Corps of Engineers Historic Discharge Position Summary

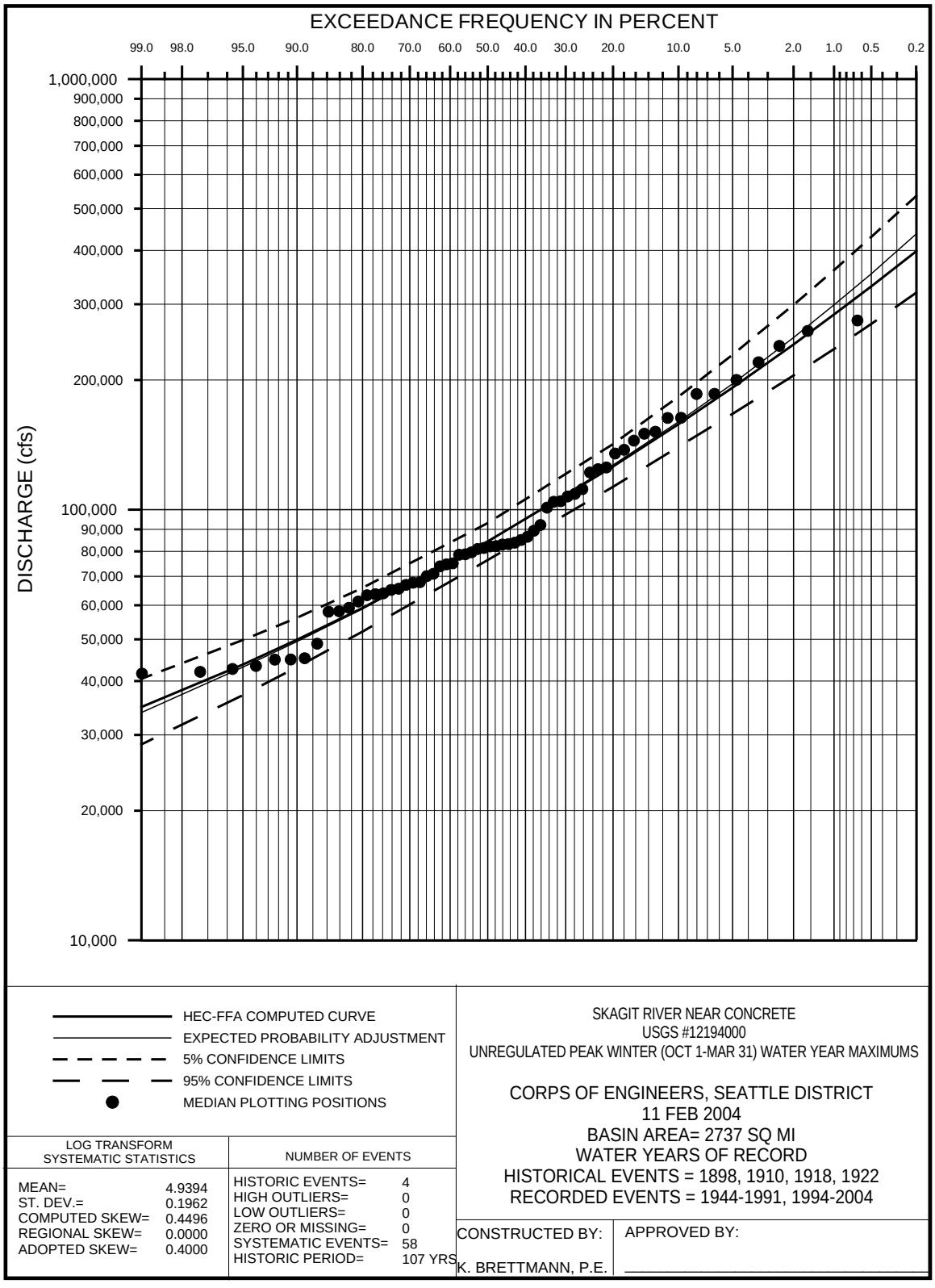
The current Skagit River flood frequency analysis (see unregulated and regulated flood frequency curves below) is the culmination of decades of study by Seattle District. The controversy over the four historic floods is not new. In the Corps' 1952 Report of Survey for Flood Control of Skagit River and Tributaries, it is noted that there has been much discussion about the accuracy of those discharge estimates and it was decided to omit them from the flood frequency analysis. That judgment changed after the USGS published WSP 1527 (Stewart and Bodhaine, 1961) that established Stewart's 1923 flood discharges as part of the agency records. The Corps' next Skagit River investigation in 1964 included the historic flood peaks in the frequency analysis, as did the Corps studies in 1967, 1979, 1993, and 2004. Two recent USGS field studies (USGS, 2005 and 2007) have resulted in about a five percent reduction in the historic peaks and the Corps has adjusted our data accordingly.

The Corps relies on the USGS for the collection and reporting of hydrologic data that we use in our flood frequency analysis. The USGS maintains a network of streamflow gaging stations in the Skagit River basin that provide a systematic record of river discharges. However, even the longest Skagit streamflow record provides only a minimally acceptable data set to estimate the magnitude of rare floods, 50-year or larger. To improve the reliability of our flood frequency analysis on the Skagit River, the Corps has included the historic flood peaks as recommended in Bulletin #17B as a means of extending the hydrologic record. In the case of the Skagit River, the historic data not only expands the data set, but it also provides important information on magnitude of the flood risk.

The City of Burlington has stated that the accepted discharges of the historic floods are statistically extremely unlikely. Statistically, this would be all the more reason to include them, as we are defining the magnitude of the expected extreme events. However, we are not just dealing with statistics; we are dealing with a large river and the weather systems that drive its flood peaks. This means we have climate cycles, such as the Pacific Decadal Osolation, El Nino, and climate change, which influence our flood events. Other rivers in the Pacific Northwest also experienced floods of record during the same time period as the historic Skagit River floods. This is demonstrated by the following flood peak plots for the Skagit, Columbia, and Willamette rivers. Flow regulation influences the Columbia River record after the 1930's and the Willamette River after 1952; although full flow regulation did not become effective on either river until after the 1960s. The occurrence of large floods on other northwest rivers during the historic flood time period suggests that there may be long term trends in climate cycles that affect floods, but resolving the potential impacts of climate cycles on hydrologic analysis is beyond the scope of this study.

TABLE 22 – COMPUTED PEAK FLOWS AT CONCRETE AND SEDRO-WOOLLEY GAGES

Recurrence	Unregulated Concrete	Regulated Concrete	Unregulated Sedro-Woolley	Regulated Sedro-Woolley
10-year	159000	116300	156920	123610
50-year	241000	180260	233290	183780
100-year	278000	209490	272220	215270
500-year	373000	316530	371670	322900



HEC-FFA COMPUTED CURVE
EXPECTED PROBABILITY ADJUSTMENT
5% CONFIDENCE LIMITS
95% CONFIDENCE LIMITS
MEDIAN PLOTTING POSITIONS

SKAGIT RIVER NEAR CONCRETE
USGS #12194000
UNREGULATED PEAK WINTER (OCT 1-MAR 31) WATER YEAR MAXIMUMS

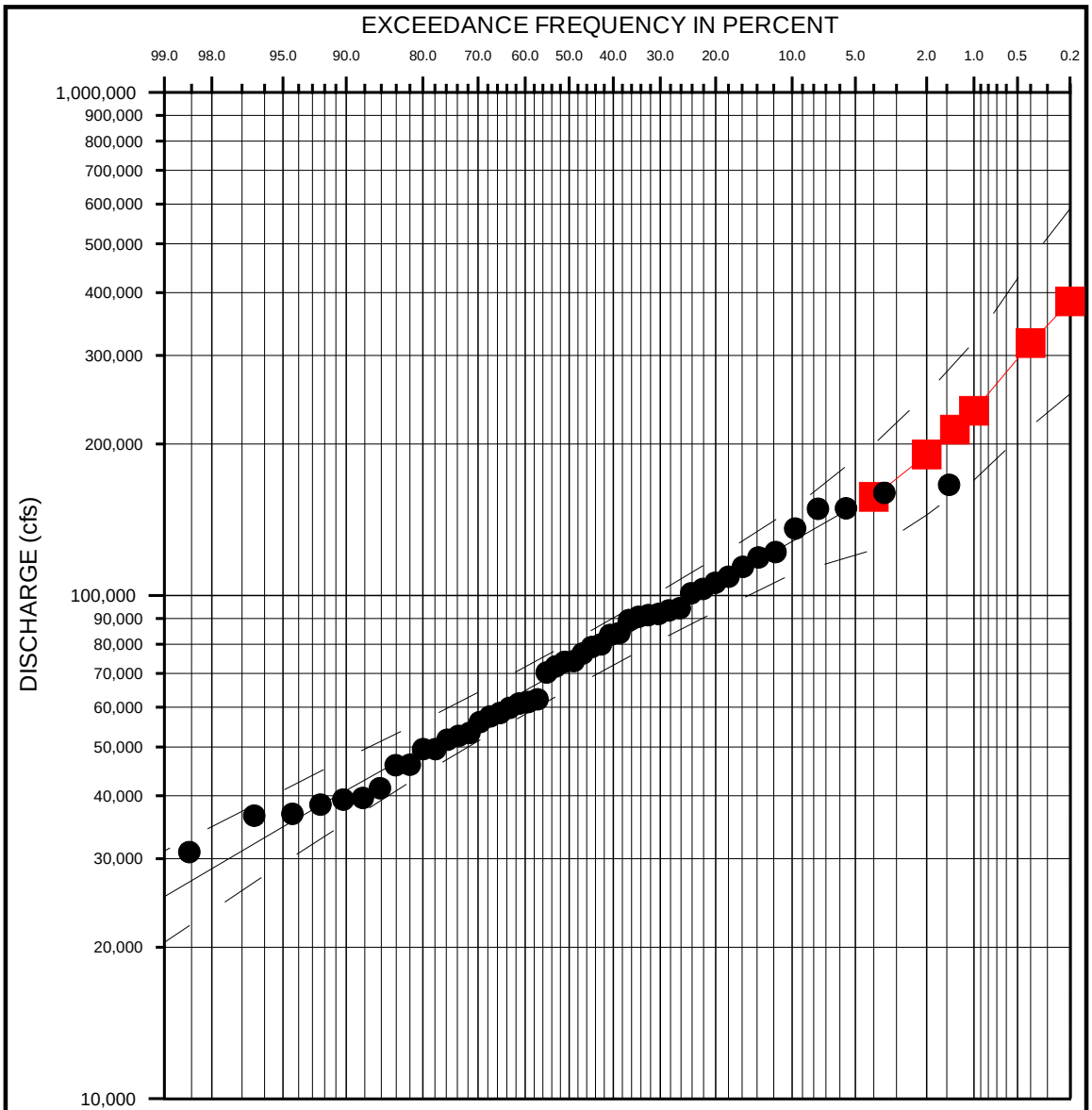
CORPS OF ENGINEERS, SEATTLE DISTRICT
11 FEB 2004
BASIN AREA= 2737 SQ MI
WATER YEARS OF RECORD
HISTORICAL EVENTS = 1898, 1910, 1918, 1922
RECORDED EVENTS = 1944-1991, 1994-2004

LOG TRANSFORM SYSTEMATIC STATISTICS	
MEAN=	4.9394
ST. DEV.=	0.1962
COMPUTED SKEW=	0.4496
REGIONAL SKEW=	0.0000
ADOPTED SKEW=	0.4000

NUMBER OF EVENTS	
HISTORIC EVENTS=	4
HIGH OUTLIERS=	0
LOW OUTLIERS=	0
ZERO OR MISSING=	0
SYSTEMATIC EVENTS=	58
HISTORIC PERIOD=	107 YRS

CONSTRUCTED BY: K. BRETTMANN, P.E.

APPROVED BY: _____



Simulated Regulated Peak Flows
Regulated Frequency Curve From Data
Observed Regulated Events
5% Confidence Band
95% Confidence Band

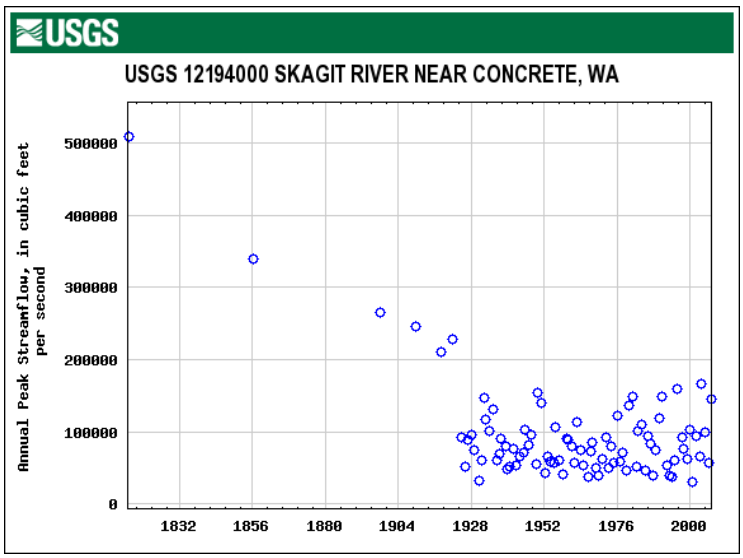
SKAGIT RIVER NEAR CONCRETE
USGS #12194000
REGULATED PEAK ANNUAL WATER YEAR MAXIMUMS

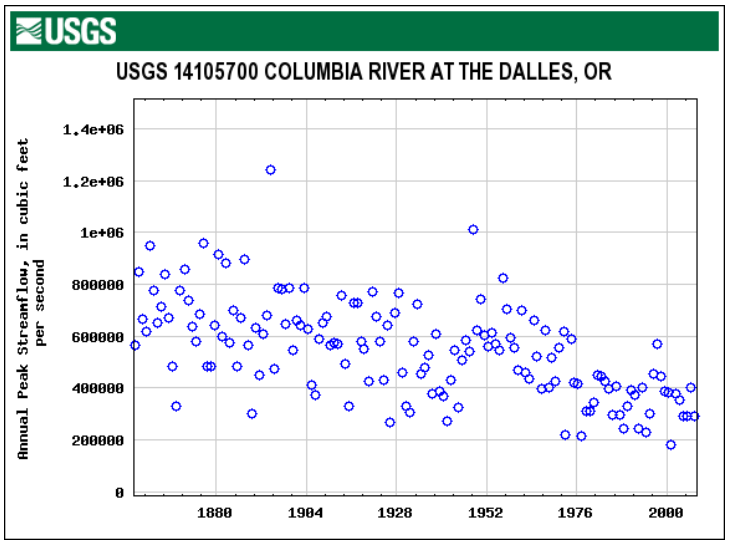
CORPS OF ENGINEERS, SEATTLE DISTRICT
03 MAR 2004
BASIN AREA= 2737 SQ MI
WATER YEARS OF RECORD SINCE 1956
RECORDED EVENTS = 1956-2002, 2004 (Water Years)

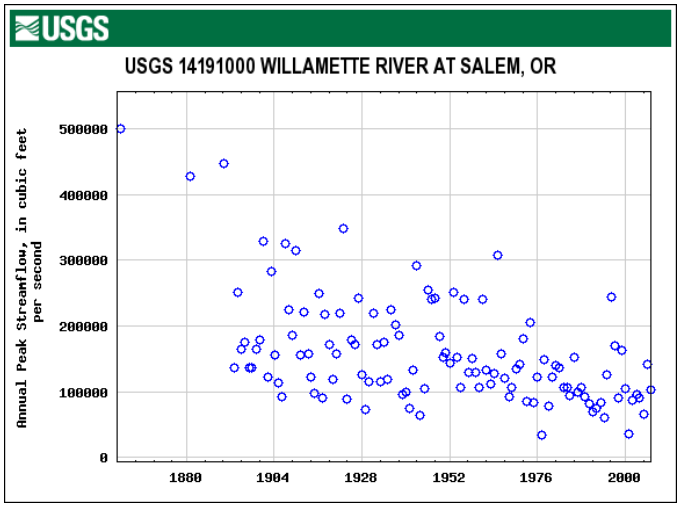
LOG TRANSFORM SYSTEMATIC STATISTICS	NUMBER OF EVENTS
MEAN=	HISTORIC EVENTS=
ST. DEV.=	HIGH OUTLIERS=
COMPUTED SKEW=	LOW OUTLIERS=
REGIONAL SKEW=	ZERO OR MISSING=
ADOPTED SKEW=	SYSTEMATIC EVENTS= 48
	HISTORIC PERIOD= 107

CONSTRUCTED BY:
Ted Perkins

APPROVED BY:


USGS
USGS 12194000 SKAGIT RIVER NEAR CONCRETE, WA
Annual Peak Streamflow, in cubic feet per second
500000
400000
300000
200000
100000
0
1832
1856
1880
1904
1928
1952
1976
2000


USGS
USGS 14105700 COLUMBIA RIVER AT THE DALLES, OR
Annual Peak Streamflow, in cubic feet per second
1.4e+06
1.2e+06
1e+06
800000
600000
400000
200000
0
1880
1904
1928
1952
1976
2000


USGS
USGS 14191000 WILLAMETTE RIVER AT SALEM, OR
Annual Peak Streamflow, in cubic feet per second
500000
400000
300000
200000
100000
0
1880
1904
1928
1952
1976
2000