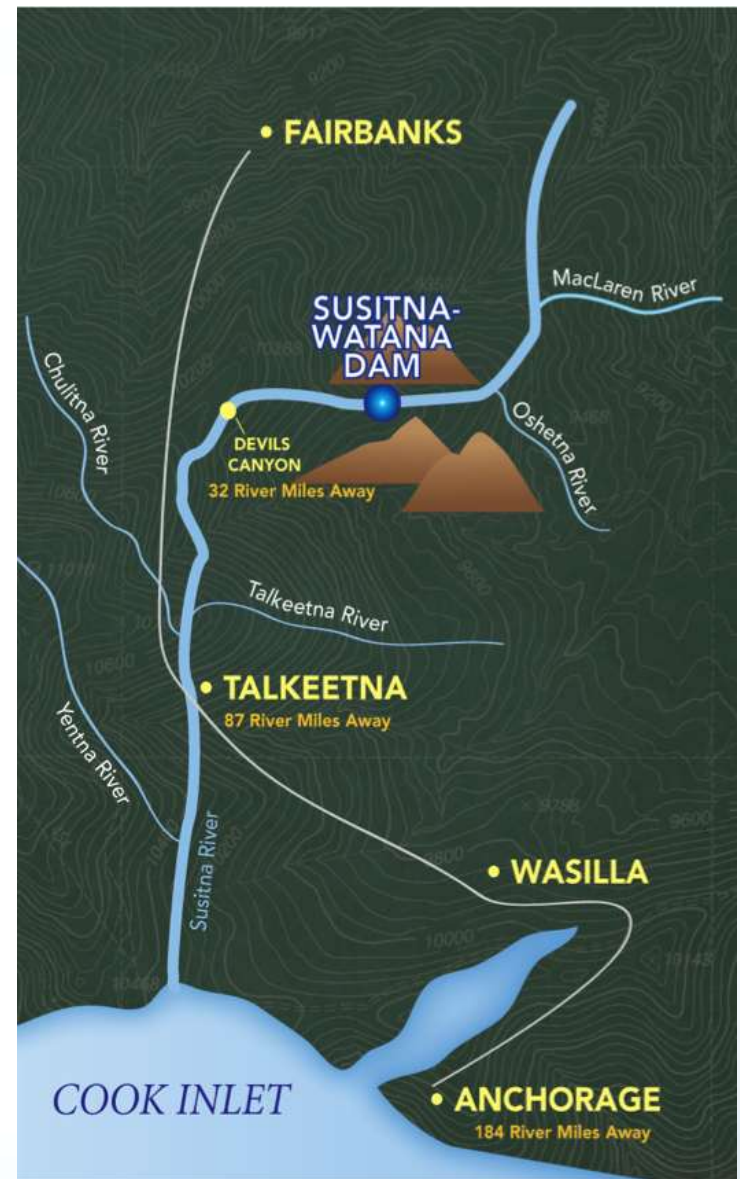


Hydrology Presentation: Existing and with-Project Hydrology

Technical Workgroup Meeting
February 14, 2013

Prepared by: Tetra Tech

Prepared for: Alaska Energy Authority



Background

2

- USGS developed 61 year extended discharge record
- HEC-ResSim model used to simulate operations for a maximum load following “bookend” scenario to develop hourly with-Project outflows (“Maximum Load Following Operation Scenario 1”)
- HEC-ResSim Muskingum-Cunge procedure with 1980s cross-sections used to route the flows downstream to Sunshine
- Both Pre-Project and Maximum Load Following OS-1 conditions analyzed
- Flow duration and peak flow analysis performed to provide initial comparison of the Maximum Load Following OS-1 scenario and Pre-Project conditions



Basis and Assumptions

- Maximum Load Following OS-1 scenario assigns load fluctuation of the entire Railbelt to Watana
- Prepared for planning purposes – **Watana load is very conservative for any period of time and not realistic for an entire year**
- Hourly open-water flow routing results from HEC-ResSim
- Uses 1980s cross-sections and HEC-2 rating curves
- Railbelt generation loads from the 2010 Railbelt Integrated Resources Plan

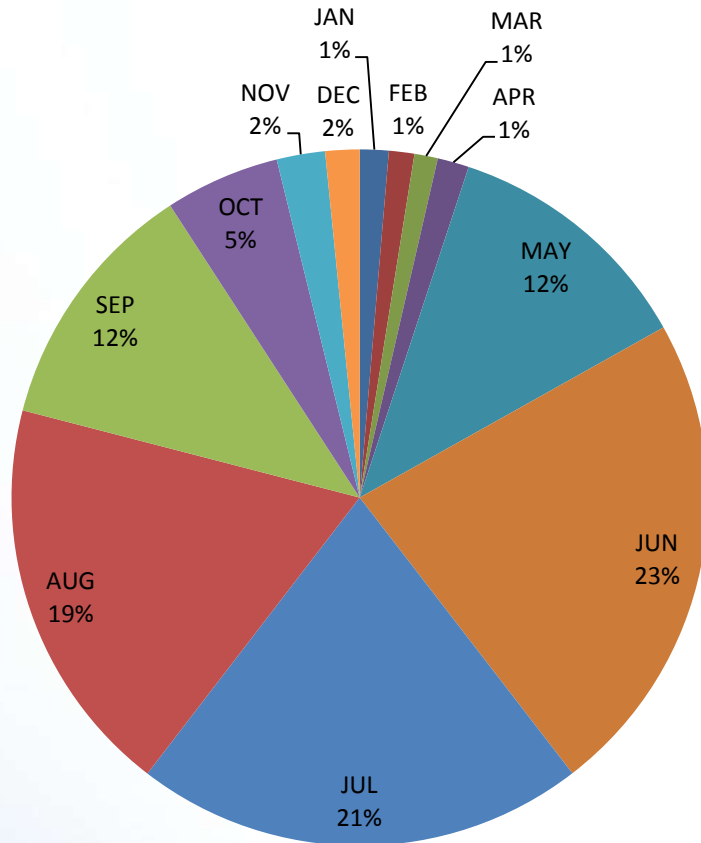


Average Monthly and Annual Flows (cfs)

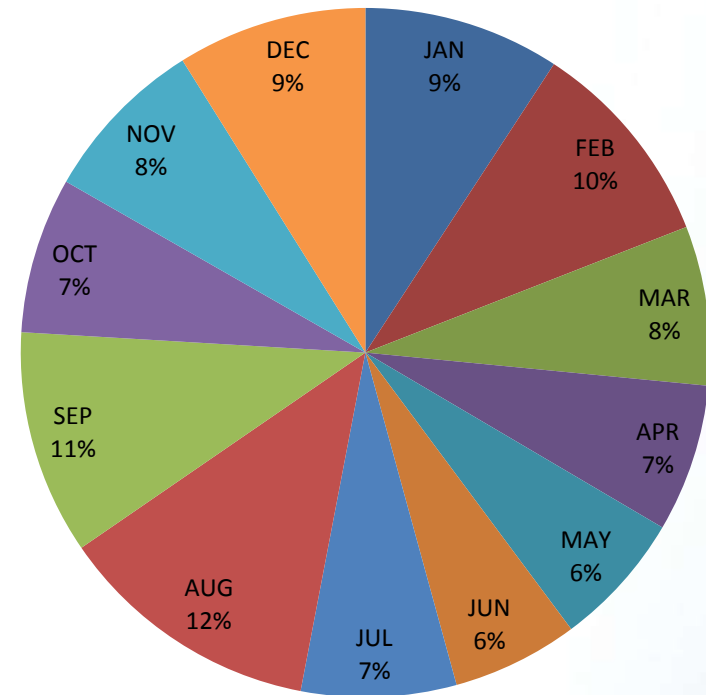
Period	Watana Dam (PRM 187)		Susitna River at Gold Creek (PRM 140)		Susitna River at Sunshine (PRM 87.9)		Susitna River at Susitna Station (PRM 29.9)	
	Pre-Project	Max LF OS-1	Pre-Project	Max LF OS-1	Pre-Project	Max LF OS-1	Pre-Project	Max LF OS-1
JAN	1,280	8,840	1,590	9,140	3,720	11,300	7,910	15,500
FEB	1,130	9,450	1,420	9,750	3,260	11,600	7,080	15,400
MAR	1,040	7,170	1,300	7,460	2,960	9,190	6,510	12,700
APR	1,400	6,650	1,740	6,950	4,030	9,160	8,990	14,100
MAY	11,300	6,090	13,800	8,490	33,200	27,400	66,100	60,200
JUN	21,700	5,680	26,300	10,200	63,700	47,500	120,000	104,000
JUL	20,000	6,980	24,000	10,800	60,500	47,200	122,000	108,000
AUG	17,800	11,900	21,400	15,400	54,200	48,400	109,000	103,000
SEP	11,300	10,100	13,700	12,700	34,900	34,100	72,800	72,000
OCT	5,100	7,020	6,320	8,240	15,900	18,000	36,000	38,100
NOV	2,150	7,520	2,670	7,990	6,490	11,900	14,400	19,800
DEC	1,520	8,540	1,890	8,750	4,490	11,300	9,510	16,300
Annual	8,010	7,990	9,720	9,660	24,100	24,000	48,600	48,500

Monthly Average Flow Comparison (cfs) ⁵

Watana Dam (Pre-Project)

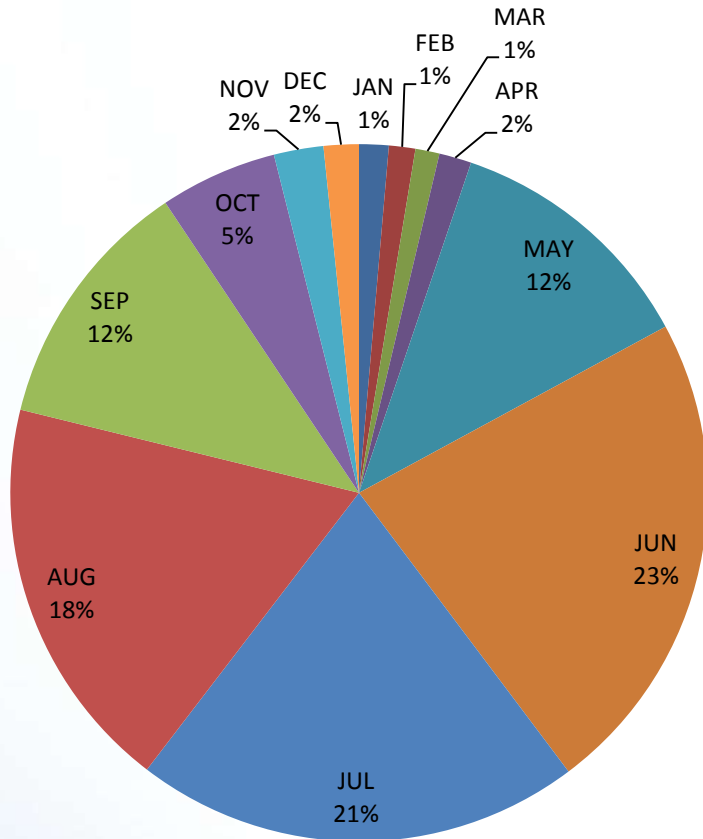


Watana Dam (Max LF OS-1)

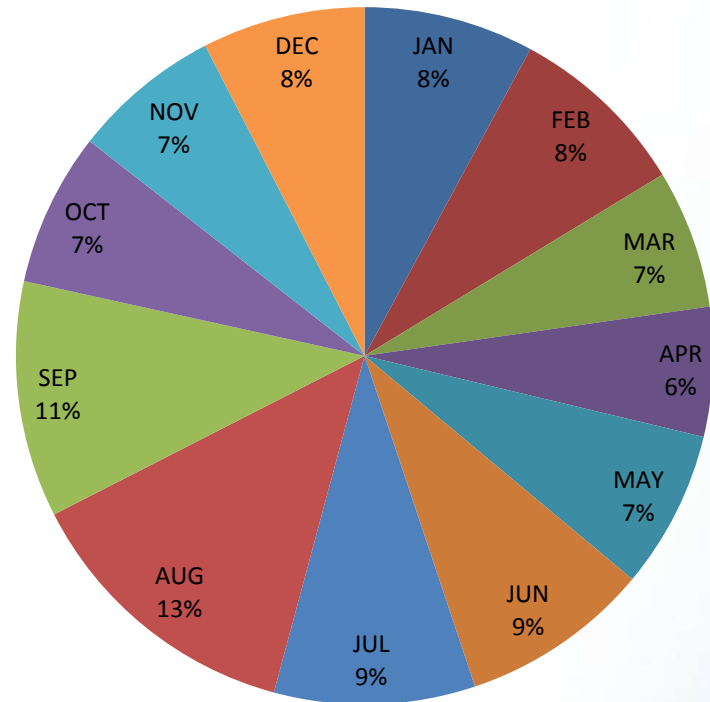


Monthly Average Flow Comparison (cfs) ⁶

Gold Creek (Pre-Project)

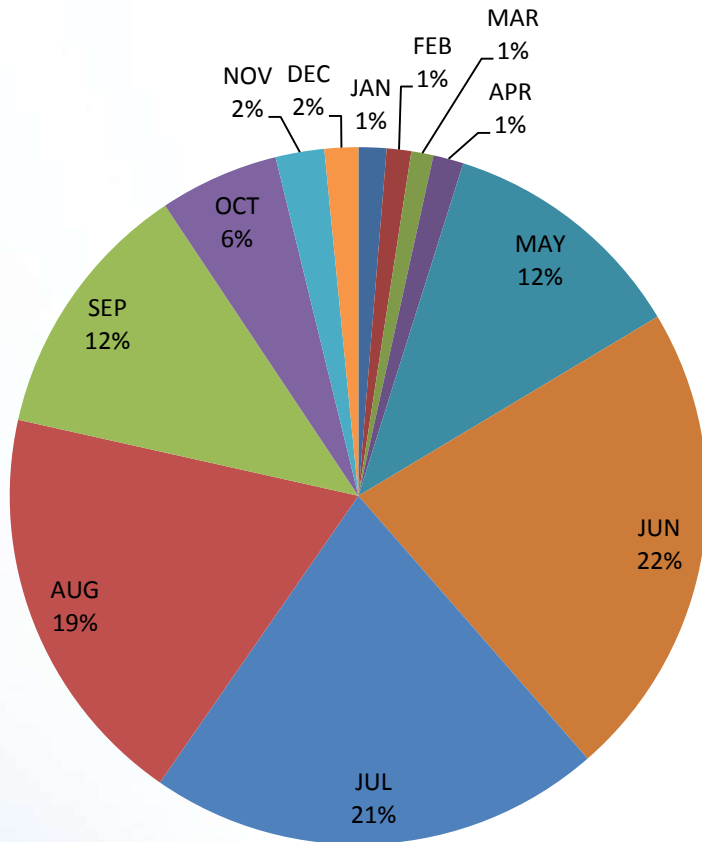


Gold Creek (Max LF OS-1)

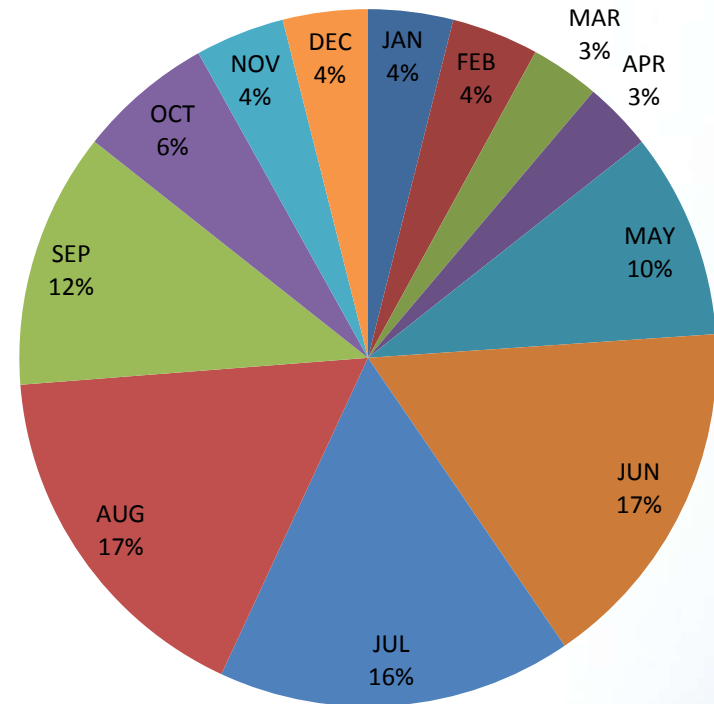


Monthly Average Flow Comparison (cfs) ⁷

Sunshine (Pre-Project)

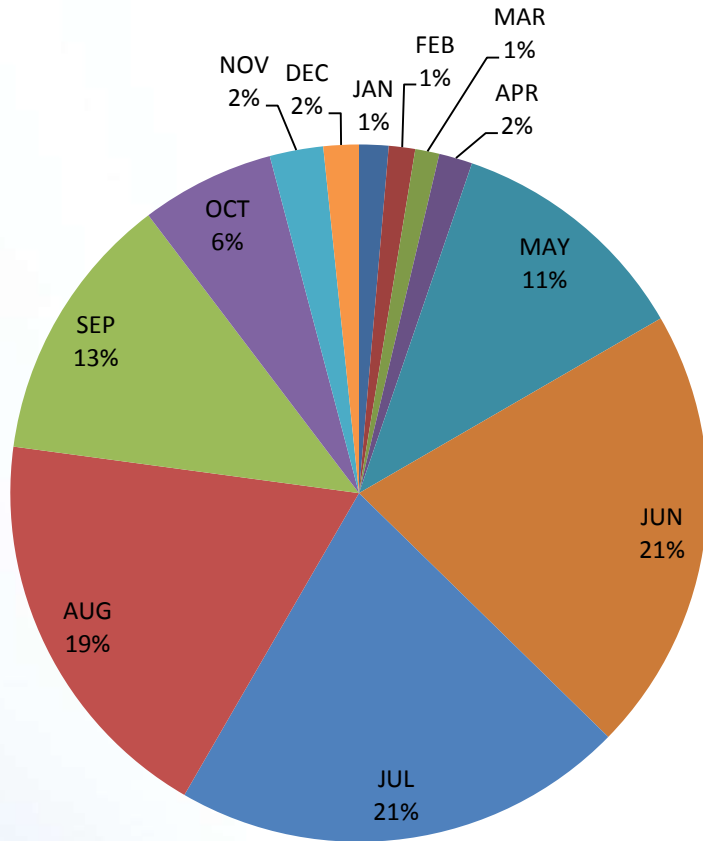


Sunshine (Max LF OS-1)

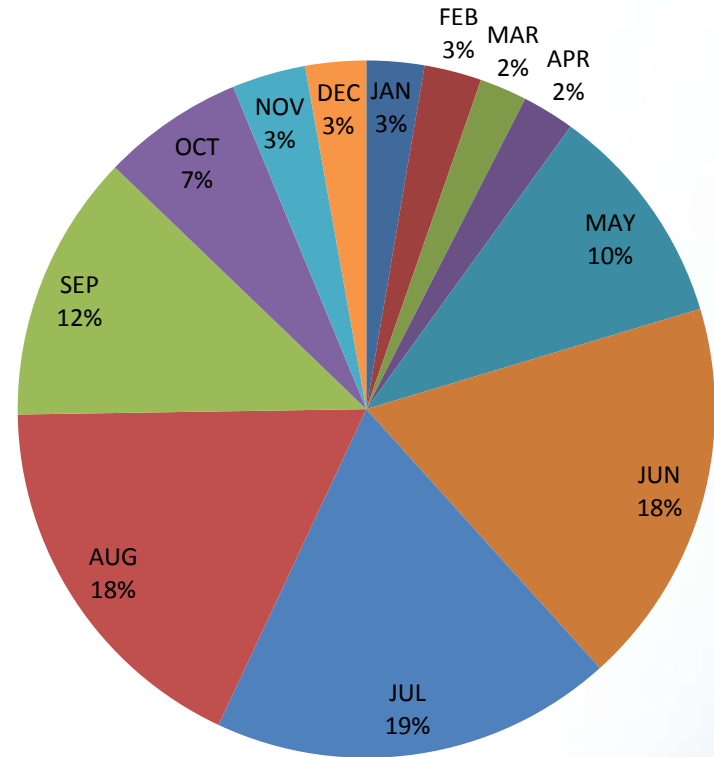


Monthly Average Flow Comparison (cfs) ⁸

Susitna Station (Pre-Project)



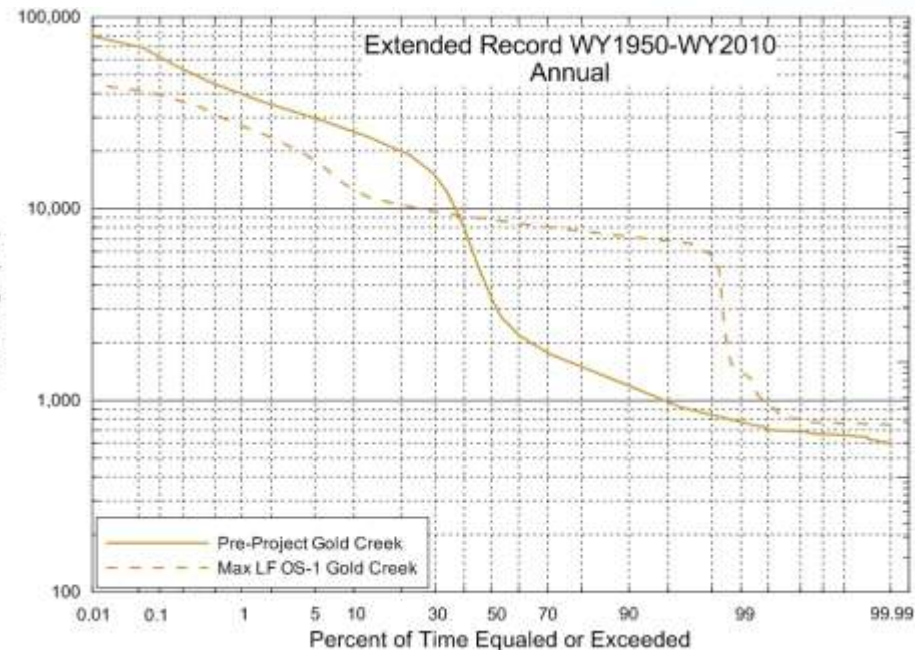
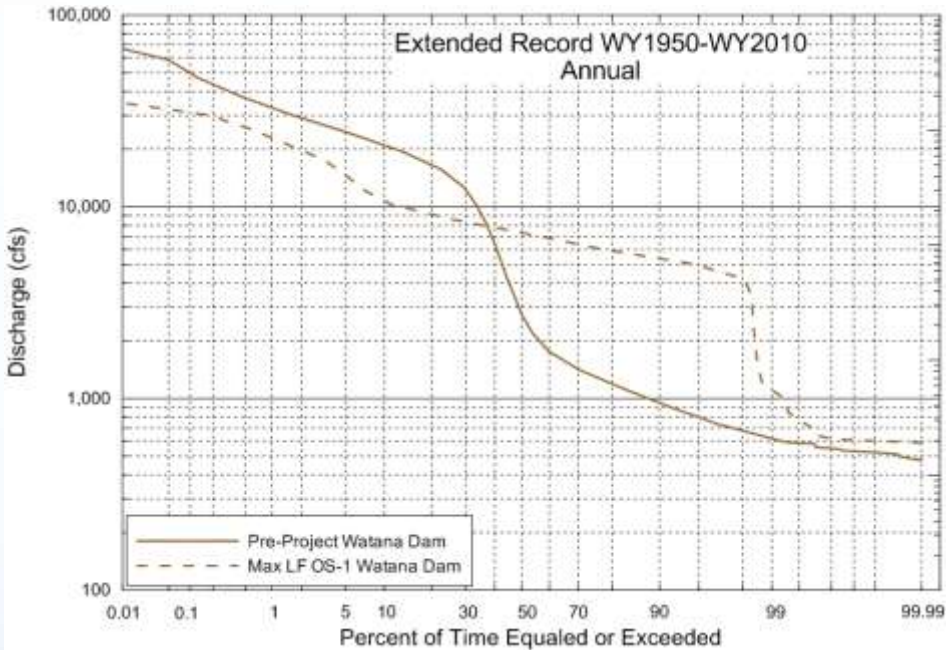
Susitna Station (Max LF OS-1)



Annual Flow Duration

Watana Dam (PRM187)

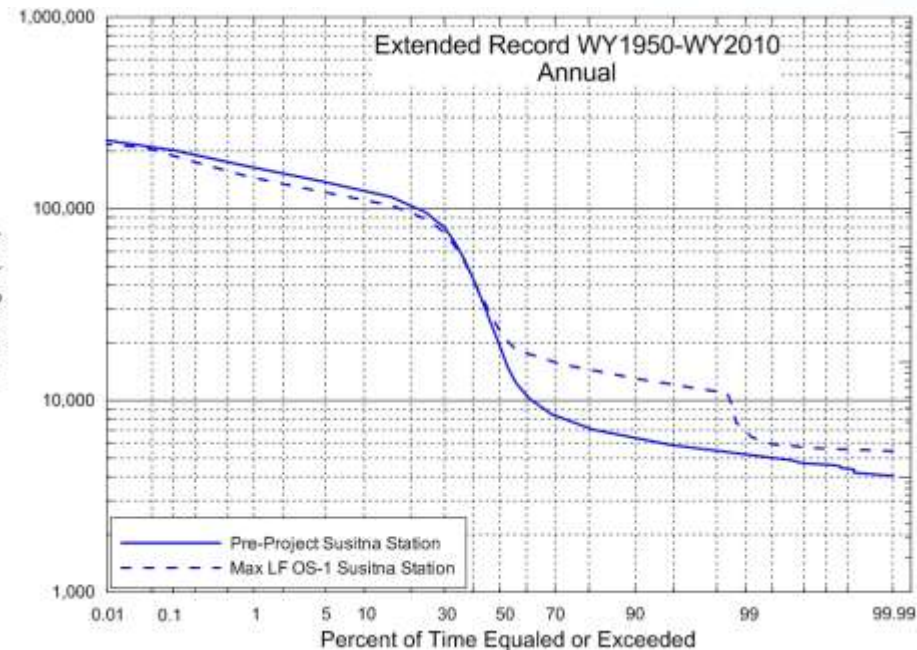
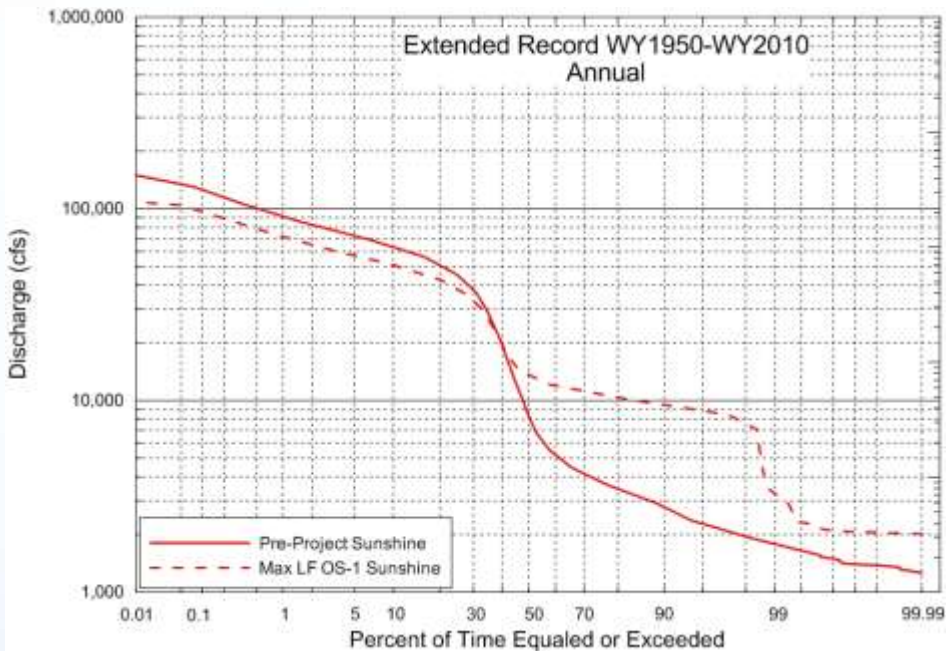
Gold Creek (PRM 140)



Annual Flow Duration

Sunshine (PRM 87.9)

Susitna Station (PRM 29.9)



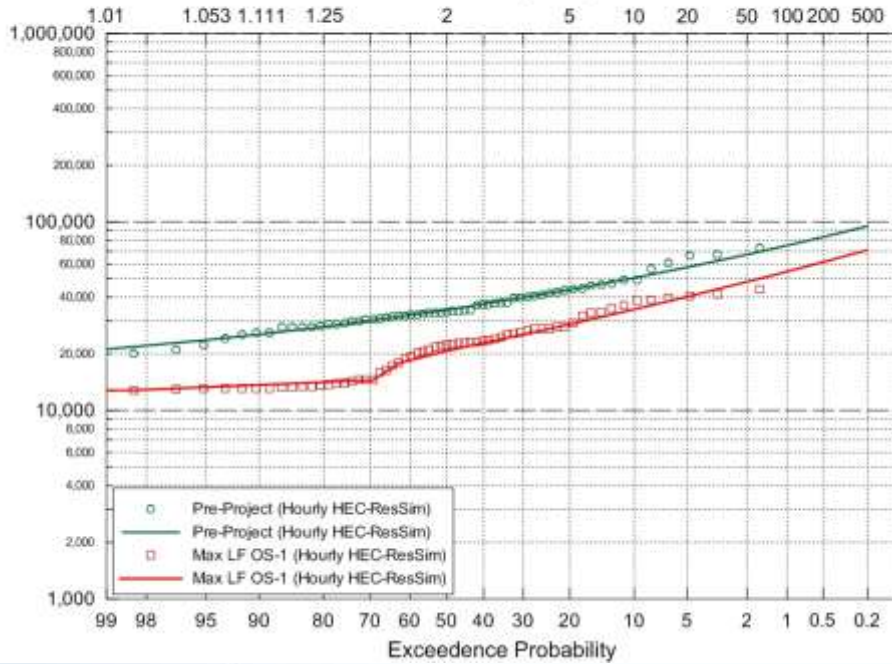
Flood Frequency Pre-Project and Max LF OS-1

Watana Dam (PRM 187)

Gold Creek (PRM 140)

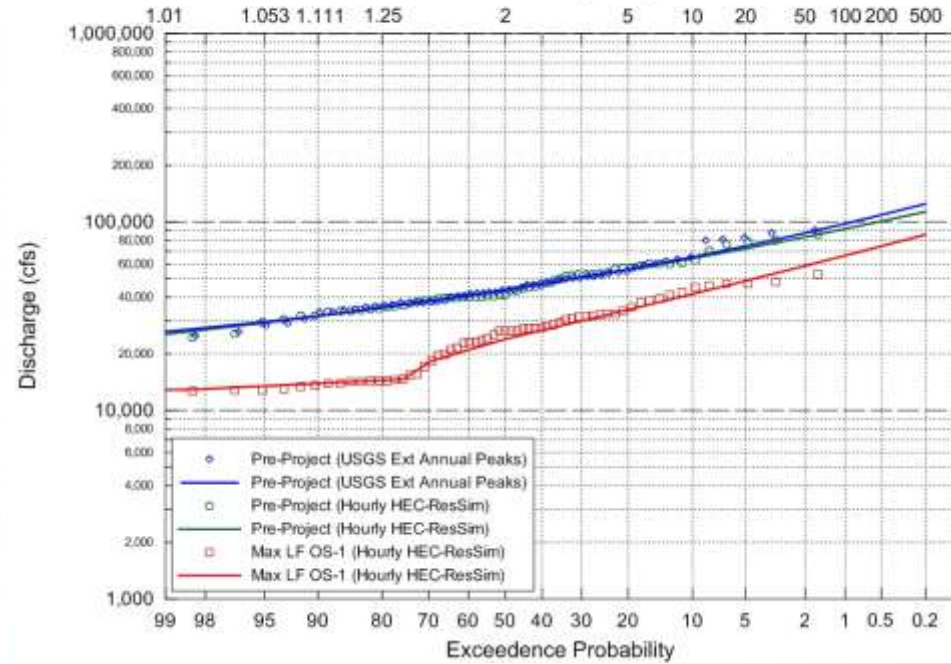
Watana Dam Site Flood Frequency Analysis

Return Period (Years)



Susitna River at Gold Creek (USGS Gage no. 15292000) Flood Frequency Analysis

Return Period (Years)



Flood Frequency

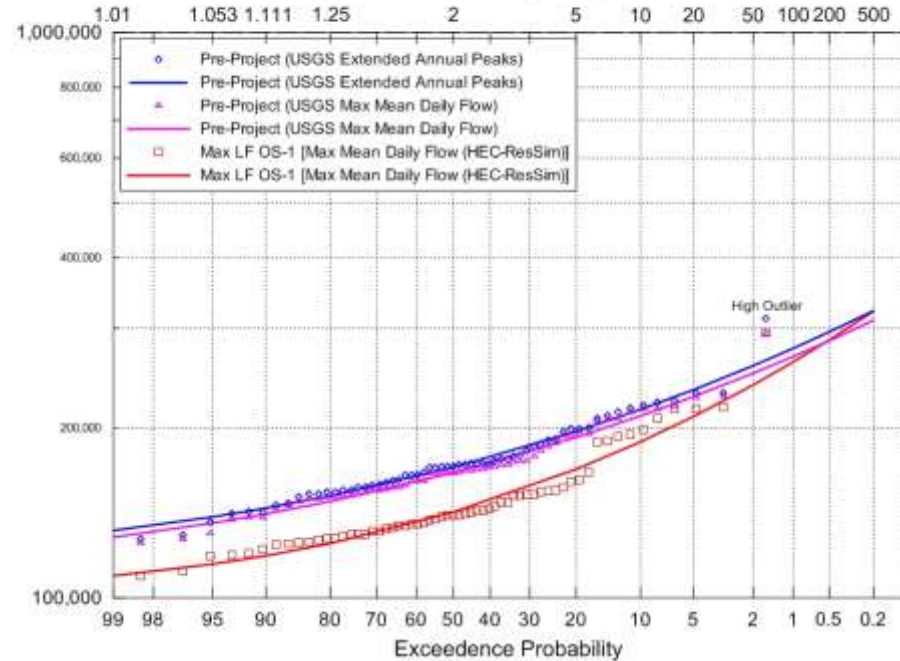
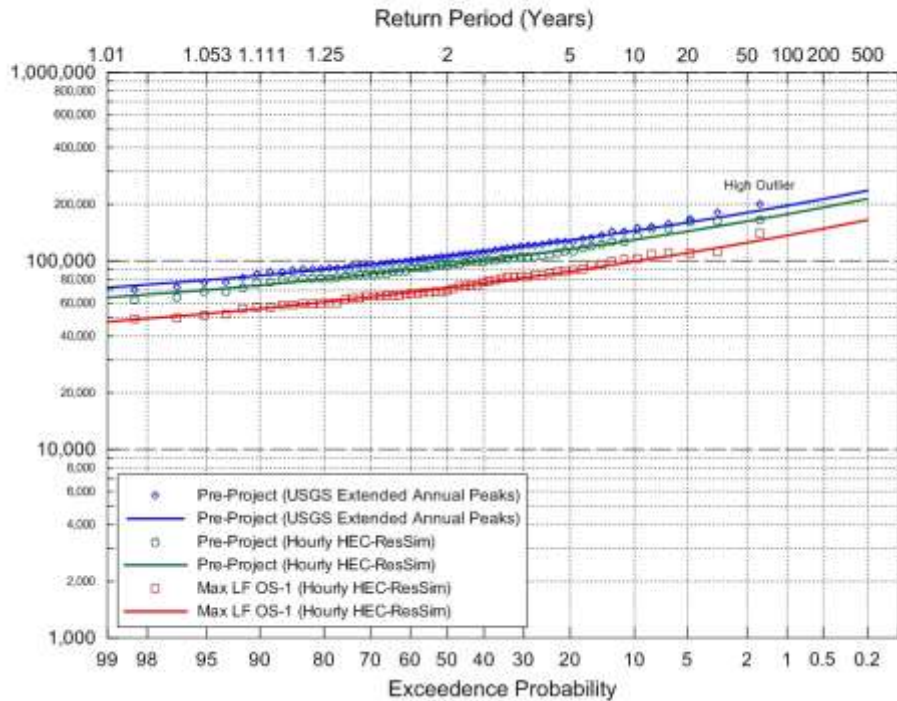
Pre- Project and Max LF OS-1

Sunshine (PRM 87.9)

Susitna Station (PRM 29.9)

Susitna River at Sunshine
(USGS Gage no. 15292780) Flood Frequency Analysis

Susitna River at Susitna Station
(USGS Gage no. 15294350) Flood Frequency Analysis



Annual Peak Flow Comparison: Watana Dam Site (PRM 187)

Return Period (Years)	Watana Dam Site			
	Pre-Project Flow (cfs)	Max LF OS-1 Flow (cfs)	Difference (cfs)	Difference (%)
1.01	21,100	12,800	-8,300	-39%
1.25	27,800	14,100	-13,700	-49%
1.5	30,700	15,800	-14,900	-49%
2	34,200	20,700	-13,500	-39%
5	43,700	28,700	-15,000	-34%
20	57,600	40,200	-17,400	-30%
50	67,300	48,200	-19,100	-28%
100	75,100	54,600	-20,500	-27%

Annual Peak Flow Comparison: Gold Creek (PRM 140)

Return Period (Years)	Gold Creek			
	Pre-Project Flow (cfs)	Max LF OS-1 Flow (cfs)	Difference (cfs)	Difference (%)
1.01	25,400	12,900	-12,500	-49%
1.25	35,100	14,400	-20,700	-59%
1.5	39,000	19,100	-19,900	-51%
2	43,700	23,900	-19,800	-45%
5	55,800	34,300	-21,500	-39%
20	72,300	48,800	-23,500	-33%
50	83,400	58,600	-24,800	-30%
100	92,100	66,400	-25,700	-28%

Annual Peak Flow Comparison: Sunshine Station (PRM 87.9)

Return Period (Years)	Sunshine			
	Pre-Project Flow (cfs)	Max LF OS-1 Flow (cfs)	Difference (cfs)	Difference (%)
1.01	64,000	47,600	-16,400	-26%
1.25	80,200	60,500	-19,700	-25%
1.5	87,000	65,800	-21,200	-24%
2	94,700	72,000	-22,700	-24%
5	115,400	88,200	-27,200	-24%
20	143,600	110,400	-33,200	-23%
50	162,500	125,100	-37,400	-23%
100	177,300	136,700	-40,600	-23%

Annual Peak Flow Comparison: Susitna Station (PRM 29.9)

Return Period (Years)	Susitna Station			
	Pre-Project Flow (cfs)	Max LF OS-1 Flow (cfs)	Difference (cfs)	Difference (%)
1.01	131,700	109,500	-22,200	-17%
1.25	151,600	124,900	-26,700	-18%
1.5	160,400	132,900	-27,500	-17%
2	170,300	141,900	-28,400	-17%
5	197,000	168,900	-28,100	-14%
20	233,500	209,400	-24,100	-10%
50	257,600	238,200	-19,400	-8%
100	276,300	261,400	-14,900	-5%

Shift in Return Period of Peak Flows Pre-Project vs. Max LF OS-1

Watana Dam Site (187)			Gold Creek (PRM 140)		
Discharge (cfs)	Pre-Project Return Period (years)	Max LF OS-1 Return Period (years)	Discharge (cfs)	Pre-Project Return Period (years)	Max LF OS-1 Return Period (years)
21,100	1.01	2	25,400	1.01	2
27,800	1.25	4	35,100	1.25	5
30,700	1.5	6	39,000	1.5	8
34,200	2	10	43,700	2	12
43,700	5	30	55,800	5	39
57,600	20	136	72,300	20	166

Shift in Return Period of Peak Flows Pre-Project vs. Max LF OS-1

Sunshine (PRM 87.9)			Susitna Station (PRM 29.9)		
Discharge (cfs)	Pre-Project Return Period (years)	Max LF OS-1 Return Period (years)	Discharge (cfs)	Pre-Project Return Period (years)	Max LF OS-1 Return Period (years)
64,000	1.01	1.4	131,700	1.01	1.5
80,200	1.25	3	151,600	1.25	3
87,000	1.5	5	160,426	1.5	4
94,700	2	7	170,300	2	5
115,400	5	27	197,000	5	13
143,600	20	149	233,500	20	43

Ratio 100-year to 2-year Peak Flows

Location	Pre-Project Ratio	Max LF OS-1 Ratio
Watana Dam (PRM 187)	2.2	2.6
Gold Creek (PRM 140)	2.1	2.8
Sunshine (PRM 87.9)	1.9	1.9
Susitna Station (PRM 29.9)	1.6	1.8

The Analysis is an Initial Assessment

- Performed to assist in study planning
- **Watana load is very conservative for any period of time & not realistic for an entire year**
- Models will be upgraded in 2013
 - Replace HEC-ResSim Muskingum-Cunge routing
 - 2012 X-sections, additional 2013 X-sections
 - Refine tributary inflows and accretion flows
 - Additional calibration

