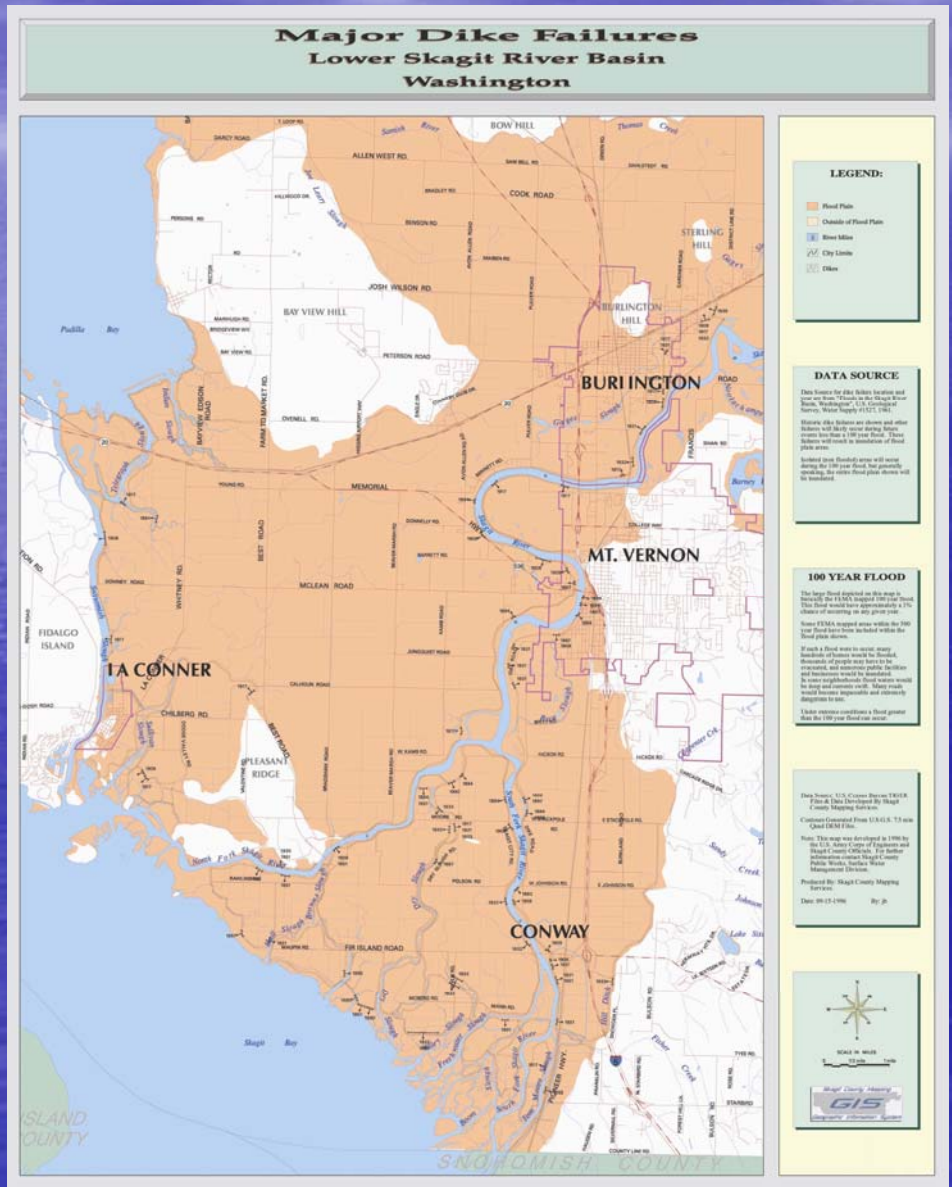
Skagit River Revised Flood Insurance Study
Levee Scenario Discussion

Ted Perkins, Hydraulic Engineer
US Army Corps of Engineers, Seattle District
8/9/2007

Skagit Levee Failure Scenarios

- Challenges of Defining Levee Failures
- FEMA Regulations
- Implementation of Regulations
- Comparison to Actual Observations

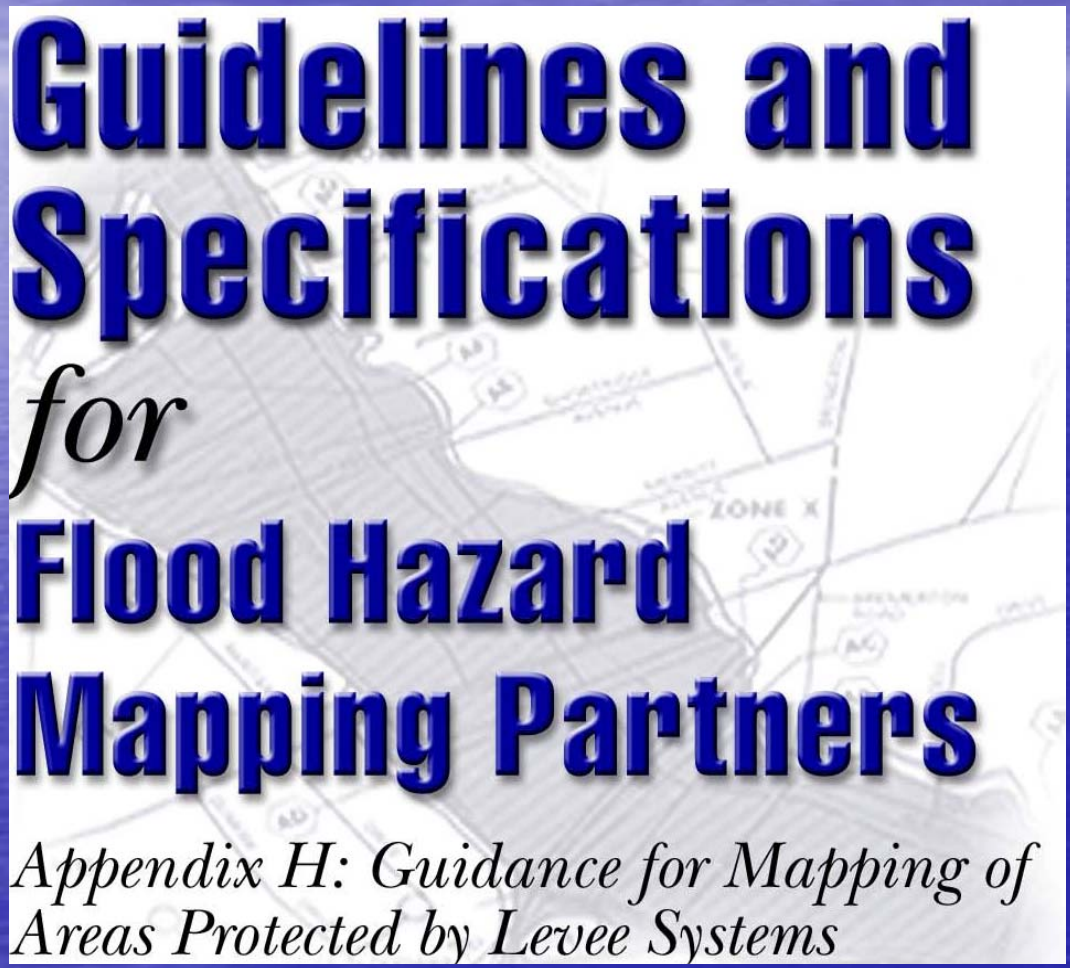
Past Skagit River Levee Failures



Isolated Levee Failures

Systemwide Levee Failures

General FEMA Levee Failure Policy



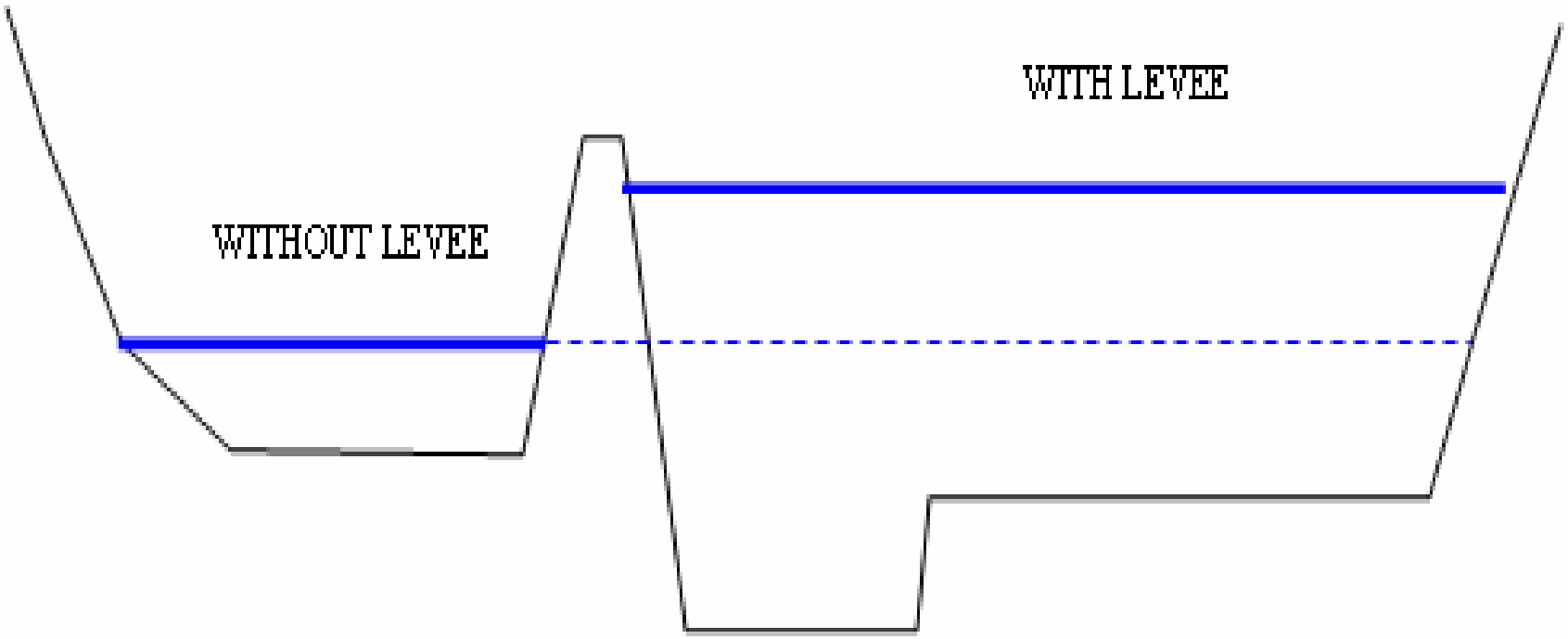
http://www.fema.gov/library/viewRecord.do?id=2206

General FEMA Levee Failure Policy

- If the subject levee does not meet the requirements stated in Section 65.10 of the NFIP regulations, as verified by the RPO, **the Mapping Partner shall recompute the 1-percent-annual-chance flood elevations as if the levee did not exist**.

(page H-11)

One Levee System



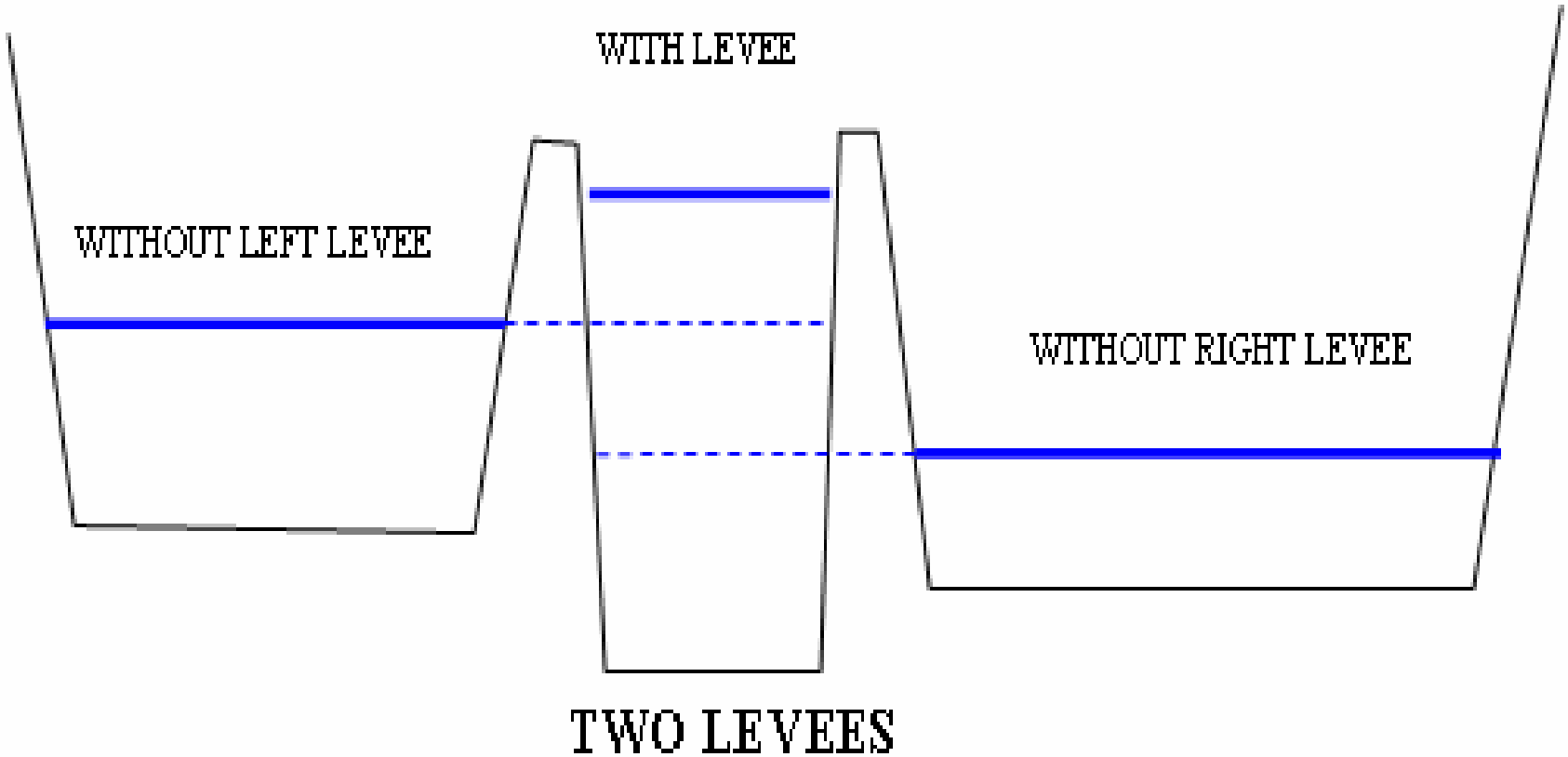
SINGLE LEVEE

General FEMA Levee Failure Policy

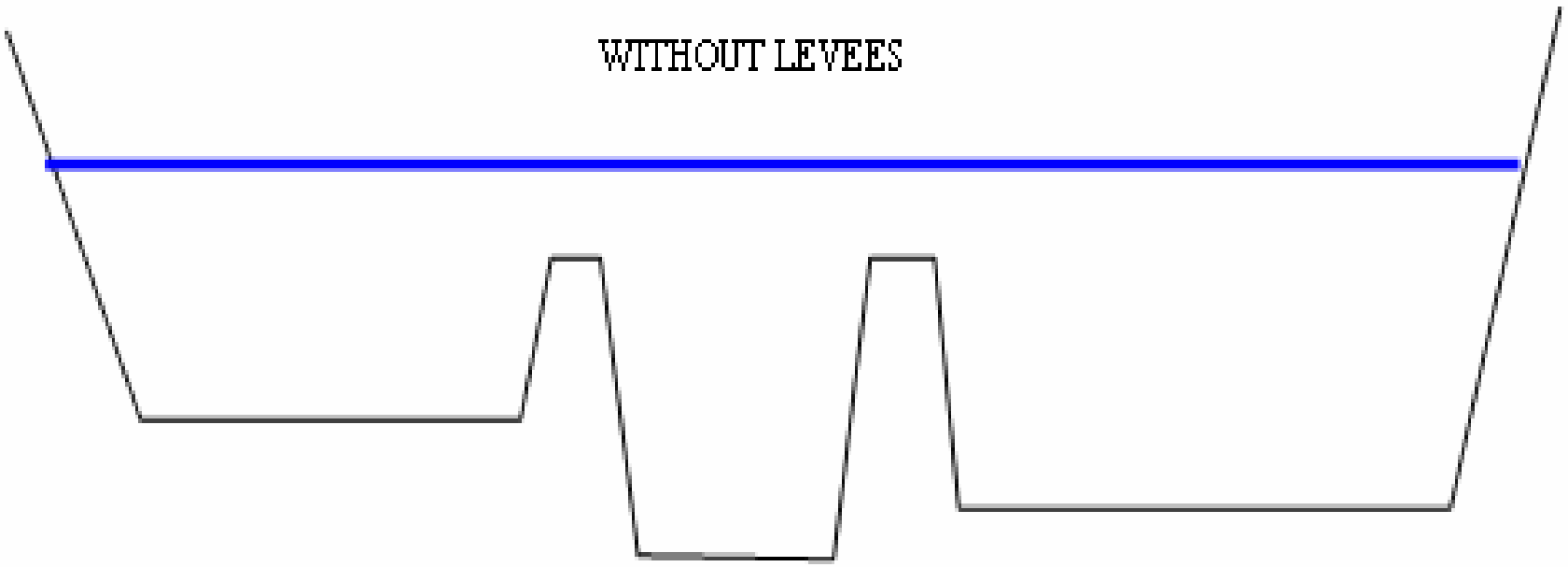
- The above procedures for the determination of BFEs and regulatory floodways also apply to the conditions where **levees exist on both sides** of the stream. In these cases, **the evaluation shall include the possibility of simultaneous levee failure, failure of only the left side, and failure of only the right side, and shall consider simultaneous levee failure for both the BFE and regulatory floodway computations**. The Mapping Partner shall contact the RPO for guidance on the evaluation of levee systems under these circumstances.

(page H-12)

Levees on Both Sides of the River



Levees Inundated



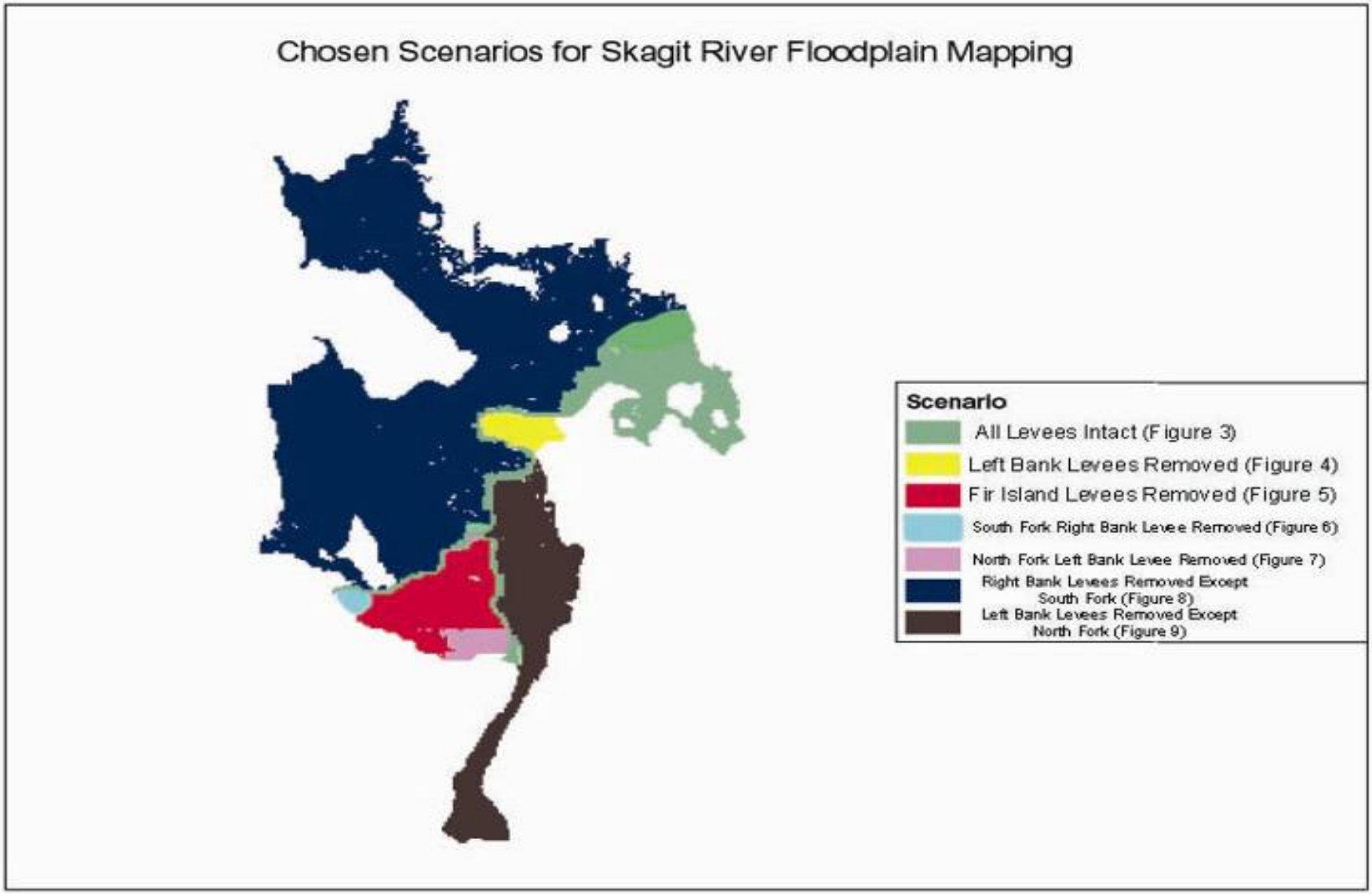
General FEMA Levee Failure Policy

- For levee systems **where an area of land may be totally or partially surrounded by levees** or where two or more flooding sources join that have levees on both sides of the stream, the Mapping Partner that is performing the analysis shall contact the RPO before proceeding with any analyses for levee failures. For these complex situations, **the flood hazard in the area** that would have been protected by the non-failed levee(s) **must be based on selection of failure scenarios that yield the highest BFE or flood hazard**.

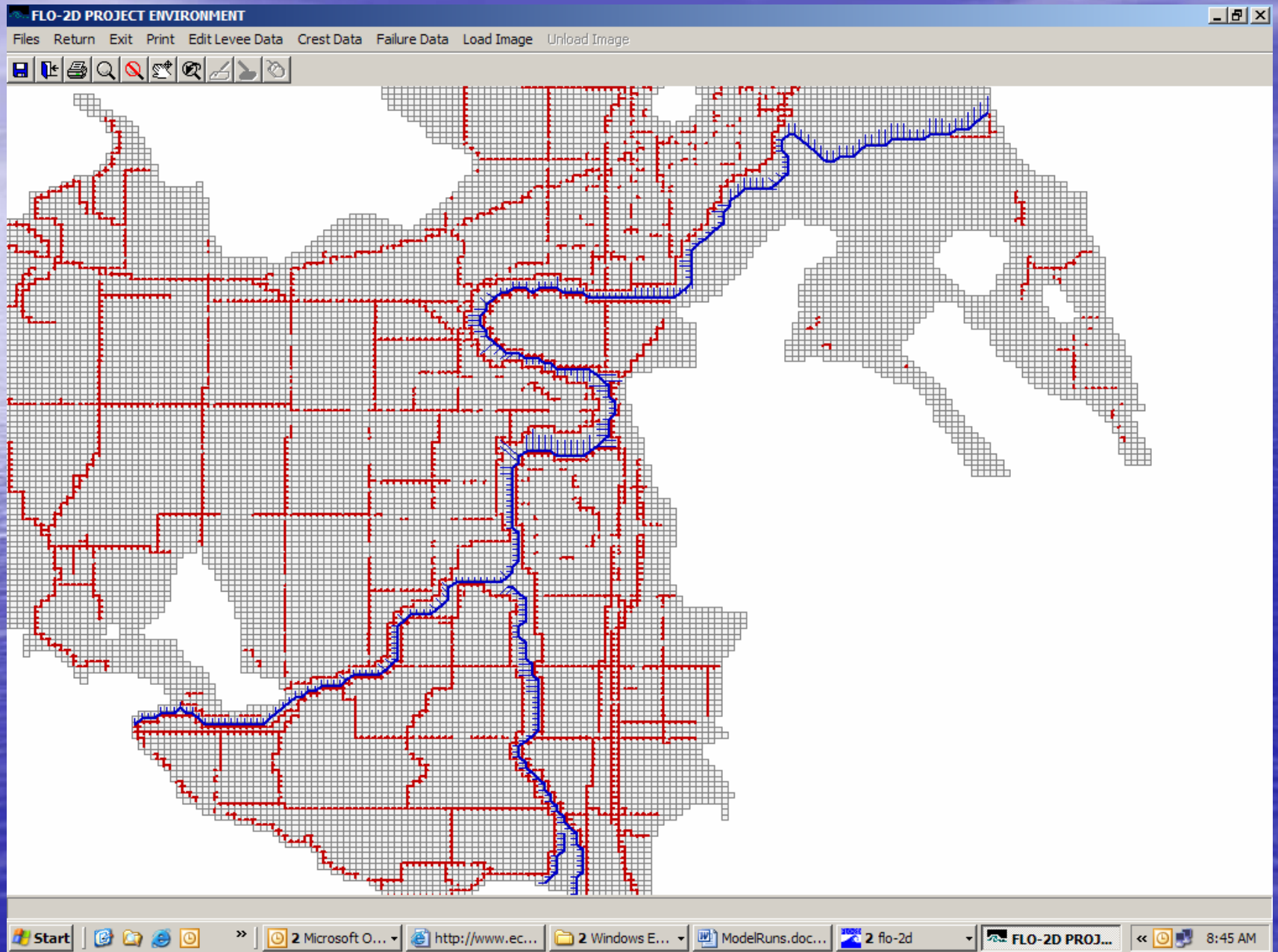
(page H-12)

Surrounded by Levees

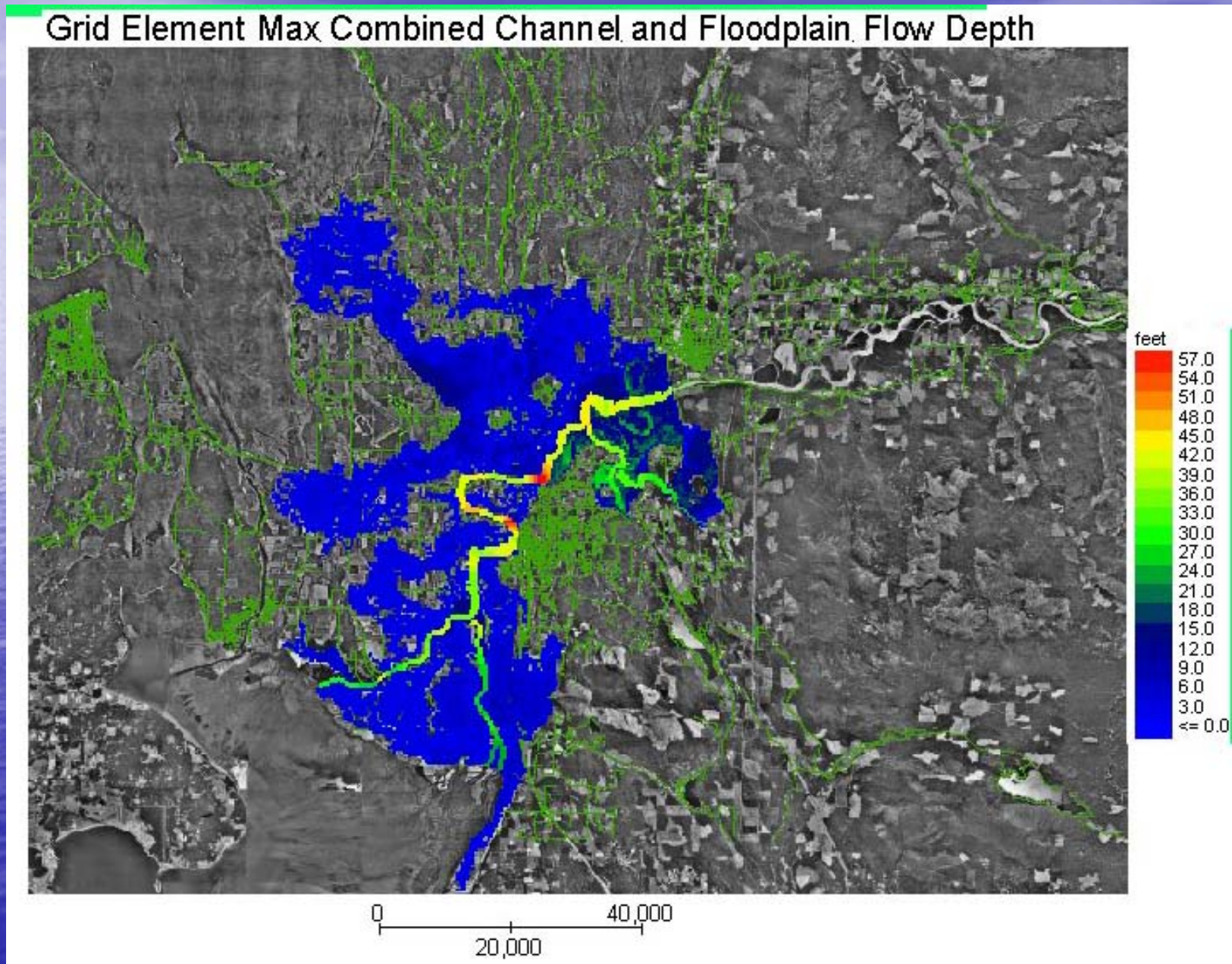
Levee Scenarios



All Levees Intact

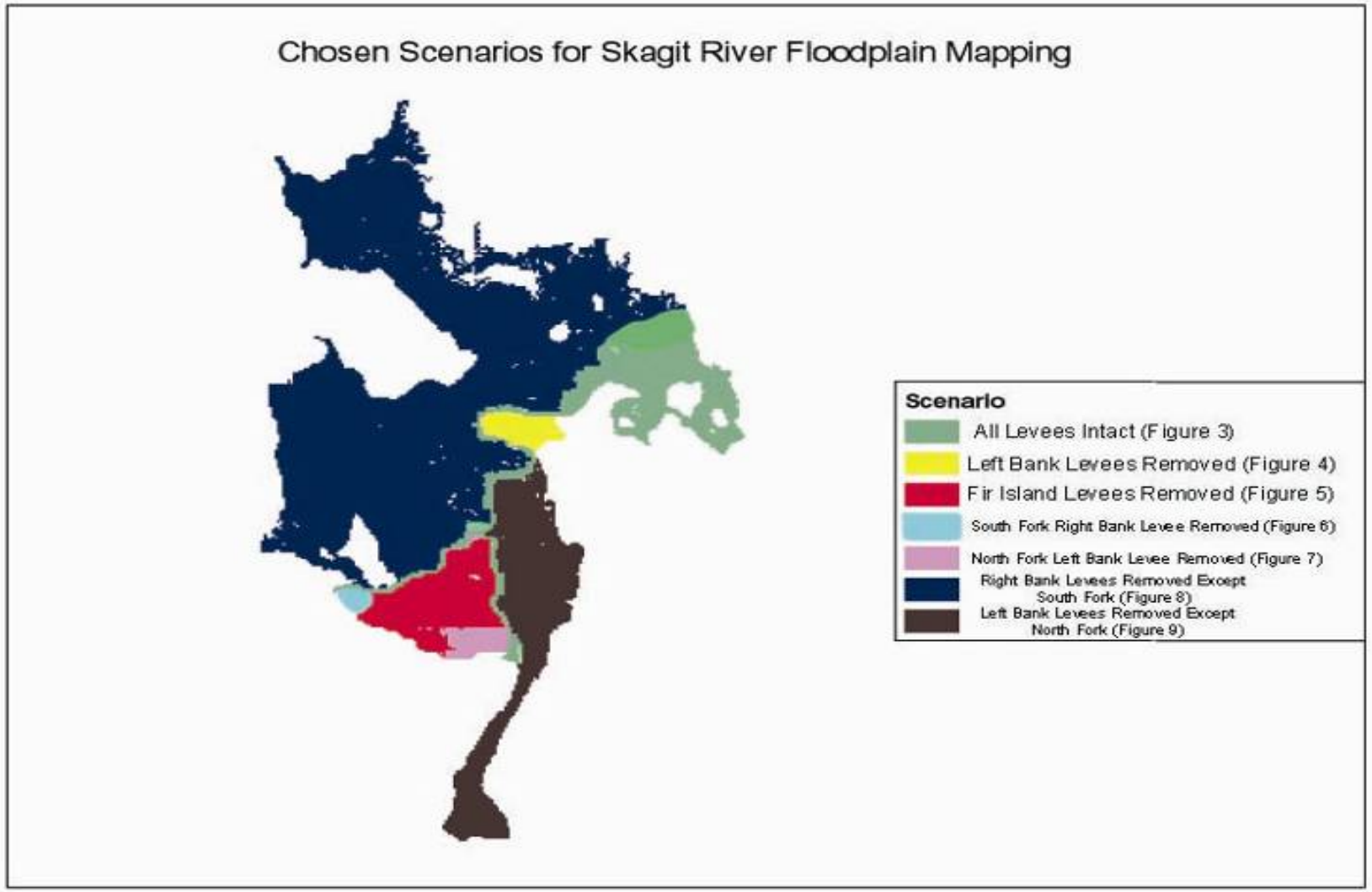


All Levees Intact

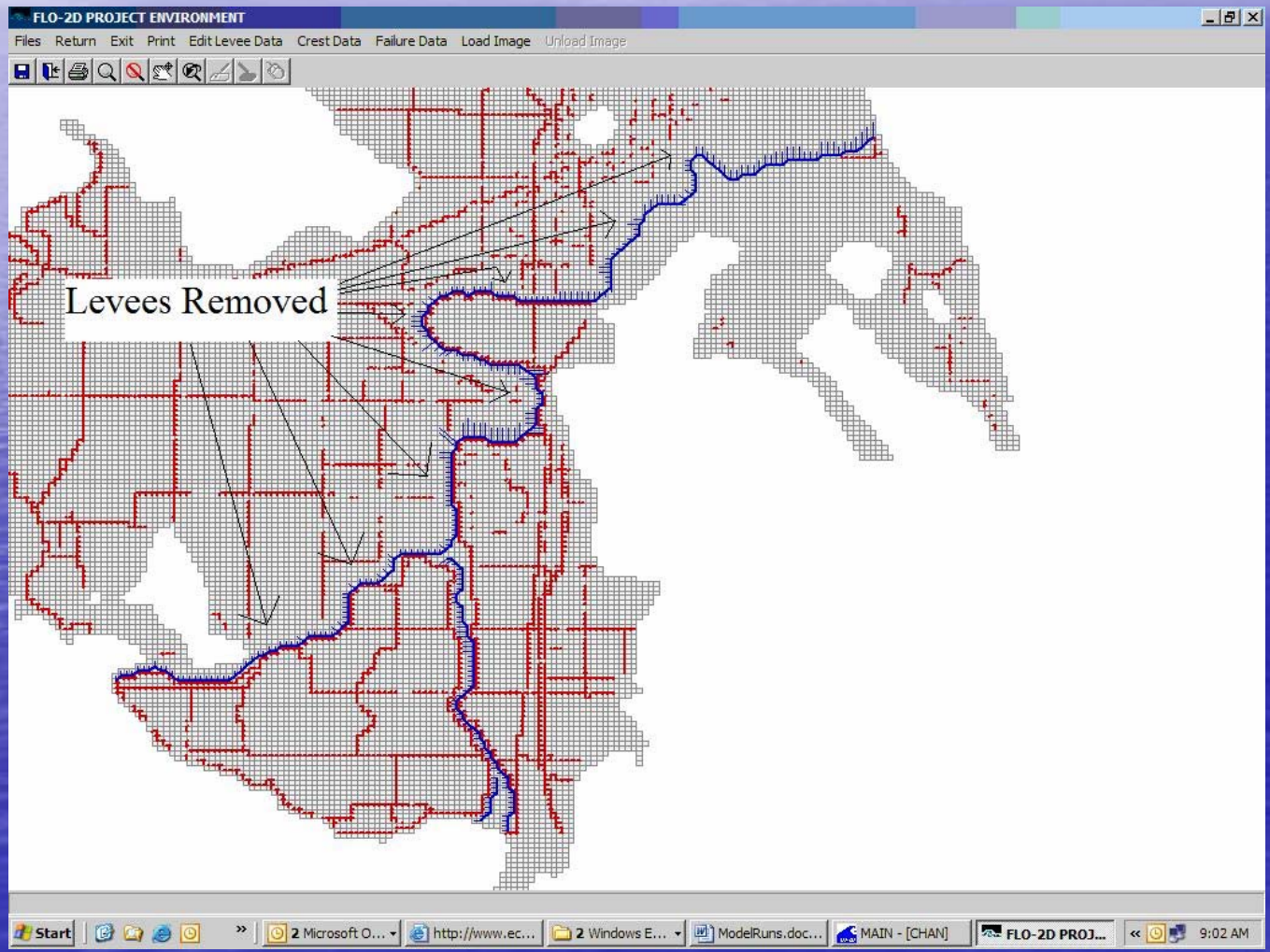


Right Bank Levees Removed
Burlington to Samish and Padilla Bays

Dark Blue Area



Right Bank Levees on Mainstem and North Fork Skagit River Removed While All Other Levees Remain Intact



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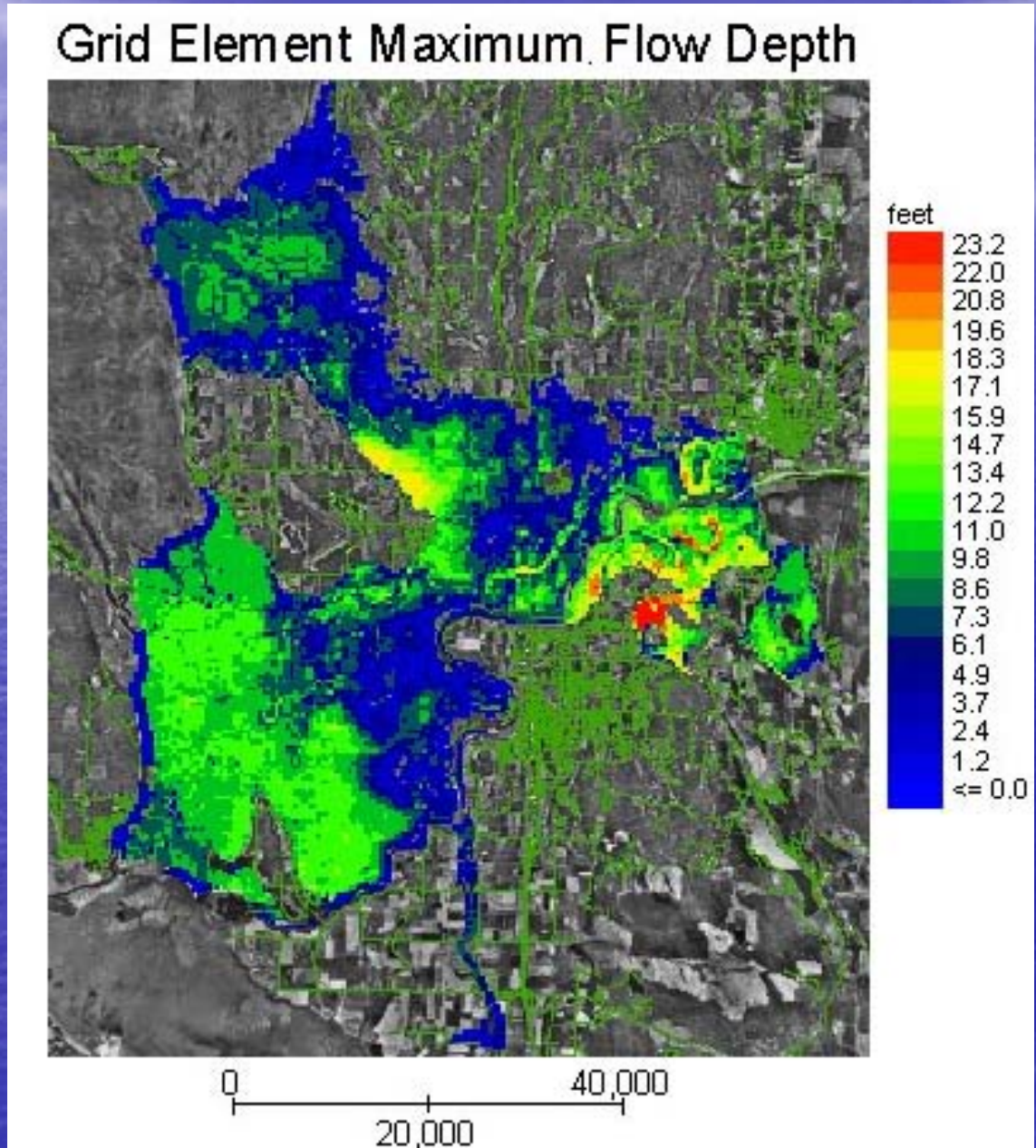
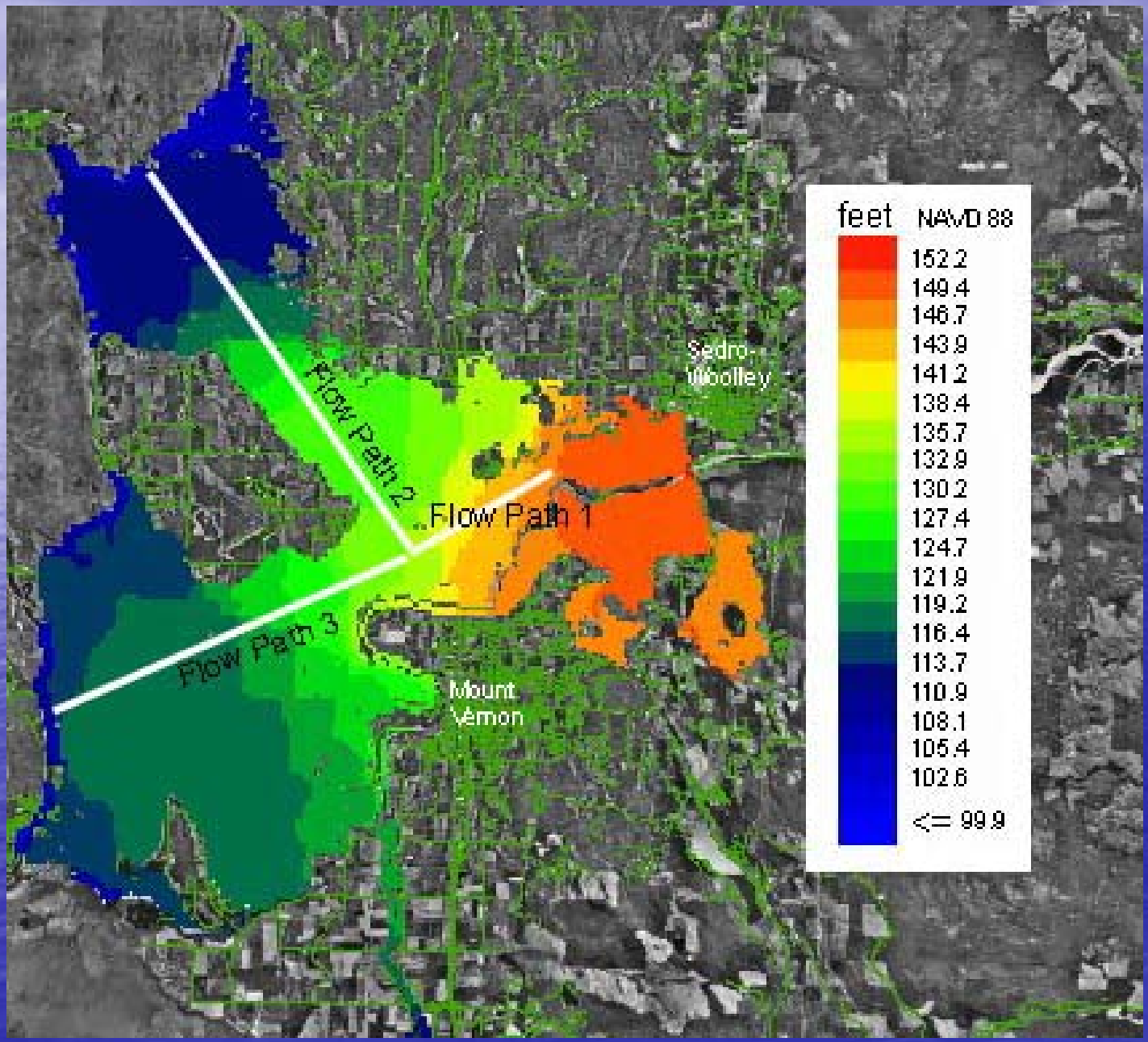
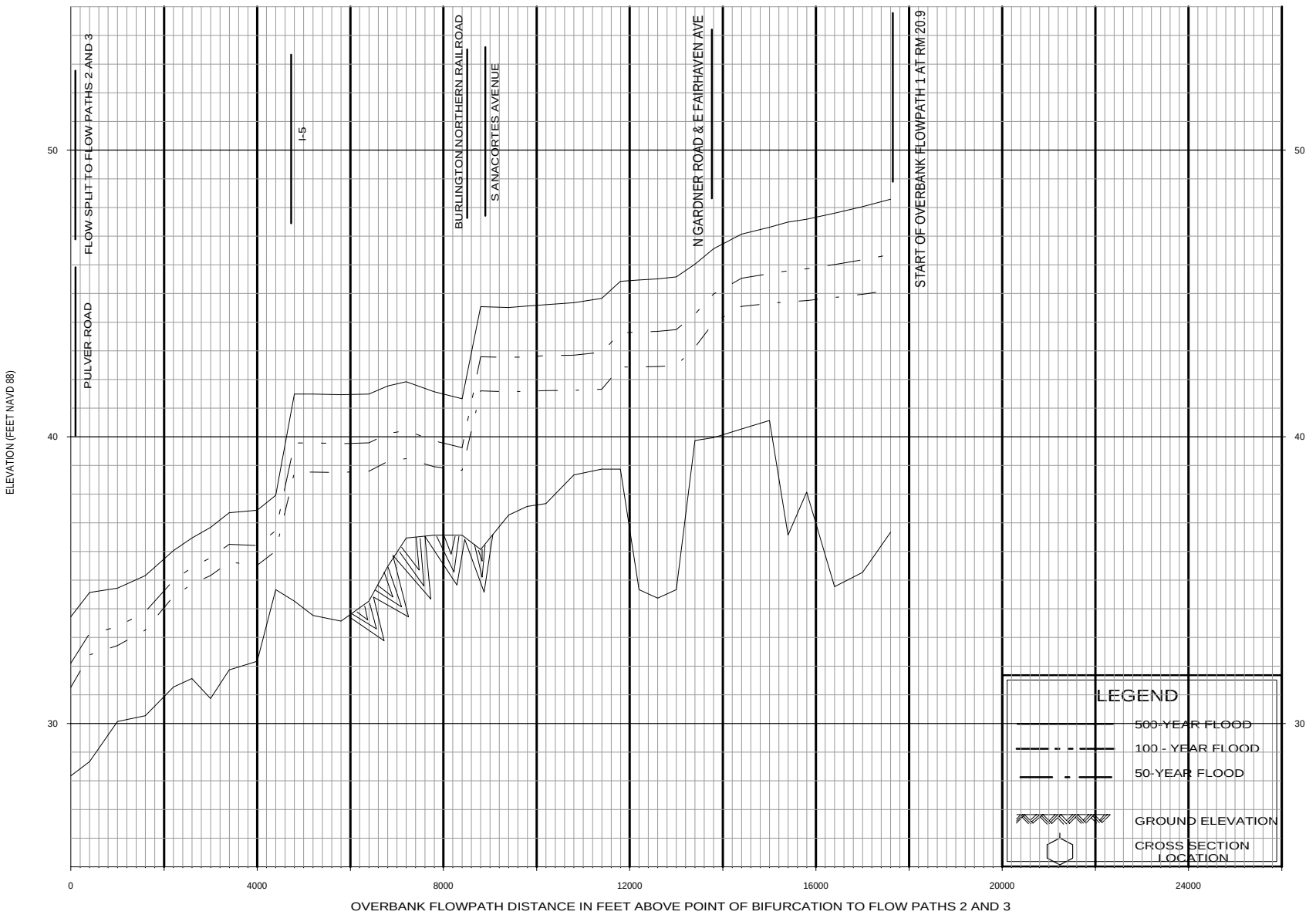


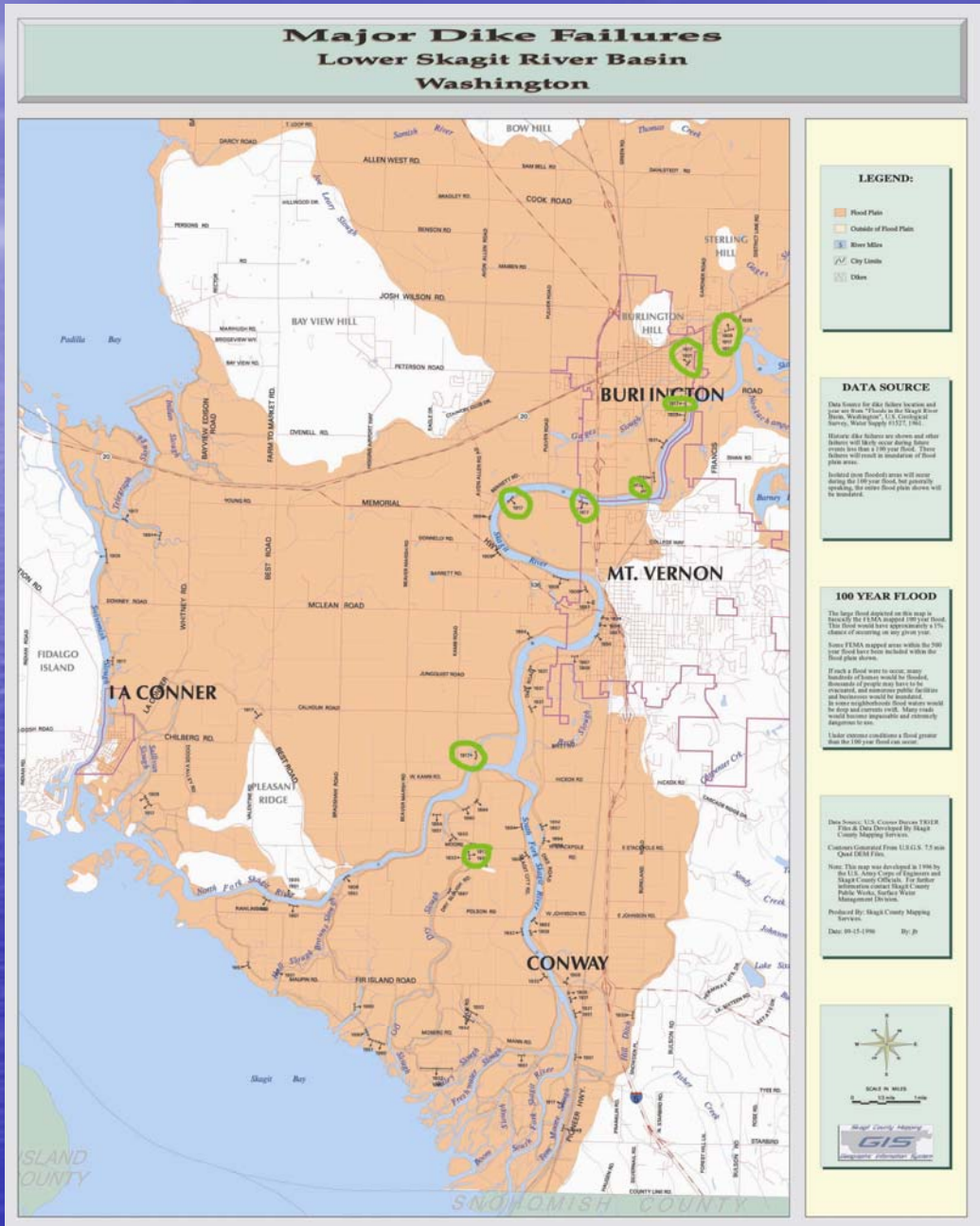
Right Bank Levees Removed Flowpaths



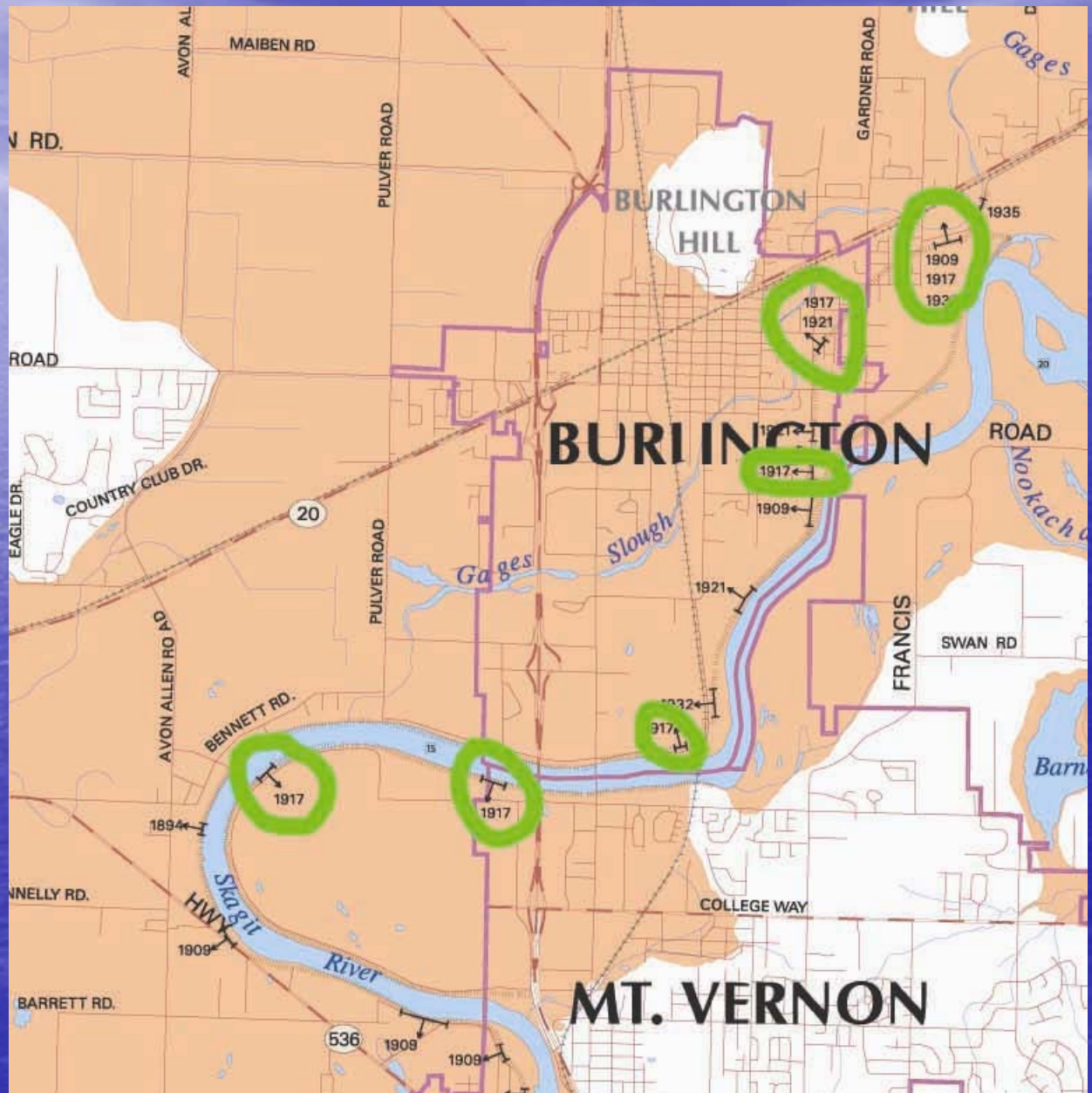
Flowpath 1 Burlington Area (Page 60)



Levee Failures 1917

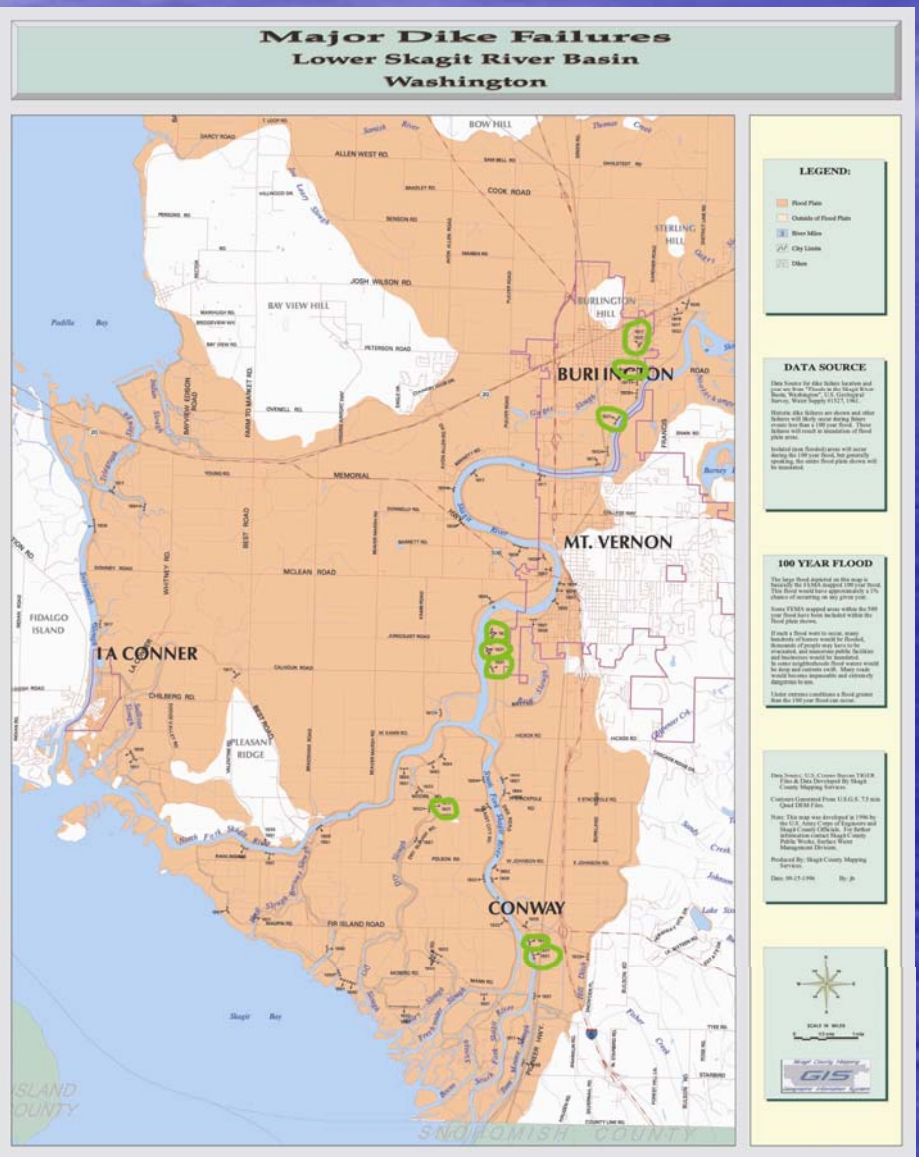


Levee Failures 1917



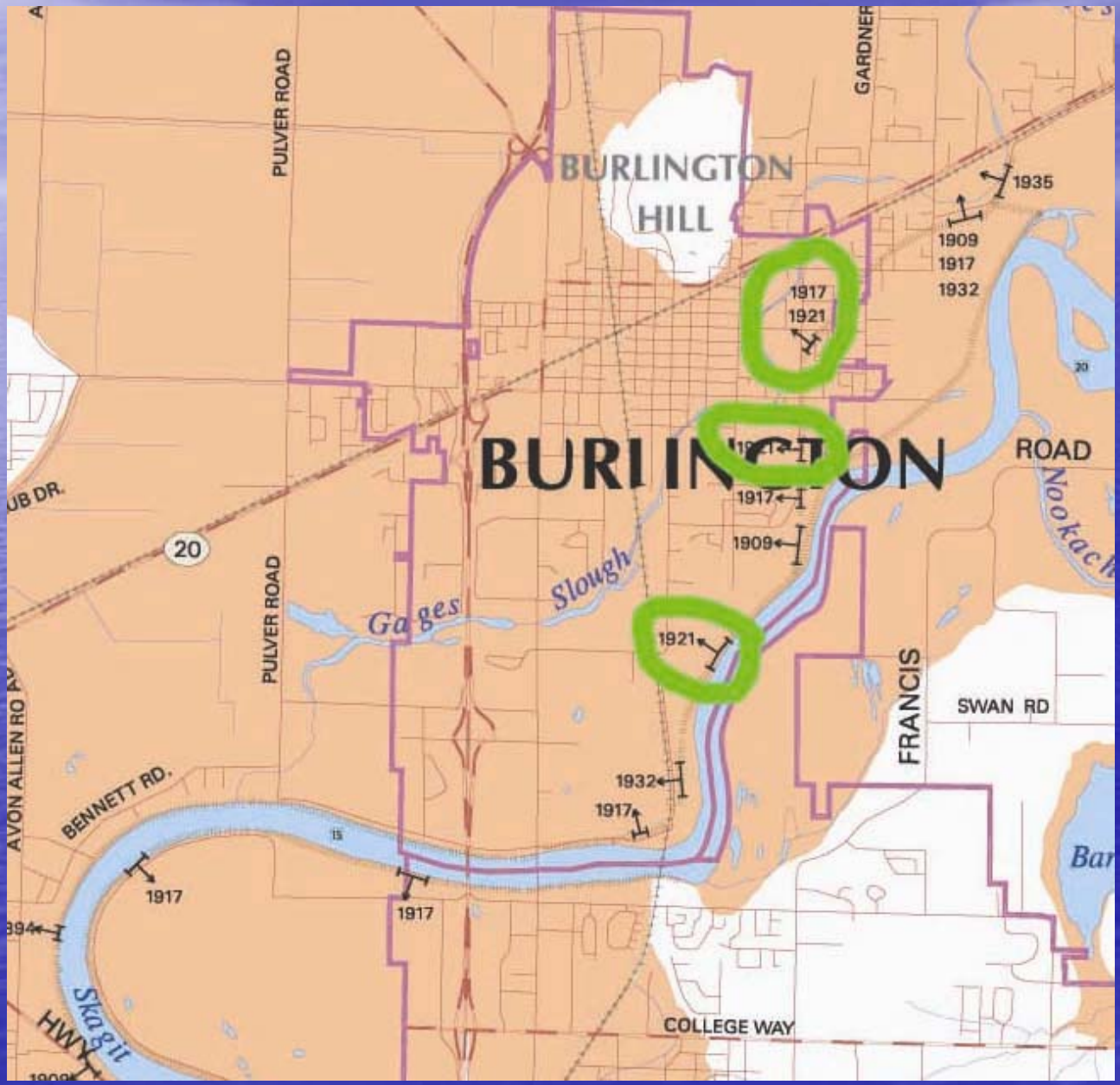
Burlington 1917

Levee Failures 1909 and 1921



Levee Failures 1909

Levee Failures 1921



Newspaper Documentation Burlington

- Concrete Herald 12/17/1921

"The entire city of Burlington was flooded to a **depth of from three to five feet**"

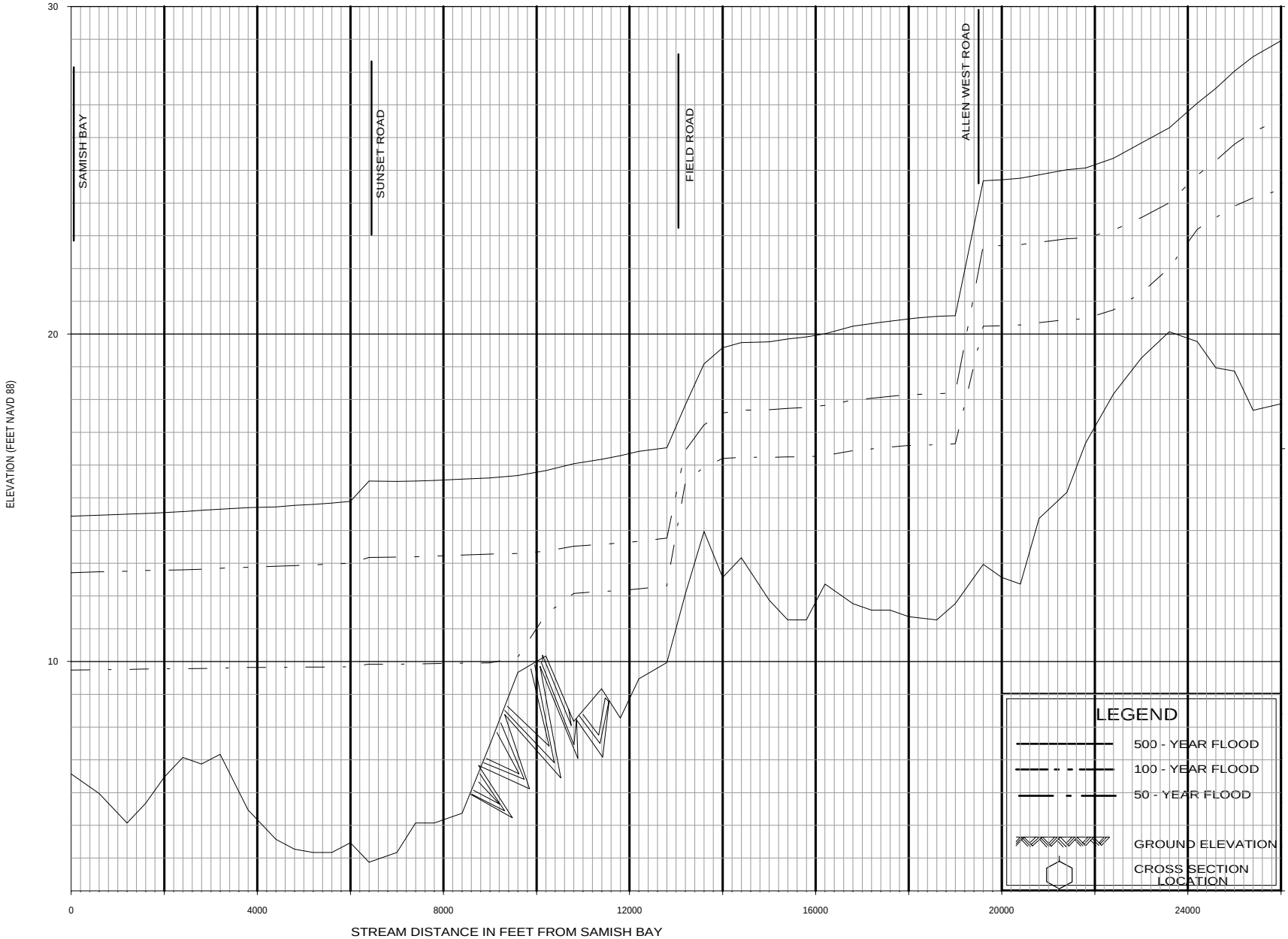
Concrete Flow = 240,000 cfs

- Skagit County Courier 12/2/1909

"The water broke the dykes guarding Burlington and almost the entire town was flooded. In the residence districts the water was over **eight feet deep** in places."

Concrete Flow = 260,000 cfs

Flowpath 2 Samish Area (Page 61)



FLOOD PROFILES

SKAGIT RIVER DELTA, OVERBANK FLOW PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA

(AND UNINCORPORATED AREAS)

02P

Newspaper Documentation Samish

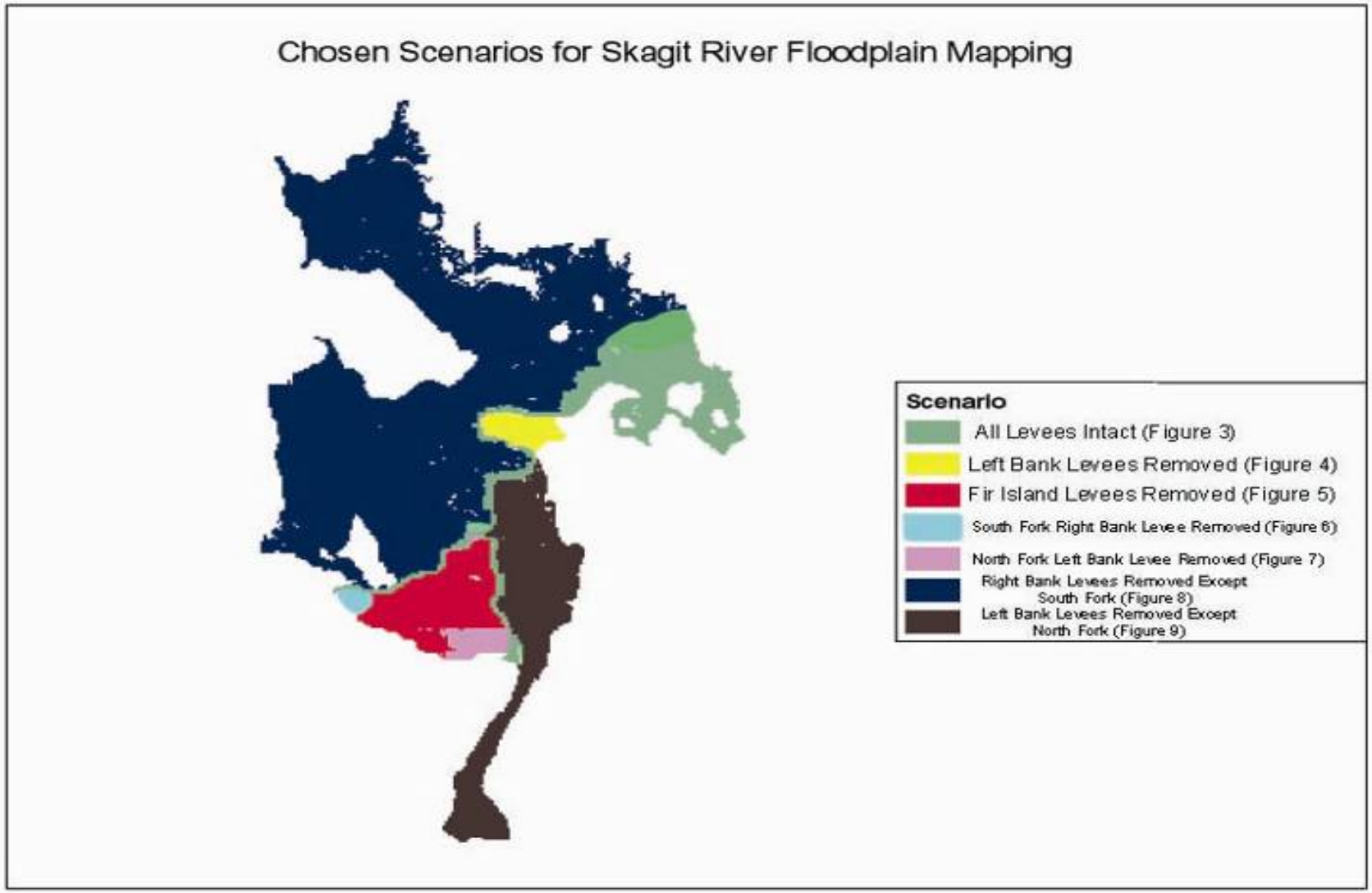
- Mount Vernon Argus 12/15/1921

"In some of the houses in the Samish flats water was **6 or 7 feet** and the occupants were forced to move to the second story."

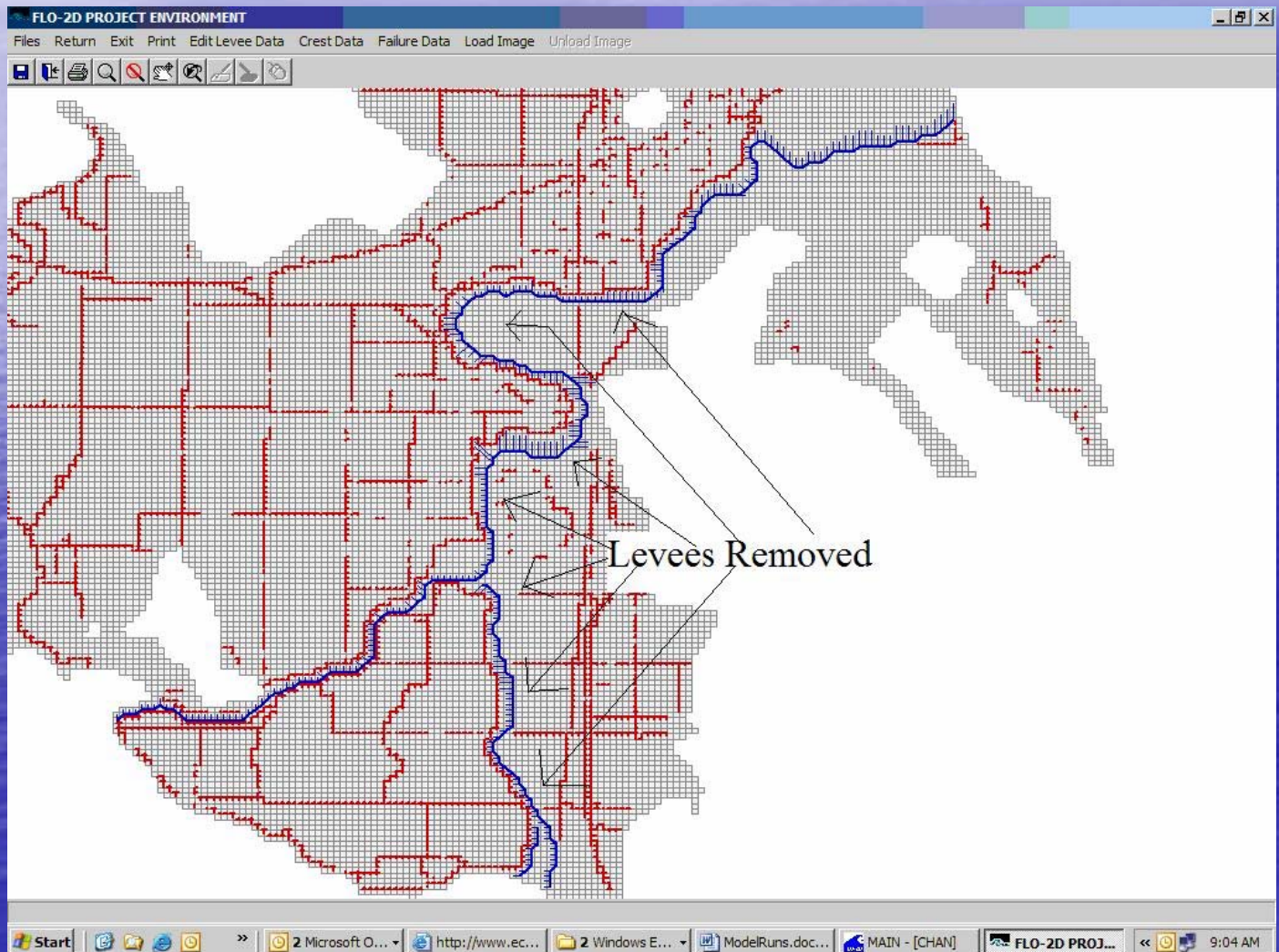
Concrete Flow = 240,000 cfs

Left Bank Levees Removed
Mount Vernon to Stanwood

Brown Area



Left Bank Levees on Mainstem and South Fork Skagit River Removed While All Other Levees Remain Intact



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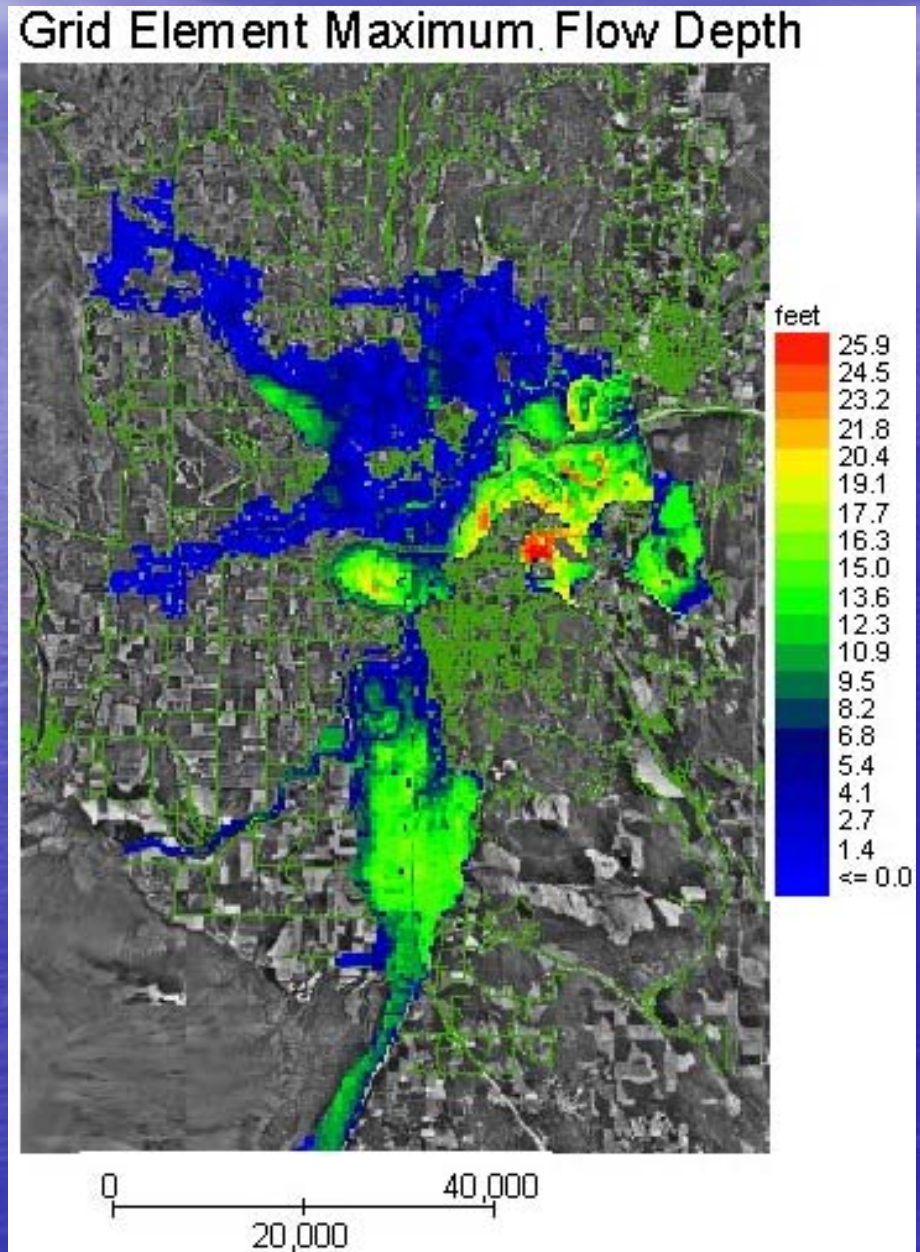

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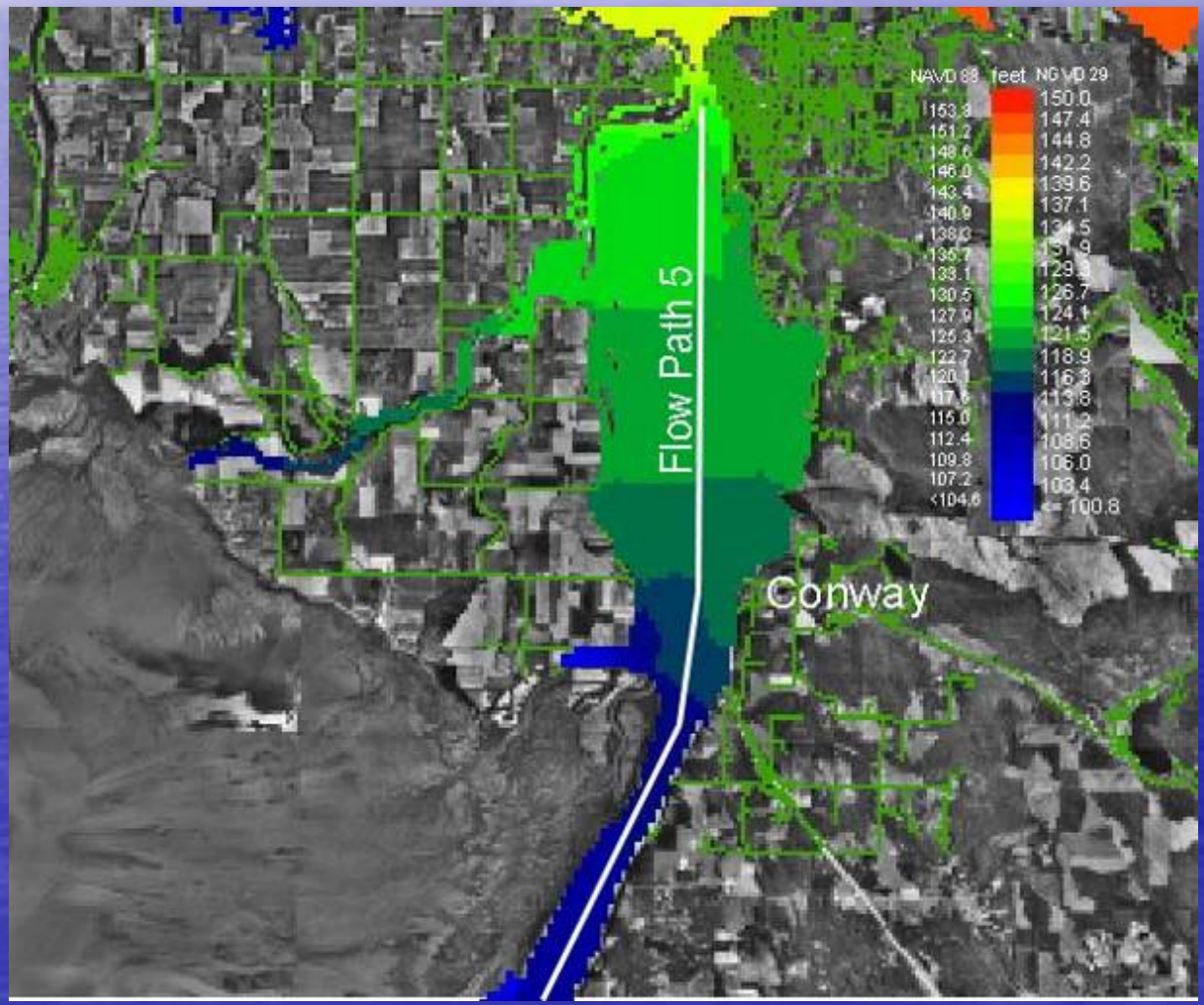
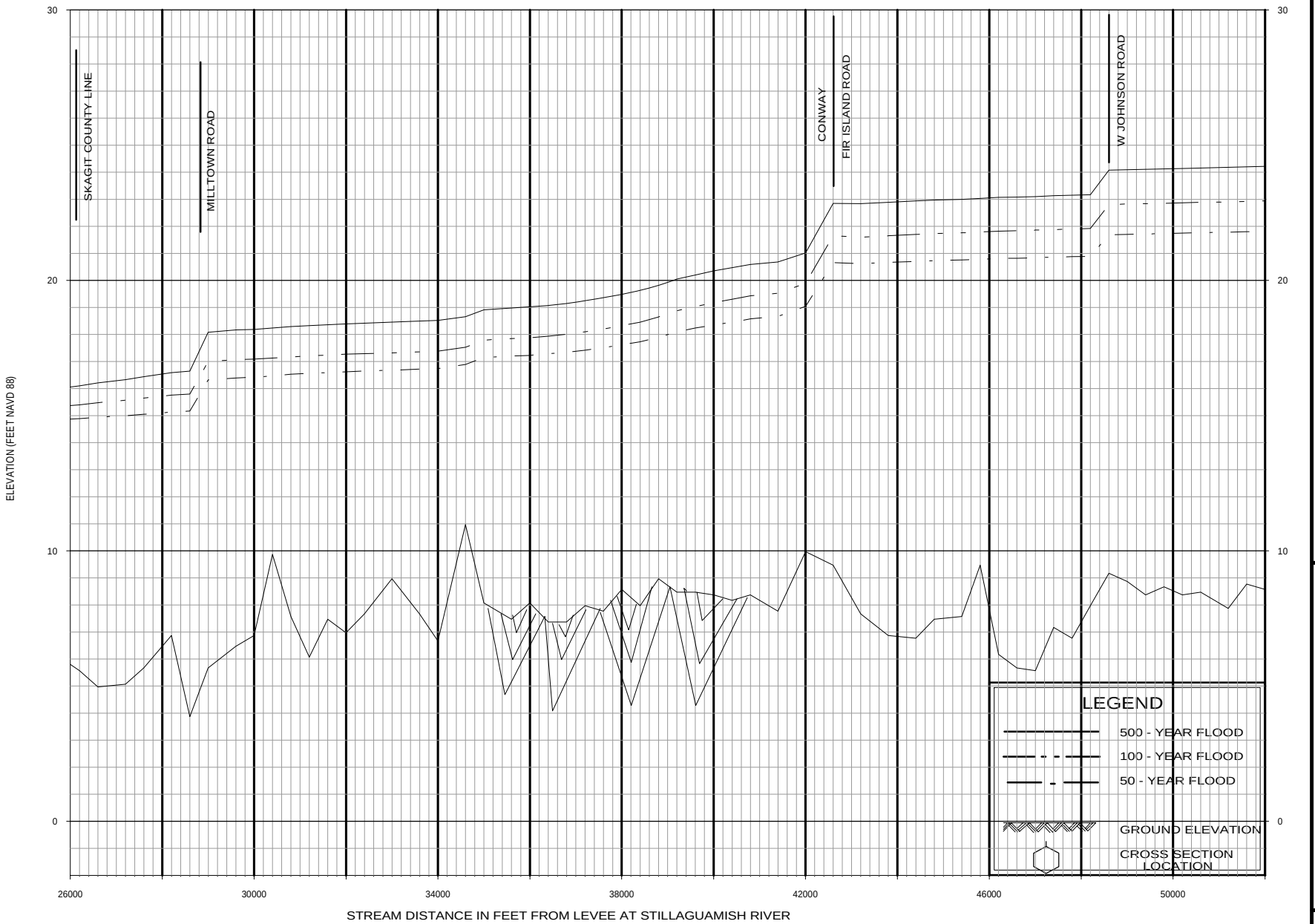


Flowpath 5 Conway Area (Page 67)



FLOOD PROFILES

SKAGIT RIVER, OVERBANK FLOW PATH 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

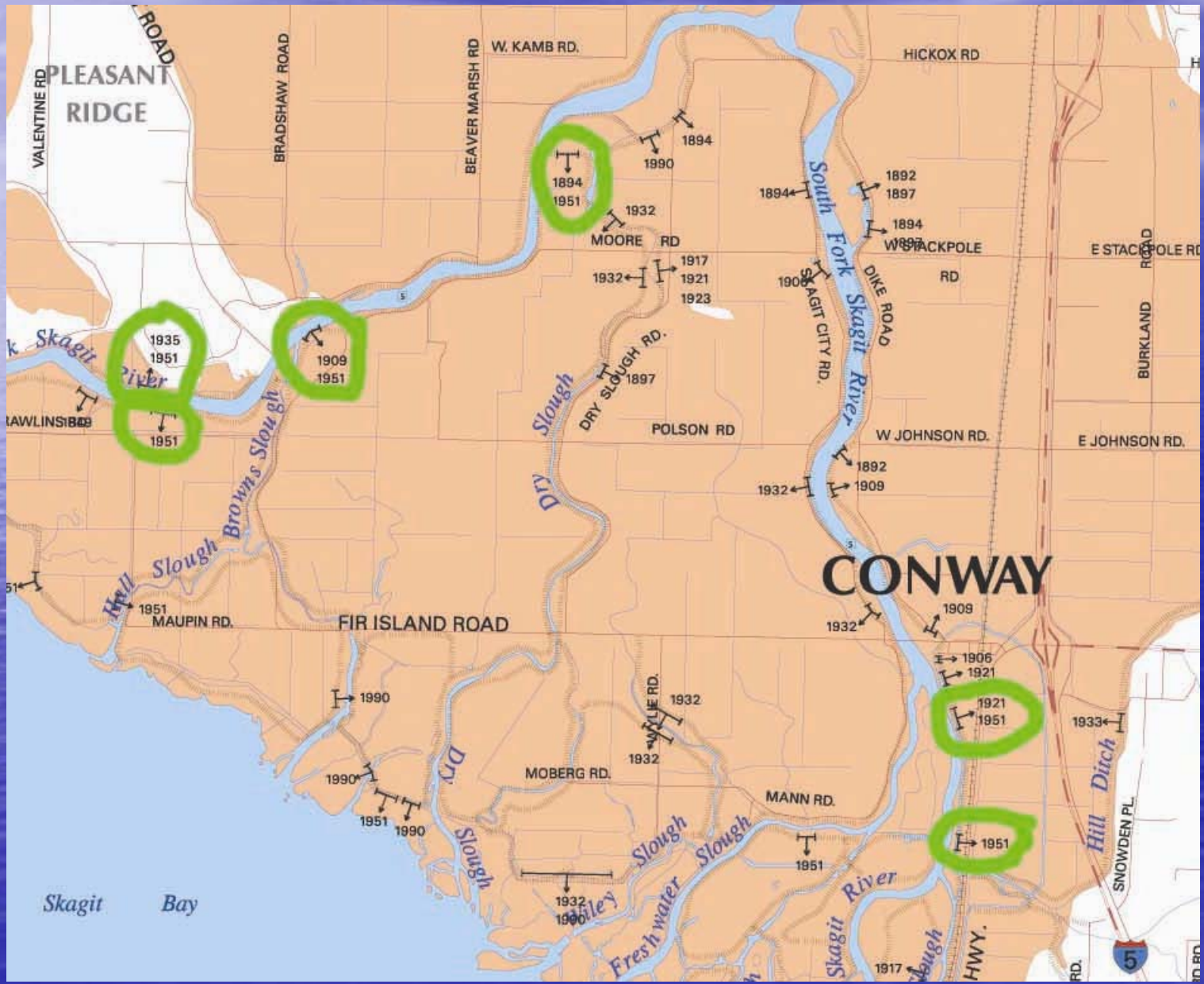
SKAGIT COUNTY, WA

(AND UNINCORPORATED AREAS)

08P

Levee Failures 1951

Levee Failures 1951



Conway 1951

Newspaper Documentation Conway

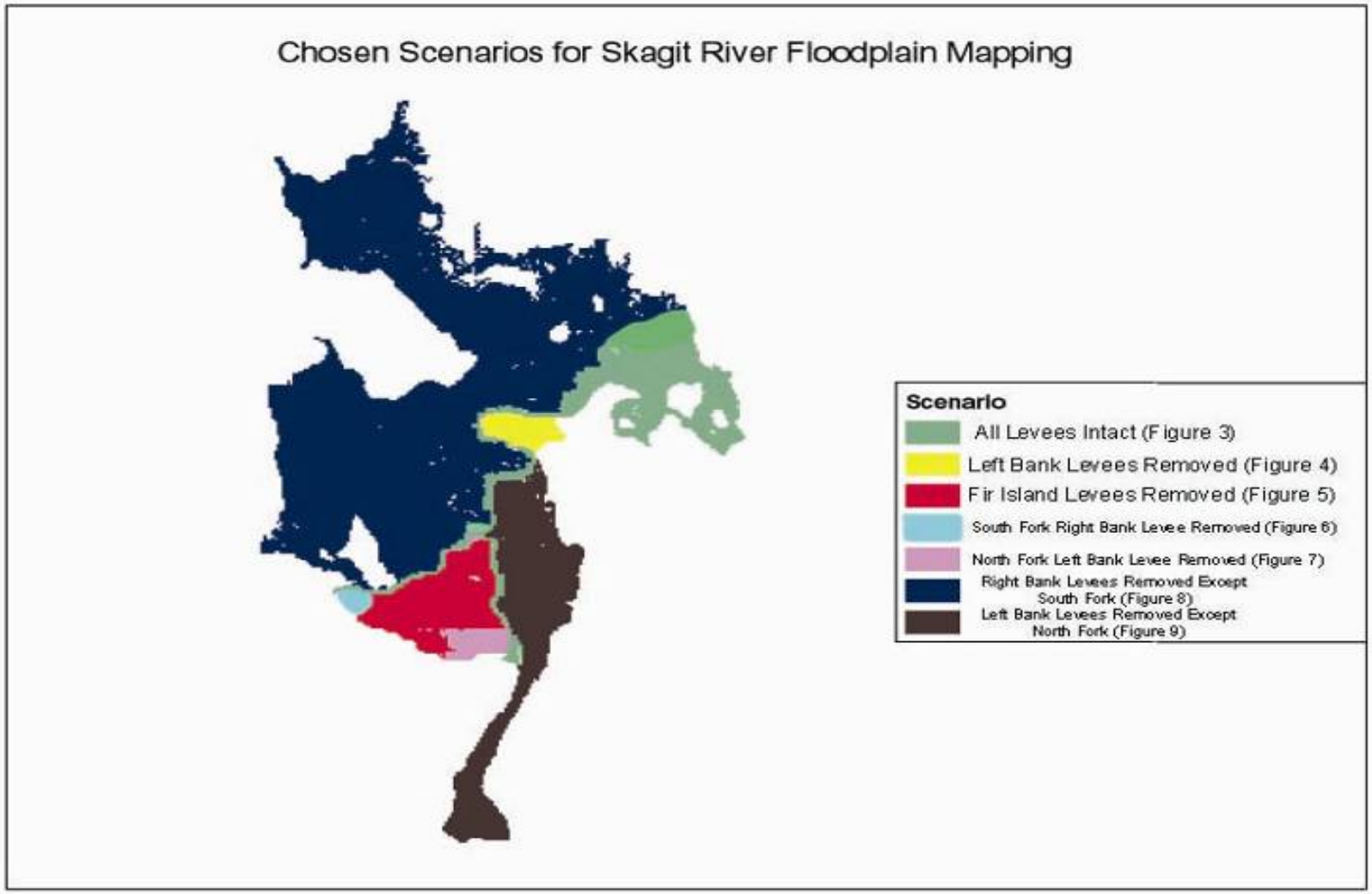
- Mount Vernon Argus 12/15/1951

"Conway residents declared the 1951 flood was two feet, 10 inches below the 1921 inundation in their community..."

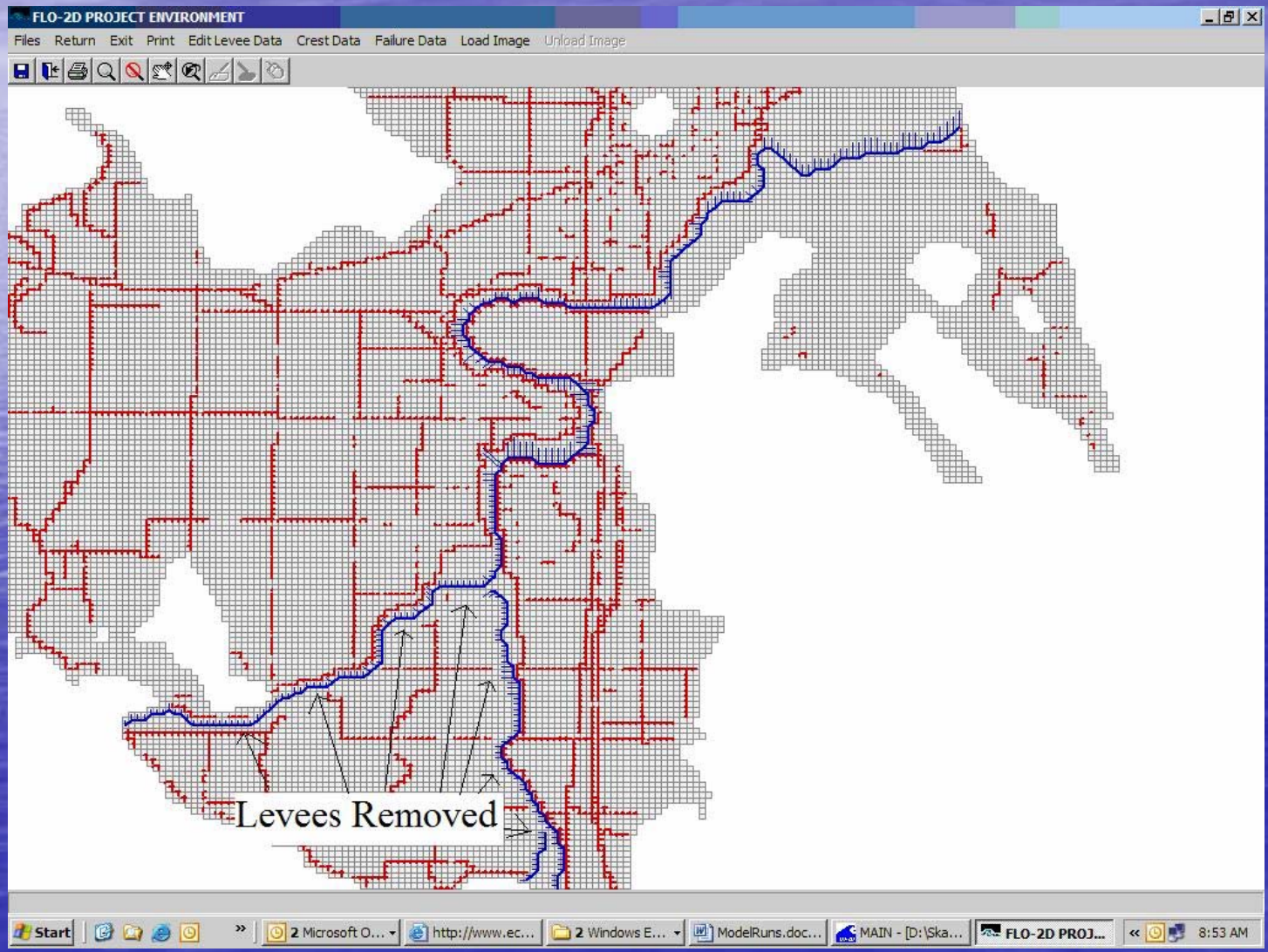
Concrete Flow = 139,000 cfs

Mount Vernon Flow = 144,000 cfs

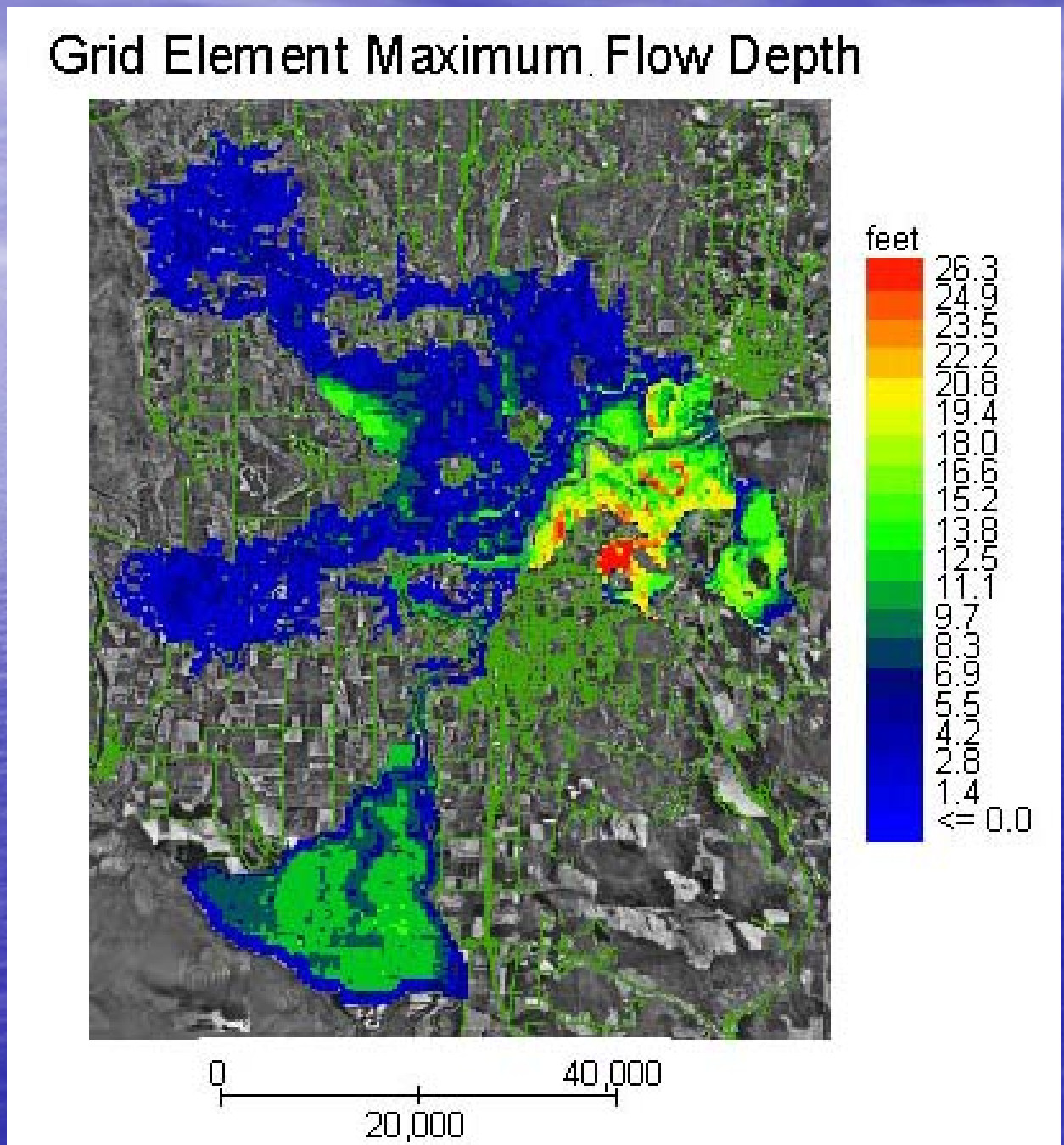
Fir Island
Red, Pink and Light Blue Areas



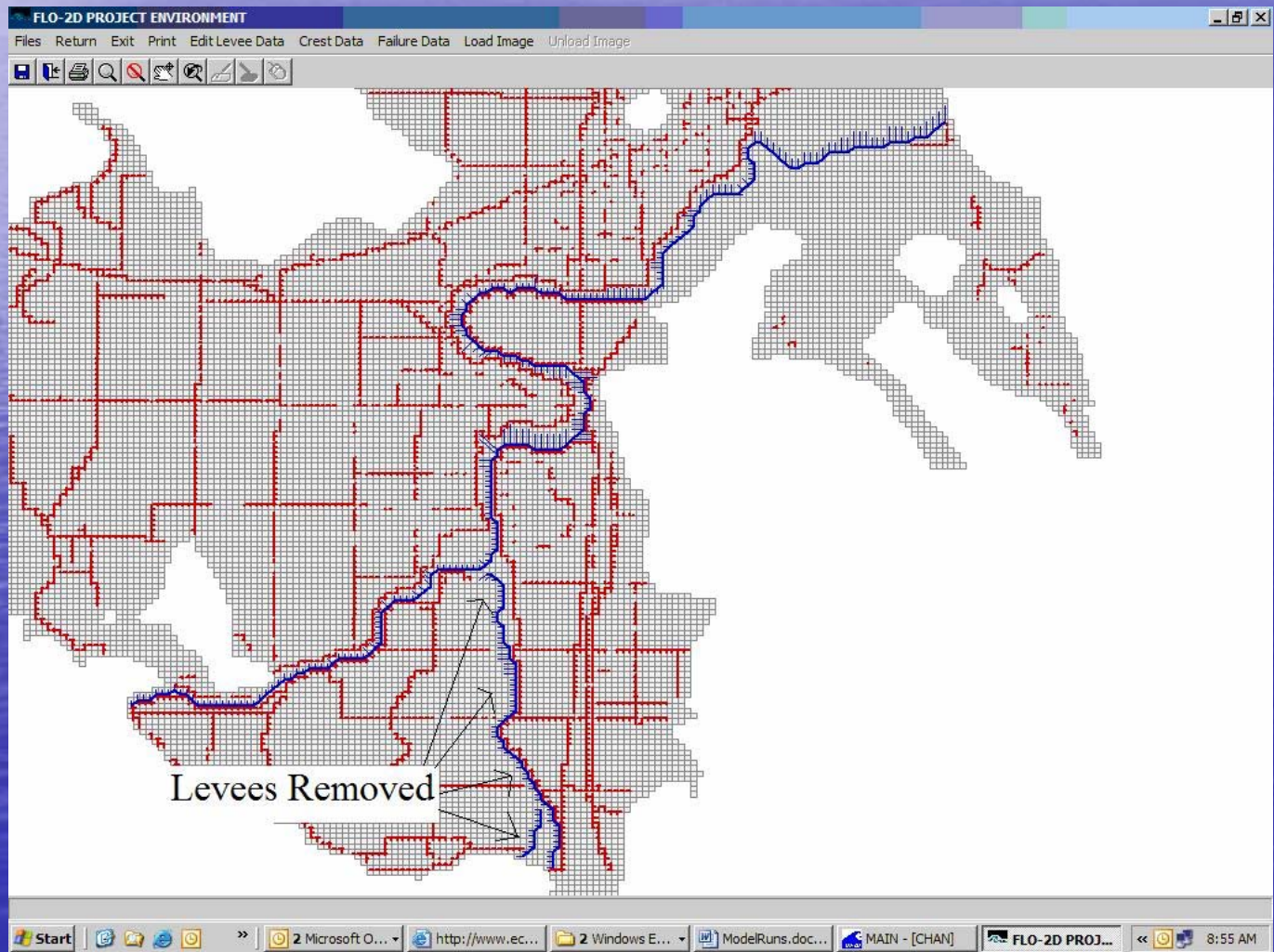
Fir Island Levees Removed While All Other Levees Remain Intact



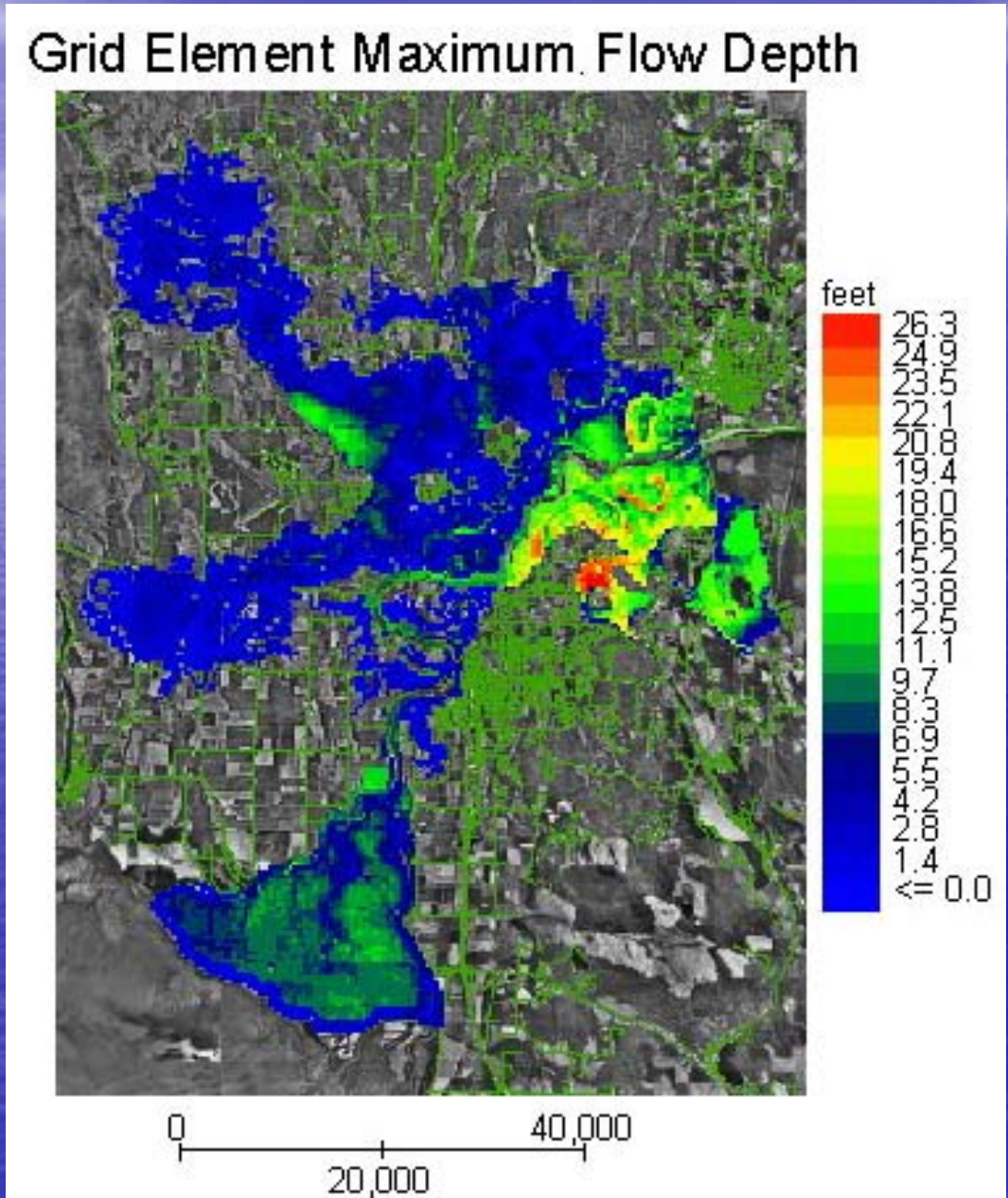
Fir Island Levees Removed While All Other Levees Remain Intact



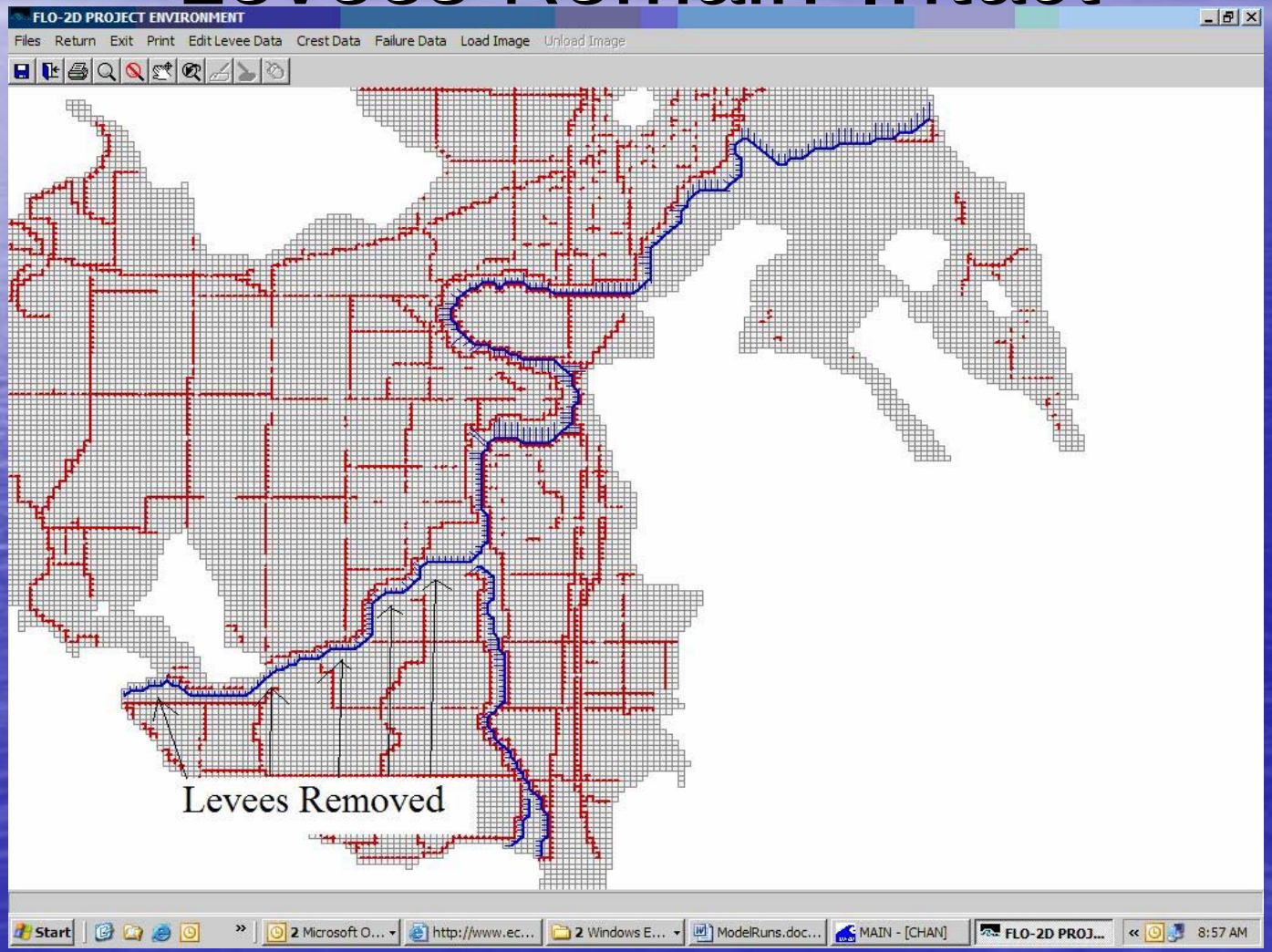
South Fork Skagit River Right Bank Levee Removed While All Other Levees Remain Intact



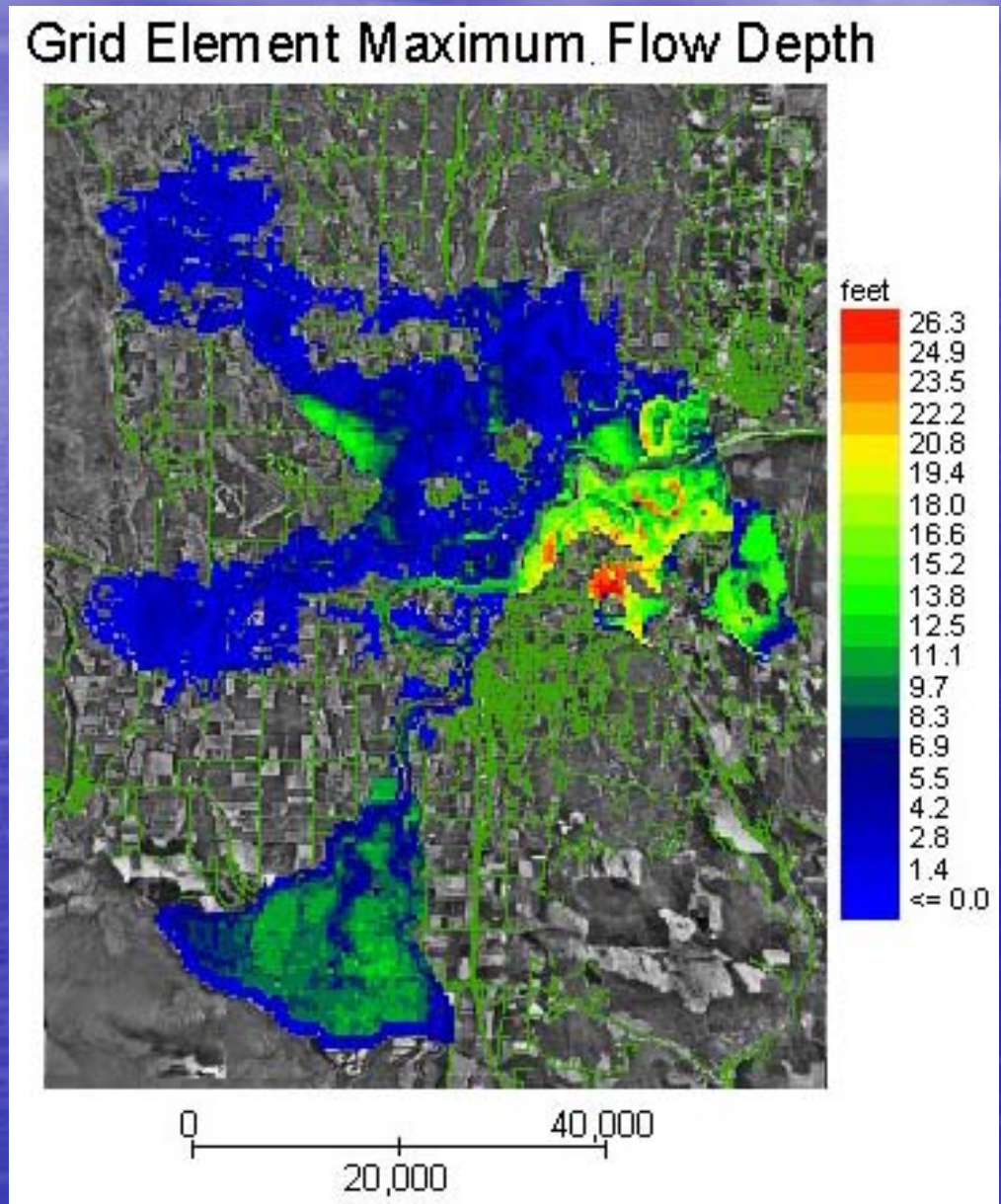
South Fork Skagit River Right Bank Levee Removed While All Other Levees Remain Intact



North Fork Skagit River Left Bank Levees Removed While All Other Levees Remain Intact

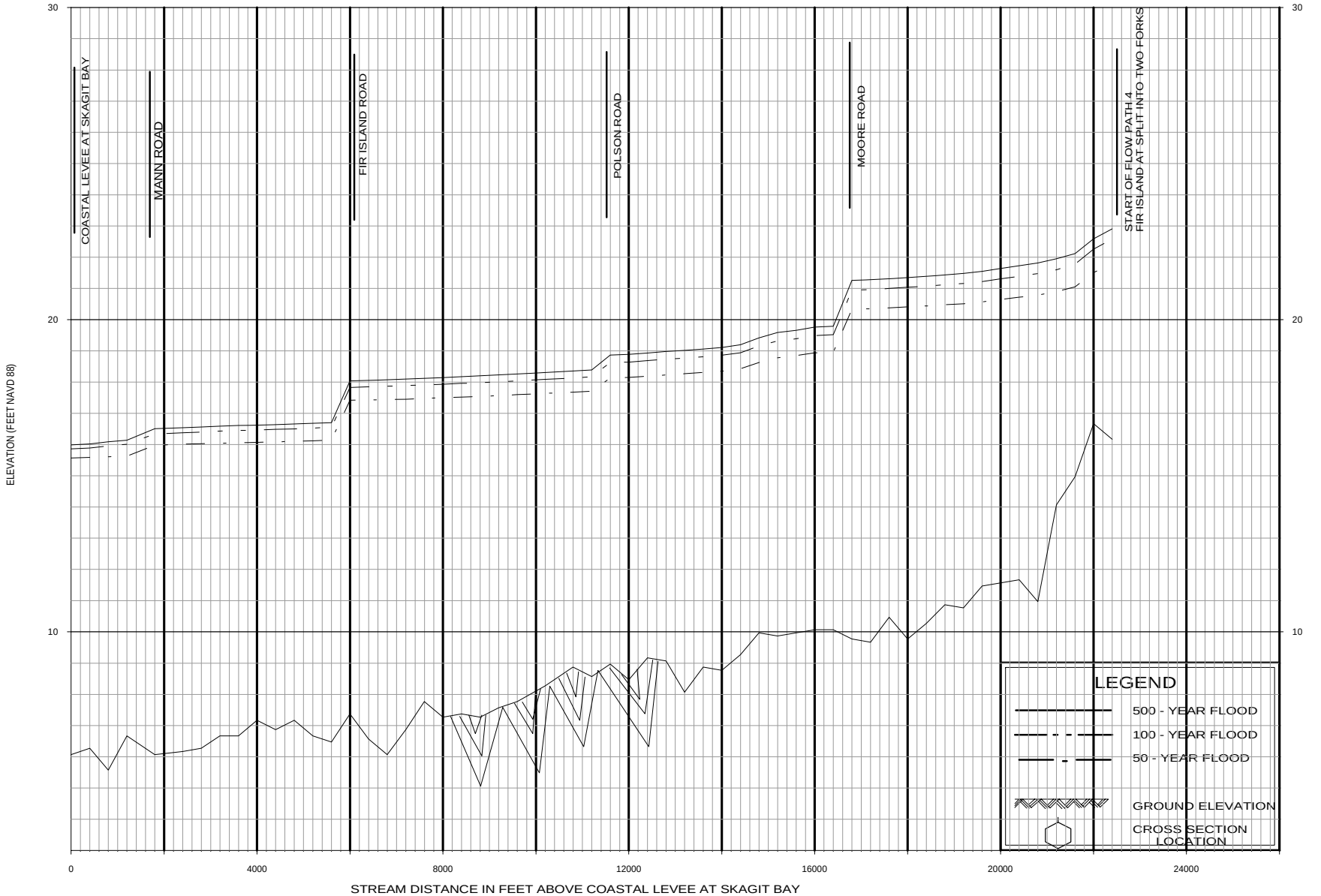


North Fork Skagit River Left Bank Levees Removed While All Other Levees Remain Intact



Fir Island Flowpath

Flowpath 4 Fir Island Area (Page 65)



FLOOD PROFILES

SKAGIT RIVER, OVERBANK FLOW PATH 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SKAGIT COUNTY, WA

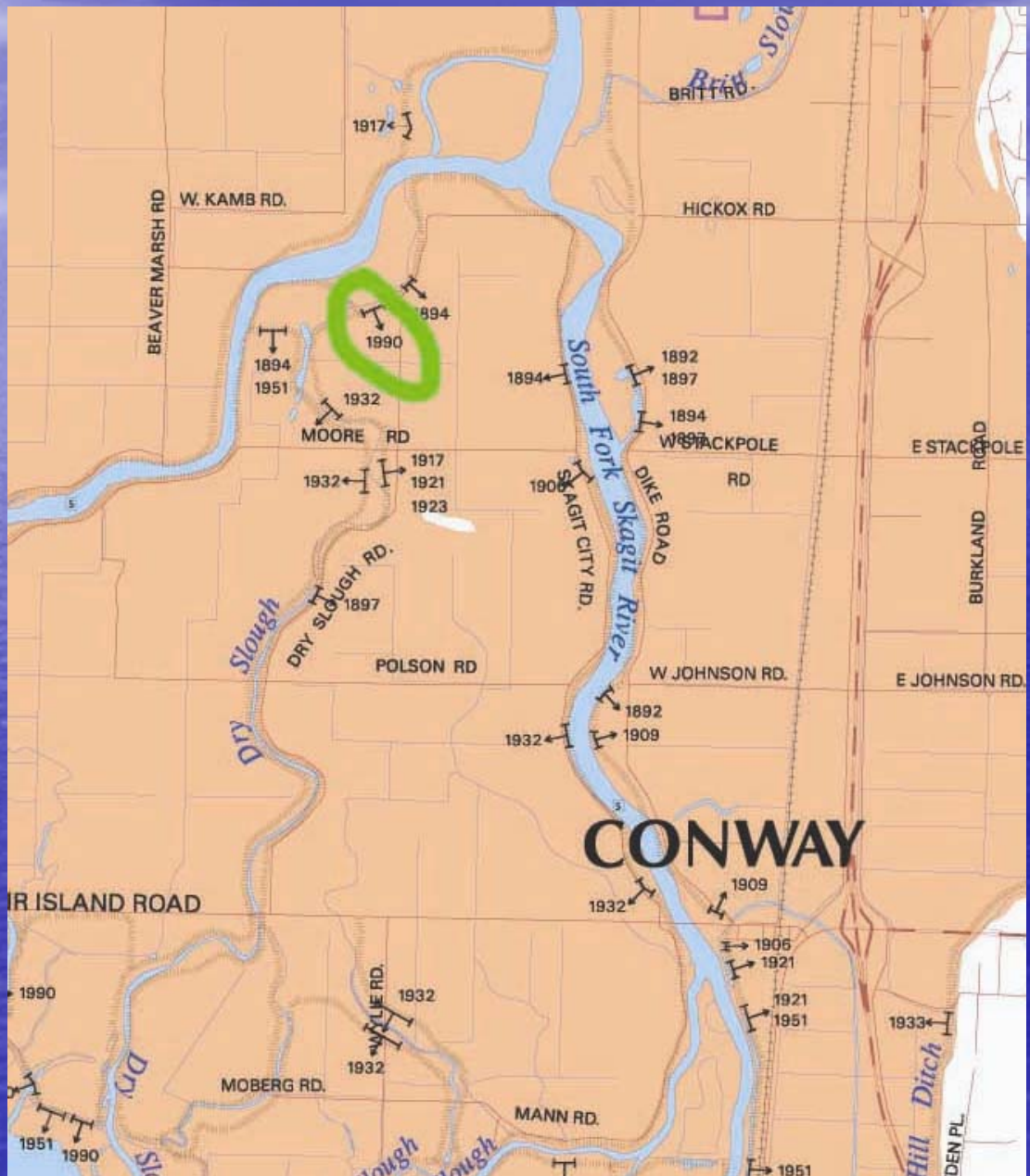
(AND UNINCORPORATED AREAS)

06P

Fir Island 1949 Flood

Fir Island 1990 Flood

Fir Island 1990 Flood



Newspaper Documentation
Fir Island

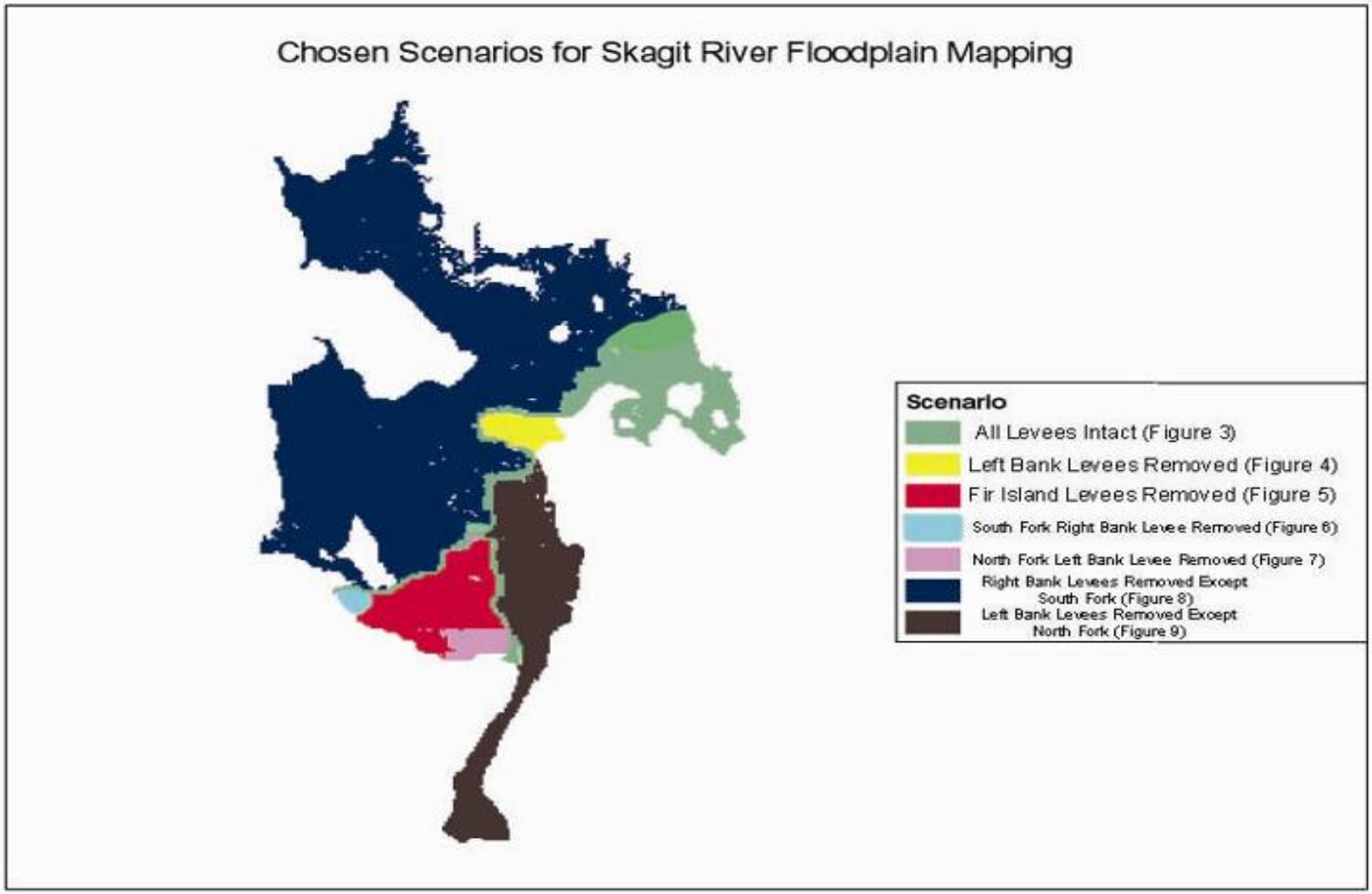
- Seattle Times 11/13/1990

"Workers have punched a hole in a dike to drain flooded Fir Island but water from the raging North Fork of the Skagit River is filling the island faster than the water can leave...Water is reportedly as deep as **10 feet**...That break sent a wall of water 10 feet high over fertile farm land...Waves were 8 to 10 feet high...He estimates he has 9 to 10 feet of water at his house."

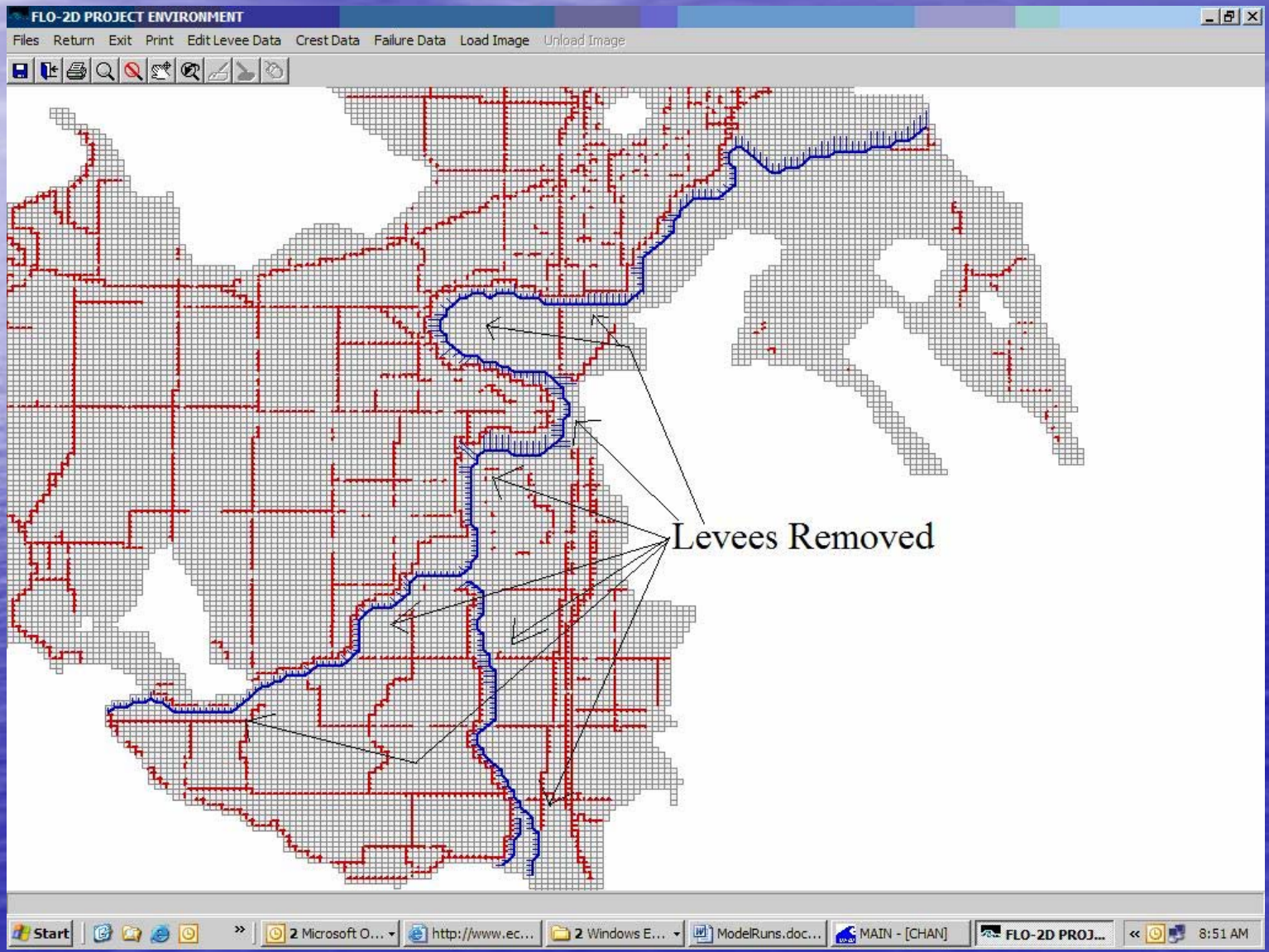
Concrete Flow = 149,000 cfs

Mount Vernon Flow = 142,000 cfs

Big Bend Area
Yellow Area



All Left Bank Levees Removed with Right Bank Levees Intact



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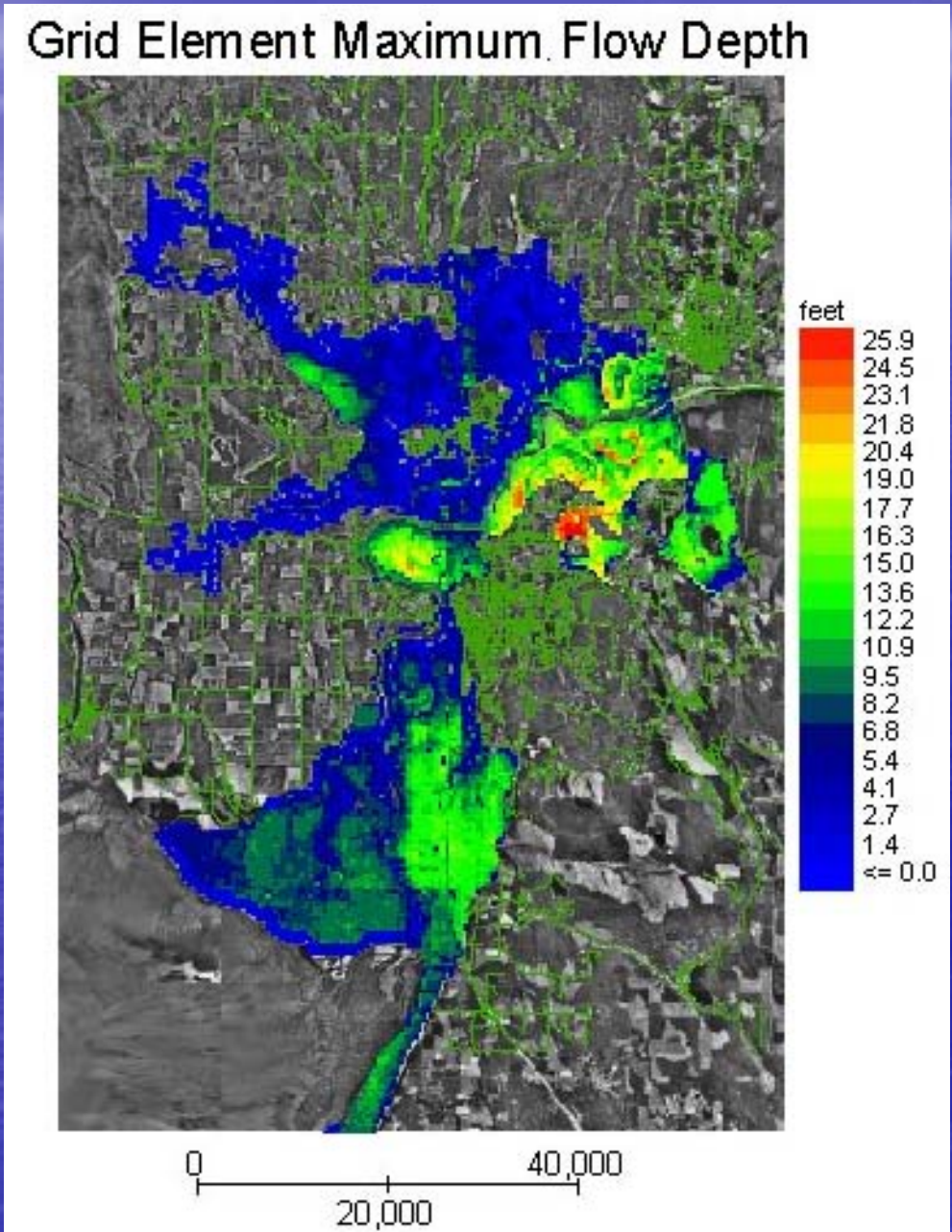
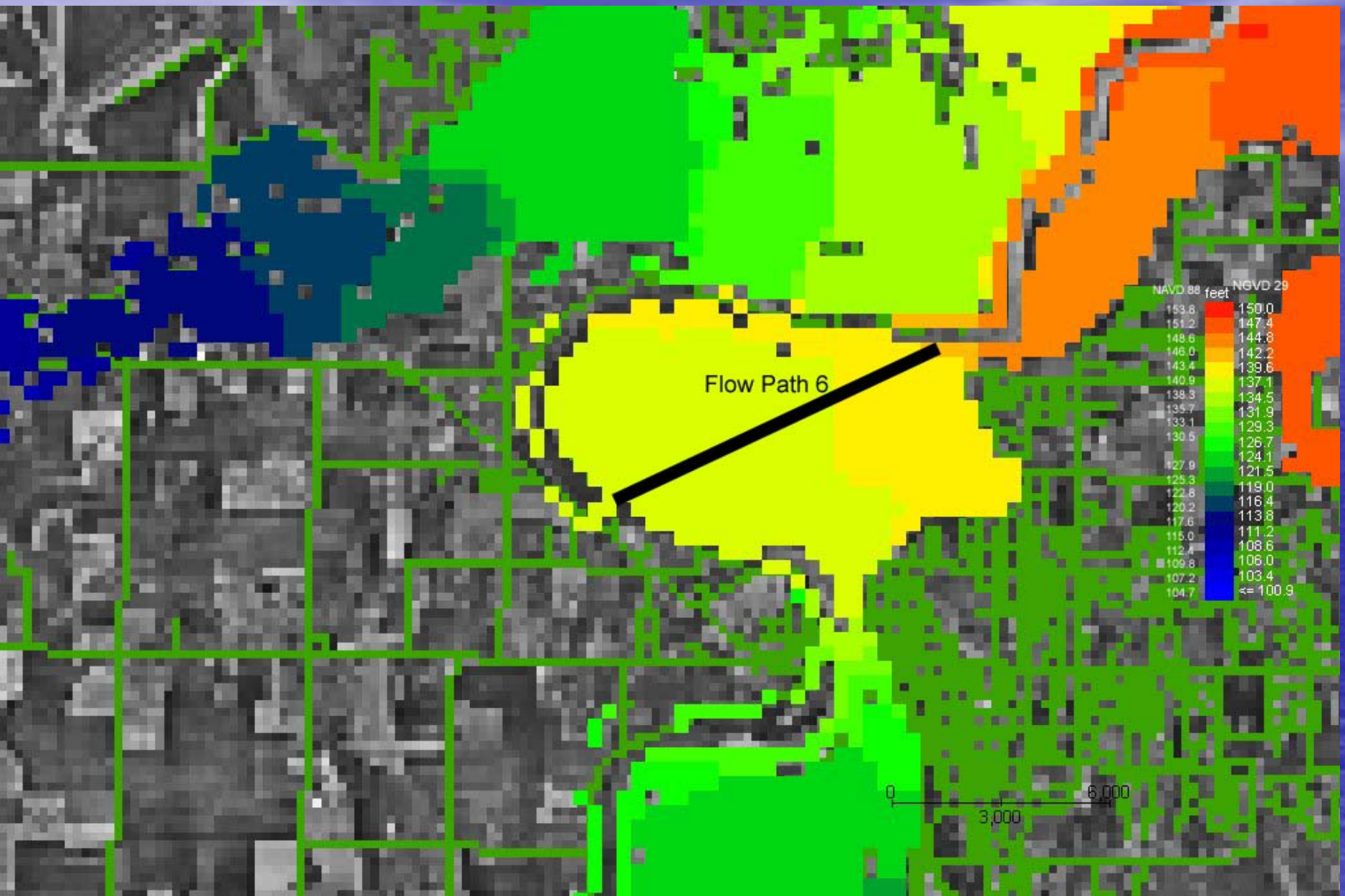
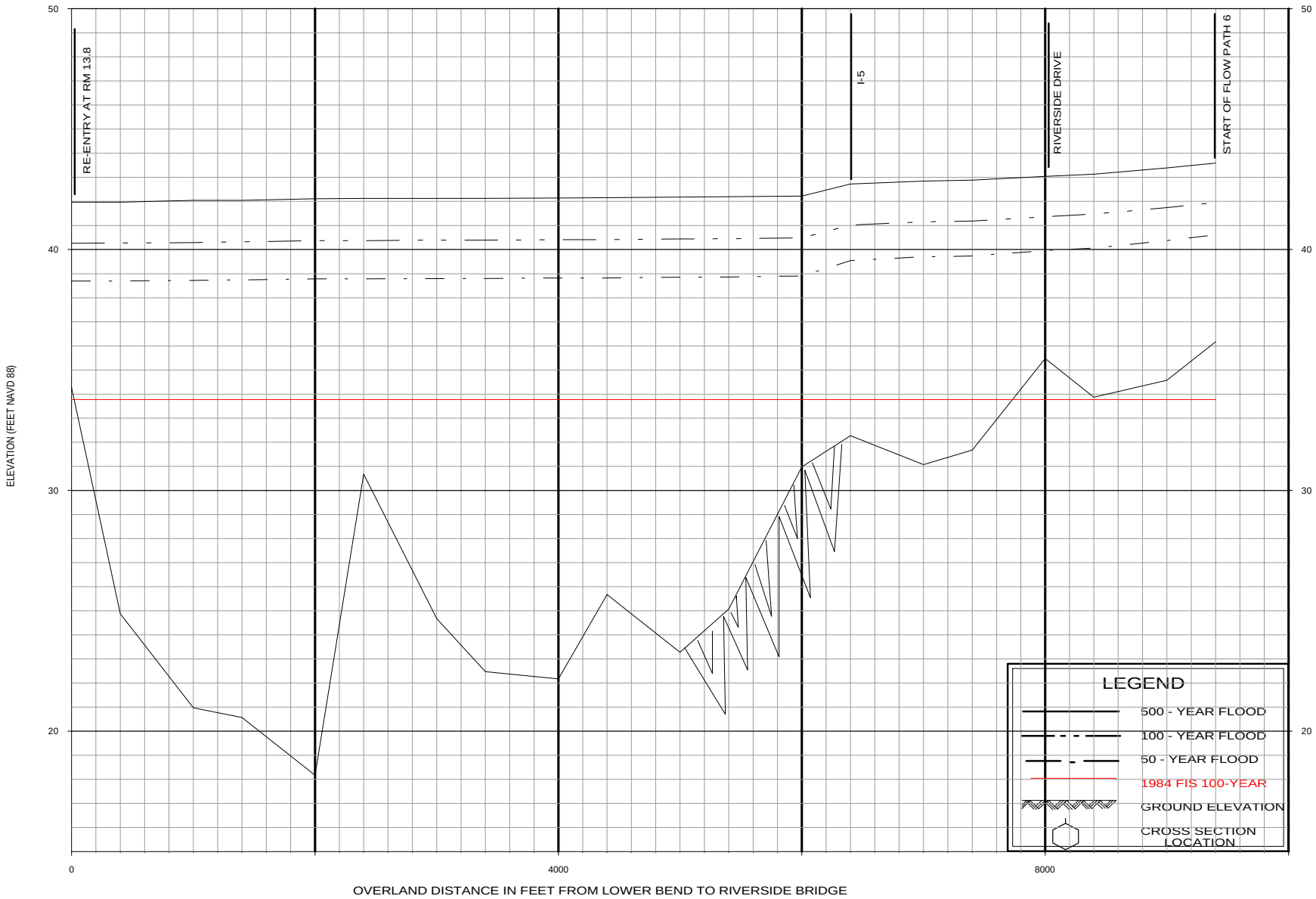


Big Bend Flow Path



Flow Path 6 – Big Bend



FLOOD PROFILES

SKAGIT RIVER, OVERBANK FLOW PATH 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

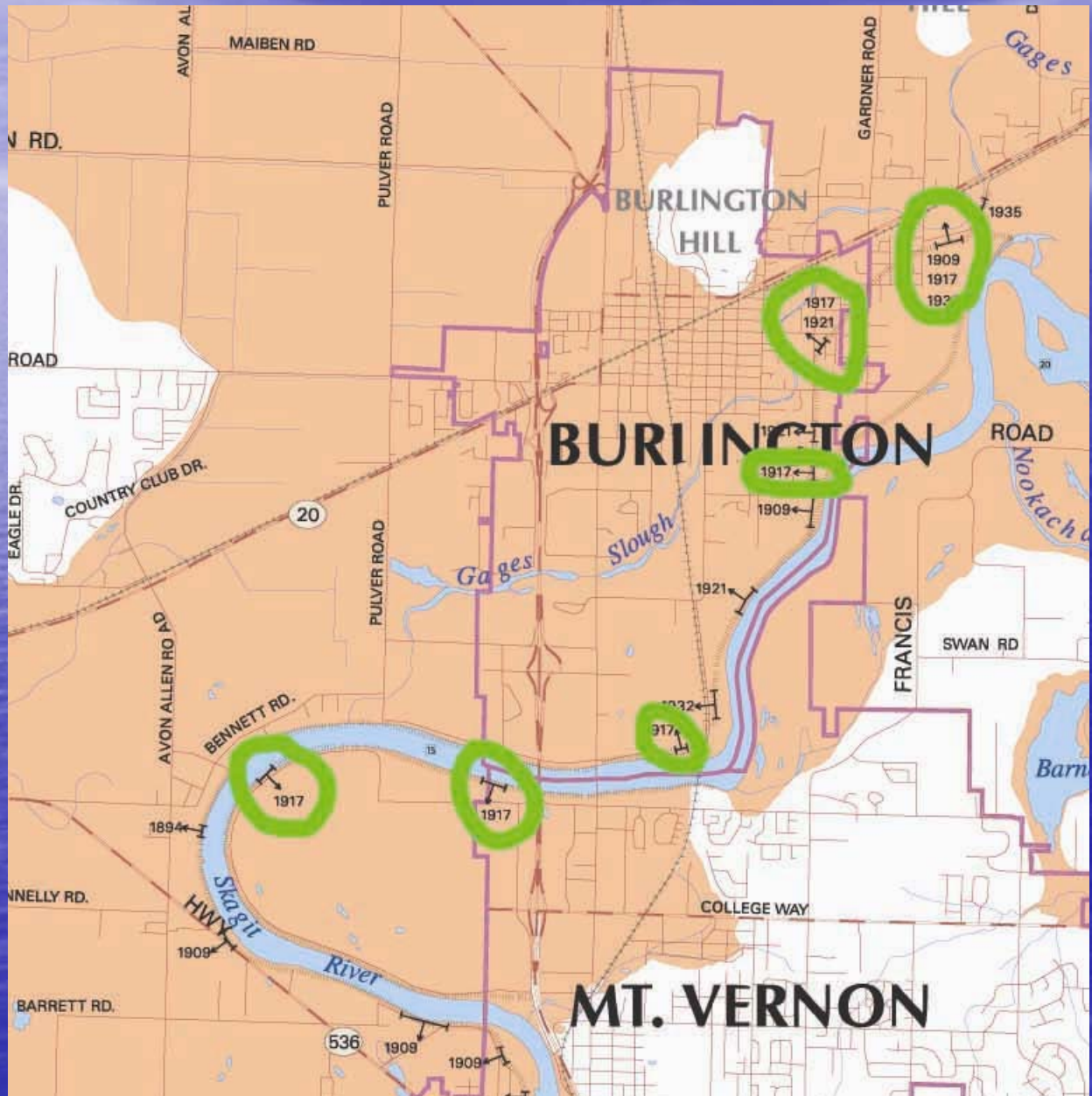
SKAGIT COUNTY, WA

(AND UNINCORPORATED AREAS)

17P

1917 Levee Failures

1917 Levee Failures



Newspaper Documentation
Big Bend – North Mount Vernon

- Burlington Journal 1/4/1918

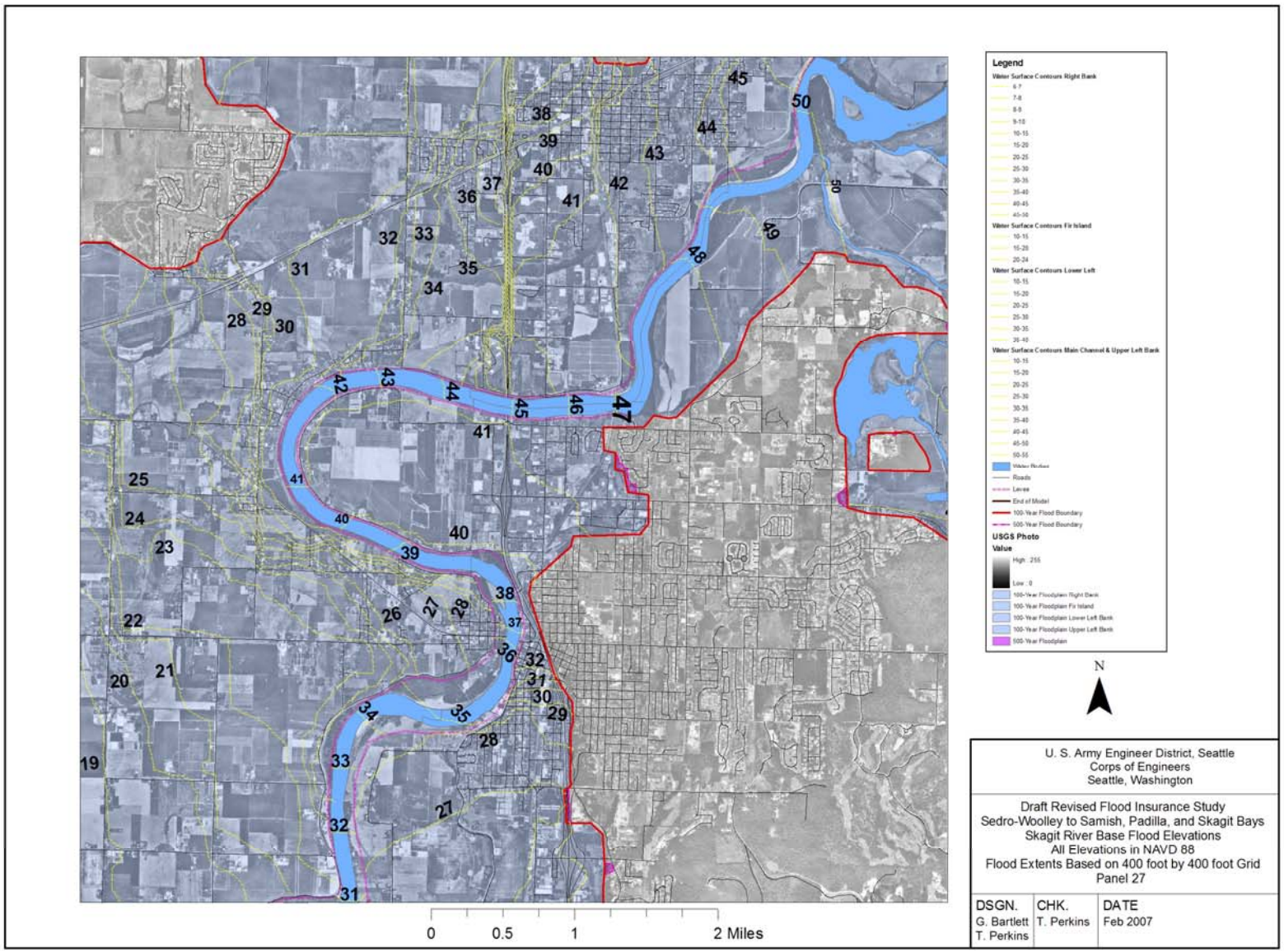
"The Riverside district south of the river on the Pacific highway to Mt. Vernon's limits suffered...The highway was under from **two to ten feet** of water..."

- Mount Vernon Herald 1/3/1918

"The Riverside section was badly hit, in some places as much as **fifteen feet** of water covered the ranch property."

Concrete Flow = 220,000 cfs

Base Flood Elevation Map



Questions/Comments/Concerns?