SUSITNA-WATANA
HYDROELECTRIC PROJECT

Hydrology and Operation Modeling

Prepared by MWH

Agency Meeting on Initial Issue Identification and Study Concepts

October 24, 2011

ALASKA ENERGY AUTHORITY

Preliminary information, subject to change in future studies

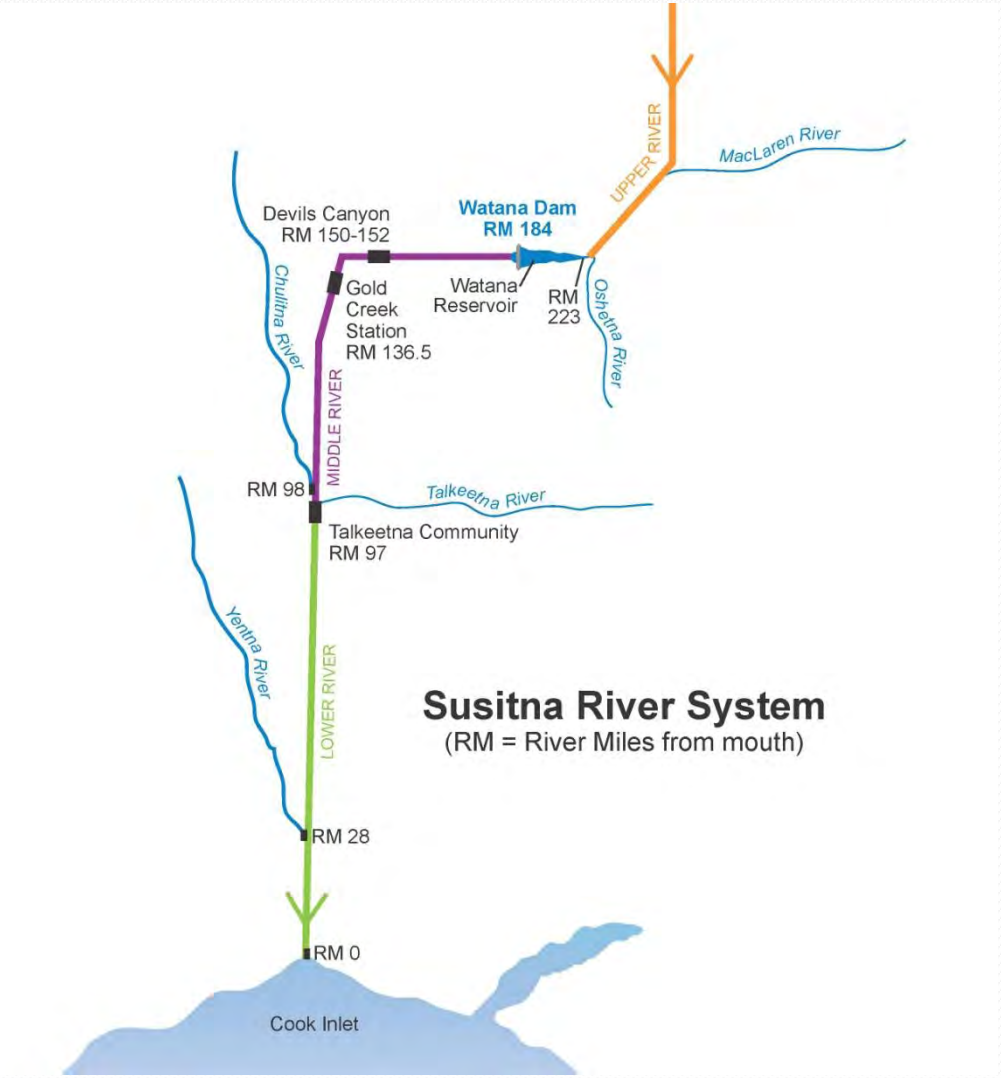
Purpose of the Project Operations Studies

- Provide detail and refinement to the concept selected in the AEA *Railbelt Large Hydro Evaluation, Preliminary Decision Document*
- Determine firm power and average energy
- Provide details of reservoir operations and flow releases
- Provide input to the PAD
- Plan and size facilities
- Develop a model with input and output capable of providing the needed data
- Other purposes – not an all-inclusive list

Presentation Outline

1. Maps and USGS Flow Data Availability
2. Monthly Power Demand and Flow Patterns
3. Watana Reservoir Inflows
4. Reservoir Power Operation Model
5. Base Case Configuration
6. Base Case Flows at Gold Creek
7. Base Case Reservoir Fluctuation (drawdown)
8. Base Case Downstream Flows

Locations and River Miles



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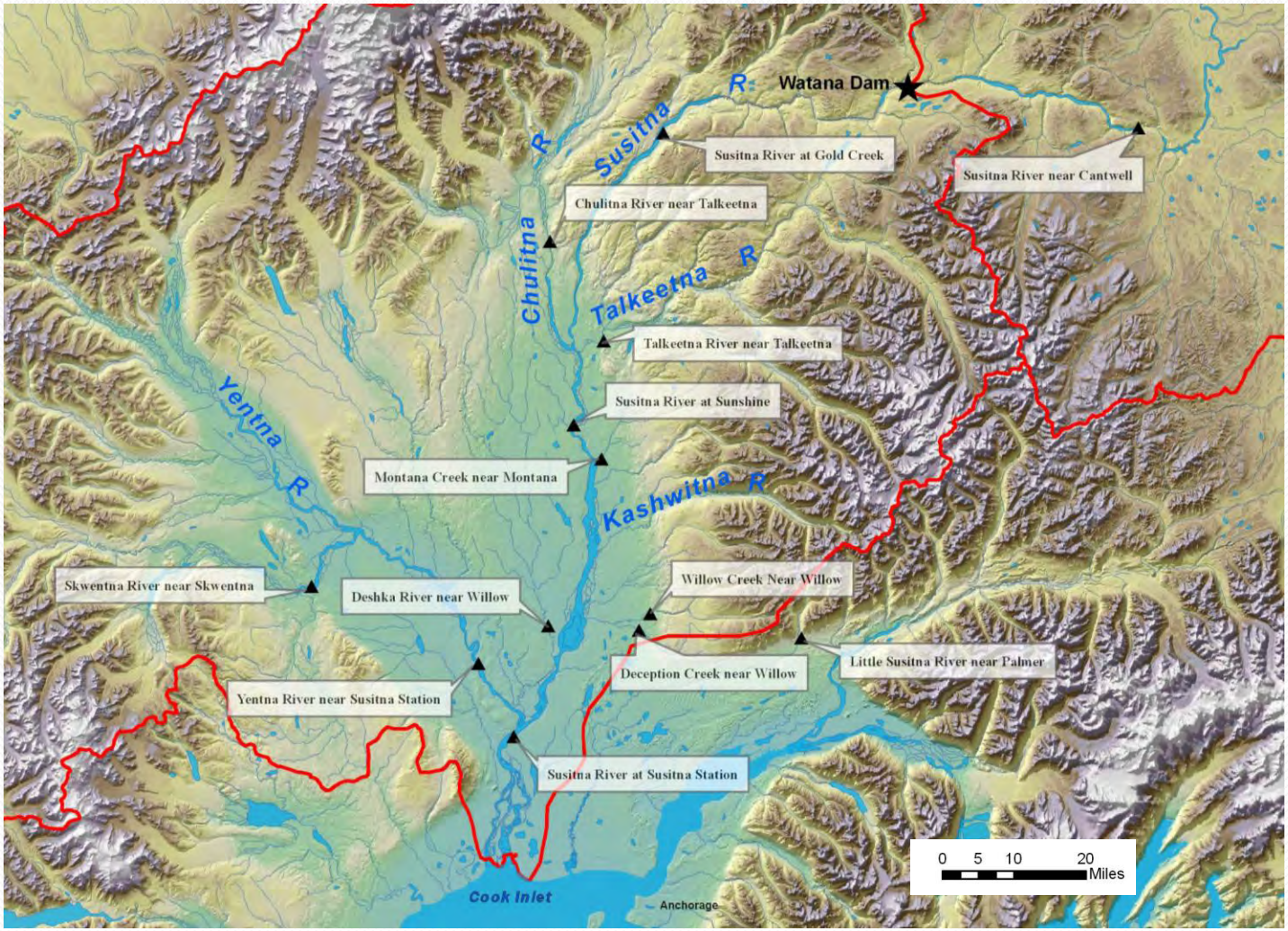
USGS Gage Locations



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USGS Streamflow Gages in the Susitna Watershed

USGS Gage Number	Gage Name	Drainage Area (sq.mi.)	Latitude	Longitude	Gage Datum (feet)	Available Period of Record
15290000	Little Susitna River near Palmer	62	61°42'37"	149°13'47"	917	63 years: 1948 - 2011
15291000	Susitna River near Denali	950	63°06'14"	147°30'57"	2,440	27 years: 1957 - 1976; 1978 - 1986
15291200	Maclaren River near Paxson	280	63°07'10"	146°31'45"	2,866	28 years: 1958 - 1986
15291500	Susitna River near Cantwell	4,140	62°41'55"	147°32'42"	1,900	17 years: 1961 - 1972; 1980 - 1986
15292000	Susitna River at Gold Creek	6,160	62°46'04"	149°41'28"	677	57 years: 1949 - 1996; 2001 - 2011
15292400	Chulitna River near Talkeetna	2,570	62°33'31"	150°14'02"	520	20 years: 1958 - 1972; 1980 - 1986
15292700	Talkeetna River near Talkeetna	1,996	62°20'49"	150°01'01"	400	47 years: 1964 - 2011
15292780	Susitna River at Sunshine	11,100	62°10'42"	150°10'30"	270	5 years: 1981 - 1986
15292800	Montana Creek near Montana	164	62°06'19"	150°03'27"	250	4 years: 2005 - 2006; 2008 - 2011
15294005	Willow Creek Near Willow	166	61°46'51"	149°53'04"	350	25 years: 1978 - 1993; 2001 - 2011
15294010	Deception Creek near Willow	48	61°44'52"	149°56'14"	250	7 years: 1978 - 1985
15294100	Deshka River near Willow	591	61°46'05"	150°20'13"	80	11 years: 1978 - 1986; 1998 - 2001
15294300	Skwentna River near Skwentna	2,250	61°52'23"	151°22'01"	200	23 years: 1959 - 1982
15294345	Yentna River near Susitna Station	6,180	61°41'55"	150°39'02	80	6 years: 1980 - 1986
15294350	Susitna River at Susitna Station	19,400	61°32'41"	150°30'45	40	19 years: 1974 - 1993

Hydrology memorandum available at Susitna-WatanaHydro.org > Documents tab

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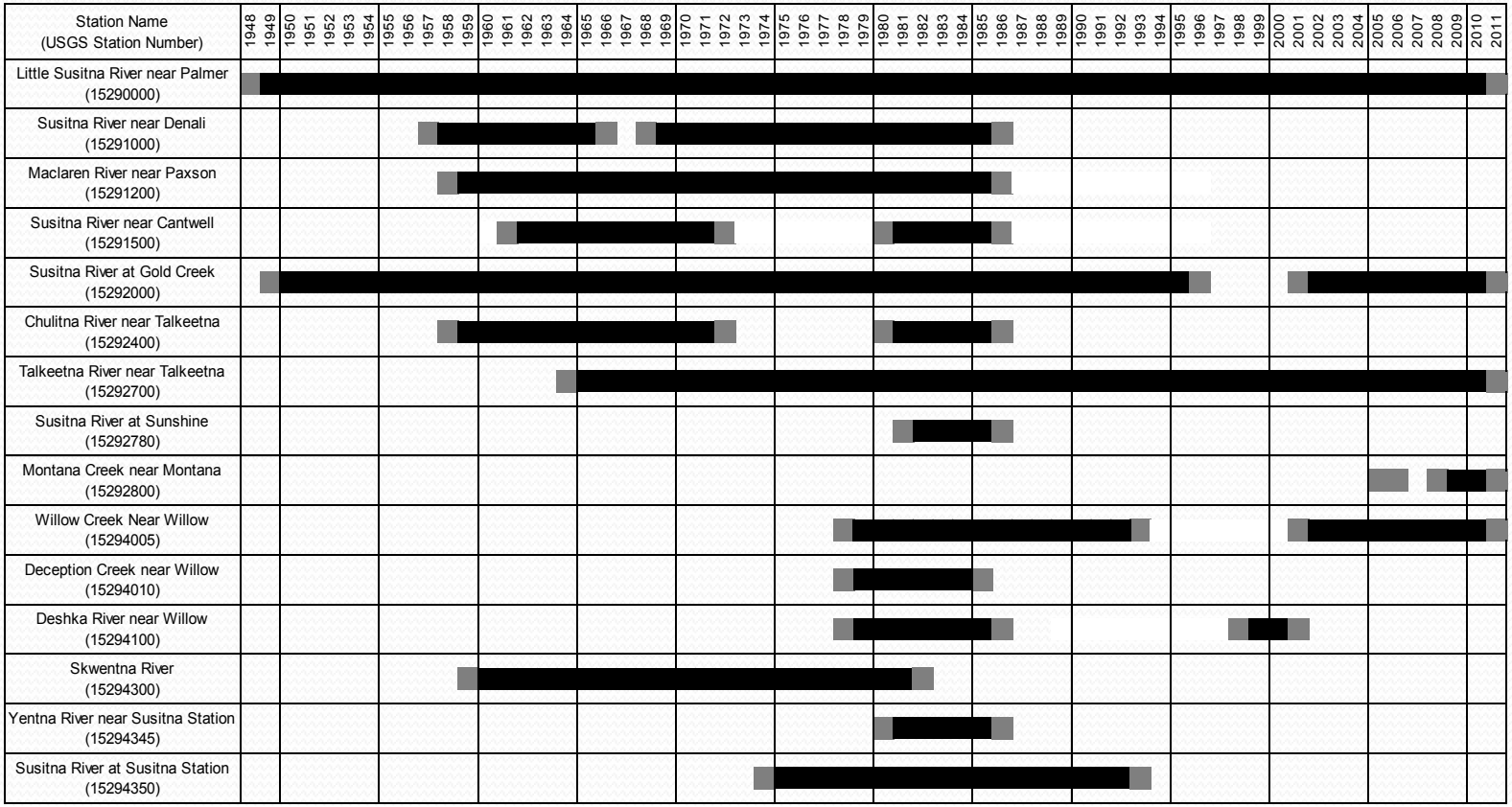
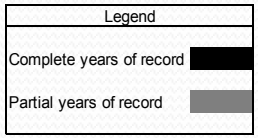
USGS Flow Data – Chronological Availability



Note: Data are on a calendar year basis.



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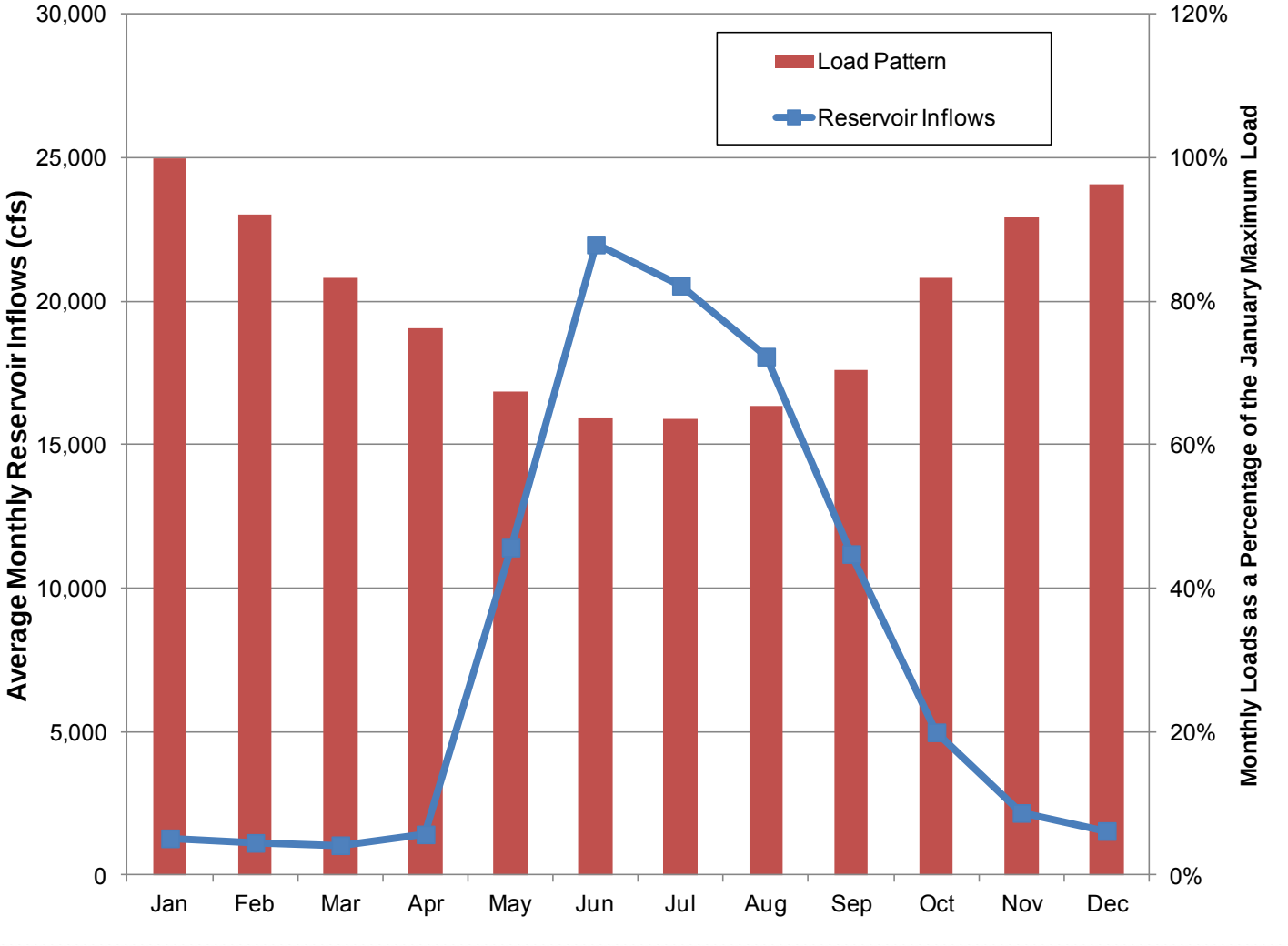
Electricity Loads and Inflows – Need for Storage



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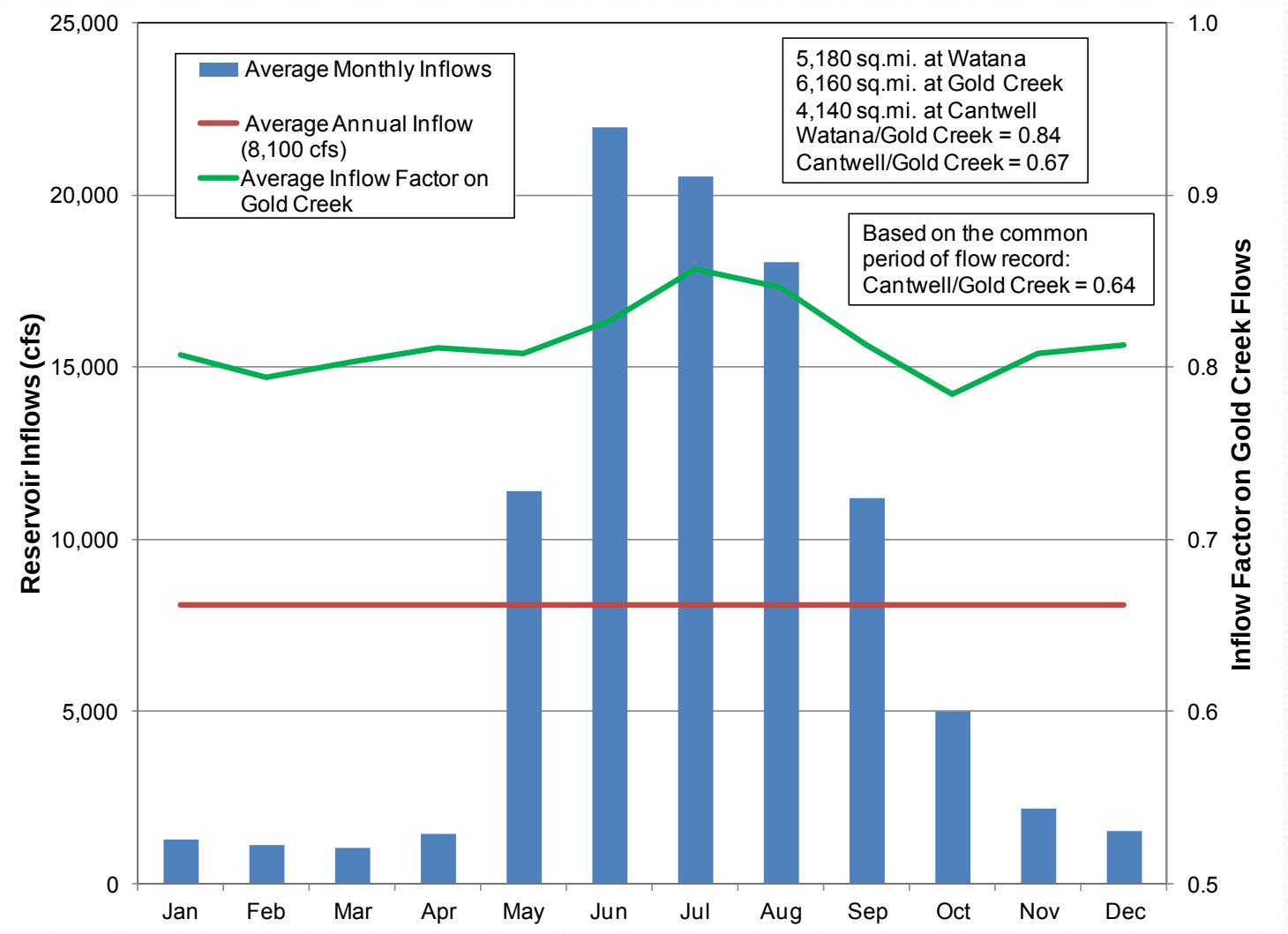
Reservoir Inflows

- 56+ years of USGS recorded flows at Gold Creek
- About 17 years of concurrent USGS recorded flows at Cantwell
- Watana is about half-way between these two gages
- Flow between gages can be determined by subtraction on a monthly basis for the concurrent period of record
- For the period of concurrent monthly record Allocate flow between gages based on drainage area. Inflow to Watana is based on an individual monthly factor on the Gold Creek flows.
- For the period of Gold Creek flow record without concurrent Cantwell records, use an average monthly factor on Gold Creek flows based on the concurrent record.

Monthly Reservoir Inflows



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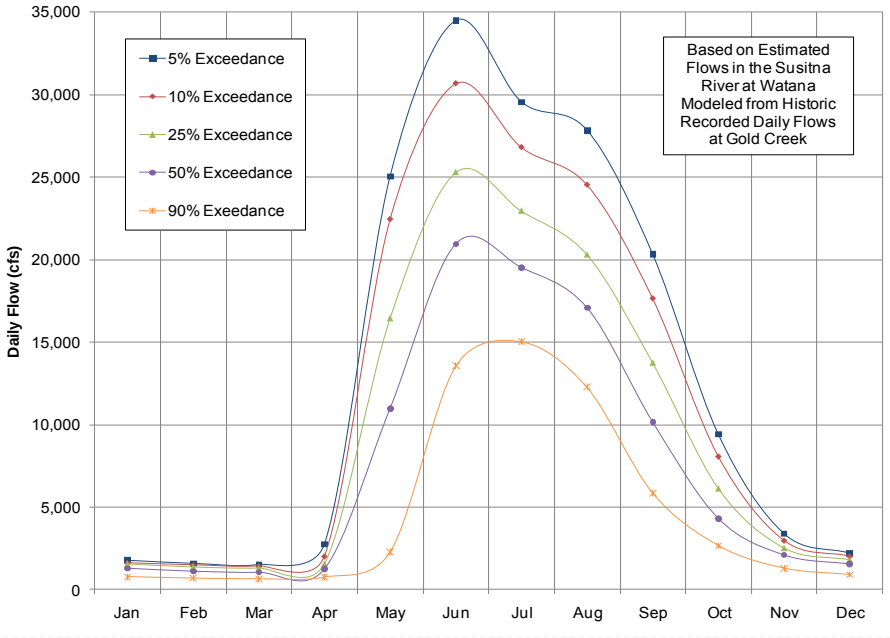
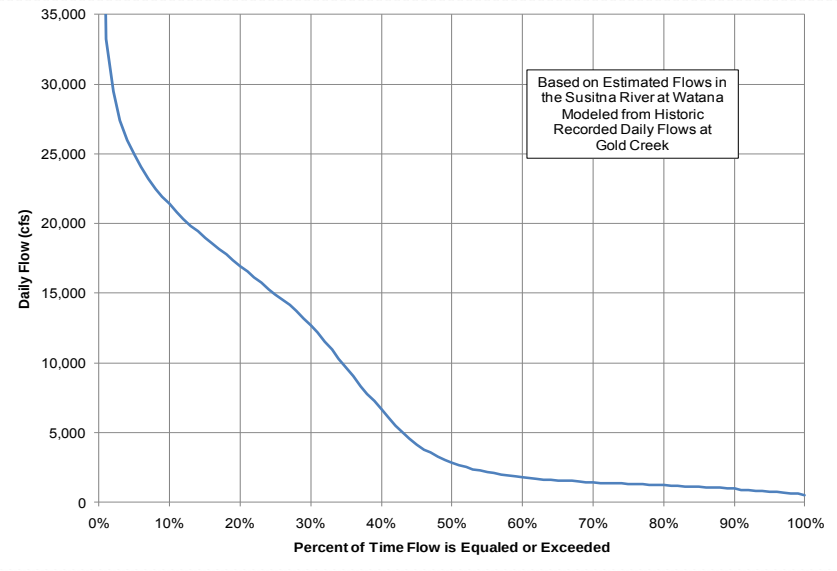
Flow Frequency and Flow Duration at Watana





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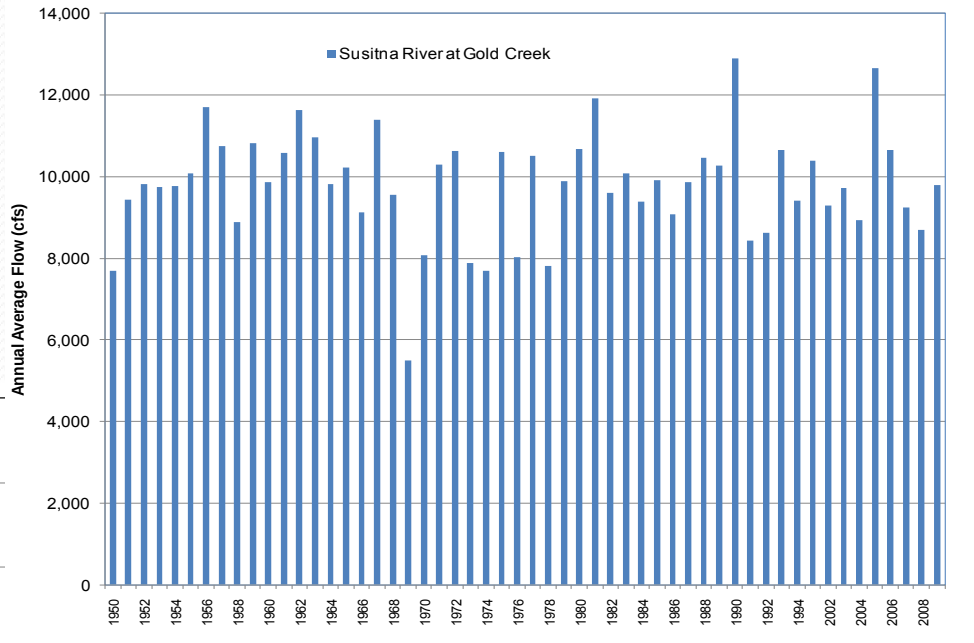
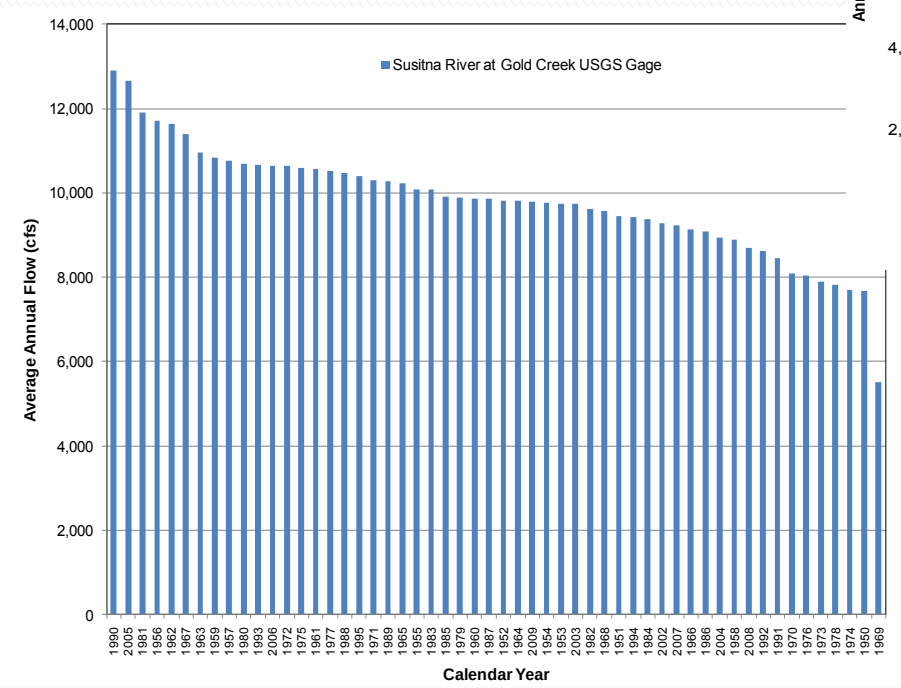
Recorded and Ranked Flows at Gold Creek





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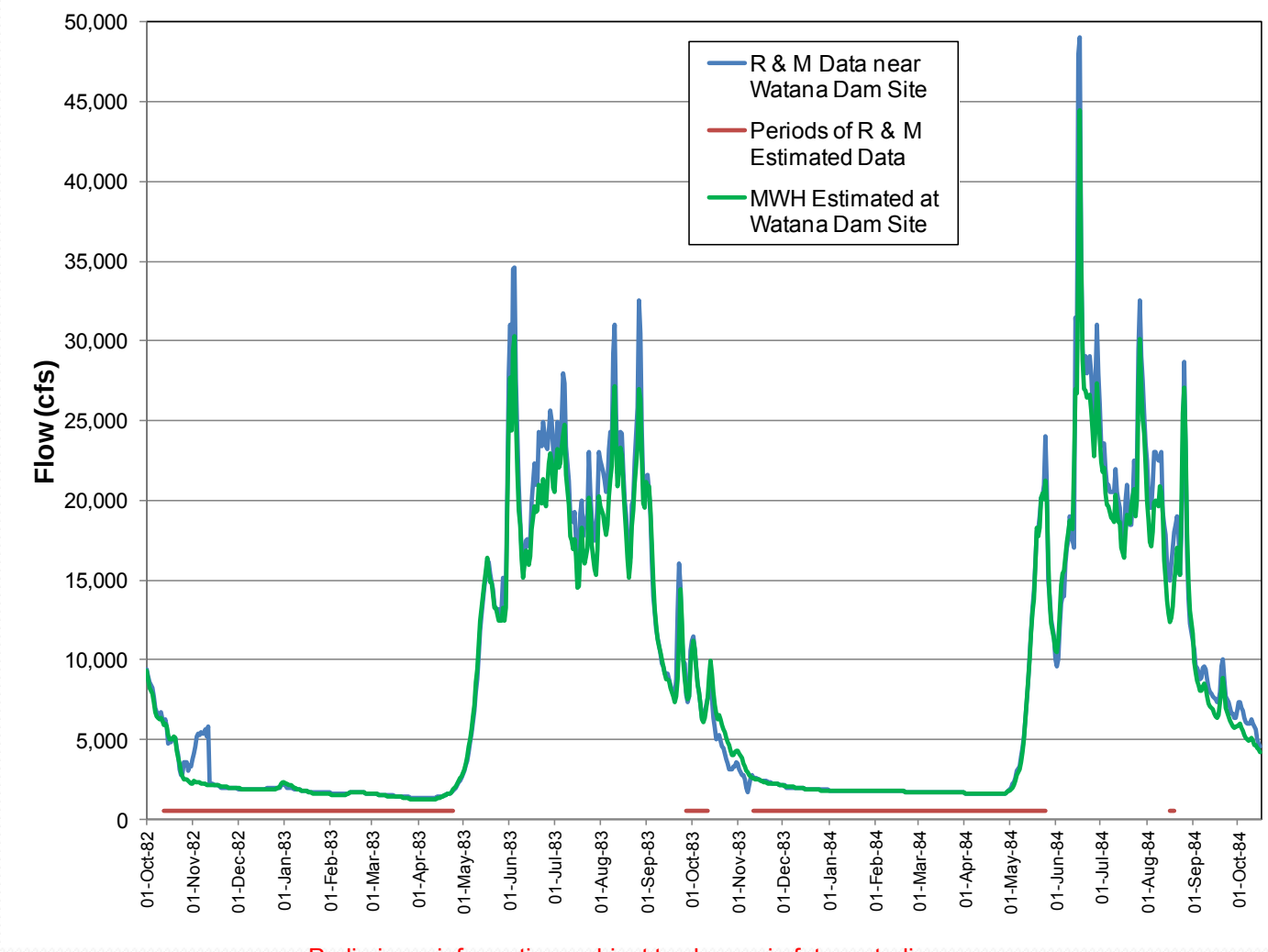
Comparison of R & M Recorded versus MWH Modeled Watana Flow



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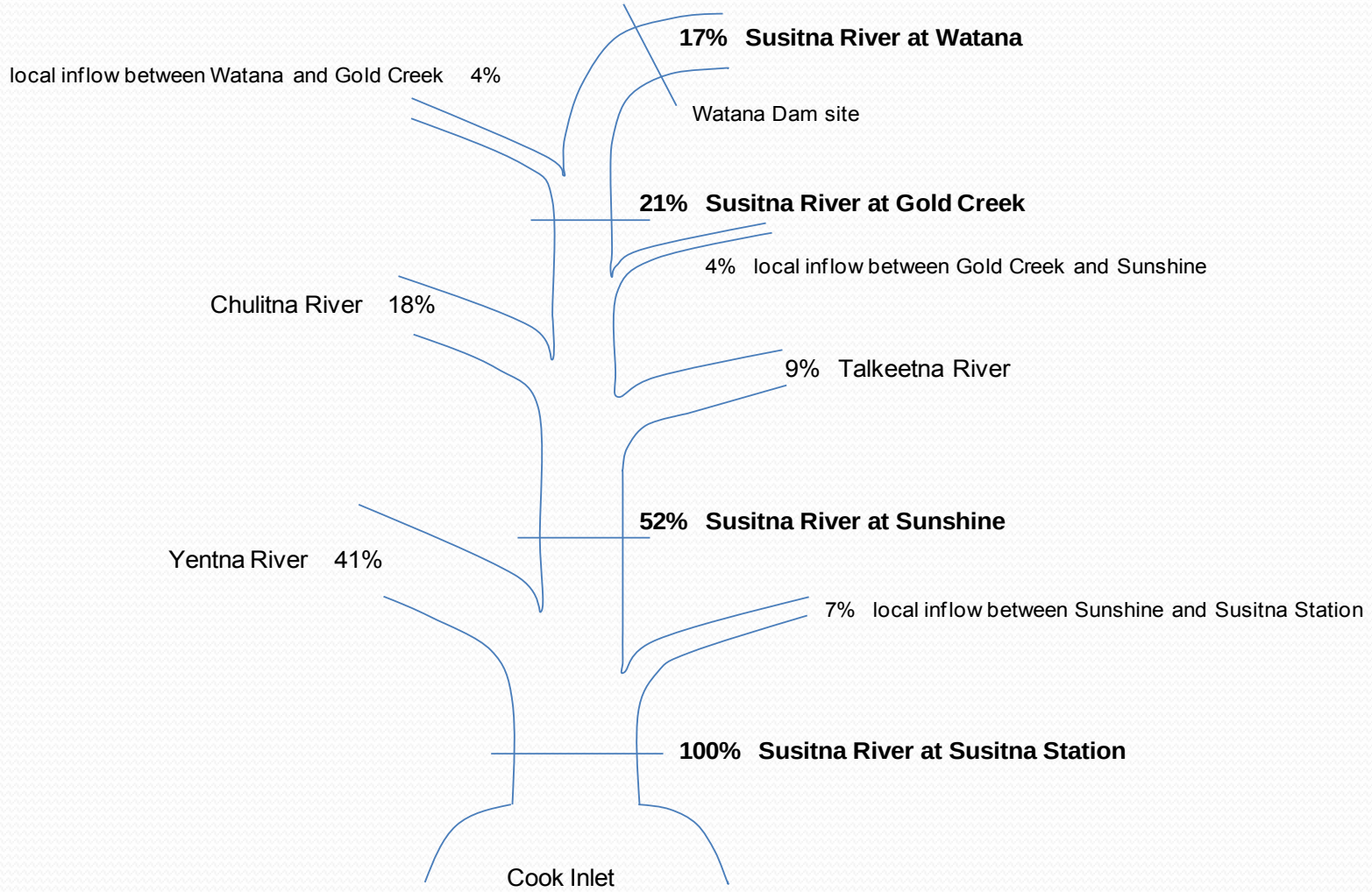
Susitna River Annual Flow Distribution



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Reservoir Power Operation Model

- Reservoir operation simulation model for period of record of daily inflows
- Programming language model (FORTRAN) – not Excel
- Model has two points where calculations are carried out – Watana reservoir and Gold Creek USGS gaging station
- Monthly, daily, and hourly output in tables and in a form compatible with Excel plotting
- The USACE model, HEC-ResSim, is in development for downstream flow routing

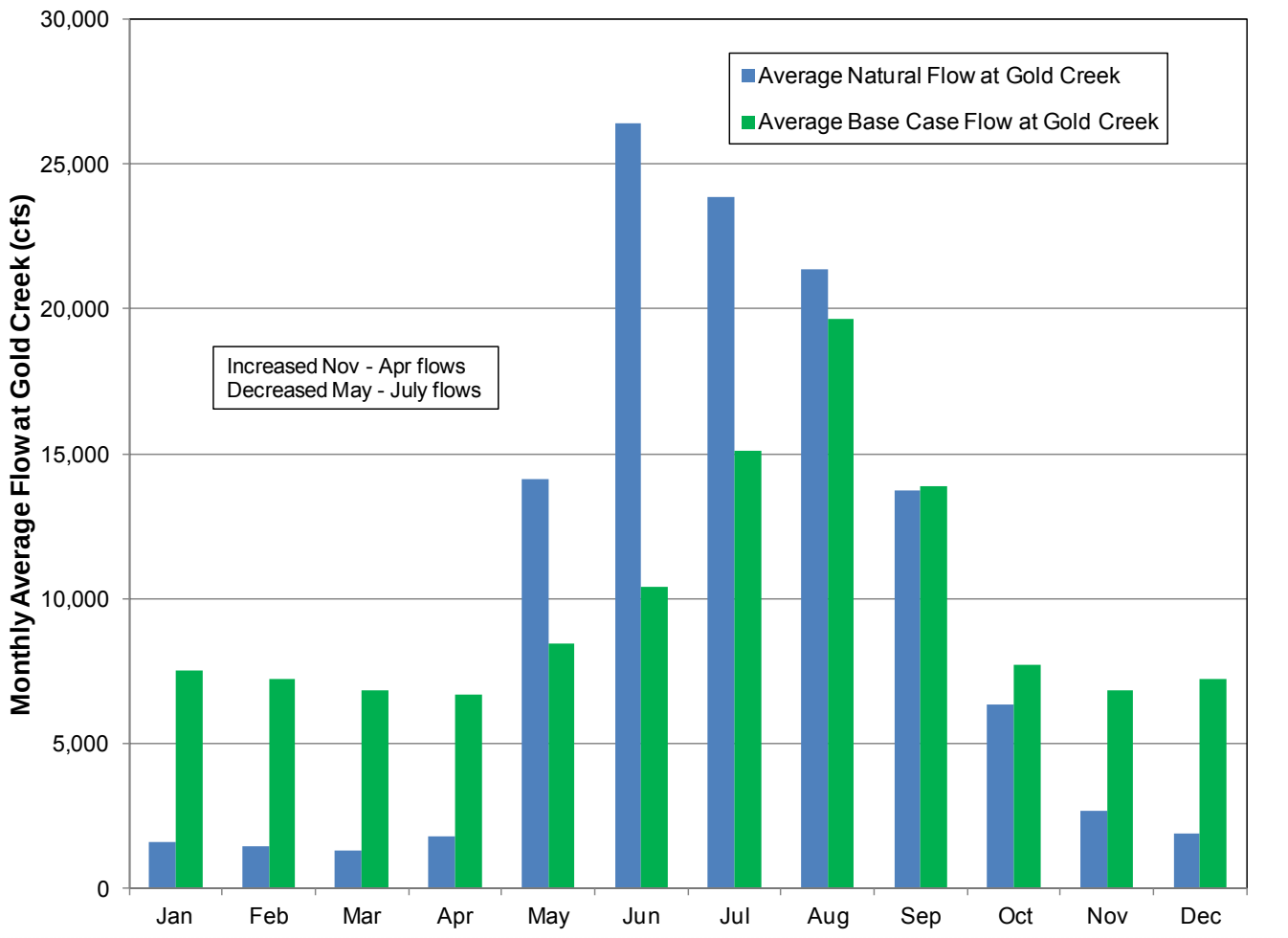
Watana Base Case Configuration

- Dam crest at El 2025
- Peak of PMF at El 2017
- Peak of 50-year flood at El 2014 (spillway operation begins above this level)
- Maximum normal pool at El 2000
- Minimum normal pool at El 1850
- Powerhouse tailwater at El 1455 at avg. flow
- 600 MW powerhouse
- Similar to Watana Stage I in 1985 FERC License Application
- The configuration and operation is not final - subject to change pending ongoing studies

Watana Base Case Operating Objectives

- Maximize November thru April firm power
- Firm power has 98% reliability
- Operate in a near base load mode
- Provide environmental flow releases
- Minimize low-level outlet releases (maximize annual generation) when the reservoir is full and the powerhouse is operating at capacity
- Shape generation to match Railbelt power demands, to the extent possible with the other given objectives

Natural and Regulated Flows at Gold Creek



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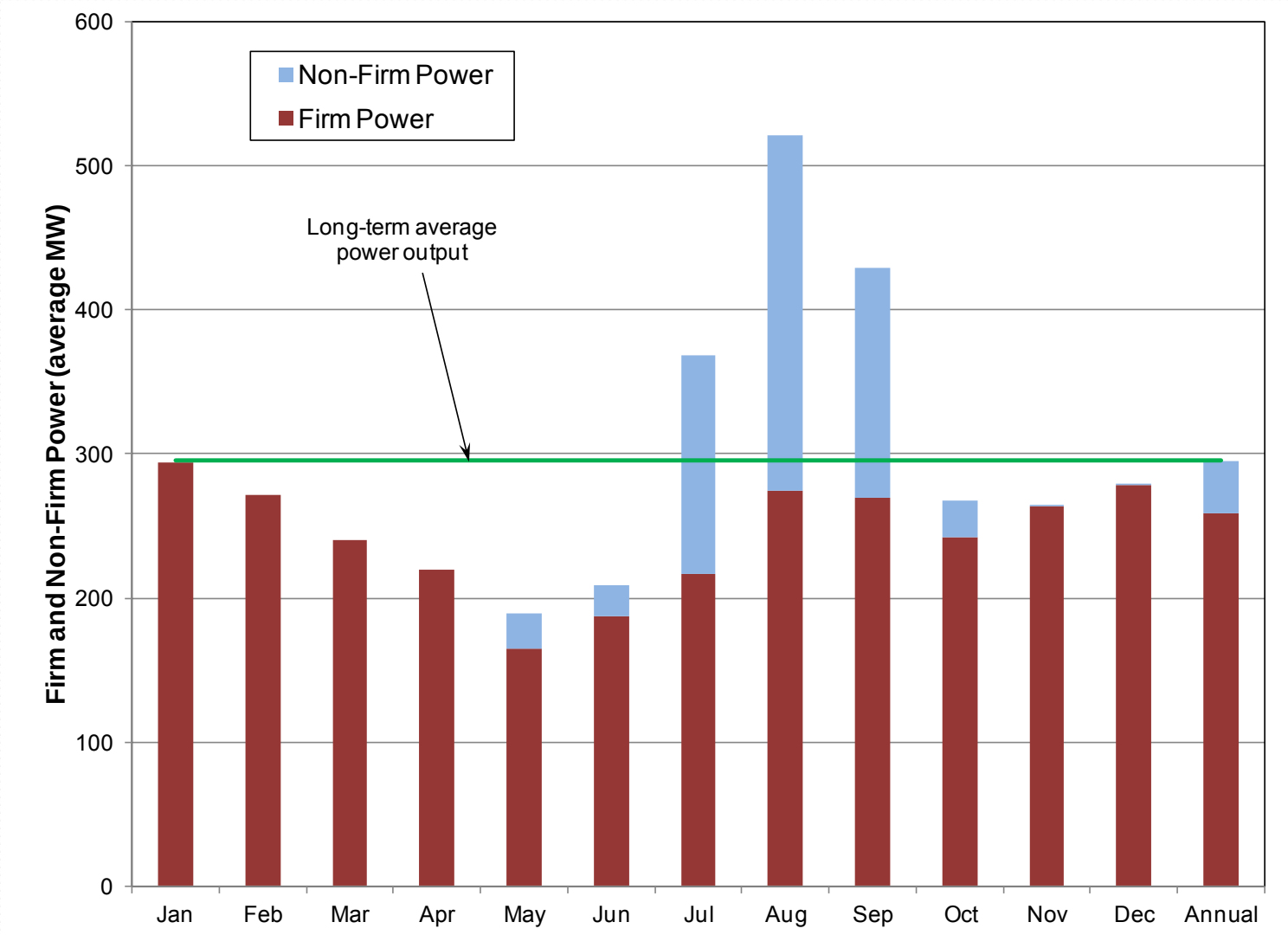
Watana Firm and Non-Firm Power – Base Case



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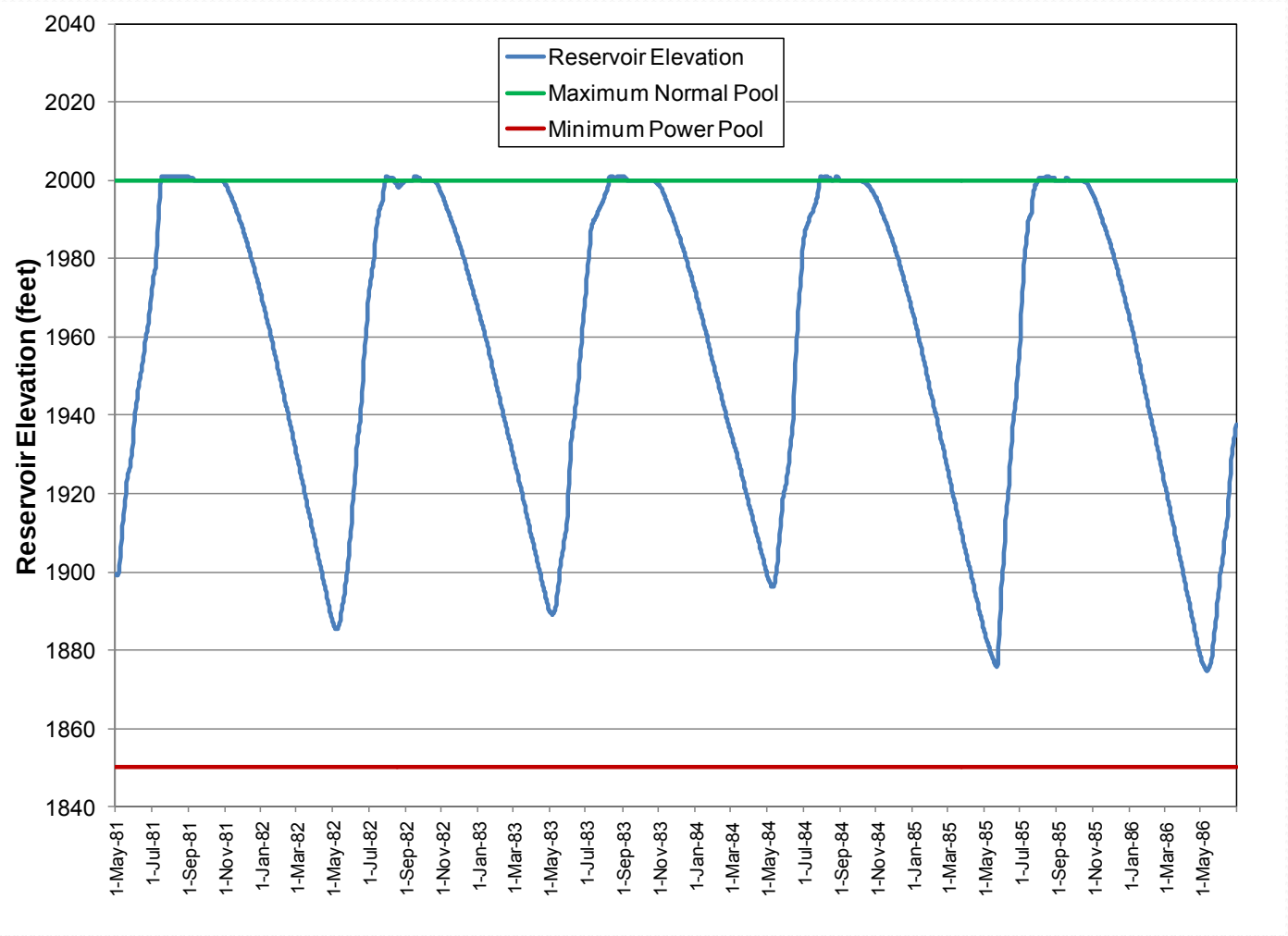
Seasonal Reservoir Elevations – Base Case



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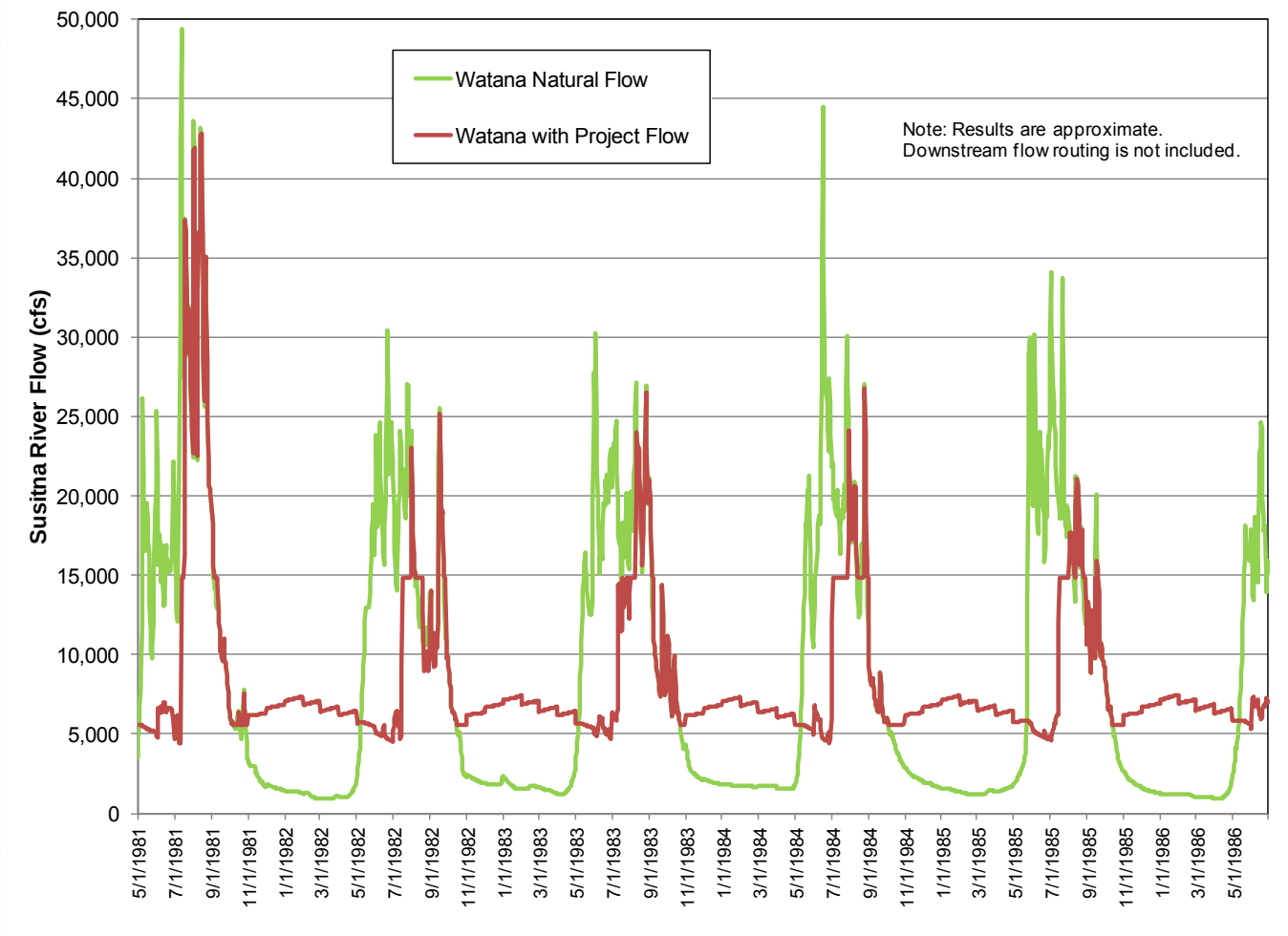
Natural and "With Project" Flows at Watana – Base Case



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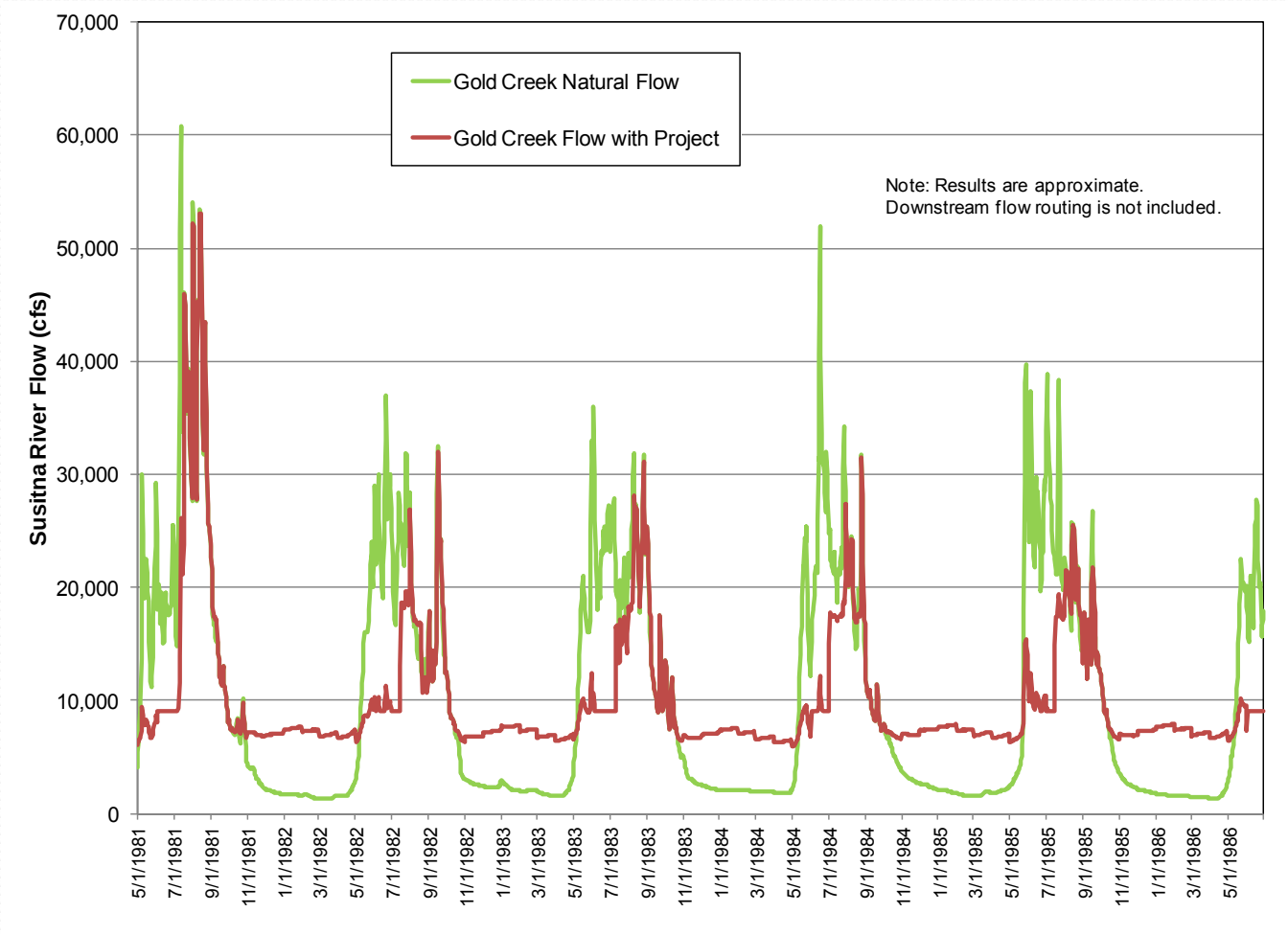
Natural and "With Project" Flows at Gold Creek – Base Case



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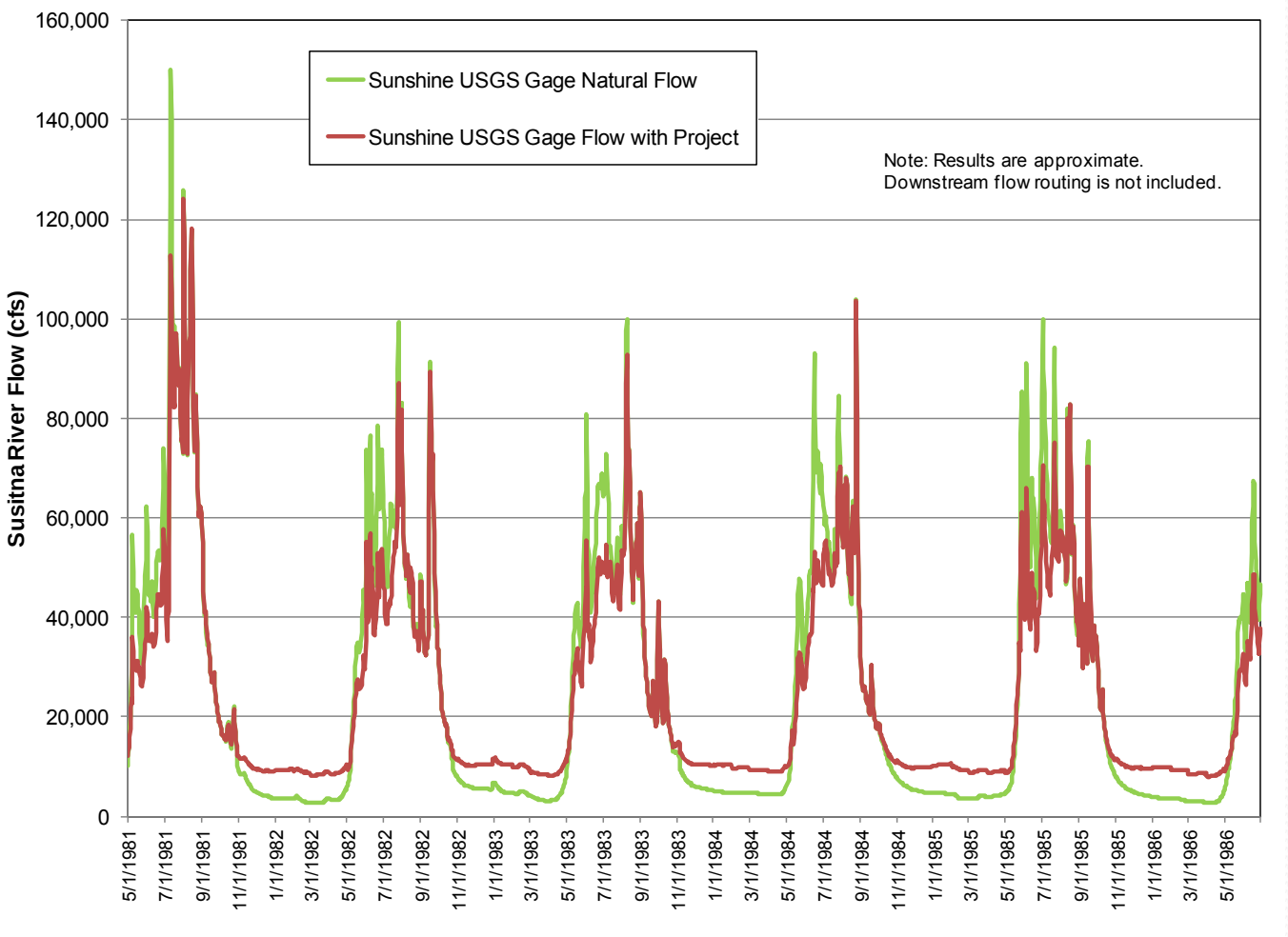
Natural and "With Project" Flow at USGS Sunshine Gage – Base Case



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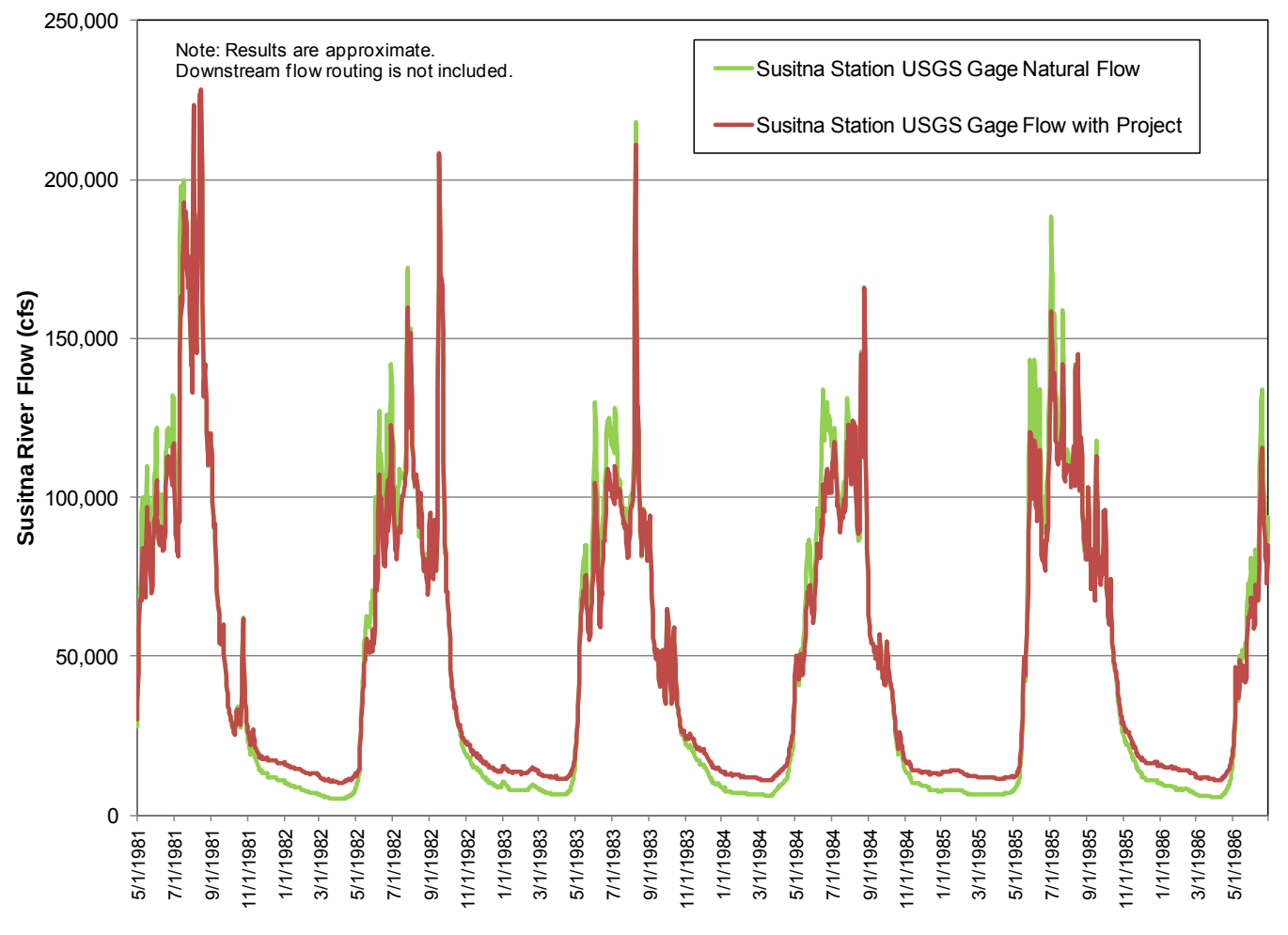
Natural and "With Project" Flows at Susitna Station USGS Gage – Base Case



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Hydrology and Operation Modeling – Next Steps

- Summary to PAD
- Project optimization
  - Dam and reservoir size
  - Installed powerhouse capacity
  - Project operation
- Environmental releases and downstream flow routing
- Responses to Agency and Stakeholder requests

Additional Discussion

- Round Table Discussion
- Hydrologic and Operation Information
- Questions
- Comments