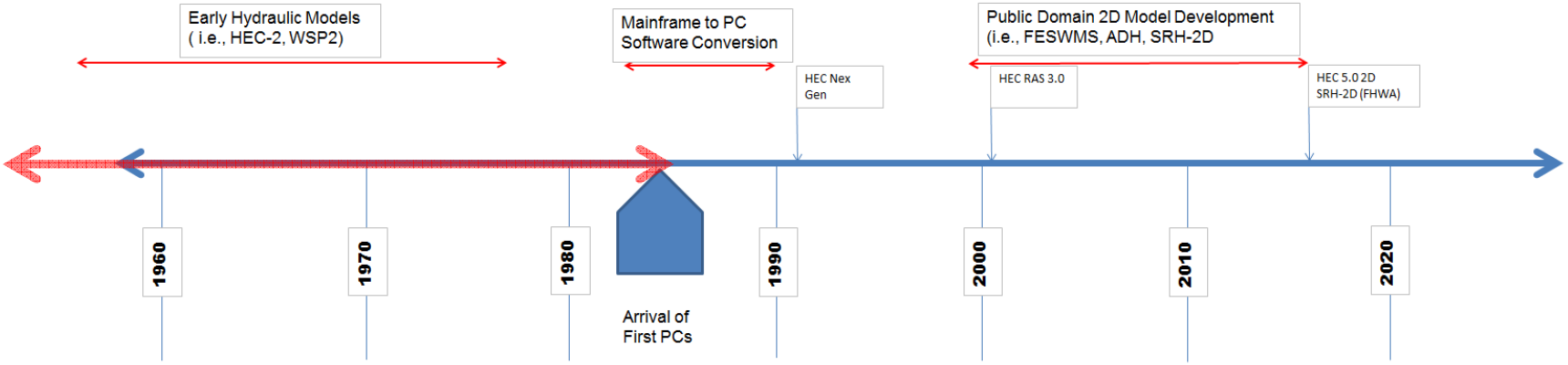
Evolution of Hydraulic Models

Pre-1985 Era – World of Mainframes

- Rented time on university mainframes
- Software options limited (public domain)
- Mostly USACE and SCS



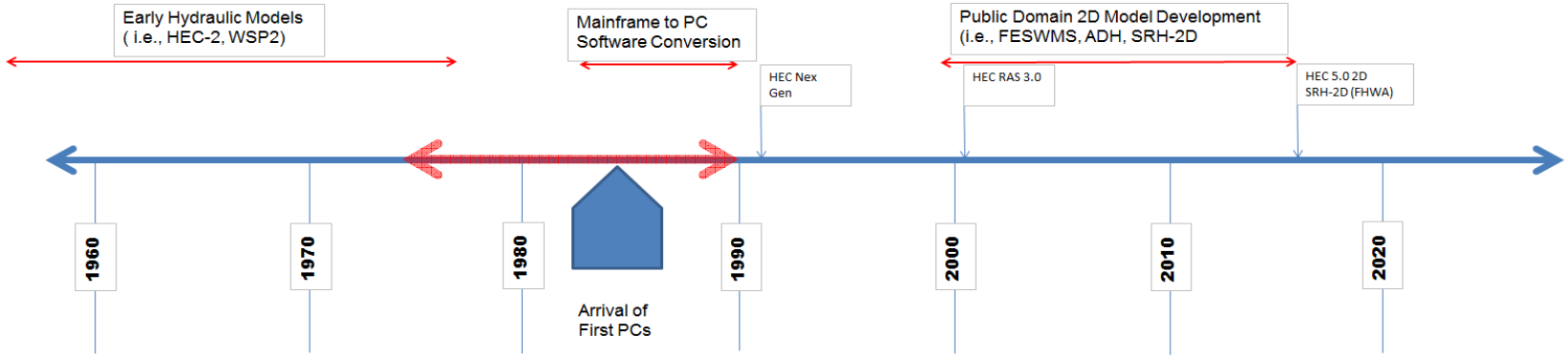




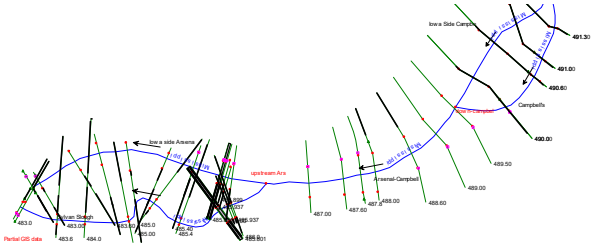
Evolution of Hydraulic Models

1975 to 1990 – Influence of National Flood Insurance Program

- Mainframe to PC conversion
- PC Hardware and transition to GUI Interface
- User friendliness changes, limited enhancement of technical capabilities

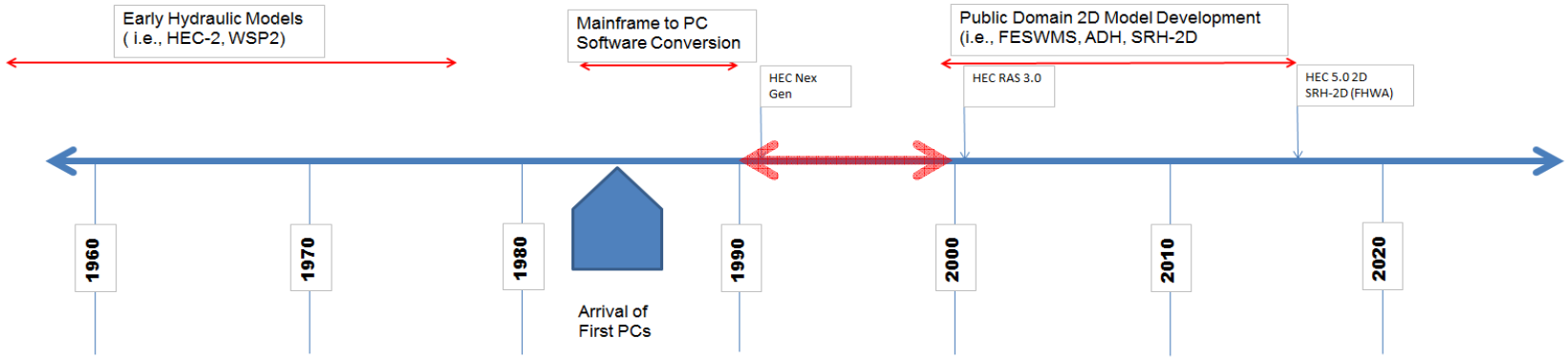


Evolution of Hydraulic Models



1990 to 2000 – Industry Driving Enhancement Needs

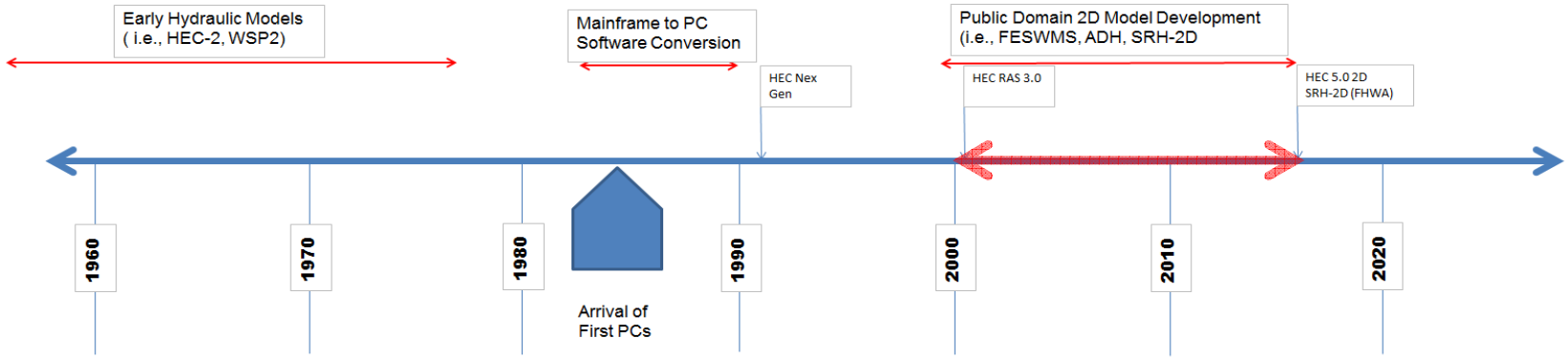
- Proprietary software entering the market, Windows opening up new opportunities
- 1991 – USACE Hydrologic Engineering Center launches Next Generation Program
- Hardware and Operating System Improvements expand options



Evolution of Hydraulic Models

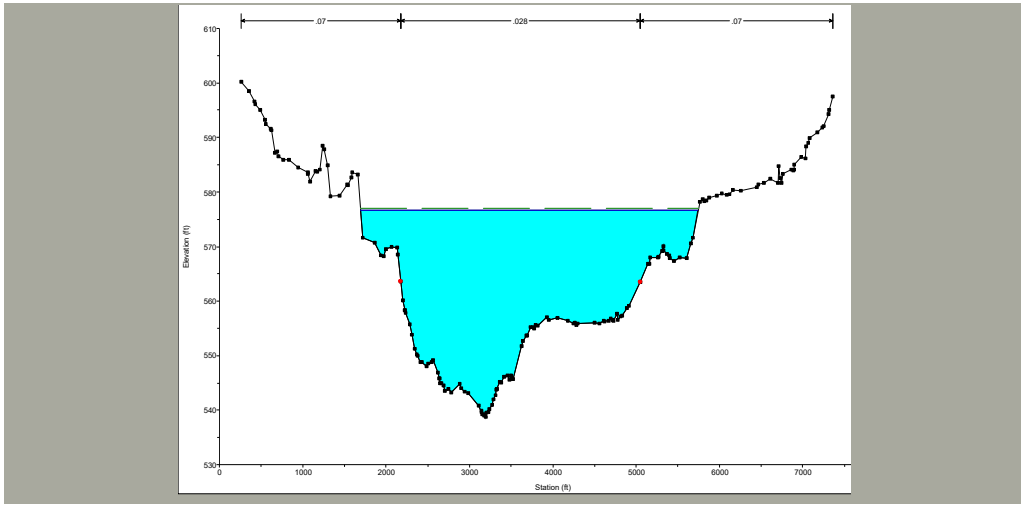
2000 to Present – Rapid Technological Change

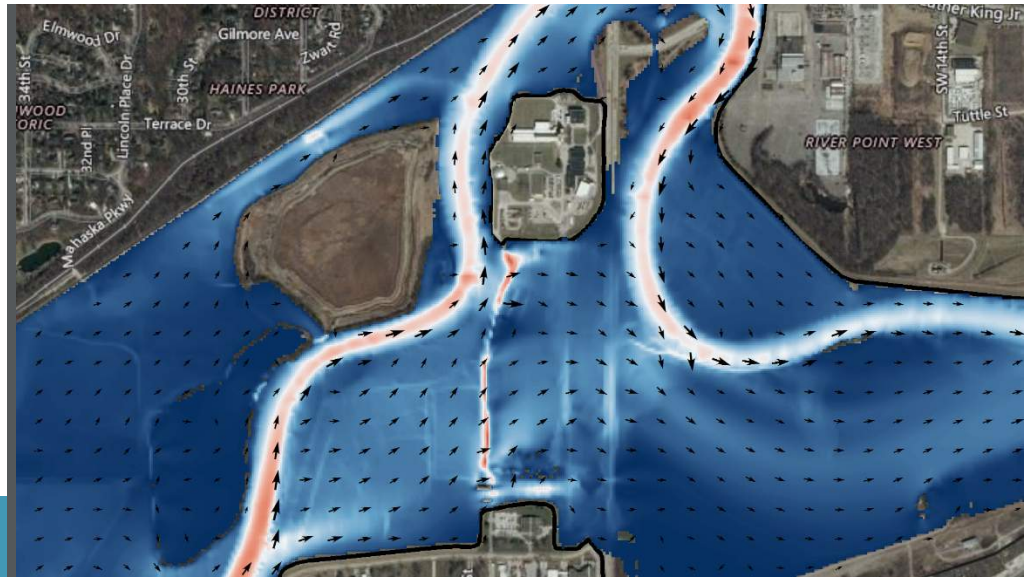
- Terrain and spatial data tools developing
- Computer architecture, storage and operating system rapidly advancing
- 1D, 2D and 3D hydraulics software developing (public and private)



1D vs 2D Modeling

- 1D Modeling
  - Output includes water surface elevation and average velocity
  - Approximate velocity distribution based on cross section shape
- 1D Unsteady Modeling
  - Flood wave attenuation
  - Storage effects
- 2D Modeling
  - Vertically-average velocity (direction and magnitude) on a grid or mesh
  - Depth, 2 velocity components
  - Resolves more flow physics





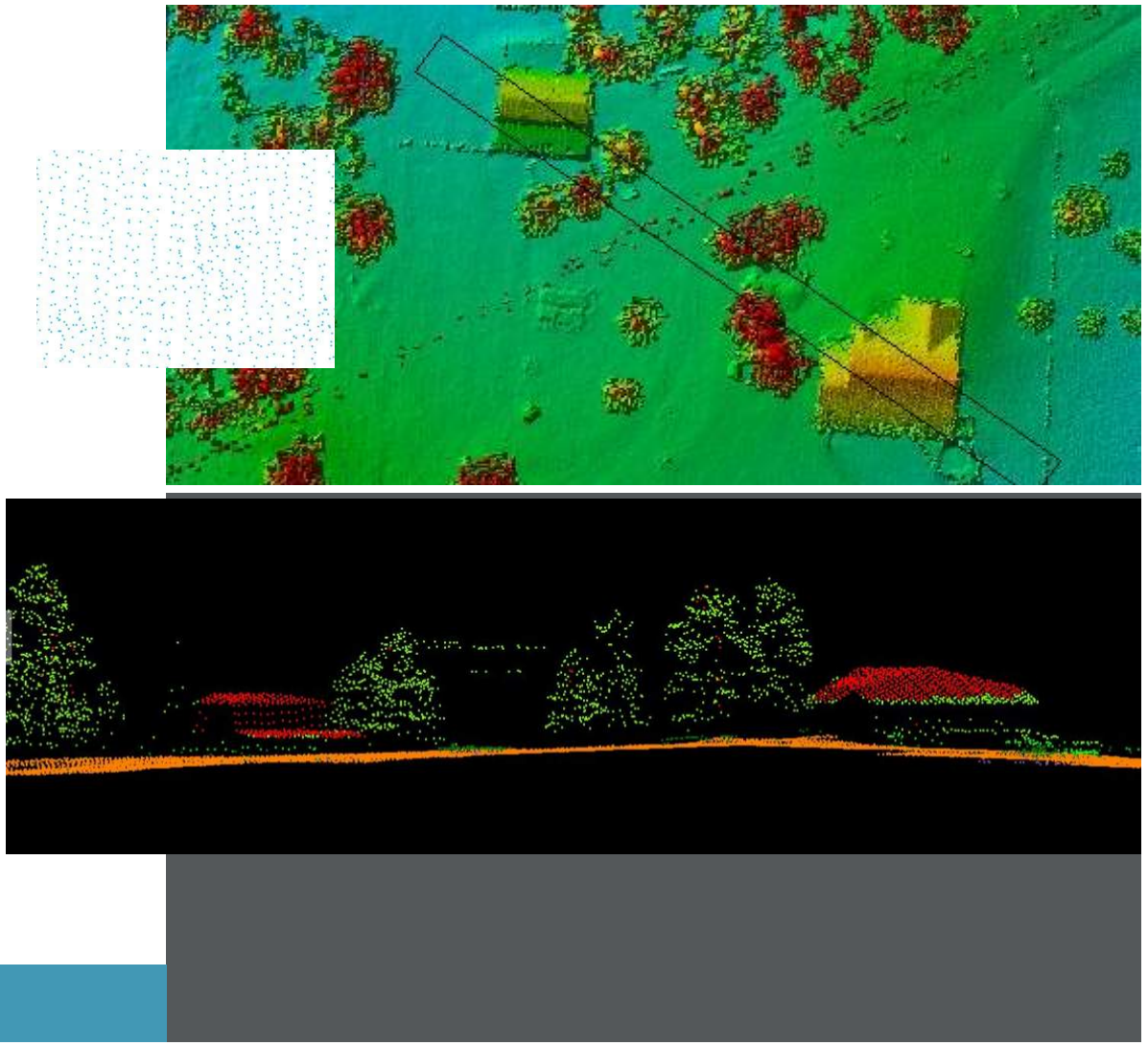
Truckee River Example

LiDAR Data

- RAW Mass Points
- Classified Mass Points
- Processed Bare Ground Data
- Gridded Mass Points
- Metadata

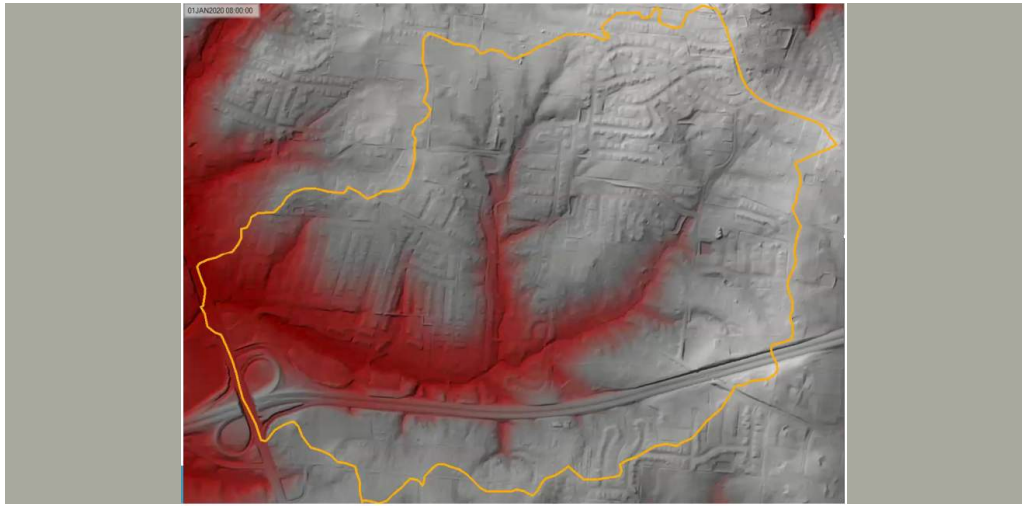
Challenges

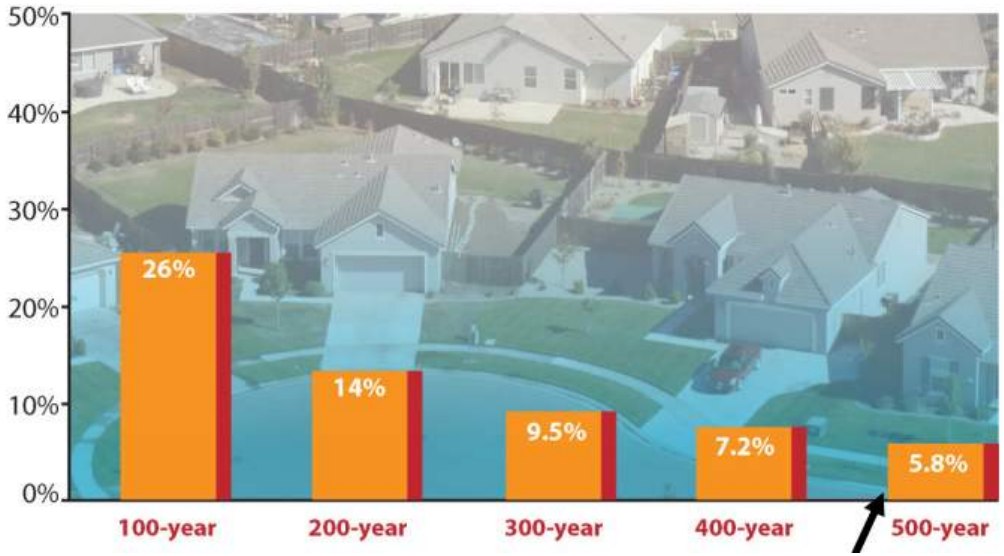
- Over-filtered Data
- Poor Classifications



Advancements in Hydrology

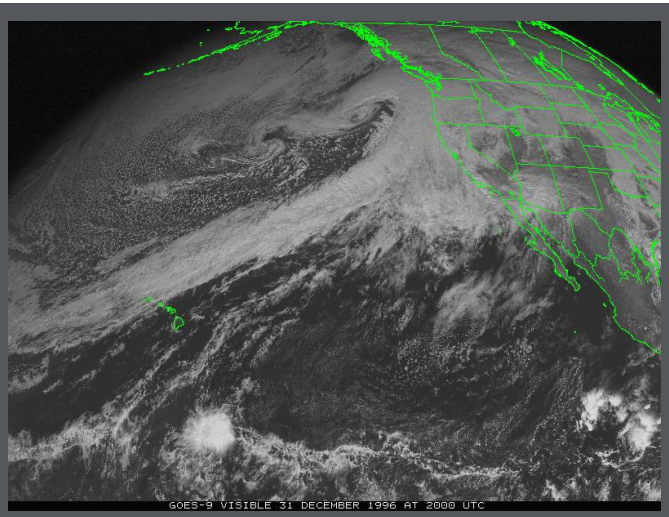
- Regression equations and gage record analysis to simulated design storms
- Routing- discretized modeling
- Climate change – amount of precipitation and snowmelt dynamics are different now than before
- Climate Science- Atmospheric rivers
- Higher design events
  - EO 13690- higher standards for federal projects
  - Critical infrastructure
  - Design life





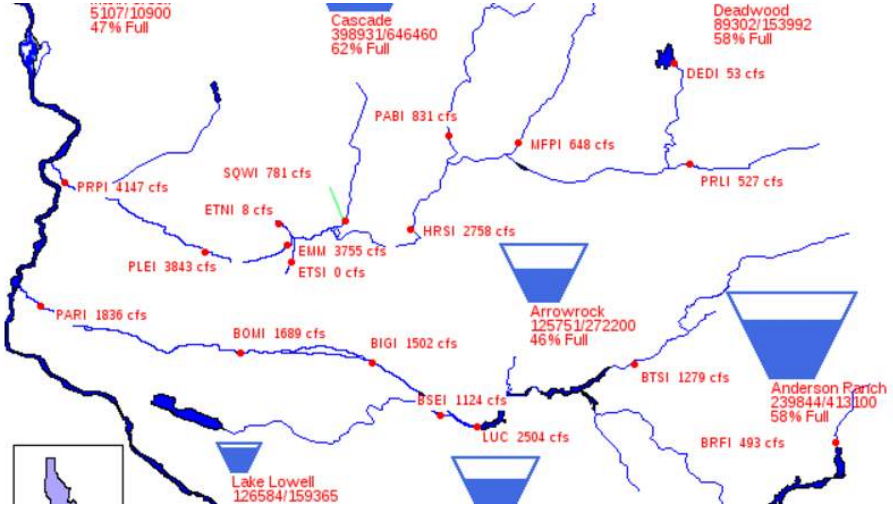
Atmospheric Conditions That Lead to Flooding

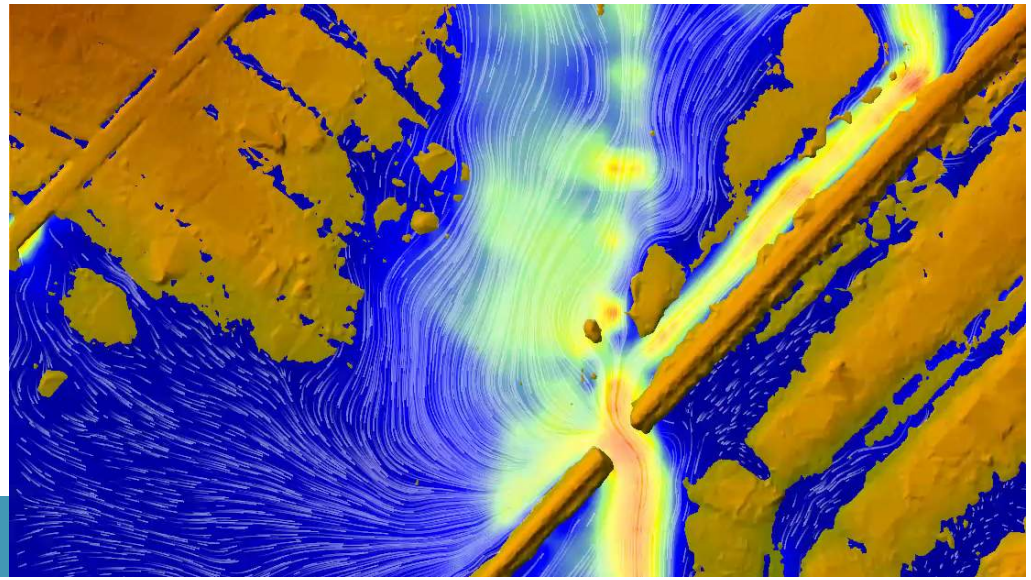
- Atmospheric Rivers
- Alternate between cold and warm
- Snow level changes leading to snowmelt as well as rainfall runoff and rain on snow
- Long duration events (days to weeks)
- Leads to saturated watershed conditions
- Some systems are partially regulated
- Reservoir storage conditions and operational criteria impacts outcomes
- Strength and duration of atmospheric rivers is increasing



What Will Drive Future Change?

- Technology changes
- Expectations of accuracy
- Future regulatory changes
- Awareness of risk
  - Design Events
  - Aging infrastructure
- NFIP Reform
- Climate informed science
- Data improvements
- Liability

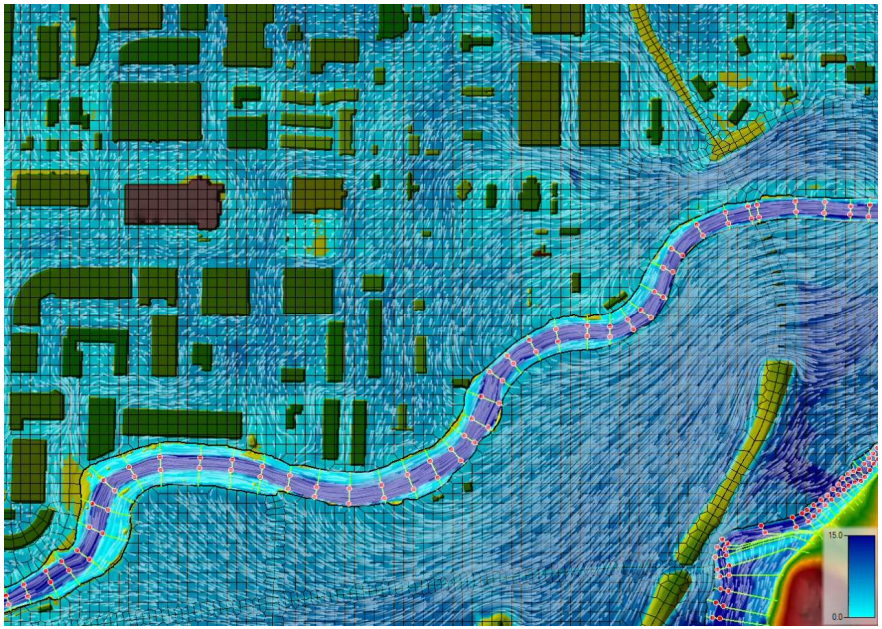


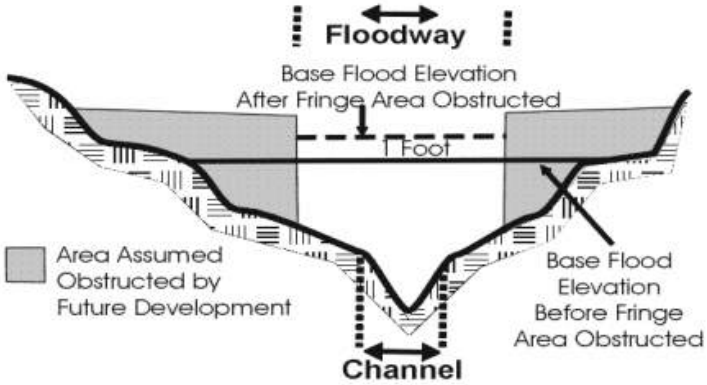


03 Challenges in Regulation and Management

2D Modeling is becoming a Normal Standard of Care

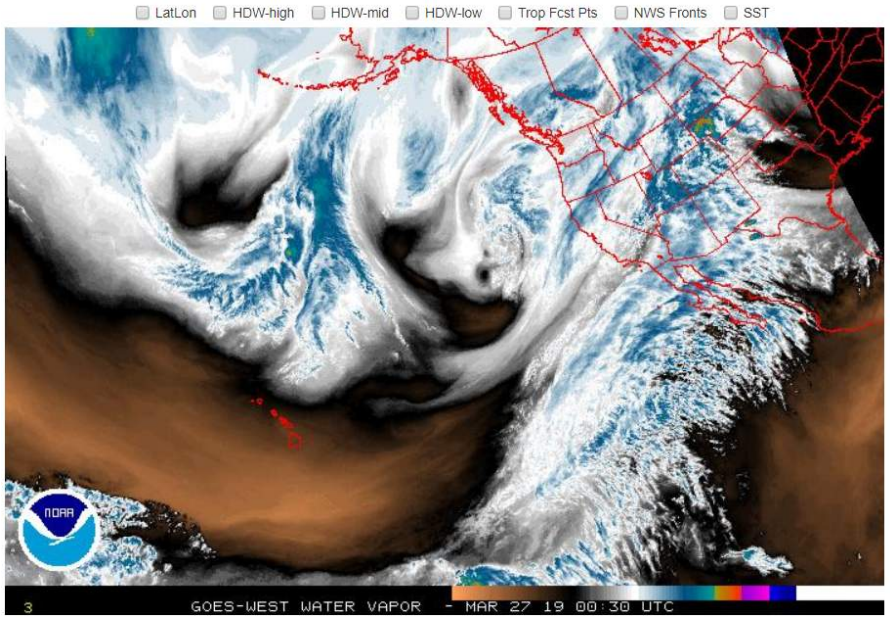
- How to we improve or inform 1D-based management concepts with better science?
- What changes are needed to ordinances? NFIP?
- How to anticipate and plan for the next evolution?





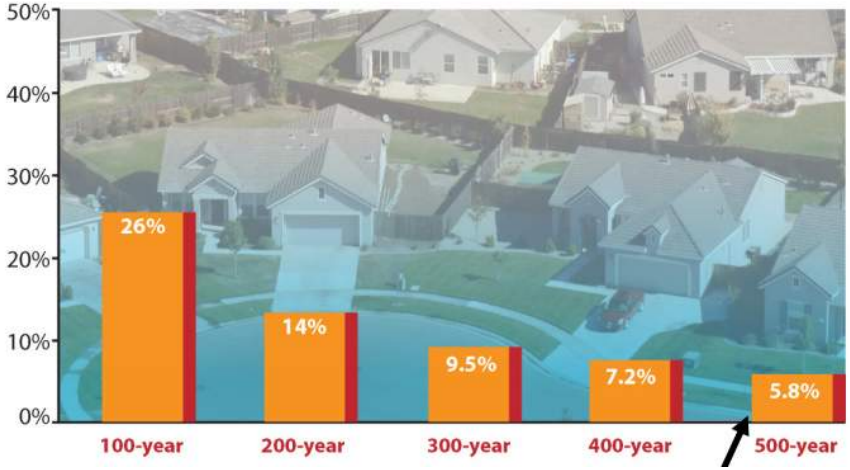
Is the Period of Record the Best Indicator of Future Risk?

- Climate Change
- Climate Science
- Black Swans



Compliance vs Managing Risk?

- FEMA and local ordinances compliance vs. Flood risk management?
- Is the 100-year level or protection really acceptable?
- Resiliency vs adaptability?
- How can these tools make better decisions?



Questions and Discussion

Mike Schubert, PE
HDR Engineering
208-387-7070
michael.schubert@hdrinc.com