Icicle Creek Instream Flow Sub Committee

Of the Icicle Work Group

March 28, 2014

- This is a working presentation. The IFC will discuss technical issues in relation to the slide content.

- Outcome (after 2nd IFC meeting): how project alternatives benefit instream flow, fish, and habitat.

IFC Primary Tasks

- Scientific defense for IWG recommendations
- Understand fish, flow, and instream habitat relationships
  - ESA – Bull trout, steelhead, spring Chinook
  - Other species – whitefish, lamprey, resident fish & shellfish
- Fish, flow, and instream habitat guidance for water management below RM 5.8

IFC Primary Tasks – cont.

- Reach agreement on biological & hydrological criteria
  - Specific reach needs
- Template for future technical review
- Identify data gaps

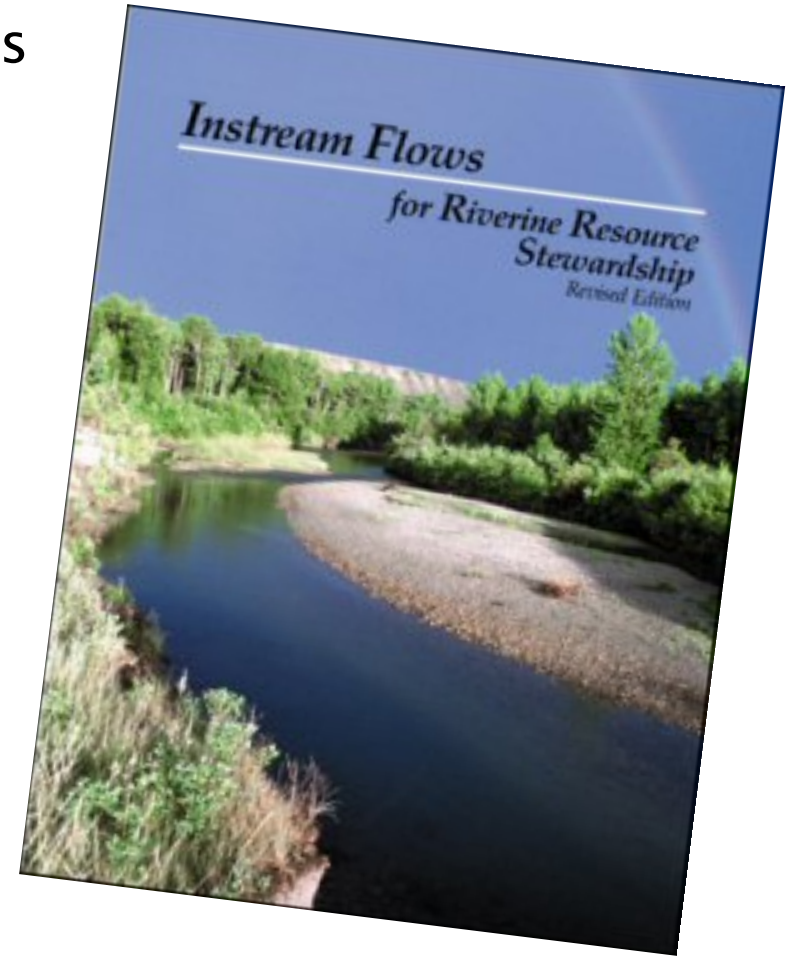
IFC Primary Tasks – cont.

- Assess flow & habitat effects/benefits from…
  - Alpine Lakes alternatives
  - Eightmile Lake storage alternatives
  - Icicle – Peshastin Irrigation District Pump Exchange project
  - Irrigation districts efficiencies
  - Groundwater studies
  - Instream flow rule feasibility – **0.4 cfs reservation allotment**
  - Sediment transport & hydrology link to instream habitat

Science Provides Best Information

- Basic Instream Flow Science
  - Eight Ecosystem Components

1. Hydrology
2. Geomorphology
3. Biology
4. Water Quality
5. Connectivity
6. Public Involvement
7. Legal
8. Institutional



IFC will NOT…..

- Address public involvement
- Address institutional needs
- Address water right validity, unless relevant
- Address screening violations
- Address recovery actions

Fish Species and Status

- **Bull trout** – ESA Threatened; adfluvial, fluvial, and resident stocks; adults, subadults, juveniles
  - est. 525 fish/mile (USFS analysis 2007)
  - smallest core Wenatchee population
- **Spring Chinook** – ESA Endangered; hatchery stock management
- **Steelhead** – ESA Threatened; No more hatchery releases. Remnant natural stock
  - Production = low

Fish Species Status – cont.

- Hatchery coho
  - Future natural production = ?
- Rainbow trout
  - 800 fish/mile (WFC 2007)
  - stocked until 1992
- Resident
  - whitefish, westslope cutthroat, redband trout, lamprey, suckers, & more
- Non resident – Brook trout

- Shellfish – biologic, cultural, & ecosystem values important

Basic Fish Needs in Lower Icicle

- Cool clean water
- Specific velocities and depth
- No migration barriers
  - includes flow
- Pools for holding
- Cover
  - avoid predators, BT subadult & adult

Basic Fish Needs – cont.

- Forage for juveniles and migrating stocks
- Substrate/gravel
  - low embeddedness
- Refuge for juveniles; low velocity water
  - Link to riparian health
  - boulders
- Over wintering habitat
- Gene fitness
  - adapt to environment; linked to passage & distribution

Target Reaches

- **Reach 1-** Upstream of Icicle & Peshastin ID POD; RM 5.7 to headwaters
- **Reach 2** – Between ID POD and LNFH POD; RM 4.5 – 5.7
- **Reach 3** – Between LNFH POD and the hatchery outflow; RM 2.7 – 4.5
- **Reach 4** – Downstream of hatchery outflow to the confluence with Wenatchee River; RM 0.0 – 2.7

Fish & Flow Habitat Functions

- Passage
  - weirs, depth, temperature, boulder field
- Cover
  - adult &juvenile refuge, including refuge for Wenatchee core BT population during fluvial migration
- Spawning
  - substrate, velocity, depth
- Rearing
  - velocity, depth,
- Channel complexity
  - low energy zones, riparian connectivity

Habitat Suitability Preferences

Species & Life Stage	Depth (ft)	Velocity (fps)	Notes
Bull trout – rearing	1.60 – 1.79	.40 – 0.49	> 35 ft width
Bull trout – spawning	.80 – .89	.70 – 0.89	
SH – rearing	2.80 – 2.89	1.40 – 1.49	> 35 ft width
SH – spawning	1.30 – 1.49	2.10 – 2.19	
Sp. Chin – rearing	2.20 – 2.29	.60 – 0.69	
Sp. Chin – spawning	1.0 – 1.09	1.90 – 2.29	
RB trout – rearing	2.80 – 2.89	1.40 – 1.49	
RB trout – spawning	.5–.59; .9–.99	1.60 – 1.89	
Whitefish – rearing	3.50 – 3.59	1.50 – 1.59	
Whitefish – adults	3.10 – 3.29	1.90 – 1.99	Combined spawning & holding

Instream Flow Study Guidelines, WDFW, Ecology 2013

Instream Habitat Values Important for Fish in Icicle Creek

- Channel meandering
- Instream debris
- Depth
- Velocity
- Substrate embeddedness
- Cover
- Hyporheic flows

How & When Does Water Savings Benefit Fish Life?

- **Passage**
  - Summer low flow
  - Culverts, by-pass, diversions, other structures

- **Fish Presence**
  - Time of year – migration needs
  - Rearing & spawning
  - Trophic relationships

- **Future Conditions**
  - Does the project facilitate barrier removal?
  - Flow supplementation potential – during which life stage?

- **Ancillary Benefits**
  - Eco-connectivity

Complex Instream Flow & Habitat Studies

- **USFWS 2013**
  - Historical channel; RM 2.7 to 3.8
    - IFIM – River 2D
- **USBOR, 2005**
  - Downstream of LNFH; RM 0.2 to 2.4
    - PHABSIM
- **Montgomery Water Group, Inc., 2004**
  - RM 3.9 to 4.5
    - Tennant, Hatfield & Bruce, PHABSIM, and fish passage depth
- **Wild Fish Conservancy 2007** – fish, fish passage, & habitat
- **1985 study?**

Icicle Instream Flows – General Info

- Icicle Creek provides 19 % of total Wenatchee River summer low flows.
- Minimum = 44 cfs
- Maximum = 14,100 cfs?
- On 303 (d) list – low flows (2008)
- Water temperature exceeds 15º C (2008)
- Peak flows reduced
  - Impacts complexity & diversity in historical channel

Weighted Usable Area (WUA)

USFWS 2013 – Historical Channel; RM 2.7 to 3.8

	Spawning			Rearing	
Species	Converted Max WUA * to ft2	Corresp Flows*		Converted Max WUA* to ft2	Corresp. Flows
		USGS	Str 2		USGS	Str2
Coho	6,178	129	90	NA	NA	NA
Chinook	3,304	193	140	8,083	193	140
Steelhead	5,651	218	160	9,752	325	250
Rainbow	1,571	129	90	9,752	325	250
Cutthroat	1,679	NA	30	6,533	193	140
Whitefish	6,770	596	500	12,787	1,115	950
Lamprey	2,615	NA	40	BT-8,686	243	180
Suckers	1,571	129	90	4,606	NA	50

* Flows are in cfs

* WUA was sq. meters of habitat per 1,000 lineal feet of stream

Weighted Usable Area (WUA)

Species	Max WUA*	Spawning Flows*	Max WUA	Rearing Flows
Chinook	45,263	400	16,366	250
Steelhead	29,411	650	15,970	550
Bull trout	18,817	70	7,257	40

USBOR 2005 – Confluence to LNFH; RM 0.2 to 2.4 PHABSIM

Species	WUA	Flows
Steelhead juveniles	141	291
Bull trout – adults & juveniles	51.8	291

Montgomery 2004 – RM 3.9 to 4.5 PHABSIM

Species	Rearing & Spawning Optimal Flows (cfs)	
Chinook	156	271
Steelhead	181	302
Rainbow	193	330

Montgomery 2004 – RM 3.9 to 4.5 Hatfield & Bruce method

* All flows are in cfs

* WUA is sq. feet of habitat per 1,000 lineal feet of stream

Flow & Habitat Data Summary By Reach

Spawning

	Steelhead		Chinook		Bull trout		Rainbow	
Reach	WUA	Flow	WUA	Flow	WUA	Flow	WUA	Flow
1	no data		no data		present		present	
2	–	302	–	271	–	–	–	330
3	5,651	160	3,304	140	–	–	1,571	90
4	29,411	650	45,263	400	18,817	70	–	–

Rearing

	Steelhead		Chinook		Bull trout		Rainbow	
Reach	WUA	Flow	WUA	Flow	WUA	Flow	WUA	Flow
1	no data		no data		present		present	
2	–	181	–	156	–	291	–	193
3	9,752	250	8,083	140	8,686	180	9,752	250
4	15,970	550	16,366	250	7,257	40	–	–

Icicle Creek Instream Flow Rule 2008 And Historical Flows Upstream at RM 5.8

Are these Qi appropriate flows for above the LNFH?

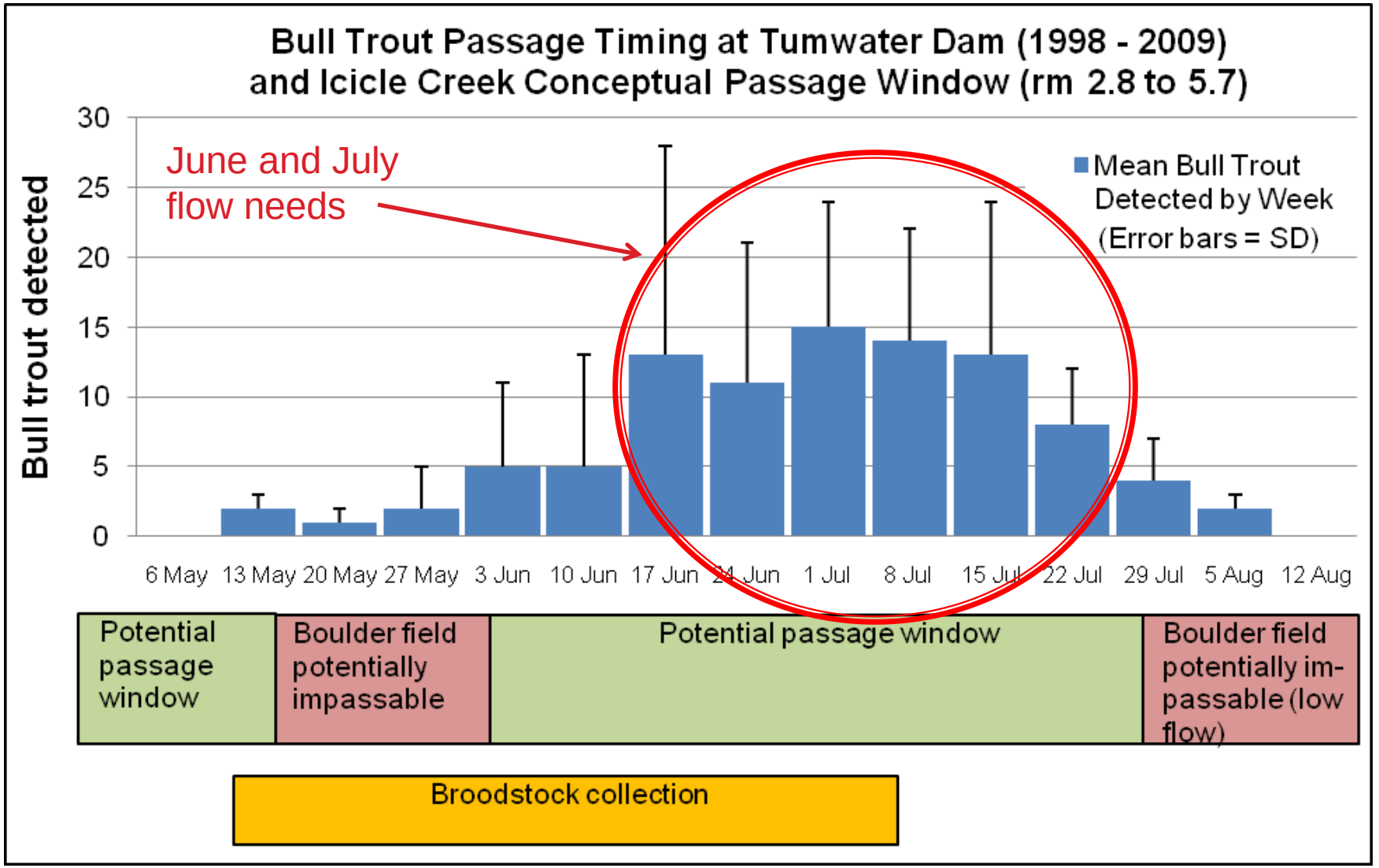
Month/Day	Rule cfs, RM 1.5	Monthly Mean at RM 5.8*
January 1	267	303
Feb 1	267	293
Feb 15	566	
March 1	518	299
April 1	650	661
May 1	650	1,690
June 1	650	1,890
June 15	550	
July 1	550	874
Aug 1	400	264
Aug 15	343	
Sept 1	275	161
Oct 1	267	235
Nov 1	267	402
Dec 1	267	341

Flow rule control point = RM 1.5, within Reach 4

***Snow Creek USGS gage #12458000 (1936 to 2014)**

Fish Passage & Flow Requirements

- Low flows
  - Depth criteria = small 0.4ft (trout), medium 0.6ft (SH), large 0.8ft (CH)
- Late summer temperatures for BT below hatchery
- Structure 2 & 5 management
- PODs fish ladders & bypass
- Boulder field
  - Bull trout observed above boulders
    - September observations, 2002 (111 cfs) & 2004 (197 cfs)



Bull trout passage

USFWS BIOP 2011

Specific Projects and Potential Flow Benefits

Water Rights

Water Right	Source	Date	Qi (cfs) or Qa	POD (RM)
Icicle ID	Icicle Creek	1910	83.3	5.7
	Eightmile Lake	1930s?	2,500 AF	
Peshastin ID	Icicle Creek	1926	34.4	5.7
Cascade Orchard IC		1905	7.0	4.5
LNFH	Icicle Creek	1942	42	4.5
	Snow Lakes	1942	16,000 AF	Upper Snow LK
	Wells	1939 – 1980	14.9	Upland near RM 2.8 to 3.8
City of Leavenworth	Icicle Creek	1912	Surface = 275 AF GW = 926 AF	5.5
Icicle Creek Reservation	Icicle Creek	2008	0.1 cfs; additional 0.4 cfs – depends on projects benefits	Var.
Others	Icicle Creek & groundwater	Var.	Surface = 986 AF GW = 106 AF	Var.

Project	Potential Flow Benefit	Reach – Potential	IFC level of review
Alpine Lakes Optimize	6.7 cfs	1-4 plus	
Raise U. Snow Lake 5ft	4.1 cfs	1-4 plus	
Raise L. Snow Lake 5ft	2.1 cfs	1-4 plus	
Increase drawdowns	1.1 cfs	1-4 plus	
Eightmile Lk – 1,600 AF	4.2 cfs		
1,827 AF			
2,500 AF			
5,000 AF	17 cfs		
IPID Pump Exchange	15 to 30 cfs	2-4, Wen. River	
IPID Efficiencies	Up to 9.9 cfs	2-4, Wen. River	
LNFH Water Conservation Study	Est.~ 10 to 20 cfs?	2-3	

Sum total = 44.8 to 90.9 cfs

Alpine Lakes Study

- USFWS & IPID
- Automation, optimization, storage capacity
- Flow Benefit
  - ~14 cfs 75 days or 2,163 AF
  - small streams to confluence with Icicle Creek
  - Reaches 1- 4, Wenatchee River, and Col. River?

- Extra flow in Reach 1-4 if other efficiencies applied

IPID Pump Exchange

- Various alternatives
- Benefits range from 15 to 30 cfs
  - Piping projects savings estimates are often conservative
- Lengthy primary reach
  - to Peshastin Ck confluence
  - to Mission Ck confluence
- Largest potential for instream flow & habitat restoration

IPID Irrigation Efficiencies + Cascade Orchard IC

- Piping
  - High cost
  - New technology and efficient operations
- Benefits depend on amount of pipe!
  - IID est. = 5 cfs
  - PID est. = 3.3 cfs
  - COIC est. = 1.6 cfs
- Lengthy primary reach
  - to Peshastin Ck confluence
  - to Mission Ck confluence

Eightmile Lake

- Range of alternatives depend on:
  - IWG consensus
  - regulatory approval – state & federal
- Flow benefits – see chart
  - place of use doesn't change?
- Complete project for mutual benefit
  - Downstream users
  - Benefit reaches 1to 4

Icicle & Peshastin ID Diversion Rate

Month	2003	2004	2005	Average
Apr	58.8	52.1	60.2	57
May	74.5	76	77.3	75.9
June	97.4	90.5	96.5	94.8
July	100.9	96.8	102.7	100.1
August	102	94.5	105.4	100.6
Sept	82.6	78.7	76.9	79.4
Total AF	31,267	29,604	31,449	30,766

LNFH Groundwater Study

- Quantity of savings?
  - further study (estimate of 10 to 20 cfs?)
- Beneficial reach – non consumptive savings for Reaches 2 & 3
- Healthy winter/high flows as important for fish life as improving other base flows
  - in historical channel
  - Reach 4

Sediment Transport & Hydrologic Modeling

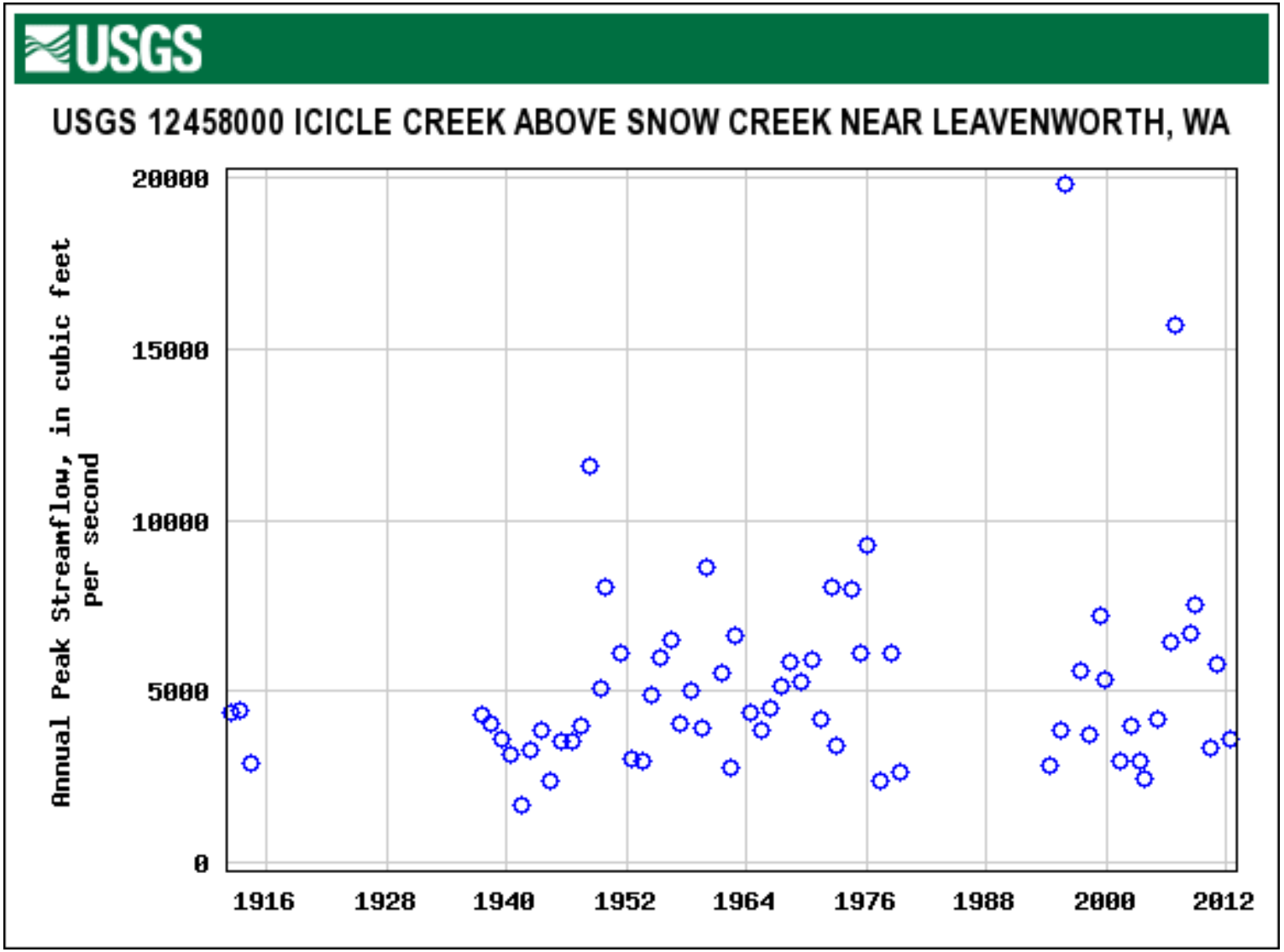
- Mostly physical instream/channel improvements
- Flow and habitat benefits?
- Flushing flow benefits to instream habitat

Snow Creek Monthly Mean Flow

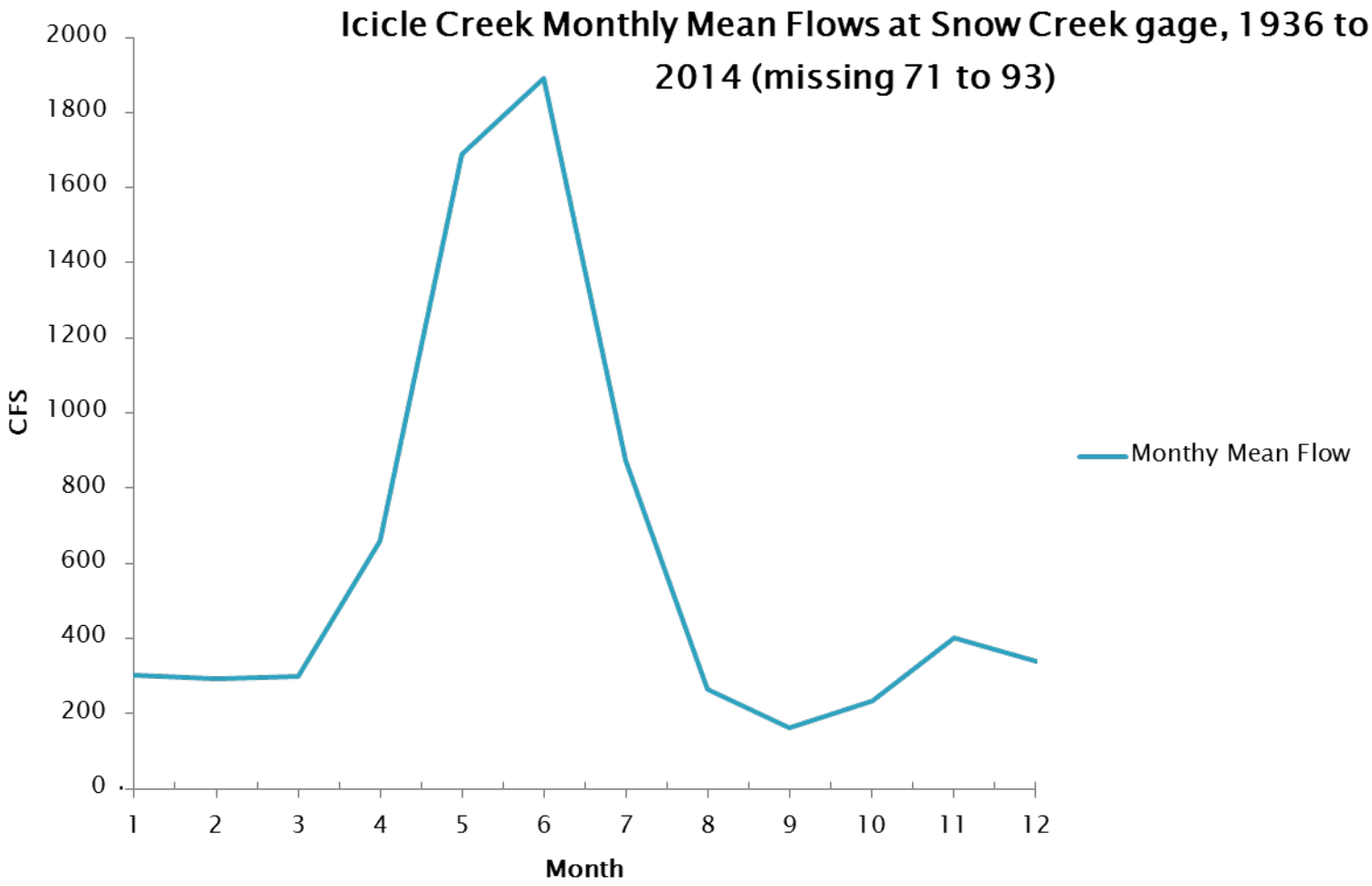
Month	Mean Flow (cfs)	Qa
Oct	33.5	2,060
Nov	3.9	232
Dec	9.0	553
Jan	9.0	553
Feb	32.3	1,794
Mar	21.6	1,328
Apr	23.7	1,410
May	56.0	3,443
June	29.6	1,761
July	43.5	2,675
Aug	36.6	2,250
Sept	43.3	2,577

-1994 to 2002
- At confluence

Upper Snow Lake capacity = 12,450 AF of storage


USGS
USGS 12458000 ICICLE CREEK ABOVE SNOW CREEK NEAR LEAVENWORTH, WA
Annual Peak Streamflow, in cubic feet per second
20000
15000
10000
5000
0
1916
1928
1940
1952
1964
1976
1988
2000
2012

Icicle Creek Flow Monitoring Gage



Climate Change Discussion

- Sustainable flows
- Water quantity and quality for fish life
  - Population persistence
- Water supply for ID, City, Hatchery, etc.
- Climate change effects are reasonably certain to continue into the foresee


Taneum Creek – May 2011

Questions?

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