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Skagit River Hydrology

Performed by Bill Cronin and Loren Jangaard, USACE
Technically Reviewed by Ken Brettmann, USACE
Presented and Backchecked by Ted Perkins

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Skagit River Hydrology

- Definition and Objective
- Weather Patterns
- Streamflow Analysis
- Limits of Flood Control
- Questions

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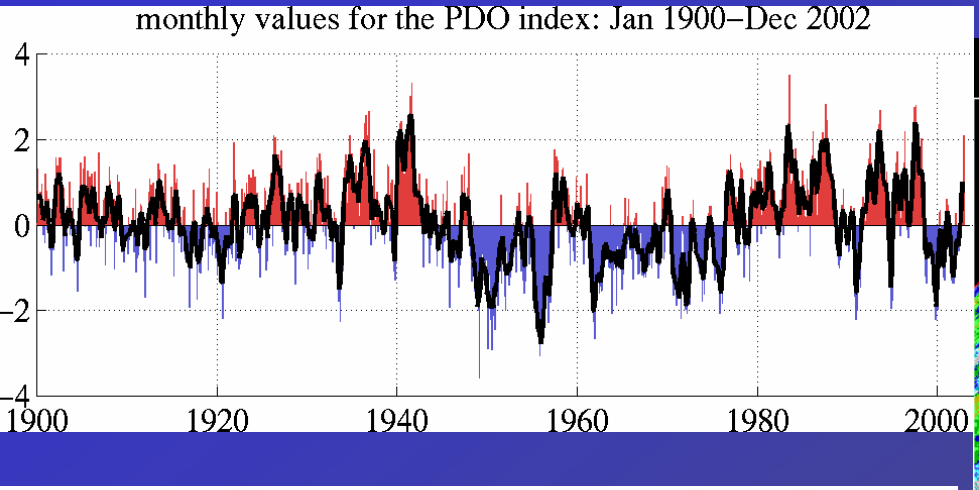
Skagit River Hydrology Definition and Objective

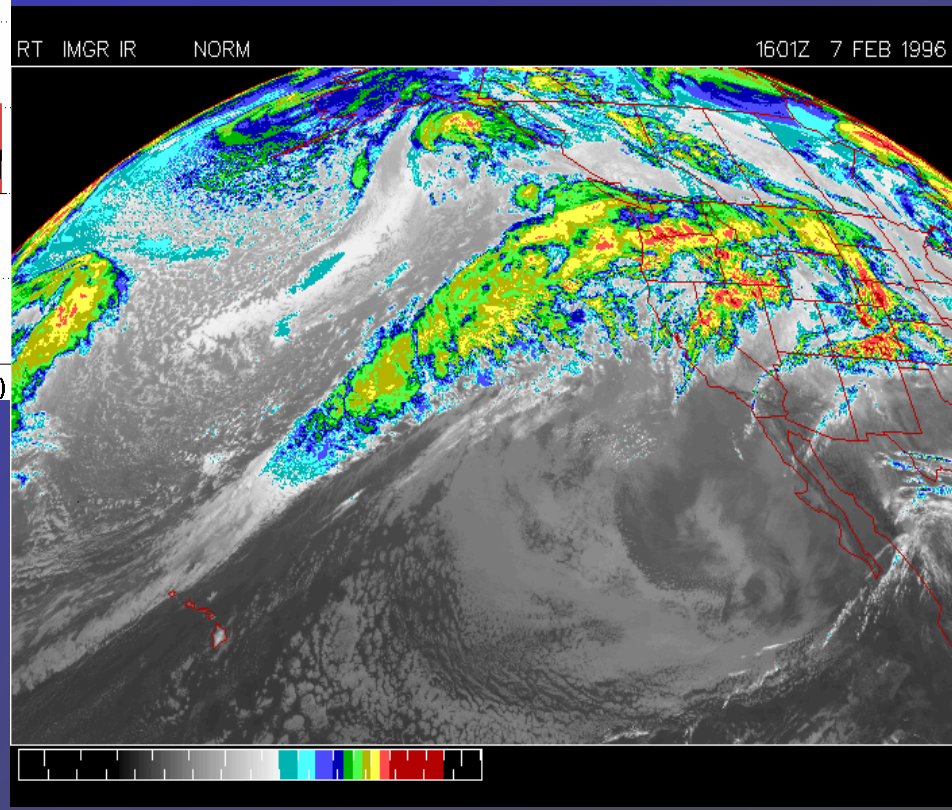
Cards	Chance of Occurrence	Recurrence	Flood Event
3 Clubs	1 in 52	1.9%	52-year
3 or 4 Clubs	1 in 26	3.8%	26-year

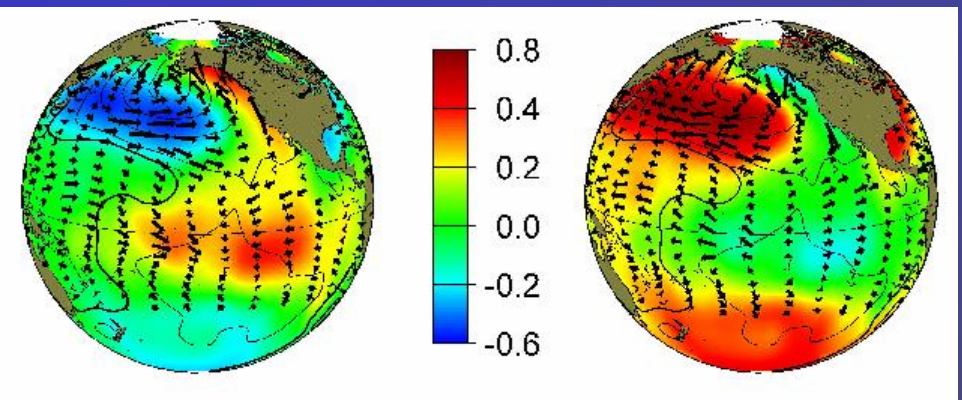
Flood Event	Recurrence	Chance of Occurrence
10-year	10%	1 in 10
100-year	1%	1 in 100
500-year	0.2%	1 in 500

How many cards are in the Hydrology deck?

Weather Patterns







- There are a lot of cards in the deck so need a long period of record

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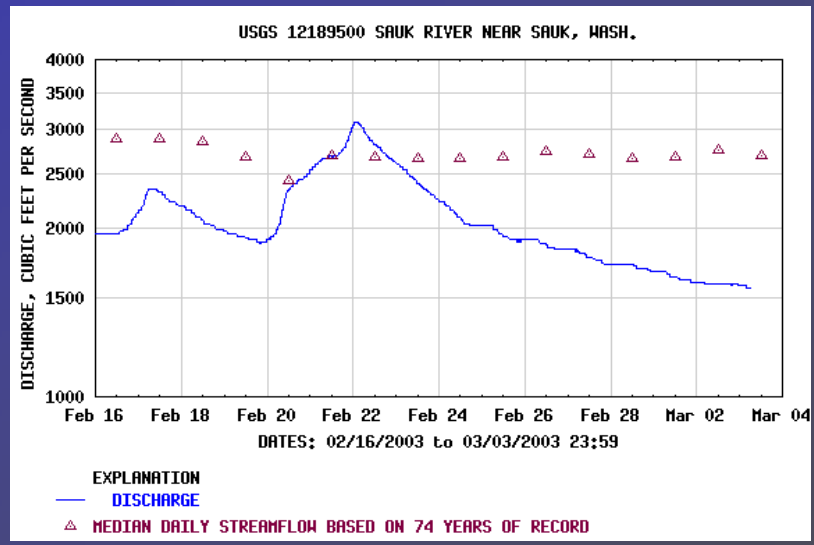
Hydrologic Record

- Long Period of Record
- Consistent human influence record
- Consistent natural influence record
- Location



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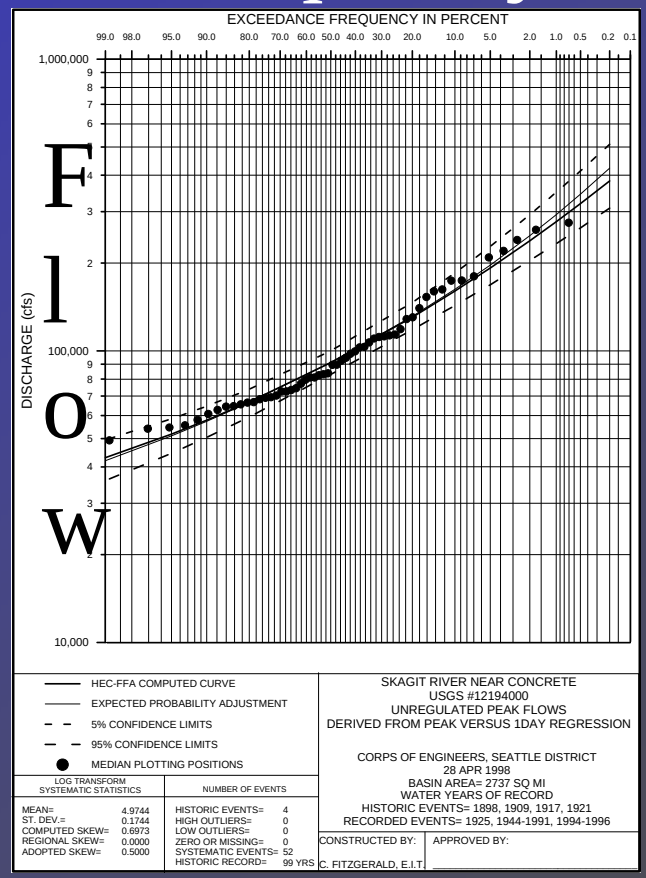
Frequency Analyses

- Rank Flood Events
- Plot Data
- Peak, 1-day, 3-day, 7-day



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Gage Assessment

Data Type	Mount Vernon	Sedro-Woolley	Concrete
Peak	1940-present	1896-7, 1906, 1908-22, 1975-9	1897, 1909, 1917, 1921, 1924-present
Daily	1940-present	1908-23, 1975-80	1924-present
Years	58	22, 16	78, 74
Problems	Changed Watershed, Dam Influence, Attenuation	Slightly Changed Watershed, Dam Influence, Attenuation	Dam Influence

- Concrete Gage Has the Longest Consistent Record
- All Gages are Used to Verify Results

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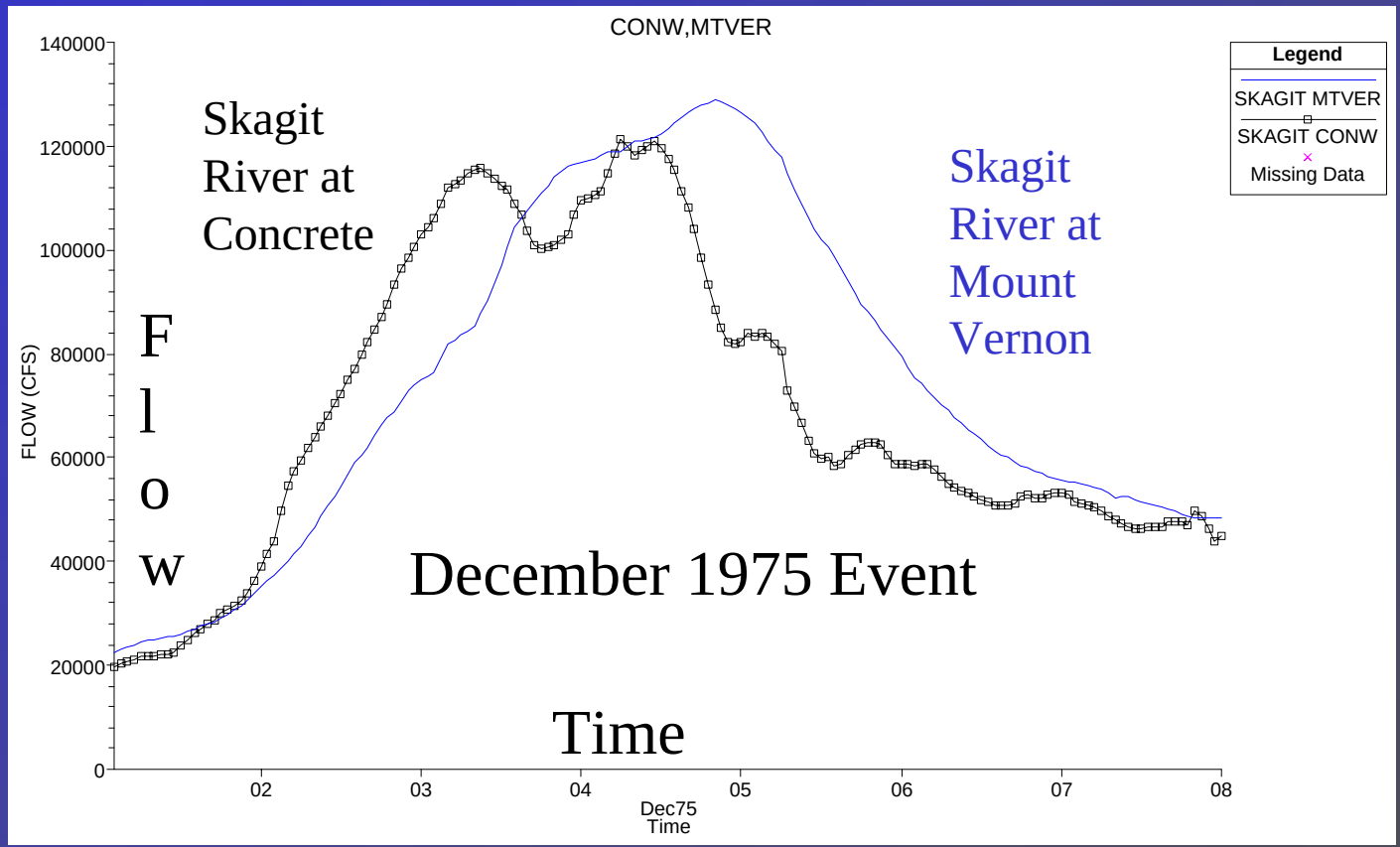
The Impact of Volume on Peaks



- The Volume of Water at Concrete is Accounted for Downstream
- Longer Duration Flood Creates Higher Peak Downstream

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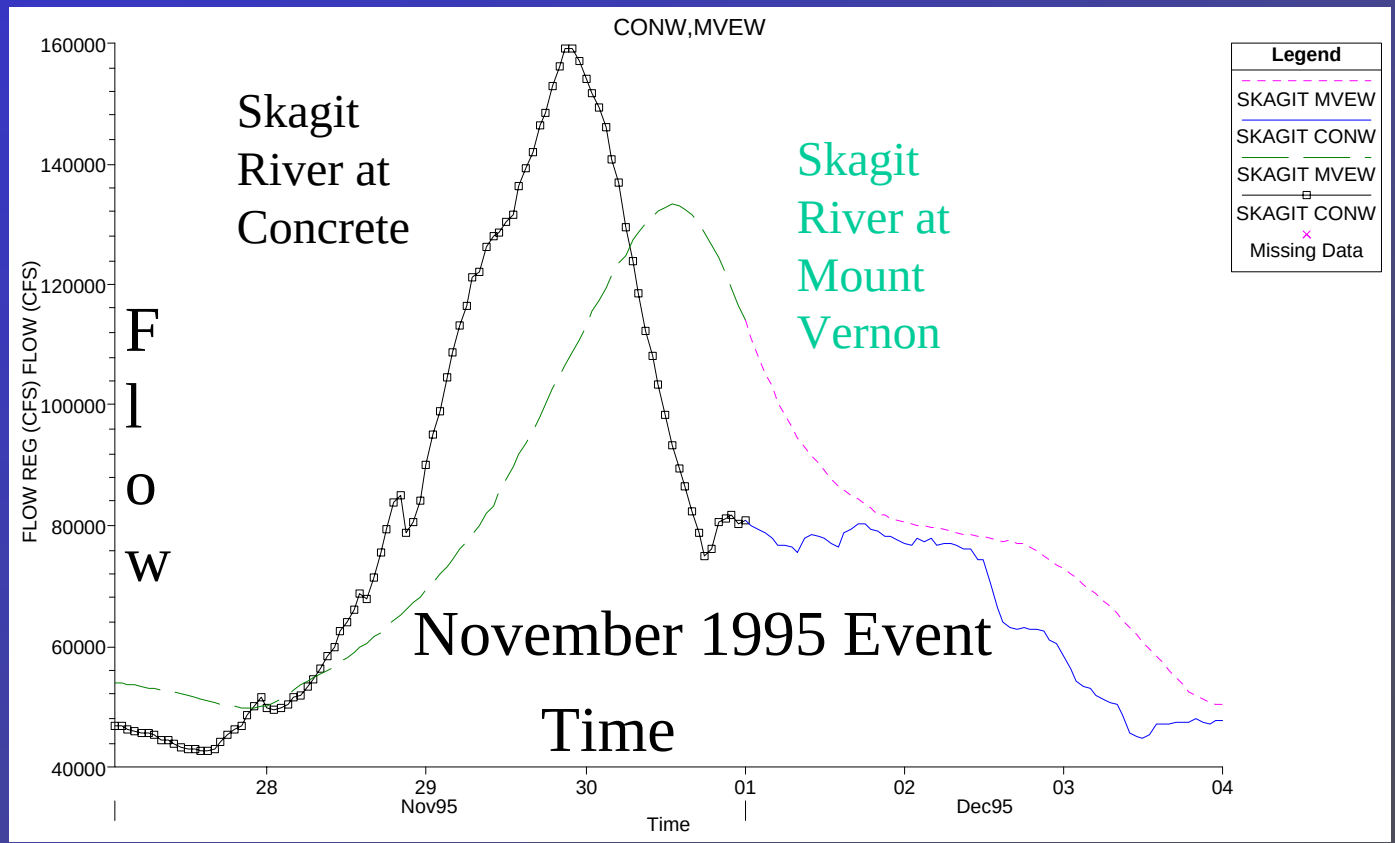
The Impact of Volume on Peaks



- The Volume of Water at Concrete is Accounted for Downstream
- Shorter Duration Flood Results in Lower Peak Downstream

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Influence of Dams

Year	Dam	Note
1924	Low Gorge	First Built
1954	Ross	Flood Storage
1956	Upper Baker	Flood Storage
1977	Upper Baker	Added Flood Storage

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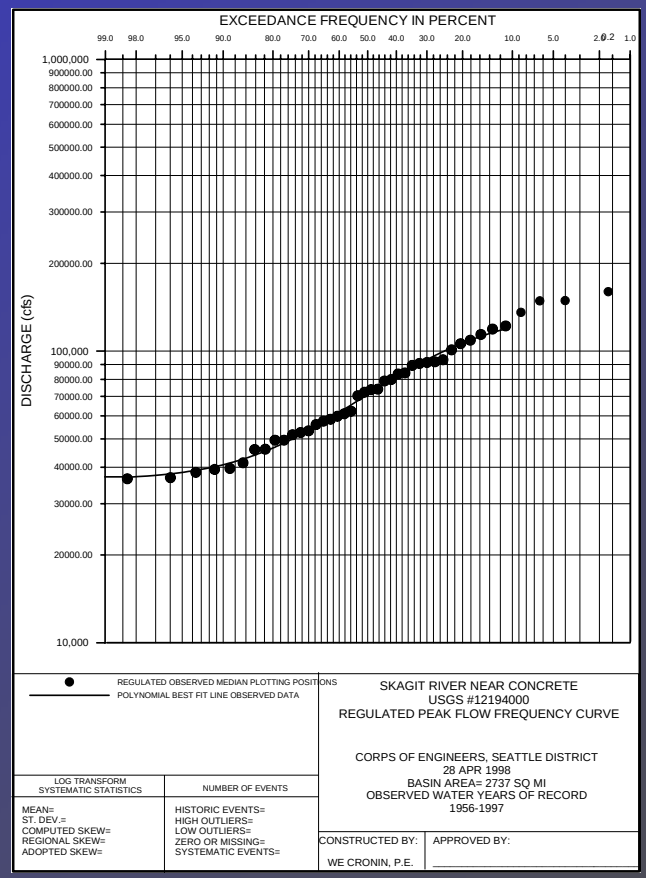
With Dams Frequency Curve

- Concrete Dam Influenced Data (1956-97)
- Control flow when expected to exceed 90,000 cfs at Concrete
- From 1956-77, only 2 events are regulated (11/20/62-114,000 cfs, 12/4/75 – 122,000 cfs)



40 year Record of Dam Controlled Peak Flows

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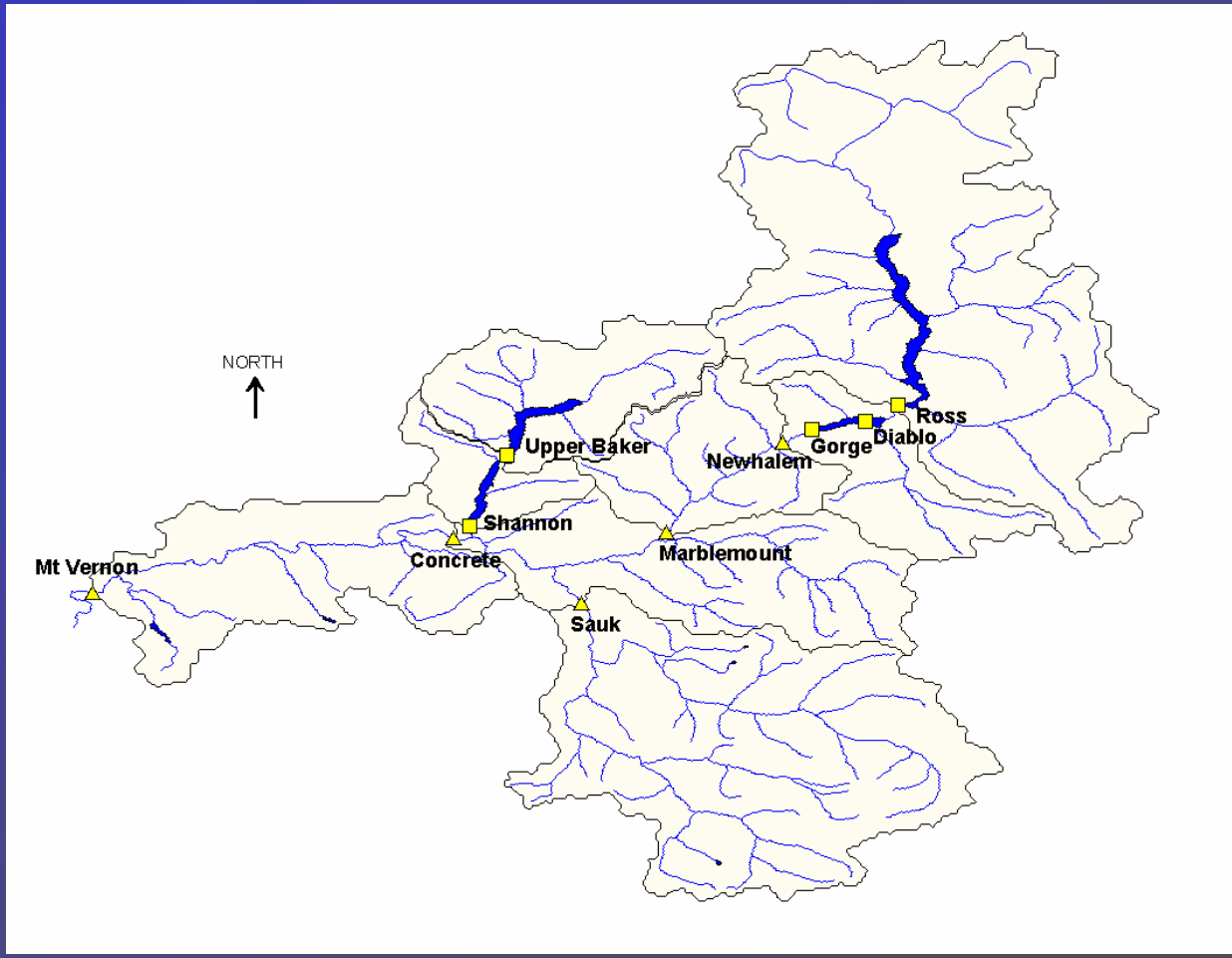
Determine Relationship between Pre-Dam and Post-Dam Flows

- Determine Dam Inflows
- Determine Local Flows Between Dams and Concrete
- Route to get Without Dam Flow at Concrete
- Perform Frequency Analysis



A Longer Period of Record is Developed for the Without Dam Condition

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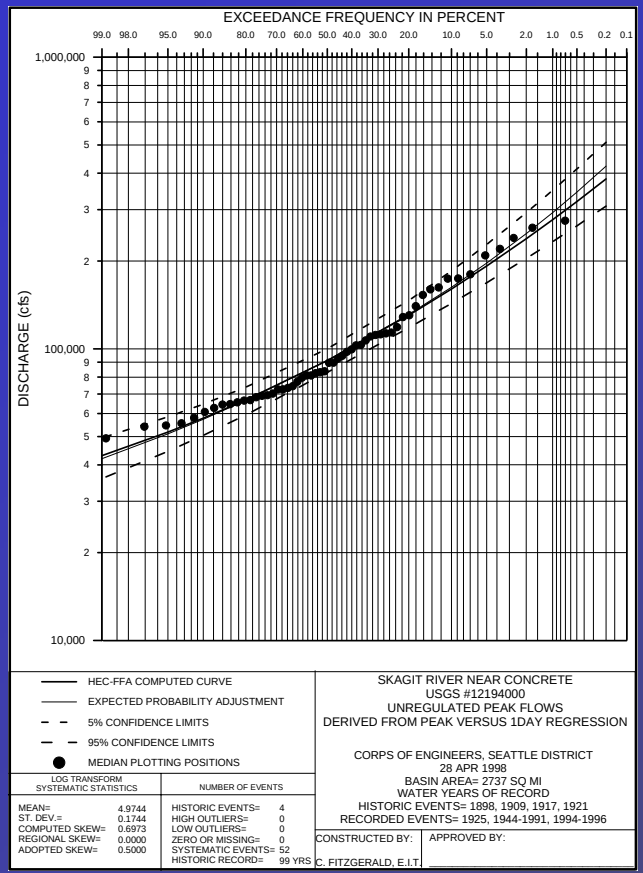
Without Dam Flows at Concrete



- Determine Upper Without Dam Frequency Events
- Correlate to Dam Inflows
- Set Up Reservoir Model to Current Conditions
- Route these inflows through dams, add in local to determine peaks at Concrete

We can route large hypothetical floods through dams

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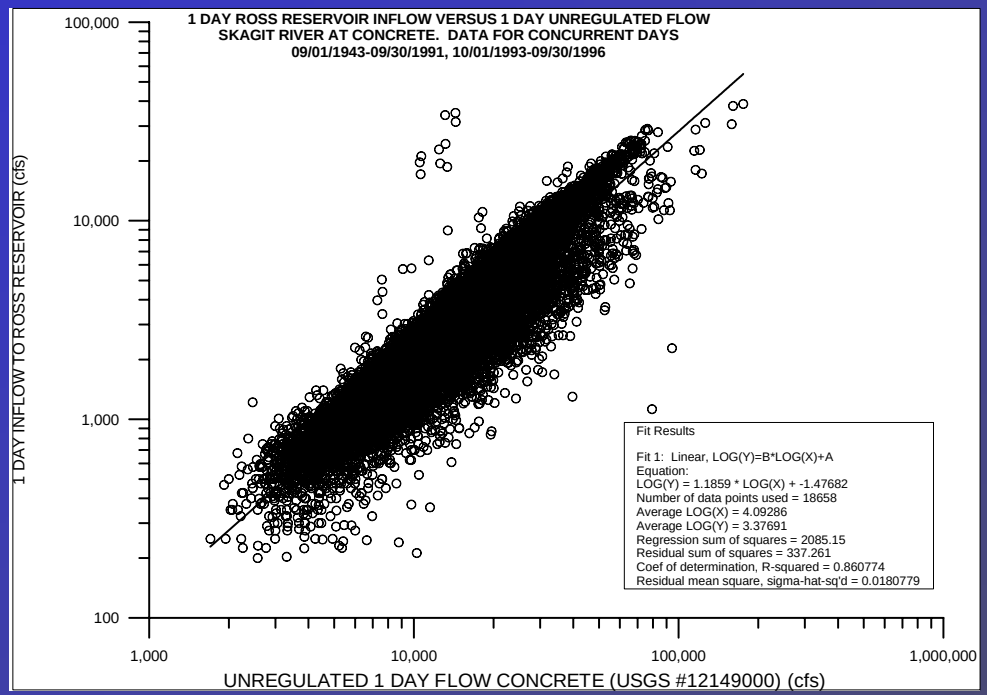
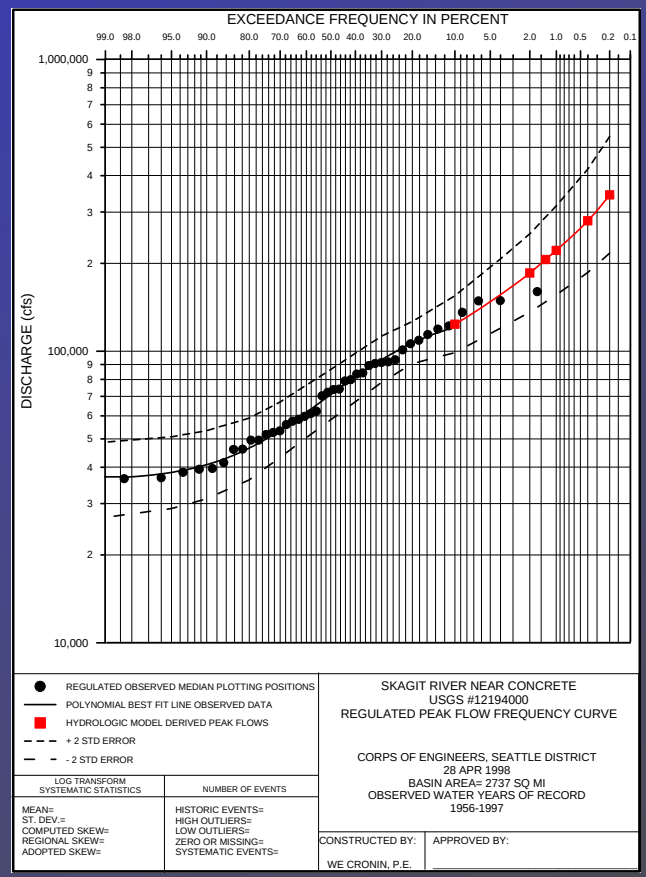
Development of Regulated Frequency Curves

- Add Routed Peaks to Regulated Frequency Curve





A Longer With Dam Record is Developed

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Skagit River at Concrete Peak Flows

Recurrence	Instantaneous Peak (cfs)	1-day Peak (cfs)	3-day Peak (cfs)
10-year	124,000	116,000	97,000
25-year	150,000	138,000	107,000
50-year	185,000	170,000	132,000
100-year	222,000	204,000	159,000
500-year	344,000	319,000	250,000

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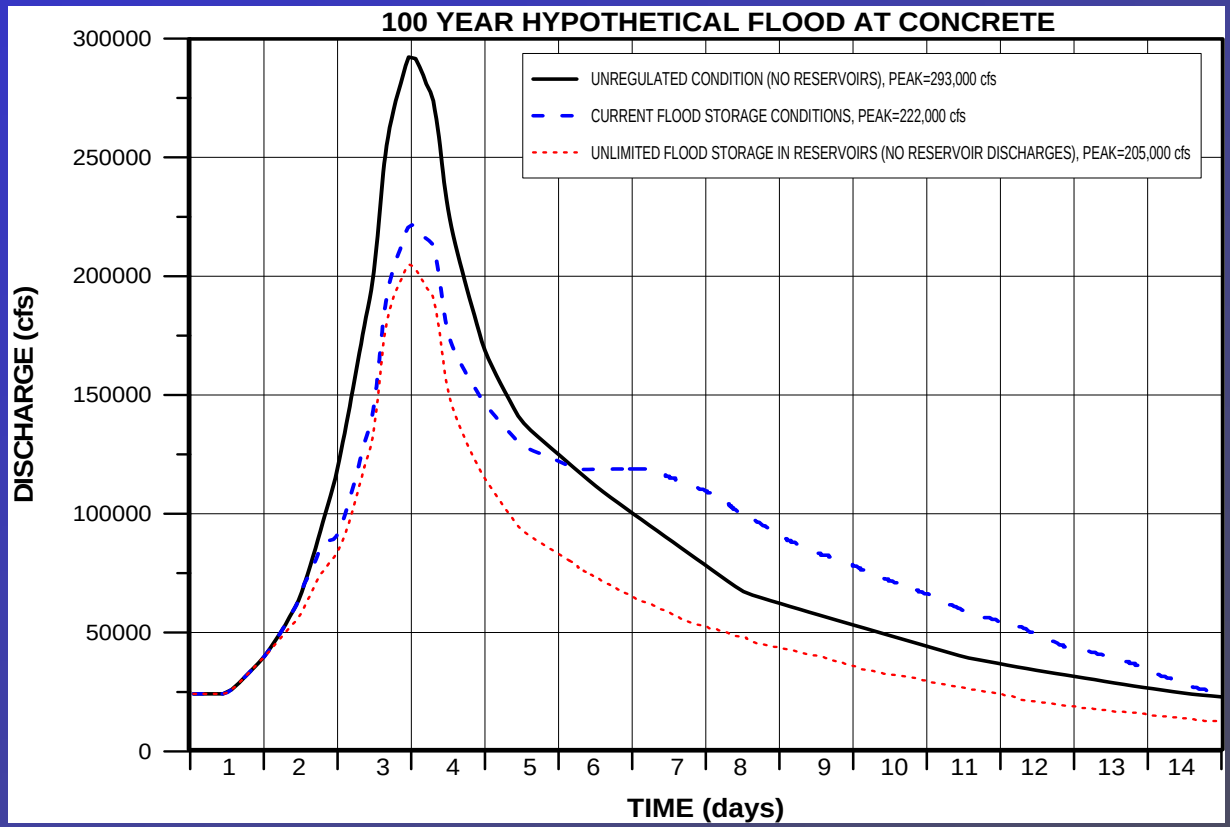
Hypothetical Hydrographs



Perform Frequency Analyses on Tributary Flows (i.e. Finney, Nookachamps) to add in flow to hydraulic model

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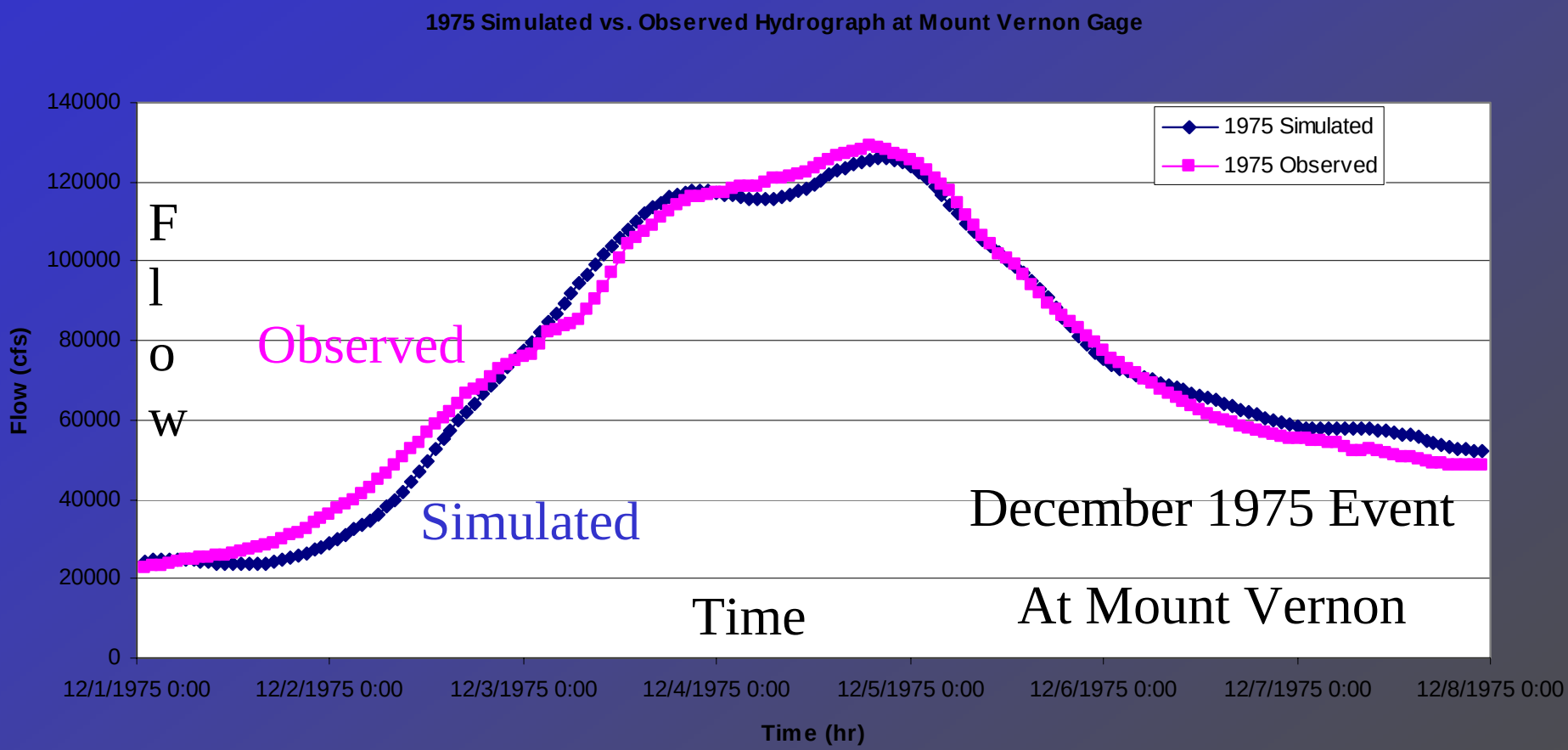
Route Flows Using Hydraulic Model



Hydraulic Model is Calibrated to Downstream Gage Data

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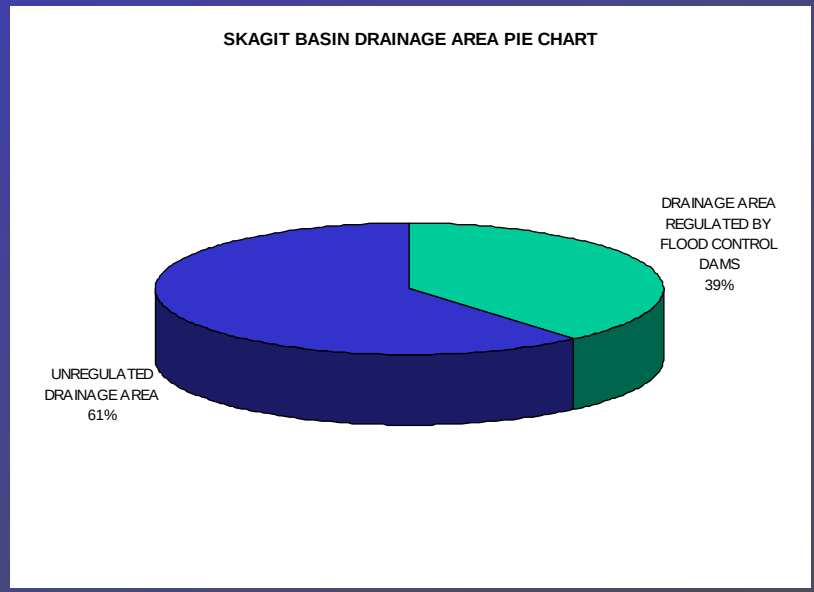
Limits of Flood Control

Location	Drainage Area (mi^2)	% of Mount Vernon
Mount Vernon	3,093	
Above Upper Baker and Ross Dams	1,214	39%
Below Dams	1,879	61%



61% of Flow is Uncontrolled

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