Project Plan: Elwha-Dungeness Watershed Planning Area Prediction of Gaged Streamflows by Modeling

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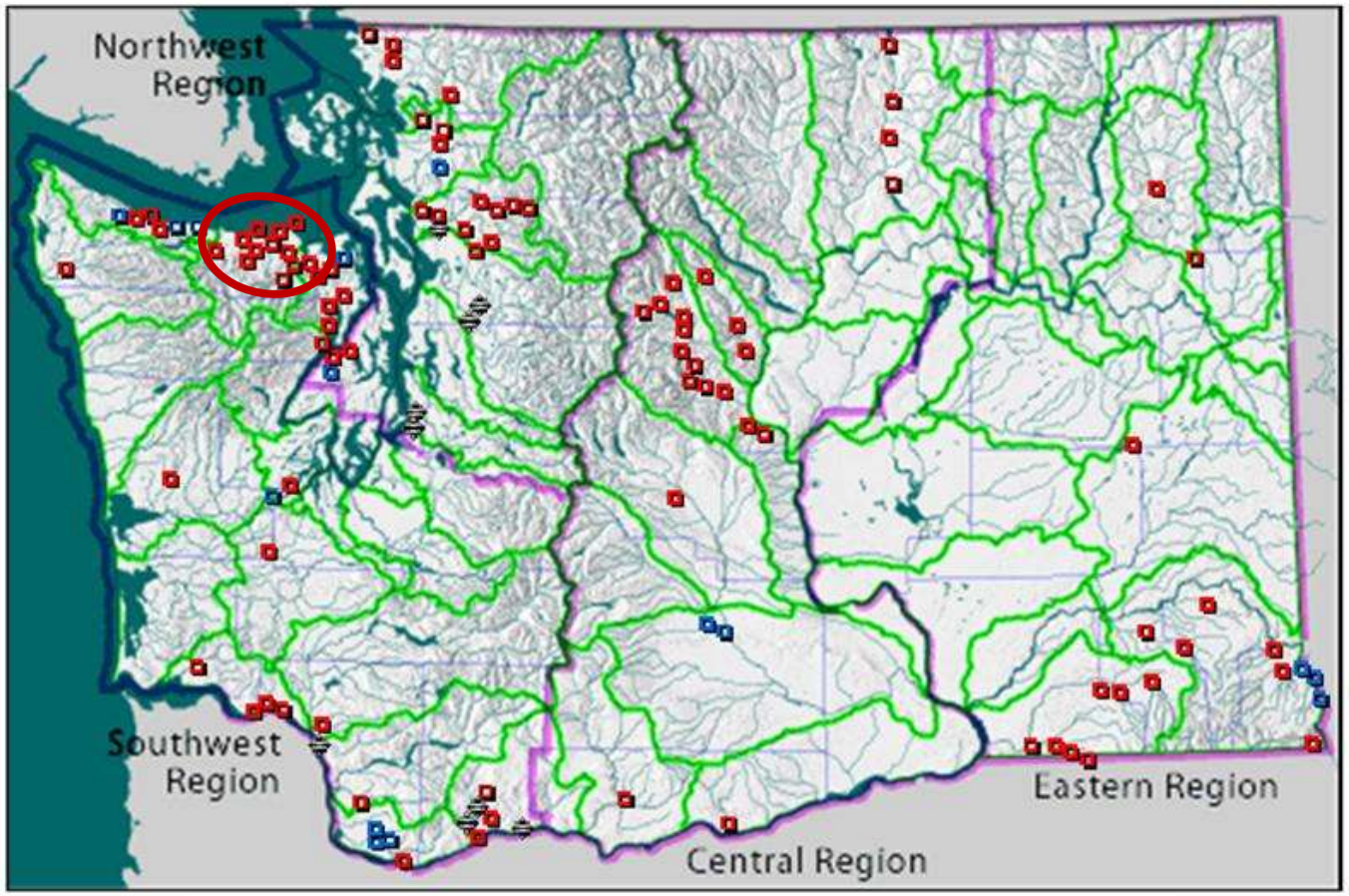
Elwha-Dungeness Basin Prediction of Gaged Flows by Modeling

Department of Ecology Monitoring Stations in Washington State



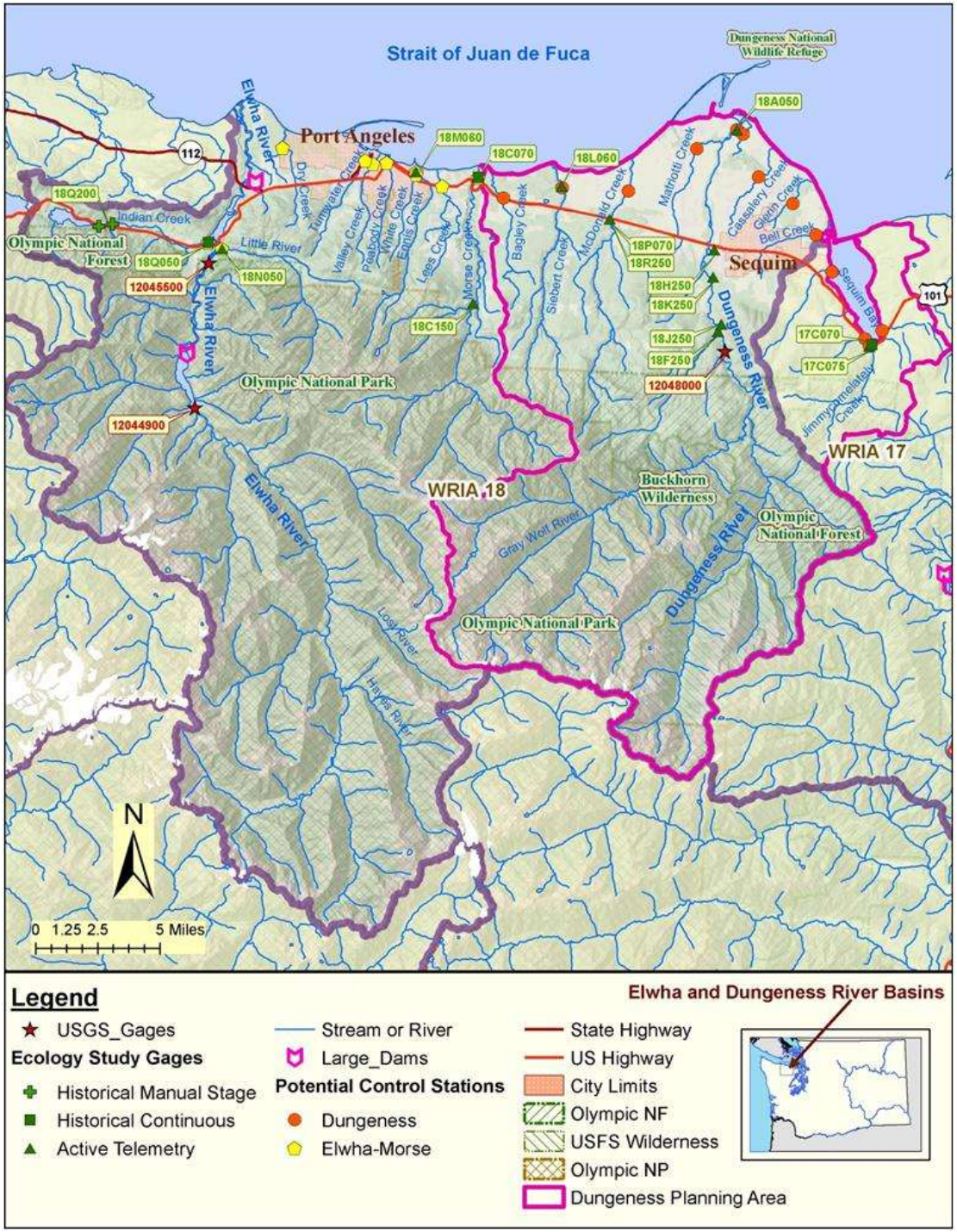
116 stations (active)

KEY

Telemetry [1]	Stand alone [2]	Manual stage height [3]
92 stations	15 stations	9 stations

Background

- Ecology has supported 19 gages in the Elwha-Dungeness watershed planning area
  - 11 active with telemetry
  - 2 historical continuous
  - 2 historical continuous and manual stage height
  - 2 historical manual stage height
  - 2 historical short-term
- Not included in study
  - 1 historic, 2 short-term, and 5 irrigation ditches
- USGS supports 3 active gages in WRIA 18
  - all real-time



Elwha-Dungeness flow gaging stations.

Elwha-Dungeness Basin Prediction of Gaged Flows by Modeling

Ecology Elwha-Dungeness active or recent flow monitoring stations

ID	Station Name	Code	Status	Type[1]	Start	End	No. days	Comment
18Q240	Indian Creek below Lake Sutherland	Ind-LS	Historical	M	16-Apr-03	4-Nov-08	219	
18Q200	Indian Creek near Maple Grove	Ind-MG	Historical	M	16-Apr-03	4-Nov-08	184	
18Q050	Indian Creek at Mouth	Ind-Mou	Historical	C/M	16-Apr-03	28-Sep-10	1575	
18N050	Little River near Mouth	Little	Active	T	30-Oct-02	present	3070	
18M060	Ennis Creek near Mouth	Ennis	Active	T	4-Sep-02	present	3077	
18C150	Morse Creek below Aqueduct	Mor-Aq	Active	T	28-Feb-03	present	2924	Historic USGS 12047300
18C070	Morse Creek at Four Seasons Ranch	Mor-4S	Historical	C	8-Aug-00	30-Sep-10	3539	
18L060	Siebert Creek at Old Olympic Highway	Siebert	Historical	C	23-Aug-02	6-Dec-10	2497	Washed out, removed
18P070	McDonald Creek at Highway 101	McD-101	Active	T	28-Feb-03	present	2745	
18A050	Dungeness River near mouth	Dun-ECY	Active	T	5-Nov-99	present	4191	Schoolhouse Road bridge
17C075	Jimmycomelately Creek at Highway 101	JCL-101	Active	T	15-Jun-05	present	1041	

[1]M = Manual Stage Height; C = Continuous; T = Telemetry

USGS Elwha-Dungeness flow monitoring stations

ID	Station Name	Code	Status	Type[1]	Start	End	No. days	Cooperator[2]
12044900	Elwha River above Lake Mills near Port Angeles	El-aLM	Active	RT	26-Mar-1994	present	4142	USBR
12045500	Elwha River at McDonald Bridge near Port Angeles	El-McD	Active	RT	1-Oct-1918	present	33804	USBR
12048000	Dungeness River near Sequim	Dun-GS	Active	RT	6-Jan-1923	present	29665	ECY

[1]RT = Real-time (Telemetry)

[2]USBR = U.S. Bureau of Reclamation; ECY = Ecology

Background

– Watershed Plan identified potential regulatory control stations for instream flows

- 9 control stations proposed in draft Dungeness rule
  - 2 are at Ecology gages – 1 active, 1 historical
- 4 potential control stations in Sequim Bay watershed
  - 1 is at active Ecology gage
- 10 potential control stations in Elwha-Morse watershed
  - 4 are at Ecology gages, 2 active, 2 historical

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Elwha-Dungeness Potential Regulatory Control Stations

Stream Management Unit Name	Control Station Gage Number	River Mile	Latitude (North) Deg	Min	Sec	Longitude (West) Deg	Min	Sec
Proposed instream flow control stations from draft Dungeness rule (Chapter 173-518 WAC)								
Bagley Creek at Highway 101		1.4	48	5	56	123	19	47
Bell Creek at Schmuck Road		0.2	48	5	1	123	3	25
Cassalery Creek at Woodcock Road		1.8	48	6	59	123	6	31
Dungeness River at Schoolhouse Bridge	ECY 18A050	0.8	48	8	37	123	7	43
Gierin Creek at Holland Road		1.7	48	6	5	123	4	40
Matriotti Creek at Lamar Lane		1.3	48	7	54	123	9	46
McDonald Creek at Old Olympic Highway		1.6	48	6	20	123	13	17
Meadowbrook Creek at Sequim-Dungeness Way		1.2	48	8	41	123	7	27
Siebert Creek at Old Olympic Highway	ECY 18L060	1.3	48	6	24	123	16	42
Potential instream flow control stations for the Sequim Bay watershed (from Elwha-Dungeness Watershed Plan)								
Chicken Coop Creek at East Sequim Bay Road		0.1	48	1	45	122	59	41
Dean Creek at Highway 101		0.2	48	1	26	123	0	41
Jimmycomelately Creek at Old Blyn Highway	ECY 17C075	0.3	48	1	11	123	0	26
Johnson Creek at West Sequim Bay Road		0.1	48	3	45	123	2	32
Potential instream flow control stations for Elwha-Morse watershed (from Elwha-Dungeness Watershed Plan)								
Dry Creek below Lower Elwha Road		0.8	48	7	25	123	31	23
Ennis Creek below White Creek	ECY 18M060	0.3	48	6	45	123	24	23
White Creek above Ennis Creek		0.1	48	6	39	123	24	22
Indian Creek near mouth	ECY 18Q050	0.1	48	4	0	123	35	4
Lees Creek near mouth		0.8	48	6	17	123	22	59
Little River near mouth	ECY 18N050	0.2	48	3	48	123	34	21
Morse Creek at Highway 101	ECY 18C070	1.1	48	6	38	123	21	8
Peabody Creek above Peabody Street		0.2	48	7	2	123	25	55
Tumwater Creek near mouth		0.5	48	7	5	123	27	3
Valley Creek near mouth		0.6	48	6	59	123	26	39

Streamflow Patterns

- Elwha R flows highest, increase in downstream direction
- Dungeness flows next highest, decreasing downstream
- Morse Creek flows also decreasing downstream
- Higher elevation streams show “bi-modal” flow
  - winter rainfall runoff and spring snowmelt
  - Elwha, Dungeness, and Little Rivers; and Morse Creek
- Lower elevation streams are rainfall dominated
  - Wide range of flows with very low summer flows
  - Broader range to east compared to west
- Inter-annual flows also variable

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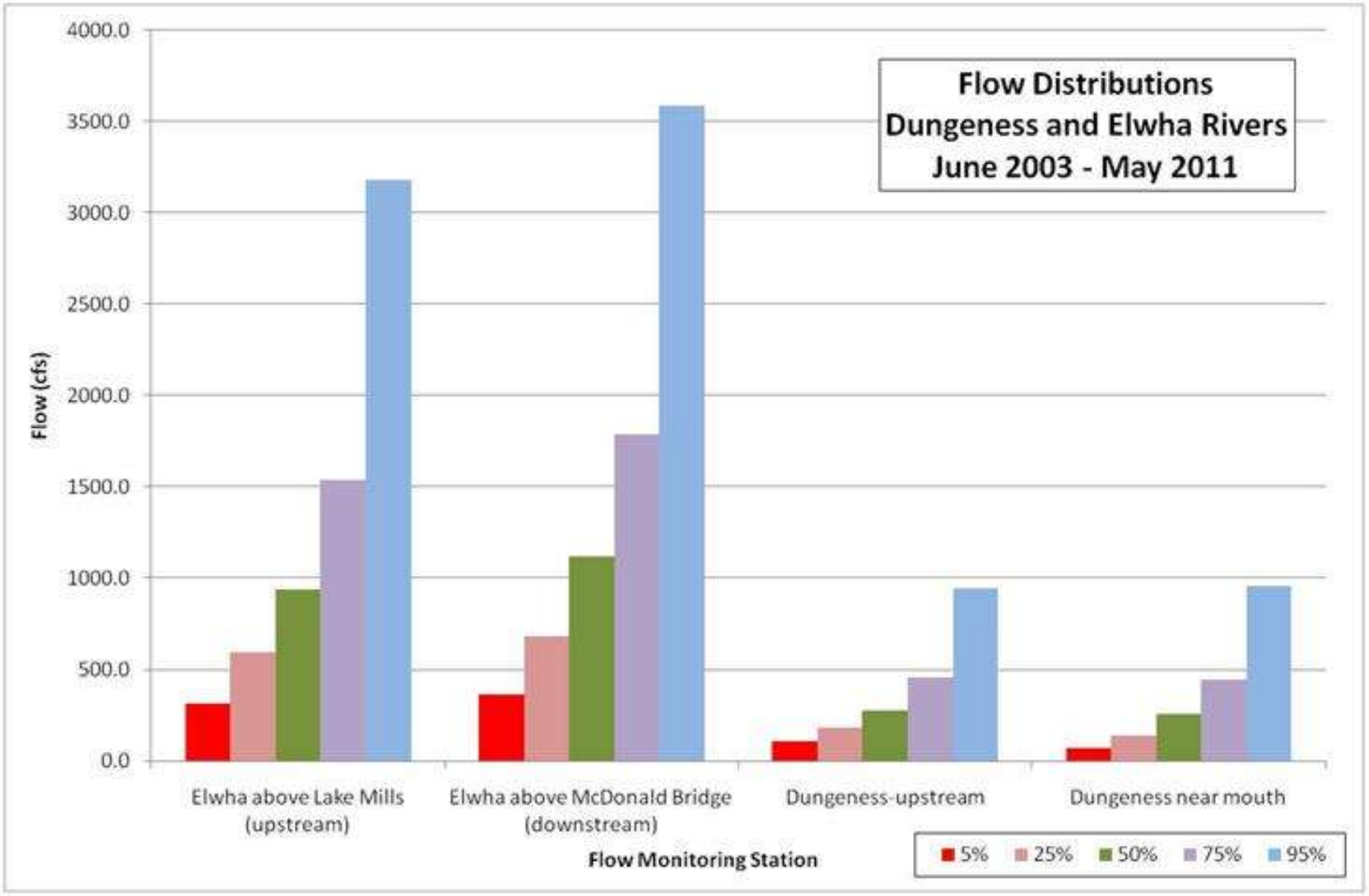

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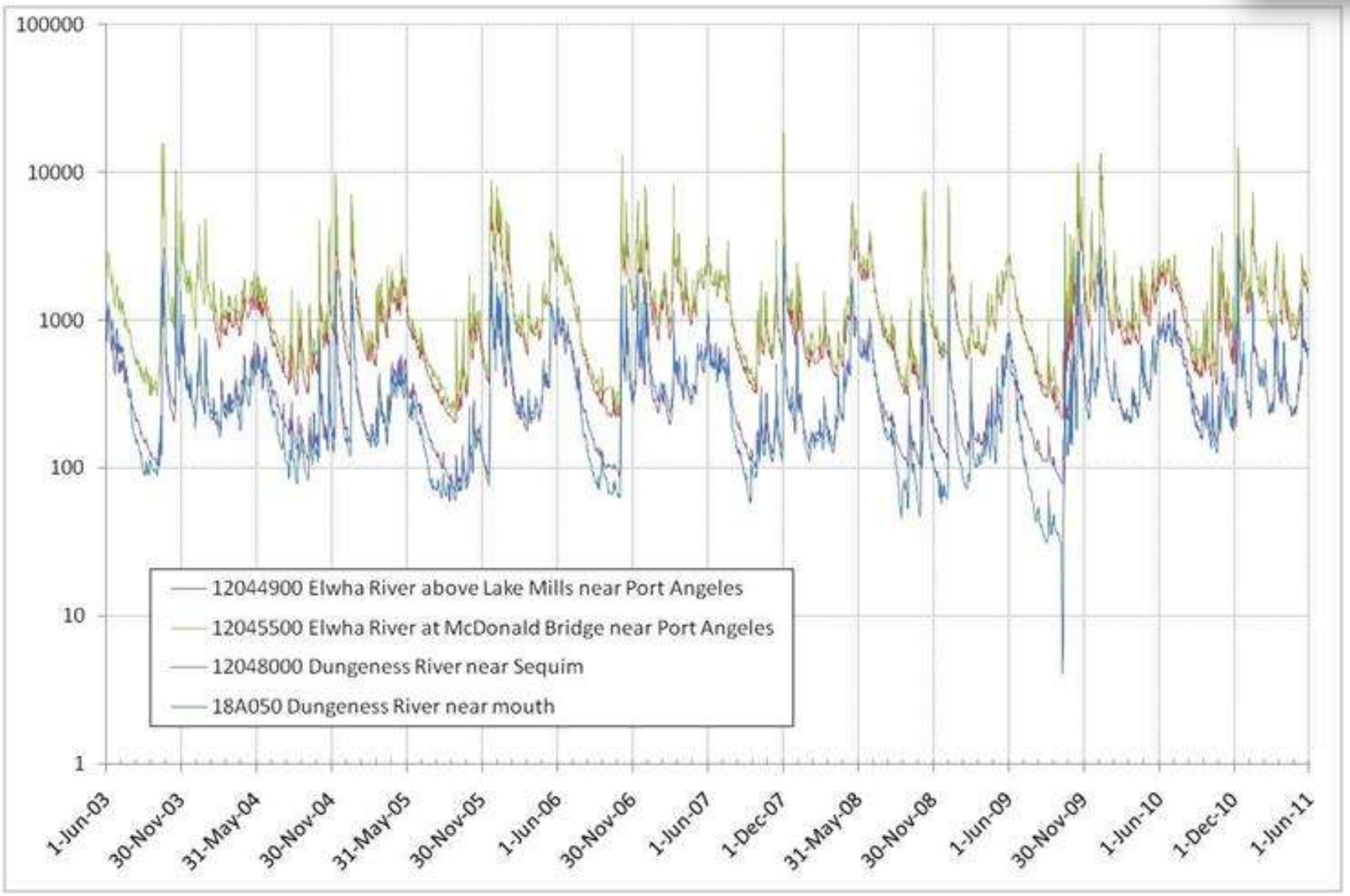

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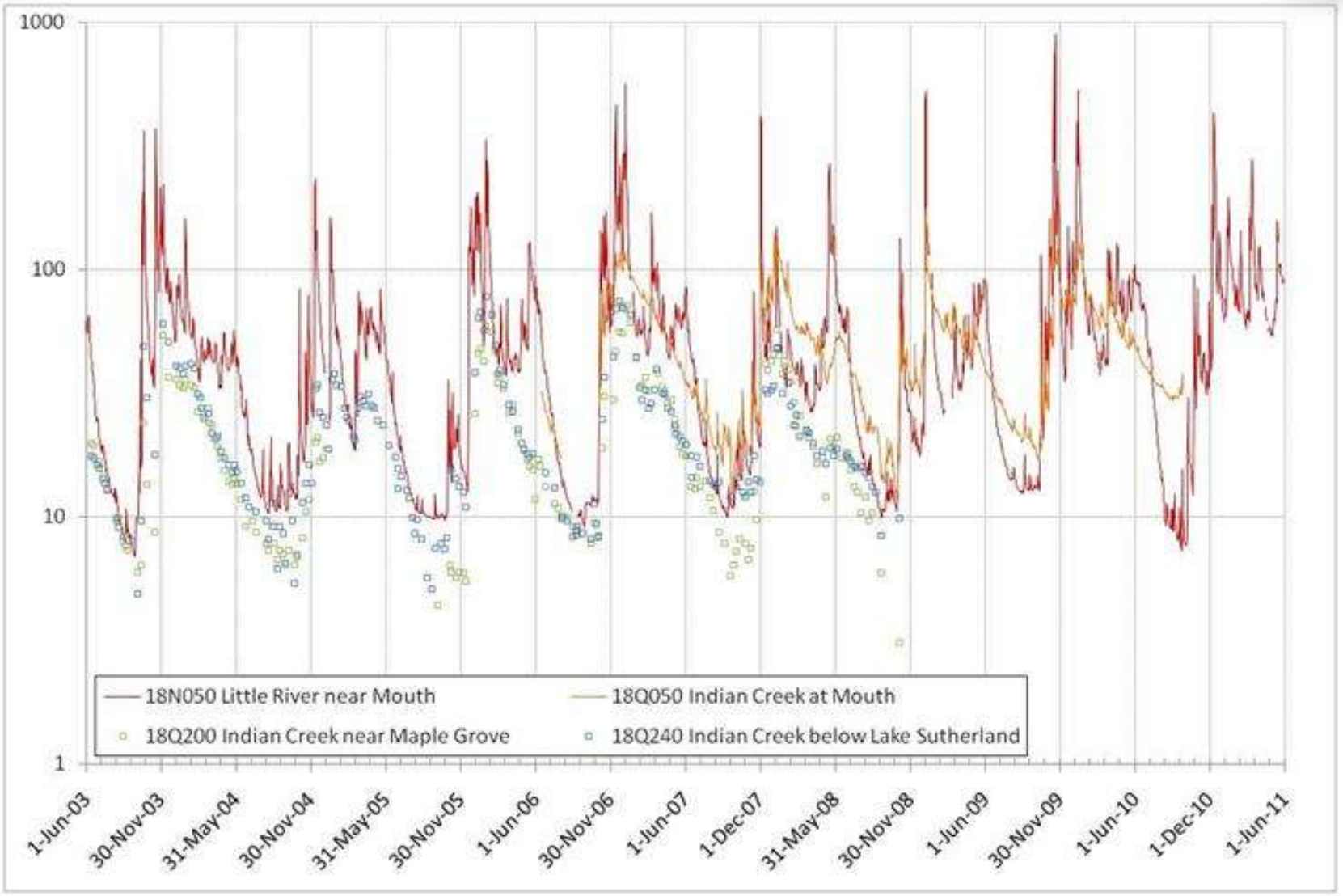

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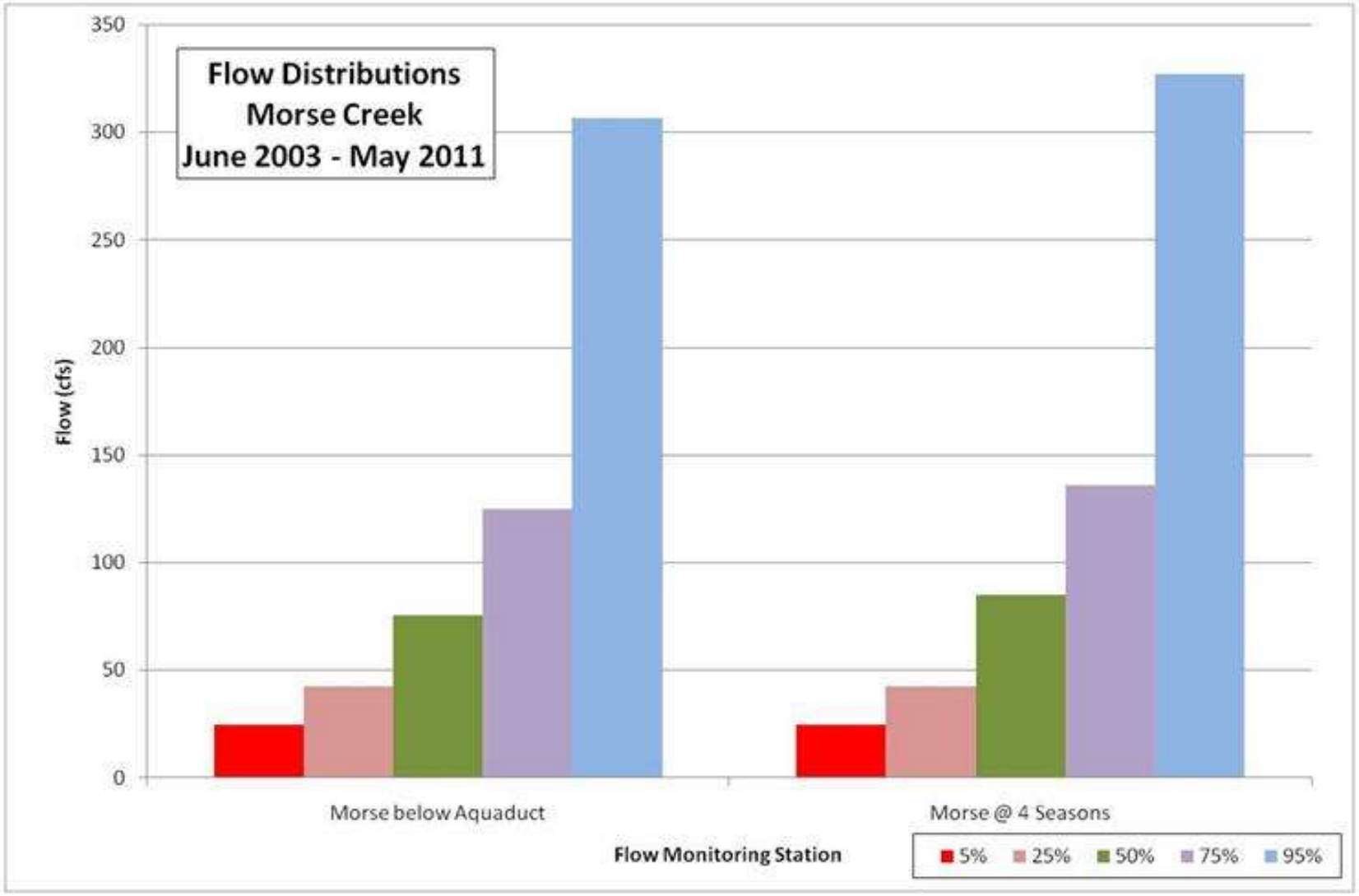

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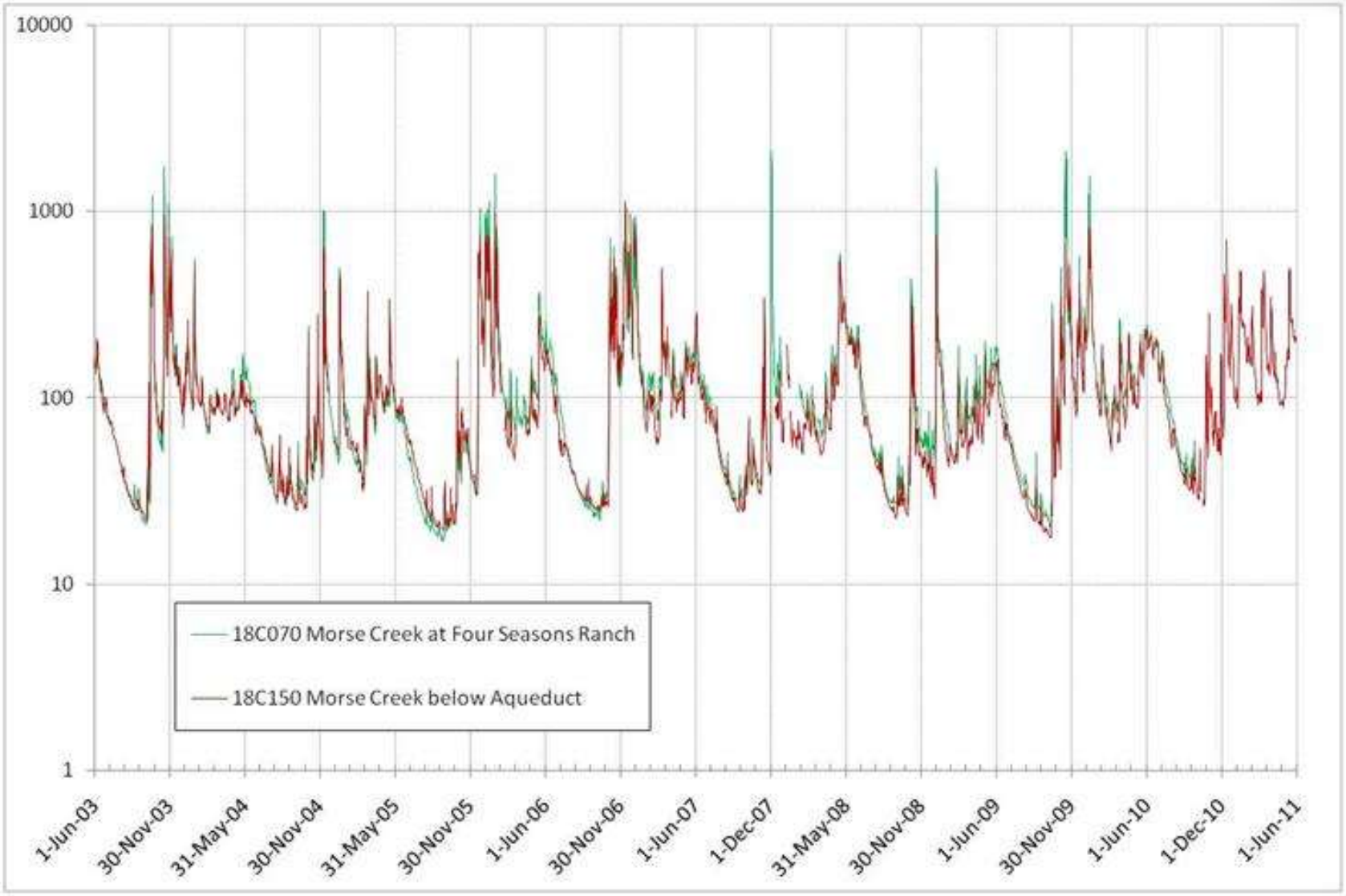

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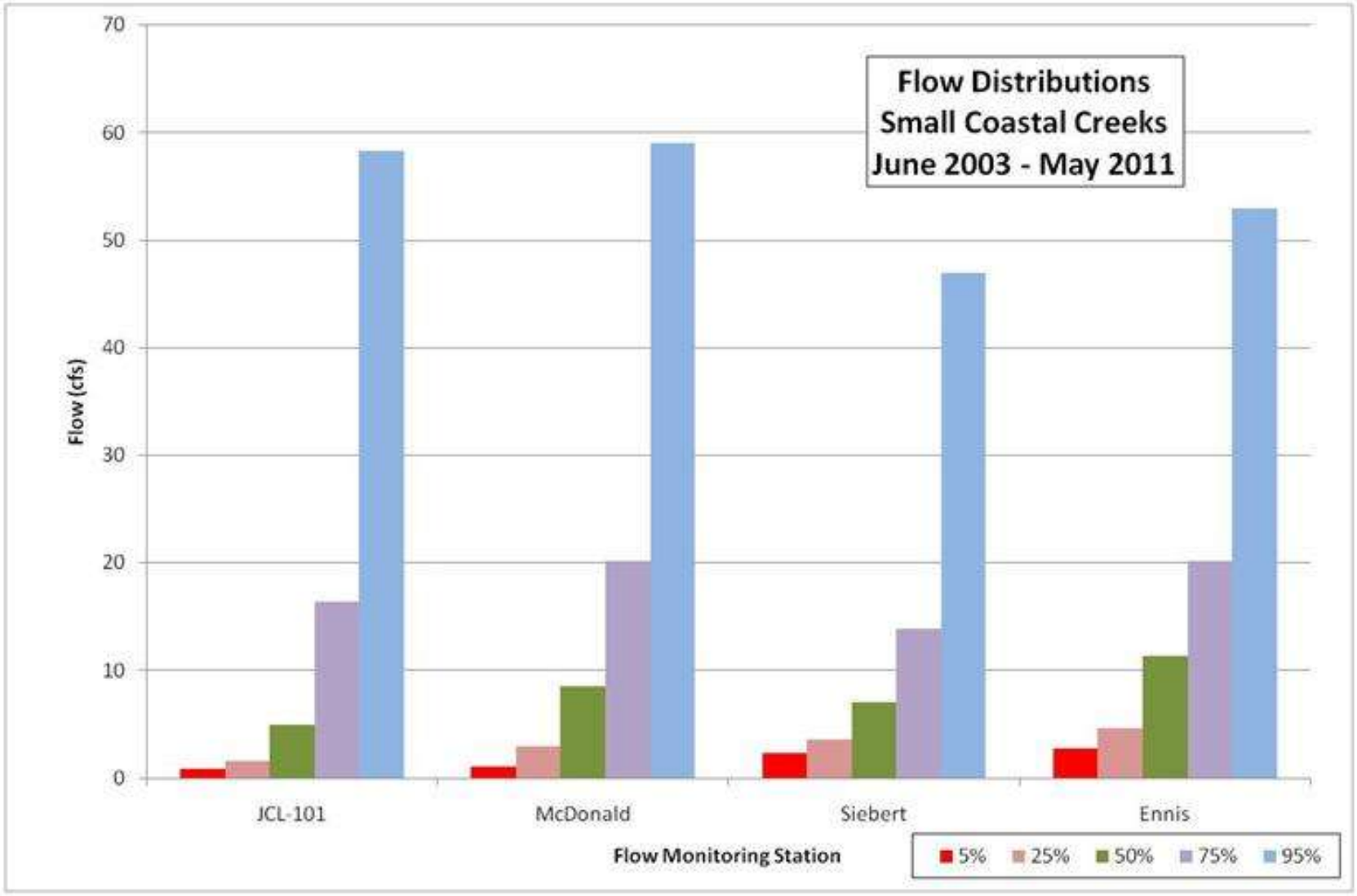

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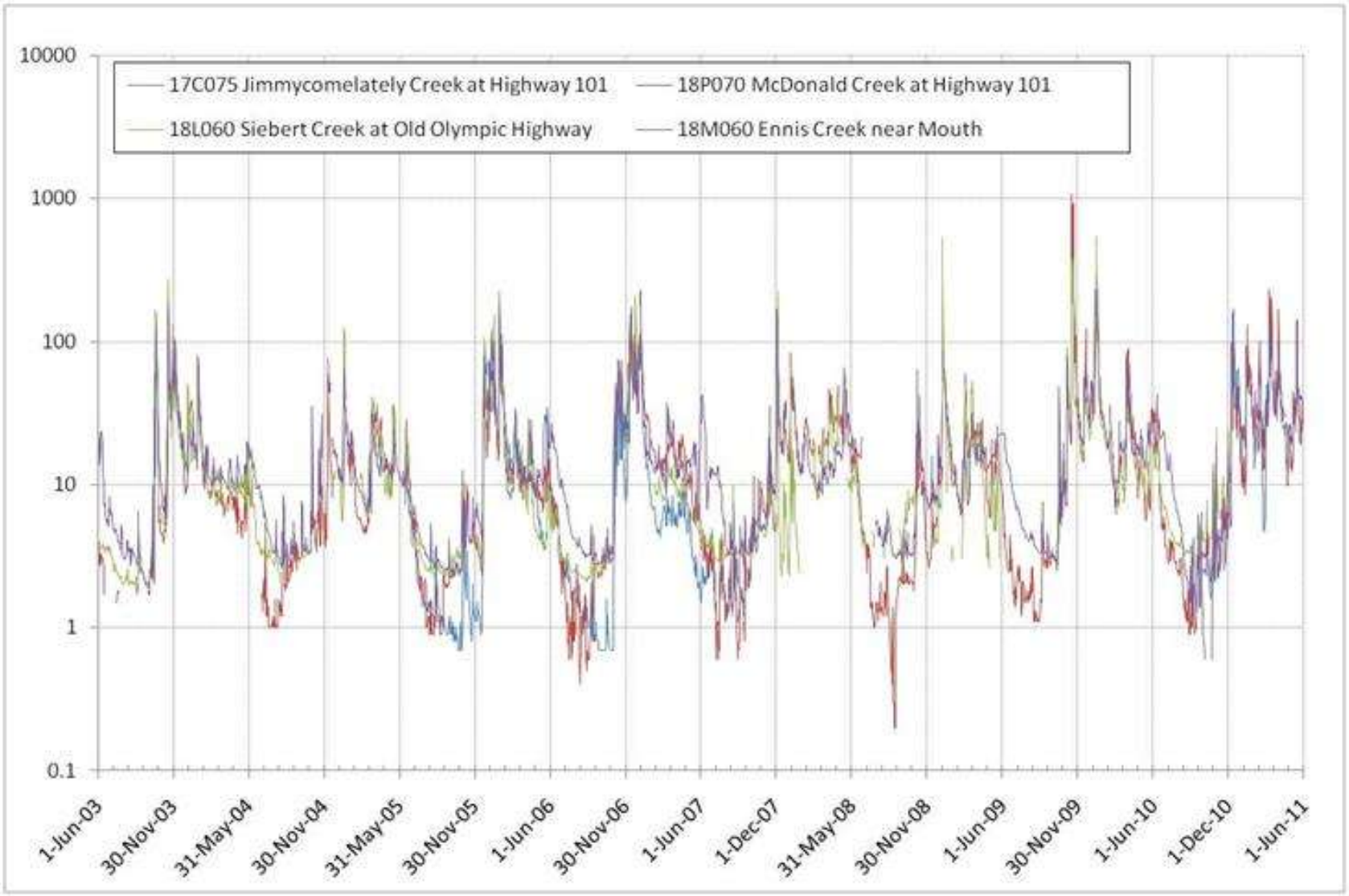


Goals

– Develop modeling tools to predict flows for Ecology flow monitoring

– Assess their ability to support water management activities for DRMT, EMMT, and Ecology

–Support Ecology decisions about flow gaging resources statewide.

Objectives

- Develop models to predict flows at Ecology flow gages from USGS and Ecology flow stations
- Review potential control stations for flow measurement and estimation
- Evaluate any existing hydrologic models
- Assess quality of models
- Recommend long-term approach to using models
- Identify data gaps and additional work
- Provide training and technology transfer

Model Development

- A number of methods will be explored, including:
  - Simple linear regression or regression after data transformation (e.g. log-transform).
  - Time lagging of data.
  - Hydrograph separation.
  - Simple hydrologic routing models.
  - Inclusion of other non-hydrologic data.
- Work from simplest to most complex
  - Move to complex if quality of simpler inadequate, data are available, and need meets priority of station

Elwha-Dungeness Basin Prediction of Gaged Flows by Modeling

	JCL-101	Dun-ECY	McD-101	Siebert**	Mor-4S*	Mor-Aq	Ennis	Little	Ind-Mou*	Ind-MG*	Ind-LS*	El-aLM	El-McD
Dun-ECY	0.62												
McD-101	**0.86**	0.50											
Siebert**	**0.87**	0.61	**0.78**										
Mor-4S*	**0.79**	**0.85**	**0.72**	**0.86**									
Mor-Aq	**0.78**	**0.84**	**0.77**	**0.77**	**0.94**								
Ennis	**0.86**	**0.70**	**0.87**	**0.86**	**0.85**	**0.84**							
Little	**0.82**	**0.76**	**0.80**	**0.84**	**0.91**	**0.89**	**0.89**						
Ind-Mou*	0.69	0.42	0.51	0.58	0.61	0.57	0.60	**0.70**					
Ind-MG*	0.67	0.30	0.64	0.52	0.46	0.49	0.59	0.63	**0.93**				
Ind-LS*	**0.73**	0.41	**0.71**	0.69	0.55	0.54	0.70	**0.71**	**0.90**	**0.92**			
El-aLM	0.57	**0.91**	0.48	0.62	**0.87**	**0.85**	**0.70**	**0.80**	0.43	0.32	0.42		
El-McD	0.58	**0.89**	0.51	0.66	**0.88**	**0.87**	**0.71**	**0.80**	0.46	0.31	0.45	**0.99**	
Dun-GS	0.57	**0.97**	0.48	0.61	**0.84**	**0.83**	0.69	**0.76**	0.35	0.24	0.35	**0.92**	**0.92**

ECY-Telemetry

ECY-Manual Stage Height

USGS

Potential Control Station

***Historical gage**

****Damaged gage**

Model Quality Assessment

- Bias
  - Relative Percent Difference (RPD)
- Precision
  - Percent Relative Standard Deviation (%RSD)
- Robustness
  - Performs well under the full range of conditions
- Sensitivity
  - Influence of model inputs

Possible Recommendations from project

– Quality of regression models for flow estimation

Median %RSD for annual streamflow and summer baseflow	Characterization
Less than 5%	Very Good
Greater than 5% and less than 15%	Good
Greater than 15% and less than 30%	Fair
Greater than 30%	Poor

–Compare model results to questionnaire results

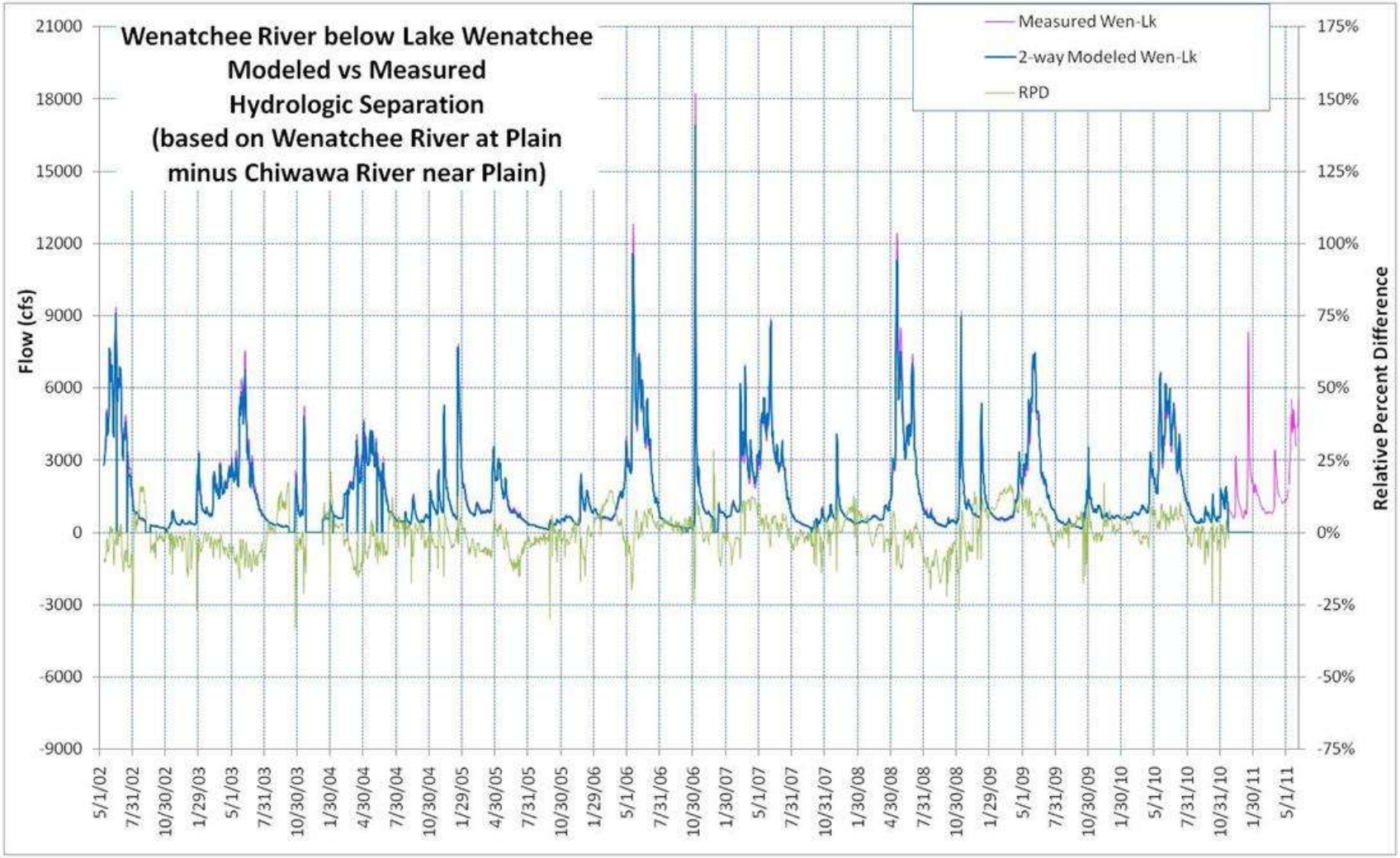
- How do needs compare to available tools?
- How does model quality inform prioritization of stations?

– Identify data gaps

– Identify future modeling work requiring additional data

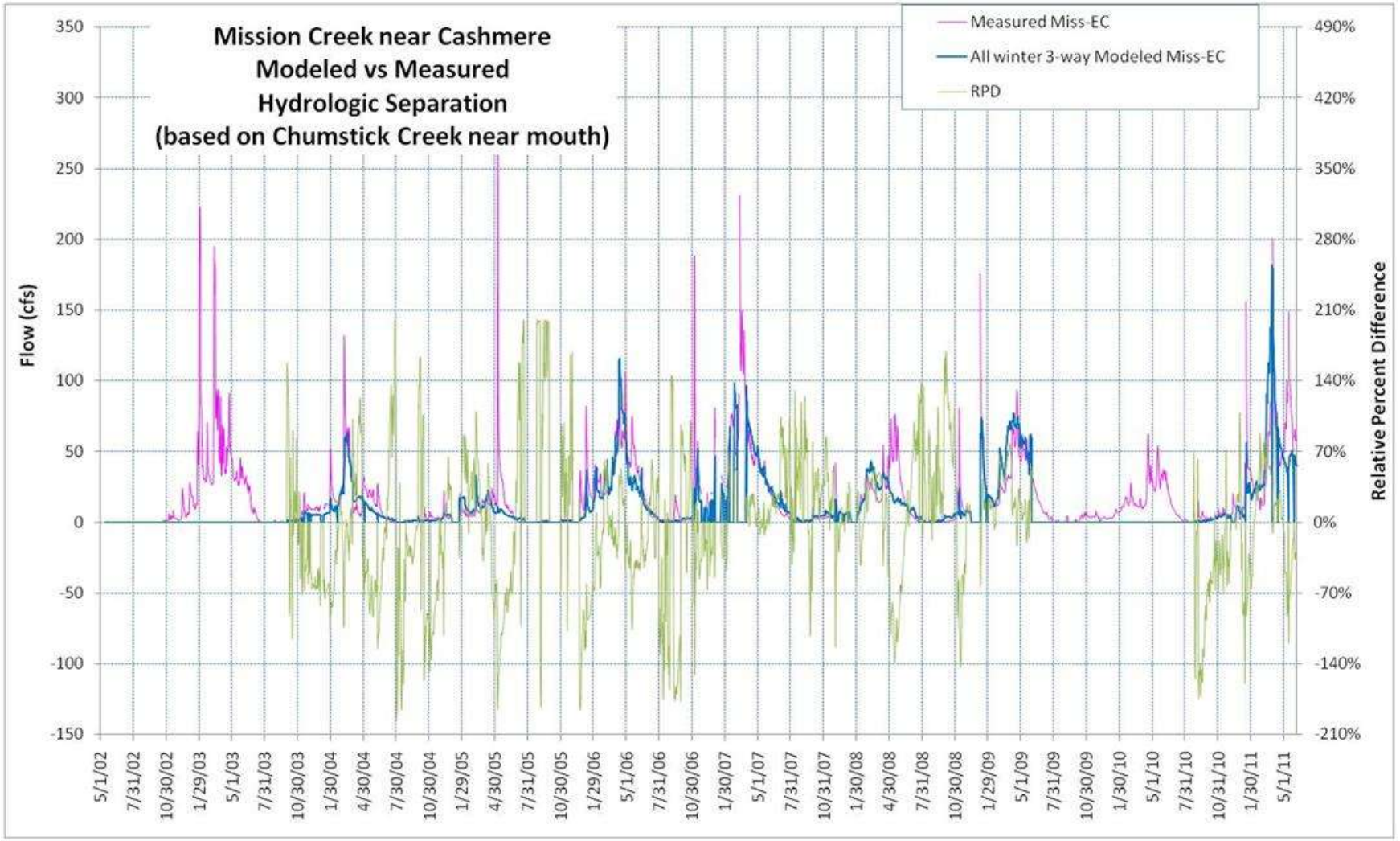
Examples of regression-based models

– Very good regression: Wenatchee River below Lake Wenatchee



Examples of regression-based models

– Poor regression: Mission Creek near Cashmere



Possible Recommendations from project

- Future of gaging stations:
  - Continued operation of the station as a telemetry gage
    - Full Ecology support
    - Seek alternative funding to support continued operation
  - Reallocation to manual-stage-height using modeled flows combined with spot flow measurements for confirmation of modeled flows.
  - Decommissioning of station, replaced with modeling of flows and spot flow measurements for confirmation of modeled flows.
  - Transfer of the station to another party.

Schedule

- Internal review of Project Plan complete
- Review of draft Project Plan by DRMT and EMMT
  - Comments due July 29, 2011
- Technical Analysis: July - September 2011
- Report review: September - October 2011
- Fall 2011: Agency review of gages and decision on retaining, decommissioning, or transferring gages
- Fall 2011 & future: Training and Technical Transfer

Responsible staff

- Paul Pickett
  - Environmental Assessment Program, technical lead
- Cynthia Nelson
  - Ecology Watershed Lead, Southwest Regional Office
- Bill Zachmann,
  - SEA Program, lead for statewide Gaging Strategy Workgroup
- Brad Hopkins
  - EA Program, lead for statewide flow gaging network

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