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October 4, 2023

MEMORANDUM

TO: Fish and Wildlife Committee Members

FROM: Kris Homel, Kate Self, Leslie Bach, and Patty O'Toole

SUBJECT: Hydrosystem categorical assessment: overview and examples

BACKGROUND:

Presenters: Kris Homel, Kate Self, Leslie Bach, and Patty O'Toole

Summary: Council staff are evaluating overall Program performance and progress through three complementary efforts: (1) the history of the Fish and Wildlife Program (**Program Retrospective**; presentations last May and the preceding August and September), (2) assessing implementation of the Program, by major category of Program work (**Categorical Assessments**), and (3) tracking progress toward Program goals and objectives listed in the 2020 Program addendum (**Status and Trends**). For the October presentation, staff will present on the first Categorical Assessment- focused on the Hydrosystem.

Relevance: Beginning with the Power Act and the first program in 1982, every fish and wildlife program has included references to aspects of program performance. The 2020 program addendum addresses program performance through tasks such as reorganizing and compiling the goals and objectives of the program and developing strategy performance indicators. The Categorical Assessments build off these tasks by assessing implementation of the Program over the last 40 years relative to established benchmarks. Further tracking of Program Goals and Objectives occurs through the status and trends assessment. Both the

Categorical Assessment and the Status and Trends evaluation incorporate Strategy Performance Indicator datasets from the Council's Program Tracker.

Workplan: Item 2.2: Program Performance- Hydrosystem Categorical Assessment

Background: The Northwest Power and Conservation Council's Columbia River Basin Fish and Wildlife Program (Program) represents a 40-year effort to mitigate the effects of the hydropower system on fish and wildlife in the Columbia Basin. The scope and investment in this Program make it one of the largest fish and wildlife mitigation efforts in the world and a significant part of the tapestry of mitigation efforts in the Columbia Basin. There is limited precedent for assessing the performance of a program the size of the Fish and Wildlife Program. Given this scale, we first developed an overall approach to manage the volume and complexity of information.

The performance assessment includes three complementary efforts- the Program Retrospective, assessments of Program implementation, by major category of work (Categorical Assessments), and a Status and Trends evaluation of progress toward Program goals and objectives.

In 2023, we developed a retrospective of the Northwest Power and Conservation Council's Fish and Wildlife Program that included a review of Program history and key events. This historical context provided key information on why different elements have been included in the Program over time, what kind of changes were expected to occur, where those changes could occur, and when they could occur. In preparing this retrospective, we went through a detailed process to assemble the full set of measures across 40 years of Programs. These were organized by similar topics so that we could determine how Programs have developed and changed over time and when different topics came to prominence, along with identifying major topics in each Program. Staff presented on the Retrospective in May, along with last August and September.

The four categorical assessments provide more detailed information on implementation of the major topics identified in the retrospective, organized according to the main categories in the Program (Hydrosystem, Habitat, Artificial production, and Program Adaptive Management). In each categorical assessment, we will address a common set of questions: (1) what was called for in the Program, (2) what was implemented, and (3) how implementation compares to existing benchmarks, when available. These assessments incorporate content from existing summaries (e.g., published research or reports, the Program Tracker with Strategy Performance Indicators, and dashboards on particular topics) and also include new summaries from a variety of information sources.

The third piece of program performance is the Status and Trends assessment of progress toward the goals and objectives described in the 2020 addendum. This assessment will occur in conjunction with the categorical assessments and relies on multiple sources of data, including the SPIs.

Staff are currently working on the first categorical assessment focused on the Hydrosystem. The Hydrosystem Categorical Assessment connects hydrosystem actions called for in the Council's Program over the last 40 years with implementation of those actions, relative to any identified benchmarks (e.g., targets for seasonal flows). The presentation will begin with an overview of Program performance and the approach to the categorical assessments. There are over 40 Program actions reviewed within the hydrosystem assessment. For this presentation, we will review two detailed, technical examples: (1) spring seasonal flows for juvenile salmon and steelhead, and (2) reservoir operations at Libby Dam for the benefit of resident fish. Examples include a timeline of how operations have developed or changed and graphs on implementation, including any associated standards. These examples were reviewed with topical experts to better understand the context around implementation. Based on those conversations, we include a summary of how adaptive management, hydrosystem priorities, and environmental conditions (including climate change) have influenced implementation of these operations, and where challenges are being addressed.

We will conclude with a discussion of Program-scale observations from these two examples and a review of next steps. Collectively, the retrospective, categorical assessments, and status and trends assessment will provide critical information to the Council and region on the Fish and Wildlife Program and serve as an educational resource leading up to the next Program amendment.

Discussion topics:

- Context around implementation
 - Role of adaptive management
 - Existing priorities
 - Challenges and improvements
- Options for communicating hydrosystem categorical assessment to region
 - Process to share and document remaining examples
- Concepts to think about leading up to the next amendment
- Concepts for the future (e.g., as the priorities or conditions of the Basin change, are operations adaptable?)

More Info: The full presentations on the Program Retrospective were delivered to the Fish and Wildlife Committee in August and September. The PowerPoint presentations are available here:

August: https://www.nwcouncil.org/fs/17876/2022_08_f1.pdf

September: https://www.nwcouncil.org/fs/18031/2022_09_f2.pdf

May: https://www.nwcouncil.org/fs/18305/2023_05_1.pdf



Hydrosystem categorical assessment: overview and examples

Kris Homel, Kate Self, Leslie Bach, Patty O'Toole

Photo credit: Erik Merrill



Northwest **Power** and
Conservation Council

Outline of today's presentation

- Introduction
 - What does the Power Act require in the Fish and Wildlife Program?
 - A call for evaluating performance
- Assessing performance through three efforts:
 - Retrospective
 - Program implementation by major category (Categorical Assessments)
 - Progress toward goals and objectives (Status and Trends)
- Overview of hydrosystem categorical assessment
 - How have operations been implemented relative to how they are described?
 - What contributes to differences in implementation?
- Technical examples
 - Seasonal Flows (spring)
 - Reservoir Operations (Libby Dam/ Lake Koocanusa)
- Discussion

The Fish and Wildlife Program includes:

- **Measures describing actions**
 - At the dams - ex: water management, flows, passage
 - Offsite (in mainstem/ tributaries/ estuary/ ocean) - ex: habitat protection and restoration, artificial production
- **Goals and objectives**



Protection and mitigation for all Fish and Wildlife affected by the hydrosystem - not just listed species

Described in 20 comprehensive or minor program amendments and addendums

Implementation occurs through

Actions:

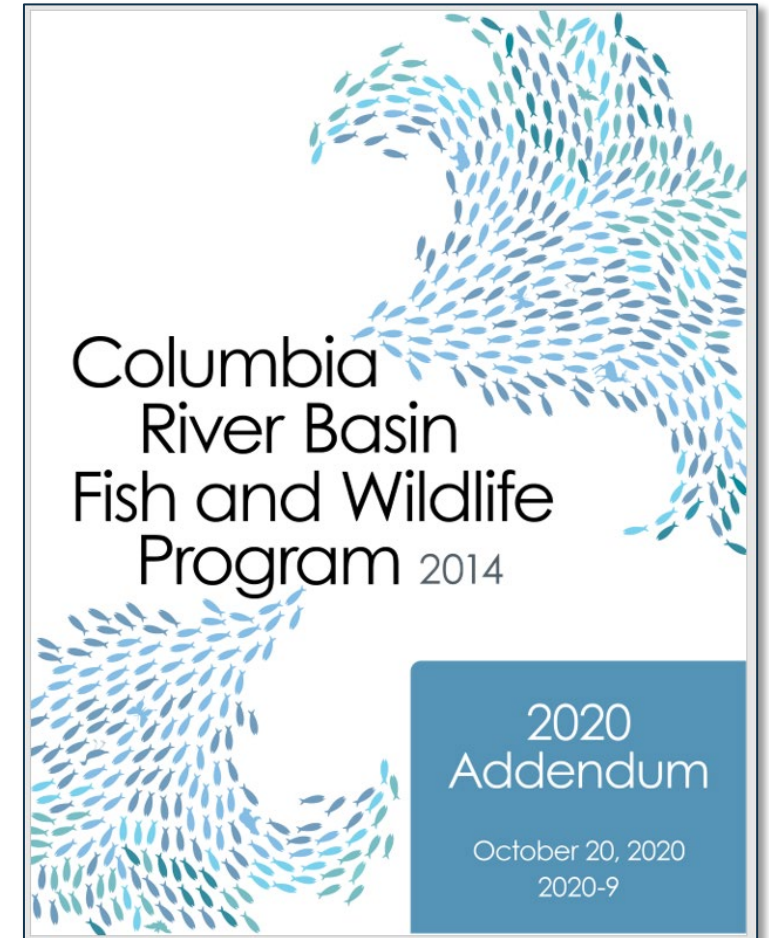
- Action agencies take Program into account at all stages of decision-making 4(h)11(A)
 - Ex: relicensing considerations and protections [FERC]
- Action agencies implement operations or build facilities
 - Hydrosystem operations [COE and BOR]
 - COE Actions including CRFM, Dam Facility O&M
- Council completes certain actions

Projects:

- Entities implement measures through projects funded by BPA 4(h)10(A)
 - Ex: tributary habitat restoration, Bi-Op actions, artificial production

Evaluating Performance of the Fish and Wildlife Program

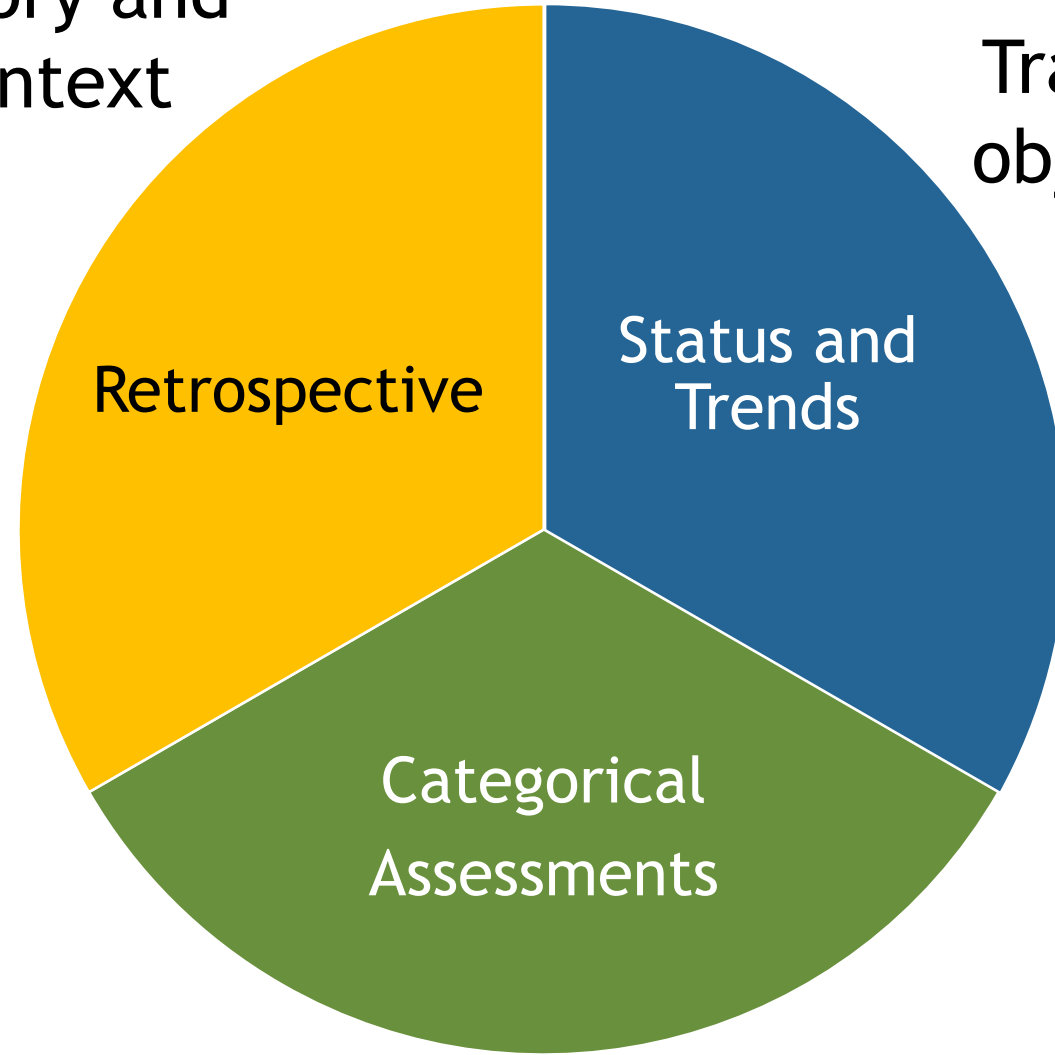
- Called for in the Northwest Power Act
- Aspects of performance in every program
- Recent increased focus on understanding progress from 40 years of investment across the Columbia Basin
- Program performance evaluation is educational resource: Identify key questions for region to consider in anticipation of next Program amendment



Program performance:
telling the story through three complementary efforts

Program history and context

Tracking goals, objectives, and SPIs



Tracking measures that are implemented as actions/projects

Retrospective

- **Identify major actions**
 - Development of Basin and Hydropower
 - Northwest Power Act
 - Program history and context by decade
 - Actions organized by major category

Categorical Assessments

- **Connect actions, implementation, benchmarks**
 - Hydrosystem
 - Habitat
 - Artificial production
 - Program adaptive management

Status and Trends

- **Track progress toward Program goals and objectives from 2020 addendum**
 - Goals
 - Objectives
 - Associated SPIs

Retrospective

- **Identify major actions**
 - Development of Basin and Hydropower
 - Northwest Power Act
 - Program history and context by decade
 - Actions organized by major category

Categorical Assessments

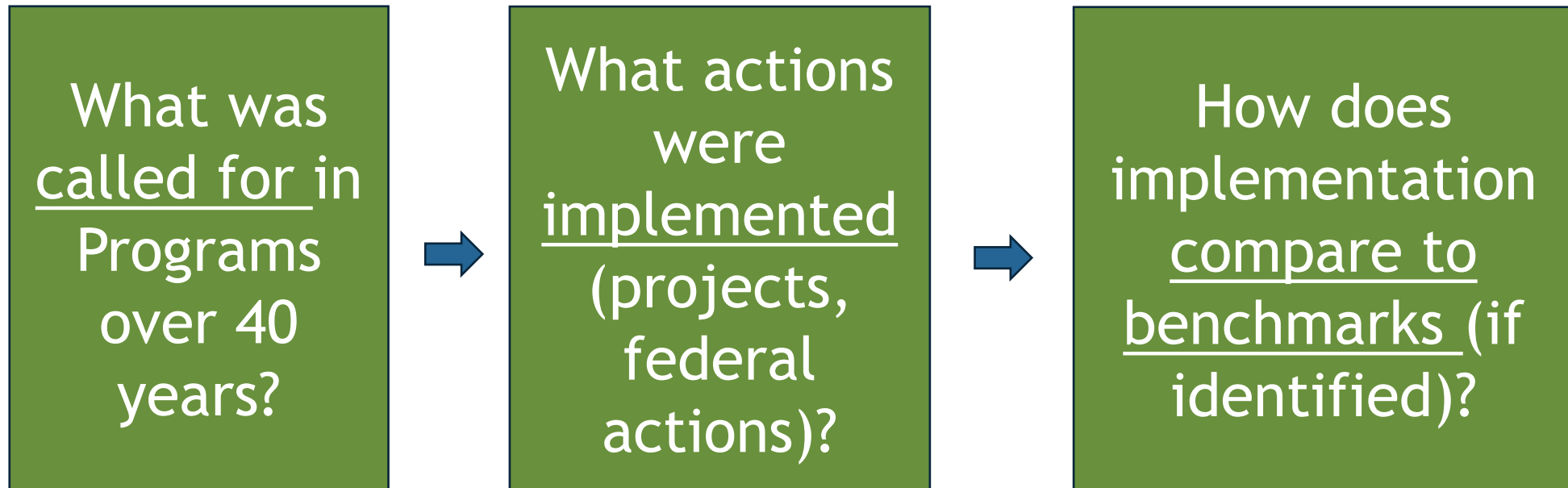
- **Connect actions, implementation, benchmarks**
 - **Hydrosystem**
 - Habitat
 - Artificial production
 - Program adaptive management

Status and Trends

- **Track progress toward Program goals and objectives from 2020 addendum**
 - Goals
 - Objectives
 - Associated SPIs

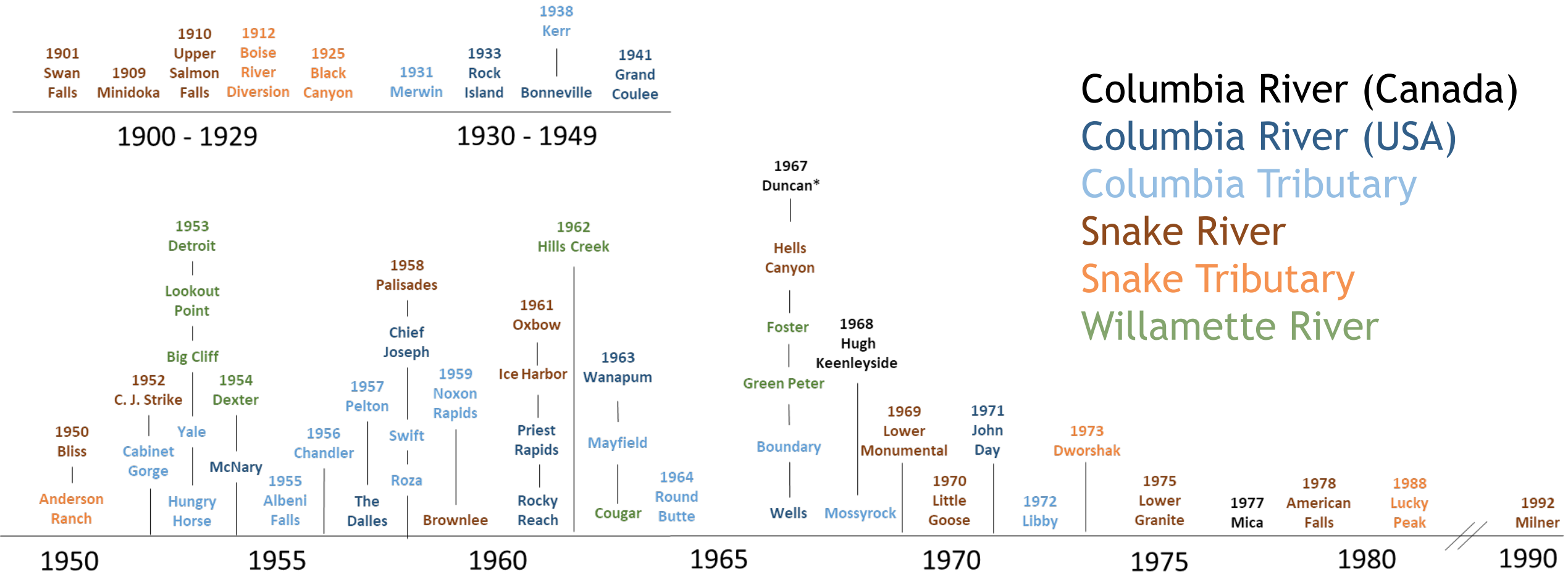
Program performance: categorical assessment steps

For each Categorical Assessment



Hydrosystem Categorical Assessment

Development of the hydrosystem



Dams listed in year construction finished and power generation began unless power retrofit to existing dam.

*dam operated for storage only

Grand Coulee

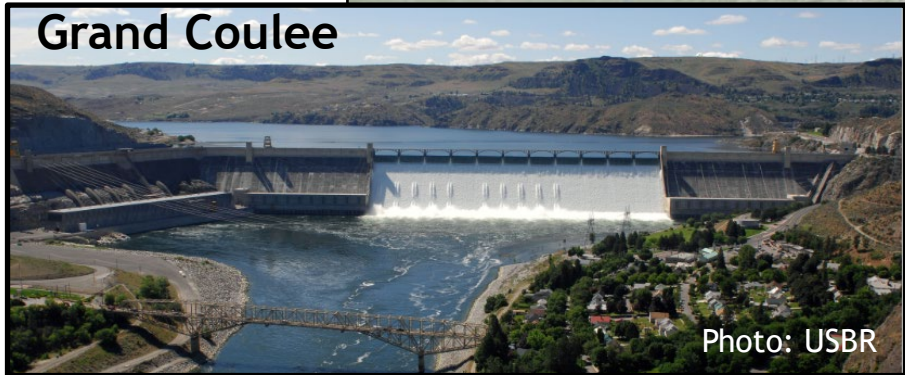


Photo: USBR

Hungry Horse



Photo: USBR

The Dalles

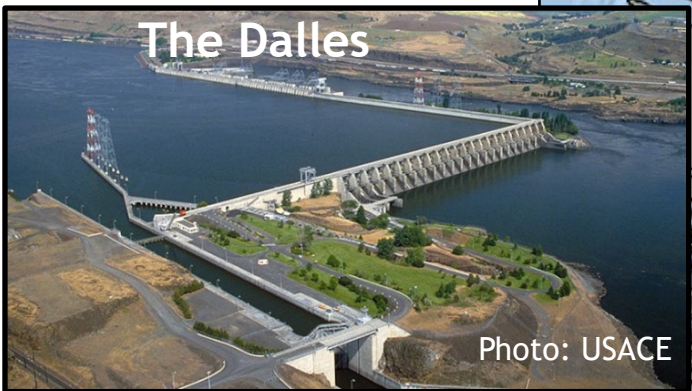


Photo: USACE

Little Goose



Photo: USACE

Detroit



Photo: USACE

Anderson Ranch



Photo: USBR



Hydrosystem operations

- Management of hydrosystem requires designing operations at multiple locations to meet:
 - Different authorizing purposes
 - Fish requirements
 - System needs
- Power planning integrates fish operations as firm constraint
 - Integrated after other critical operations like flood management, structural limits to flow and reservoir elevation, etc.
- Implementing individual fish operations not always feasible given environmental conditions (seasonal precipitation, timing of runoff)

Objectives of hydrosystem assessment

1. Describe (where available):
 - What actions have been called for in each Program
 - What actions have been implemented over time?
 - How implementation relates to specific targets (such as flow or reservoir elevations)
 - Context around implementation
2. Report on progress and challenges in implementing hydrosystem measures
3. Identify key questions for region to consider in anticipation of next Program amendment

Hydrosystem measures can be grouped by

Types of actions:

- Water management
- Passage
- Water quality

Purpose of actions- to improve:

Juvenile Migration
(salmon and
steelhead)

Adult Migration
(salmon, steelhead),
Lamprey Migration

Mainstem Spawning
and Rearing
(resident and
migratory fish)

Reservoir Rearing
(resident fish)

- Water budget/seasonal flow (Columbia and Snake Rivers)
- Spring and summer
- Reservoir drawdown (Lower Snake/John Day Dam)
- Passage structures (all mainstem dams)
- Spill/TDG
- Transportation (barging)

Juvenile Migration

Salmon/Steelhead

- Summer flows
- Reservoir elevations
- Temperature
- Passage Structures
- Spill
- Transportation

Lamprey

- Flow
- Reservoir elevations
- Structures

Native Fish Passage

- (Bull Trout) Albeni Falls
- (Sturgeon) Prevent entrainment

Adult Migration

Below Libby

- Minimum flow
- Sturgeon pulse
- Seasonal flows
- Ramp rates
- TDG
- Temperature

Below Hungry Horse

- Minimum flow
- Ramp rates
- TDG
- Temperature

Hanford Reach (Fall Chinook)

- Seasonal flow
- Stable flow

Columbia/ Snake River (Sturgeon)

- Flow
- Temperature

Below Bonneville (Chum Salmon)

- Seasonal flow

Mainstem spawning and rearing

Reservoir rearing

Libby/Lake Koocanusa-

- Reservoir drawdown
- Reservoir refill
- Stable reservoir elevation
- Reservoir end of summer draft

Hungry Horse

- Reservoir drawdown
- Reservoir refill
- Reservoir draft limits

Grand Coulee

- Reservoir refill
- Reservoir draft limits
- Water retention time

Dworshak

- Reservoir refill

Albeni Falls/ Pend Oreille

- Reservoir refill
- Reservoir drawdown

- **Water budget/seasonal flow (Columbia and Snake Rivers)**

- -Spring and summer

- Reservoir drawdown

- (Lower Snake/John Day Dam)

- Passage structures (all mainstem dams)

- Spill/TDG

- Transportation (barging)

Juvenile Migration

Salmon/Steelhead

- Summer flows

- Reservoir elevations

- Temperature

- Passage Structures

- Spill

- Transportation

Lamprey

- Flow

- Reservoir elevations

- Structures

Native Fish Passage

- (Bull Trout) Albeni Falls

- (Sturgeon) Prevent entrainment

Adult Migration

Below Libby

- Minimum flow

- Sturgeon pulse

- Seasonal flows

- Ramp rates

- TDG

- Temperature

Below Hungry Horse

- Minimum flow

- Ramp rates

- TDG

- Temperature

Hanford Reach (Fall Chinook)

- Seasonal flow

- Stable flow

Columbia/ Snake River (Sturgeon)

- Flow

- Temperature

Below Bonneville (Chum Salmon)

- Seasonal flow

Mainstem spawning and rearing

Reservoir rearing

Libby/Lake Koocanusa-

- Reservoir drawdown

- Reservoir refill

- Stable reservoir elevation

- Reservoir end of summer draft

Hungry Horse

- Reservoir drawdown

- Reservoir refill

- Reservoir draft limits

Grand Coulee

- Reservoir refill

- Reservoir draft limits

- Water retention time

Dworshak

- Reservoir refill

Albeni Falls/ Pend Oreille

- Reservoir refill

- Reservoir drawdown

Biological purpose of action

Juvenile Migration (salmon and steelhead)

Adult Migration (salmon, steelhead), Lamprey Migration

Mainstem Spawning and Rearing (resident and migratory fish)

Reservoir Rearing (resident fish)

Biological purpose

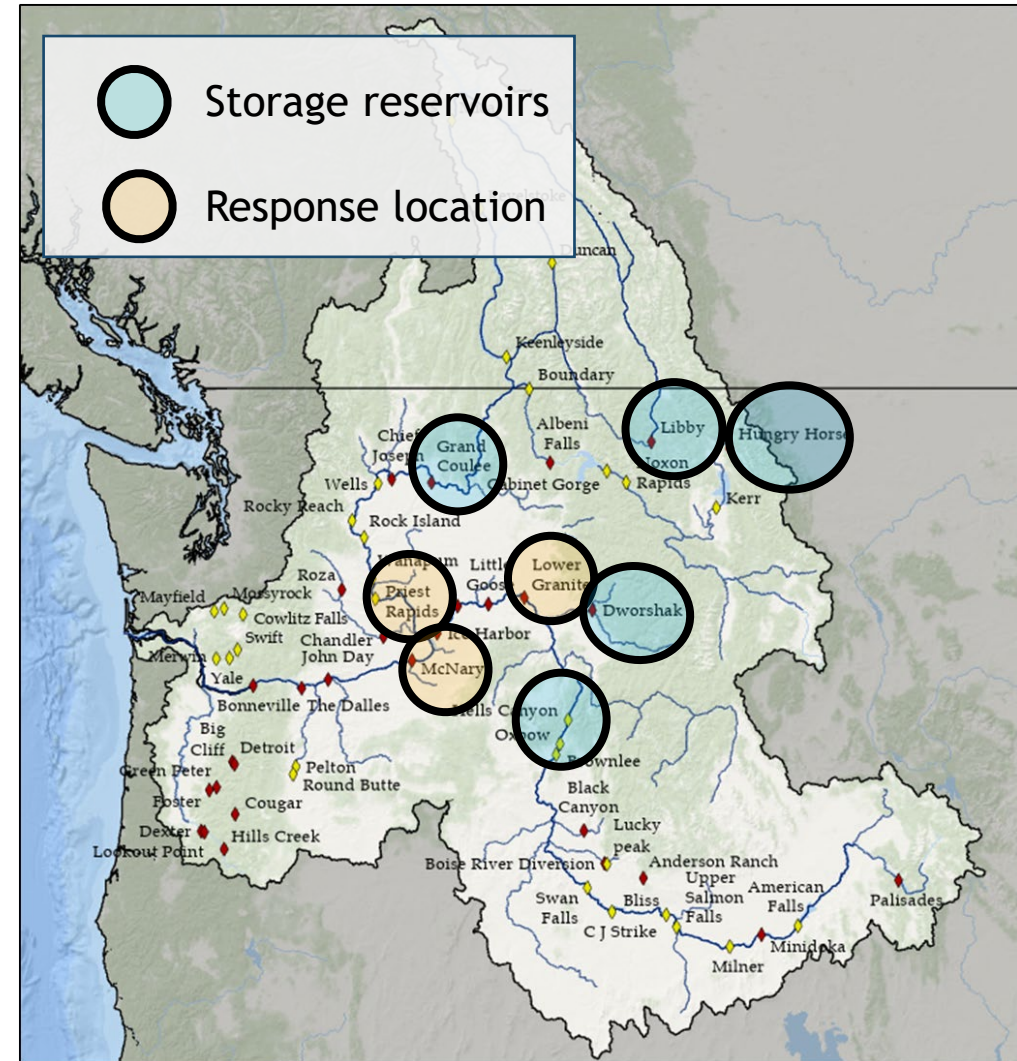
Juvenile Migration (salmon
and steelhead)

Program action summary:

- Improve migration conditions and survival through augmenting seasonal flows, managing reservoir elevations to speed migration, implementing seasonal spill, installing passage structures, and transporting fish seasonally.

Juvenile Migration and Seasonal Flows

- Water management timeline
 - 1980s example and lessons learned
- Spring season at Lower Granite, McNary, and Priest Rapids Dams
 - How often are target flows met?
- Case studies: Lower Granite Dam
 - Examples of operations in recent years
 - Building context around flow management
- Key points
- Discussion



Location of major dams (diamonds; red = federally owned, yellow = publicly or privately owned) in the Columbia River Basin. Map created in ArcGIS Pro (C) 2020 ESRI. All rights reserved.

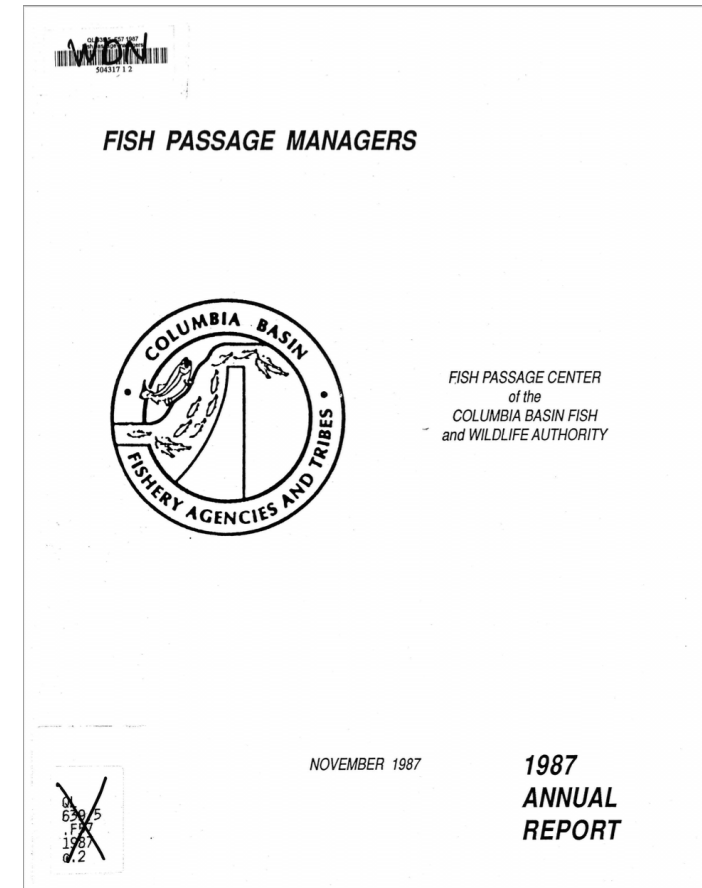
Water Budgets to Seasonal Flows

| | |
|-------------------------------------|---|
| 1980's | NPCC Fish and Wildlife Program Water Budget. Water managed as a total volume to be shaped by the managers. <i>Example: 58 kcfs for 3 months for a total of 3.45 Maf at Priest Rapids Dam</i> <i>Example: 20 Kcfs for 3 months for a total of 1.19 Maf at Lower Granite Dam</i> |
| 1992-1995 Council | Average monthly flow equivalents. A flow equivalent is defined as the flow level required to achieve the same water particle travel time as an equivalent flow at normal average pool elevations at all projects. <i>Example: 85-140 kcfs average monthly flow equivalent at Lower Granite Dam.</i> |
| 1994-1998 BiOps | Seasonal average flow target ranges adopted. <i>Example: 220-260 kcfs at McNary Dam and 85-140 kcfs at Lower Granite Dam.</i> |
| 2000 - Present Council/ BiOp | Continued seasonal average flow target ranges for Lower Granite (85-100 kcfs) and McNary (220-260 kcfs) dams. Priest Rapids target set at 135 kcfs. |

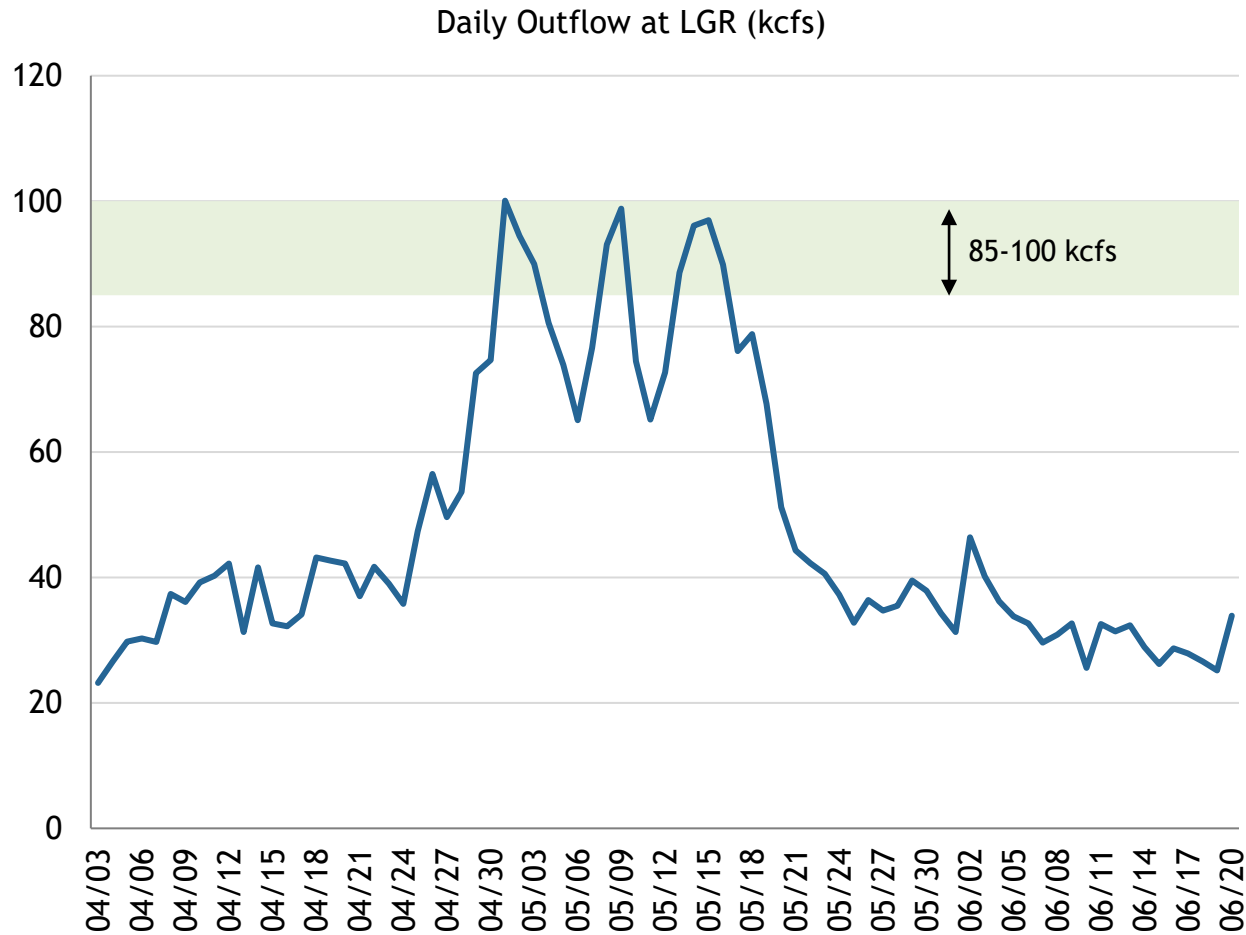
Spring 1987 - Council Water Budget Example

1987 was considered the first low runoff year in which to truly test the Water Budget Measures of the Council's Fish and Wildlife Program.

→ *The intent of the Water Budget is to provide minimum flows for at least the middle 80% of the spring outmigration of juvenile salmon and steelhead during low runoff years.*



1987 at Lower Granite - Water Budget Example



- 1987 average spring season flow 45.9 kcfs
- Total Water Budget usage of 439,000 acre feet was 98% of the 1987 450,000 acre-foot allocation.
- Despite efforts to increase the amount of water via ramping, flows of 90 kcfs or greater were achieved only 5 days.

Lessons learned:

- There is an extremely limited amount of water available in the Snake River system for shaping flows to meet the needs of the fish.
- Simply having a volume target does not guarantee the appropriate flows for fish.

Post-2000 spring seasonal flows targets at Lower Granite, McNary, and Priest Rapids Dams

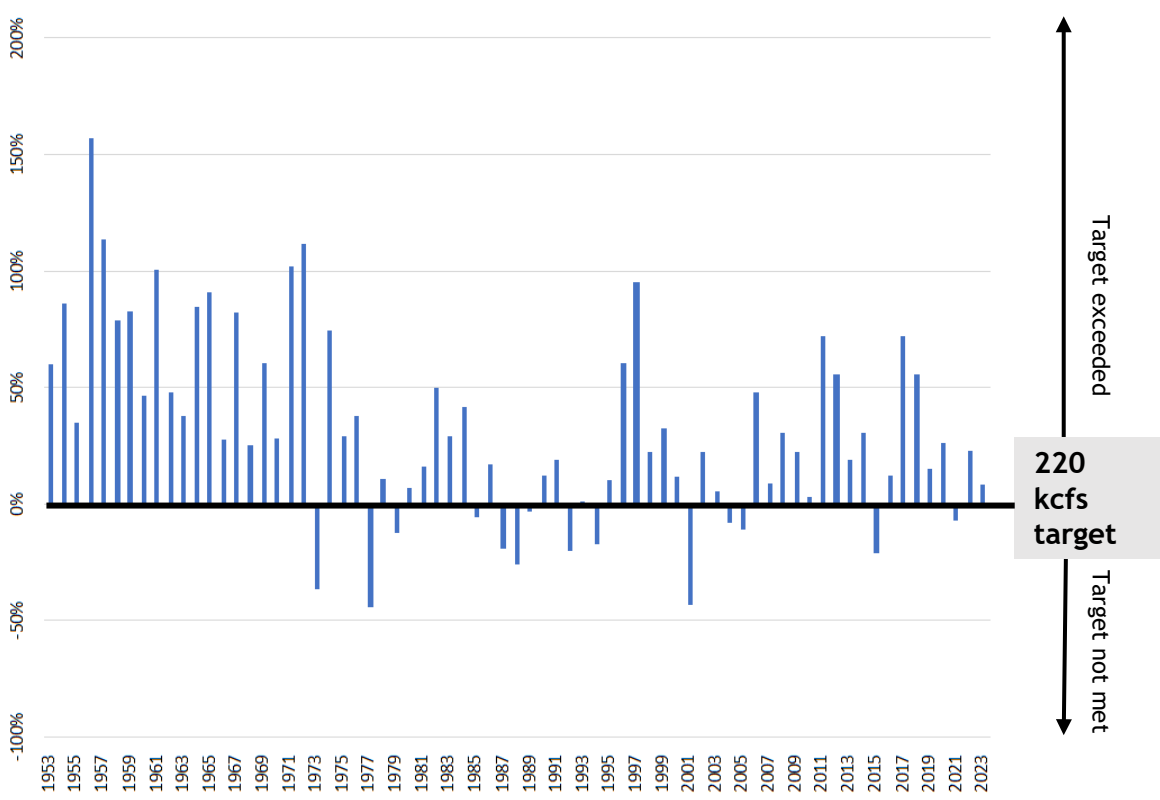
- Seasonal flows are largely driven by annual precipitation.
- A spring forecast adopted in early April determines the target flow for each year.
- Each year, for dams that have a target flow “range”, a point target is selected based on the final spring forecast (i.e. 85 kcfs in a lower water year at LGR).

| Location | Spring Season | Target Flow Range |
|---------------|------------------|-------------------|
| Lower Granite | April 3-June 20 | 85-100 kcfs |
| McNary | April 10-June 30 | 220-260 kcfs |
| Priest Rapids | April 10-June 30 | 135 kcfs |

Spring Season at McNary and Priest Rapids Dams

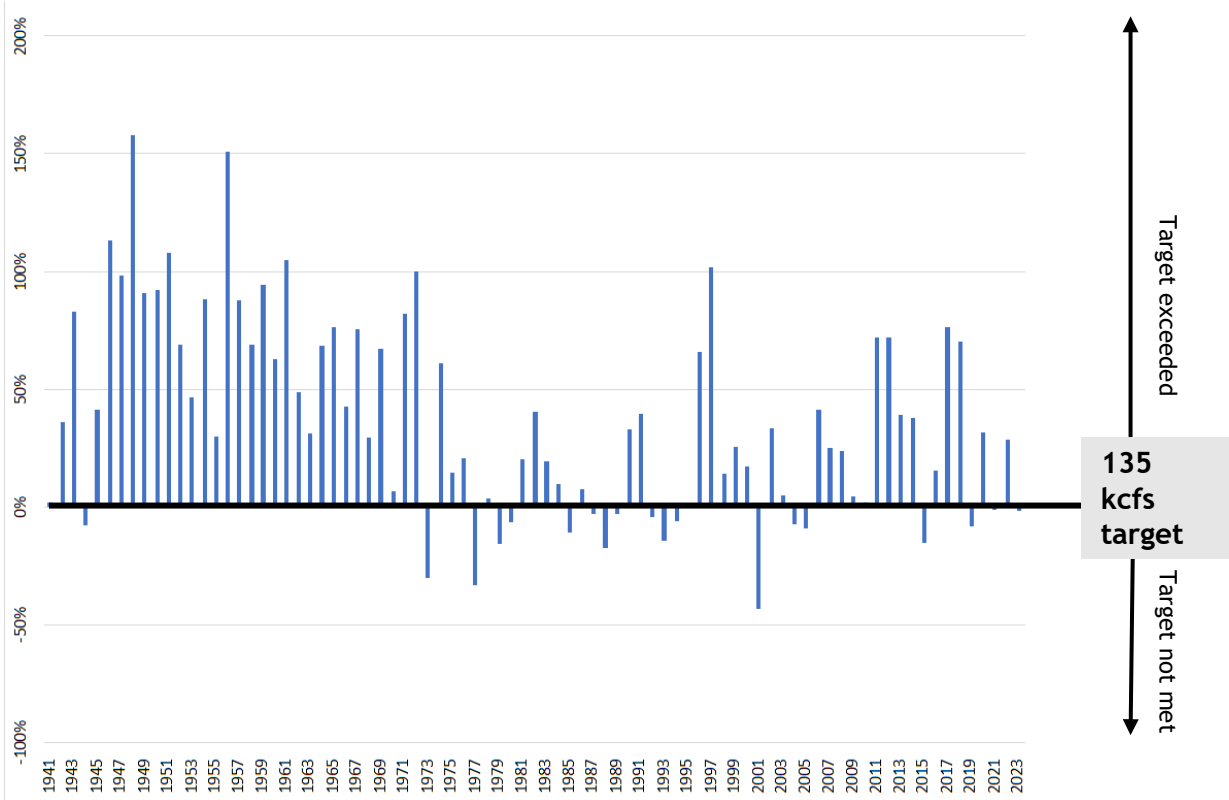
McNary Dam

% Annual Spring Seasonal Flow Target Performance (220 kcfs)



Priest Rapids Dam

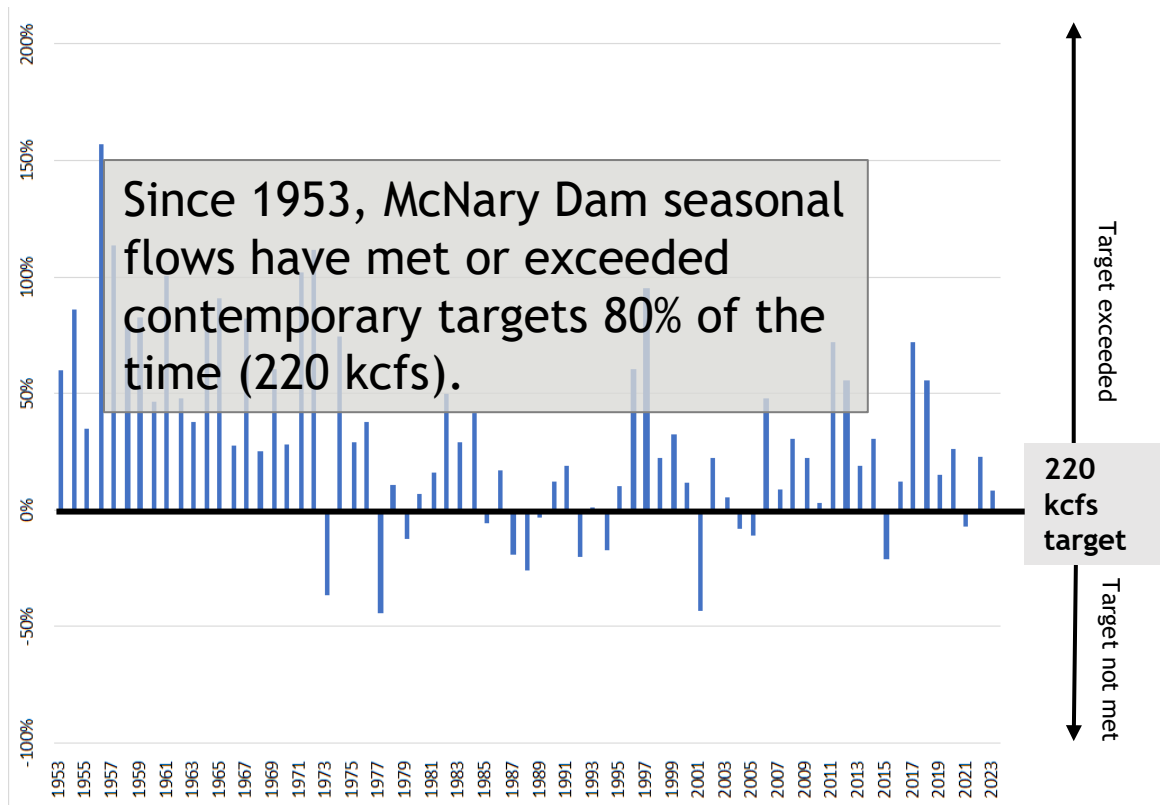
% Annual Spring Seasonal Flow Target Performance (135 kcfs)



Spring Season at McNary and Priest Rapids Dams

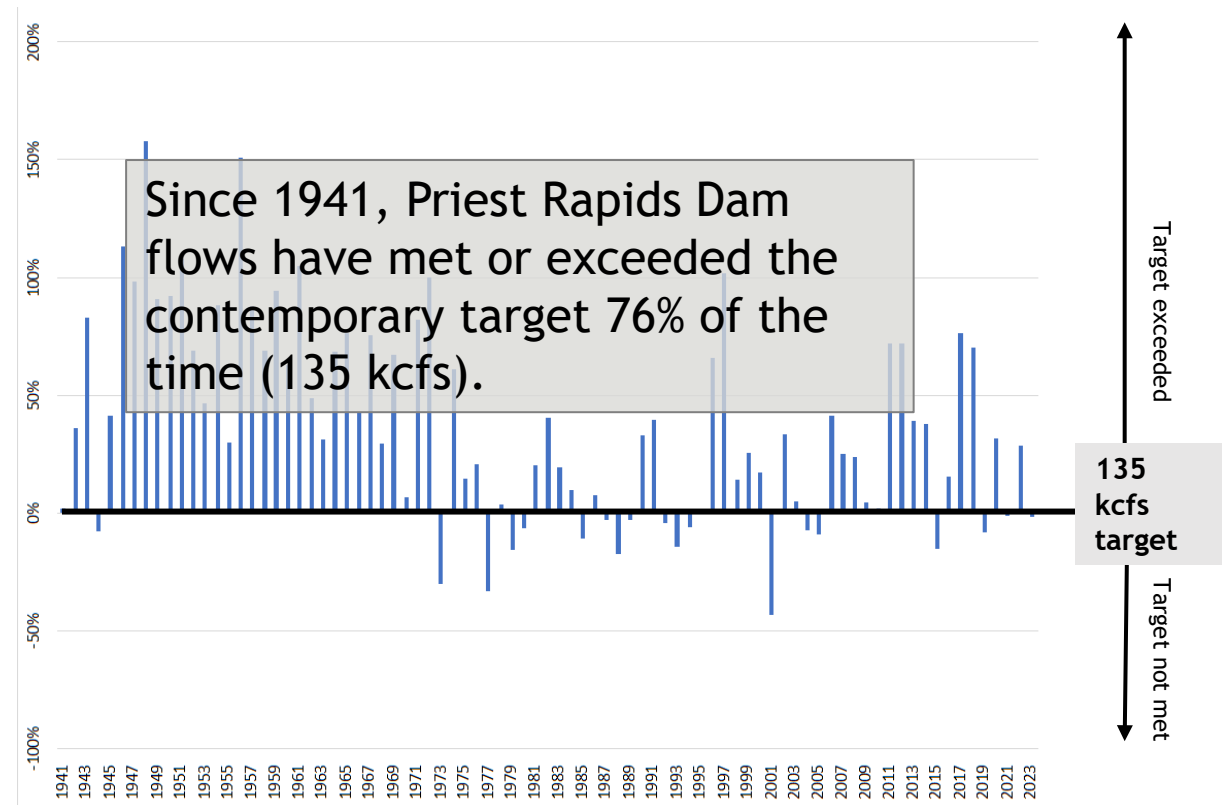
McNary Dam

% Annual Spring Seasonal Flow Target Performance (220 kcfs)



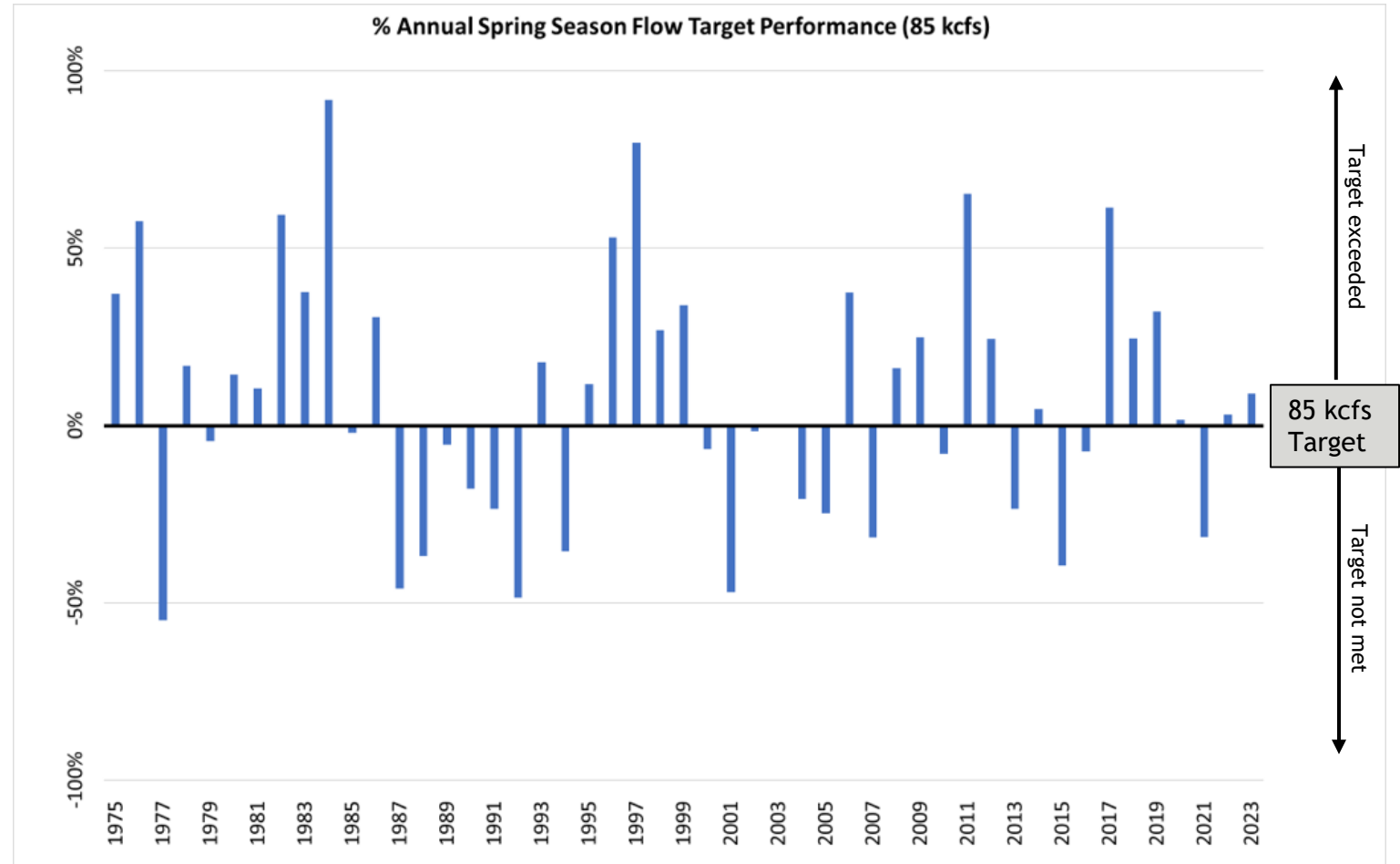
Priest Rapids Dam

% Annual Spring Seasonal Flow Target Performance (135 kcfs)

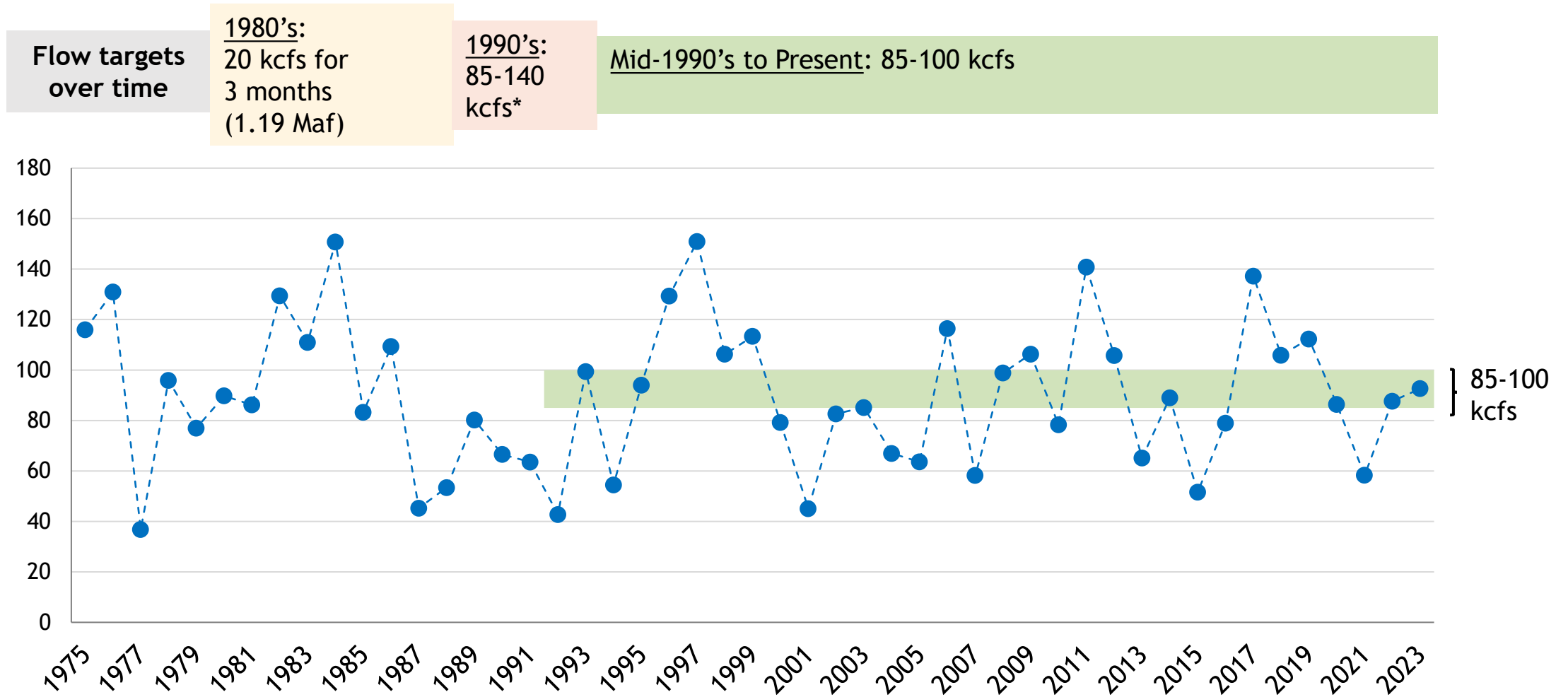


Spring Season at Lower Granite Dam

- The minimum target flow of 85 kcfs has been met 57% of the time since 1975 and 61% of the time since 1995.
- There is less capacity to regulate flows in season at Lower Granite Dam than at Priest Rapids Dam or McNary.



Average annual spring flow at Lower Granite Dam

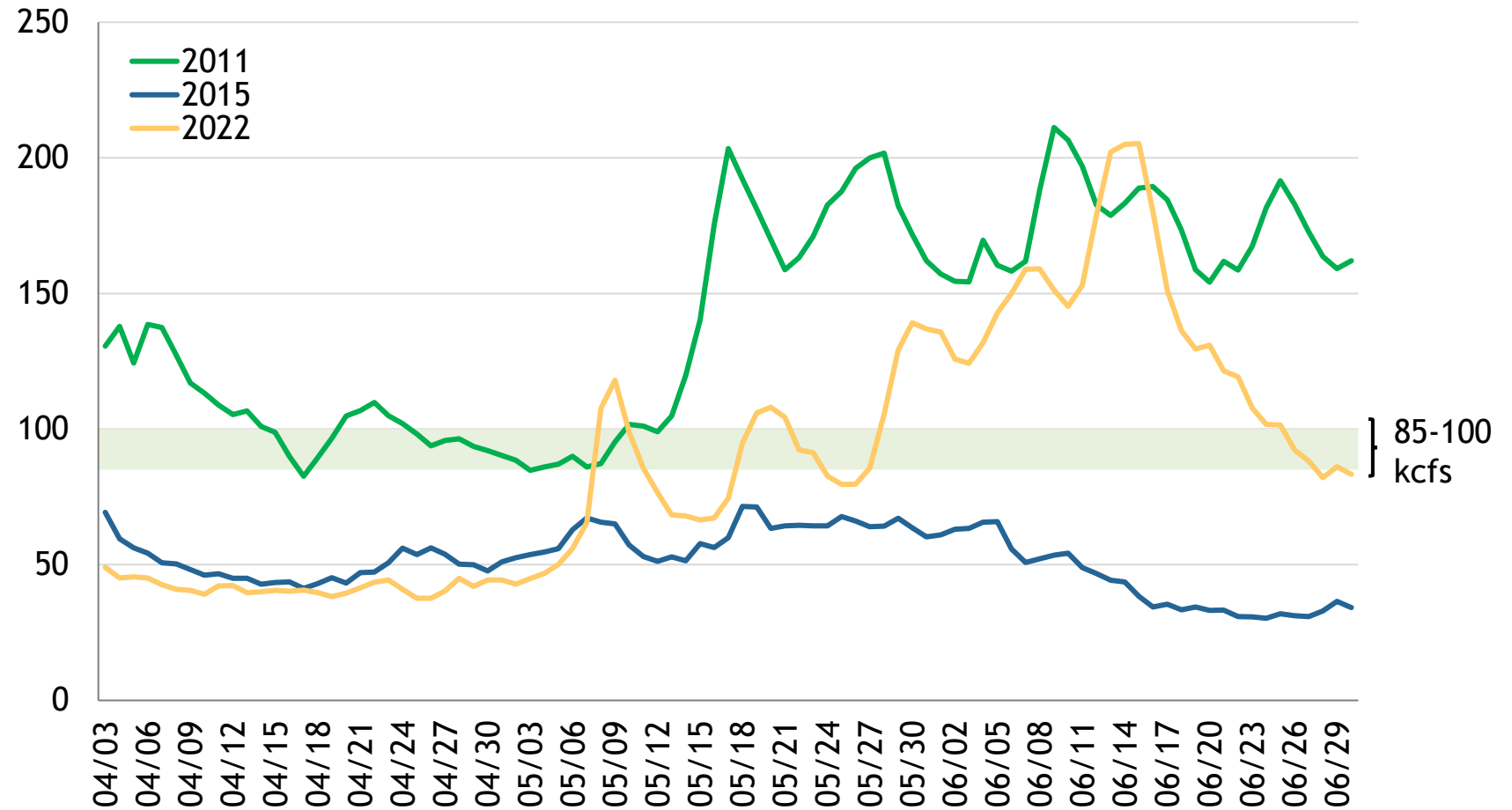


*Average monthly flow equivalent

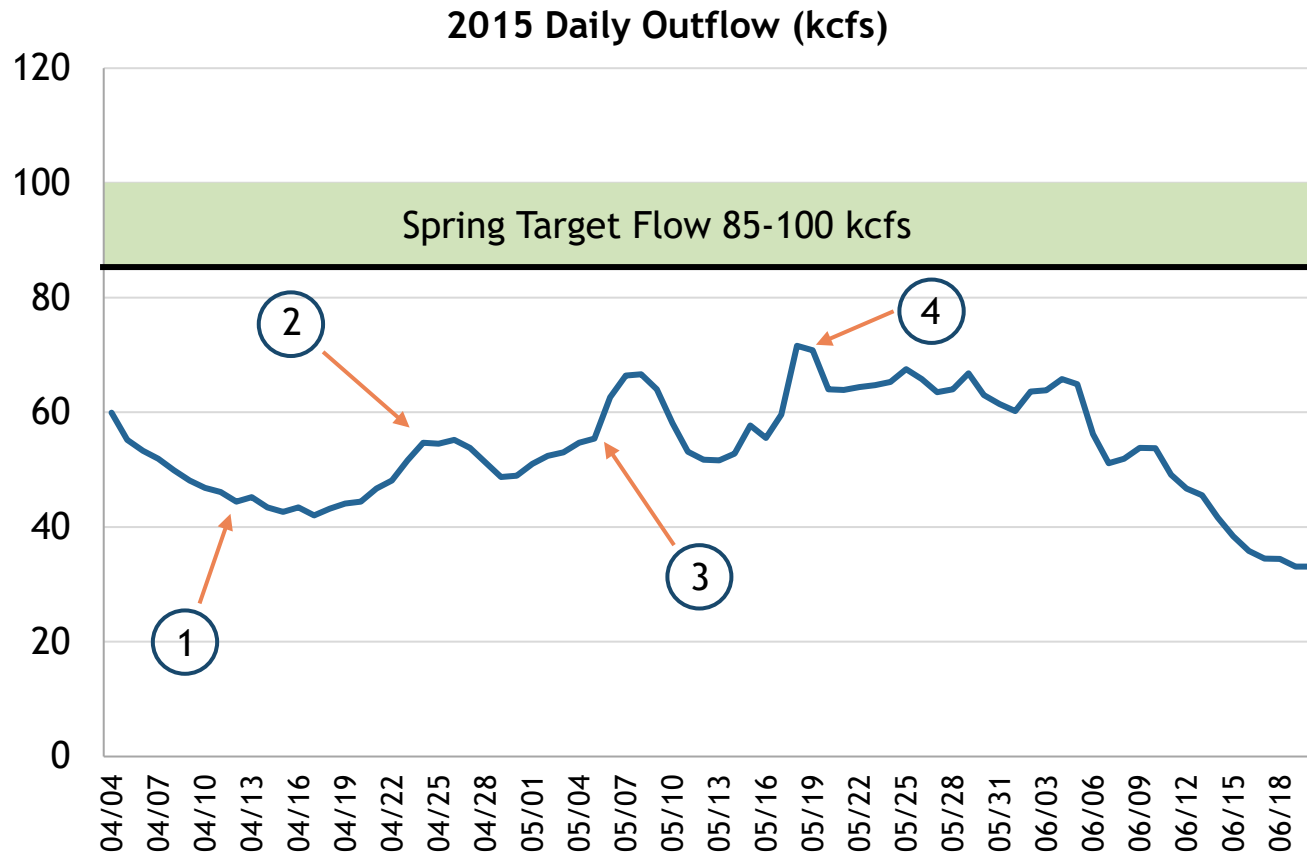
Contemporary spring flow comparisons at Lower Granite Dam

| Year | Flow target (kcfs) | Observed seasonal flow average (kcfs) | % above or below actual flow objective |
|------|--------------------|---------------------------------------|--|
| 2011 | 100 | 137 | +37% |
| 2022 | 100 | 88 | -12% |
| 2015 | 85 | 52 | -39% |

Daily Outflow at LGR (kcfs)



Low flow year example of in-season adaptive management at Lower Granite Dam



2015 spring flow objective = 85 kcfs

- ① Flows at LGR Dam averaged 51.6 kcfs between April 3 and May 14, 2015.
— 65% of the previous 10-yr average (2005-2014)
- ② After high passage numbers from April 25-27th, yearling Chinook and steelhead passage decreased substantially for 8-10 days.
- ③ Salmon Managers requested that outflows from Dworshak Dam be increased to 9.5 Kcfs May 5-9, at the same time that flows in the Snake River were expected to increase.
→ Result: increased passage numbers for yearling Chinook and steelhead for several days.
- ④ A third increase in flows did not change the passage indices for steelhead or yearling chinook.

<https://www.fpc.org/documents/weekrpt/wr2015/WR15-11.pdf>

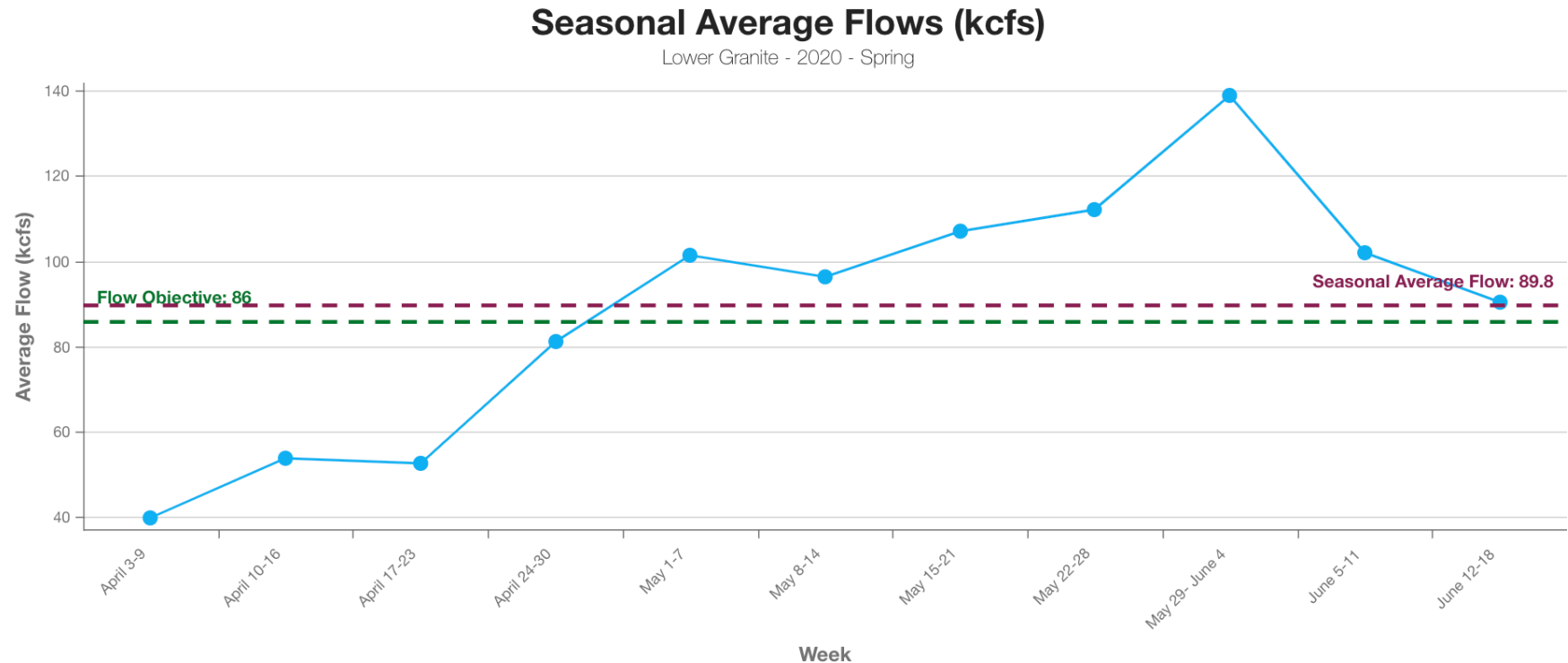
SPI Program Tracker example at Lower Granite Dam



Seasonal average flows at Lower Granite Dam in 2020

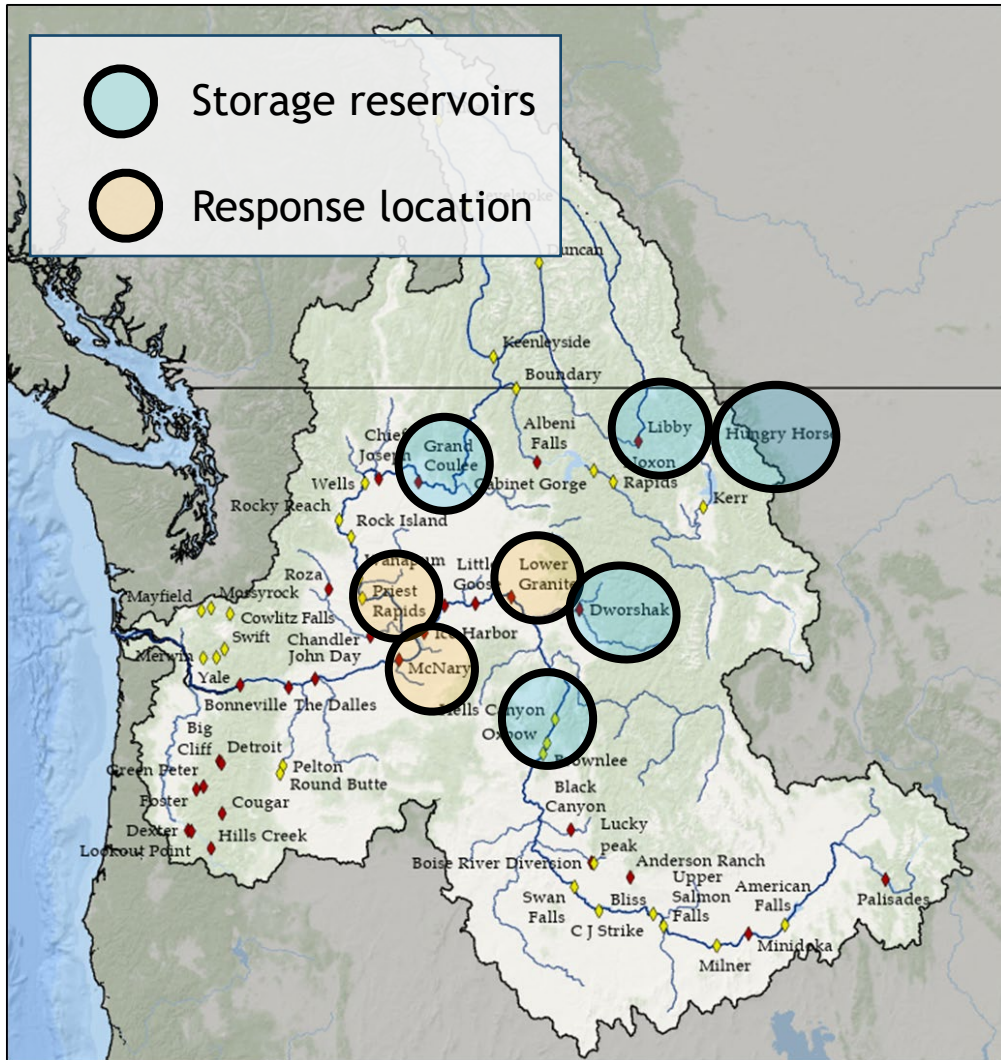
Includes:

- Seasonal Average Flow (89.8 kcfs)
- Weekly average flows



Summary of juvenile migration results

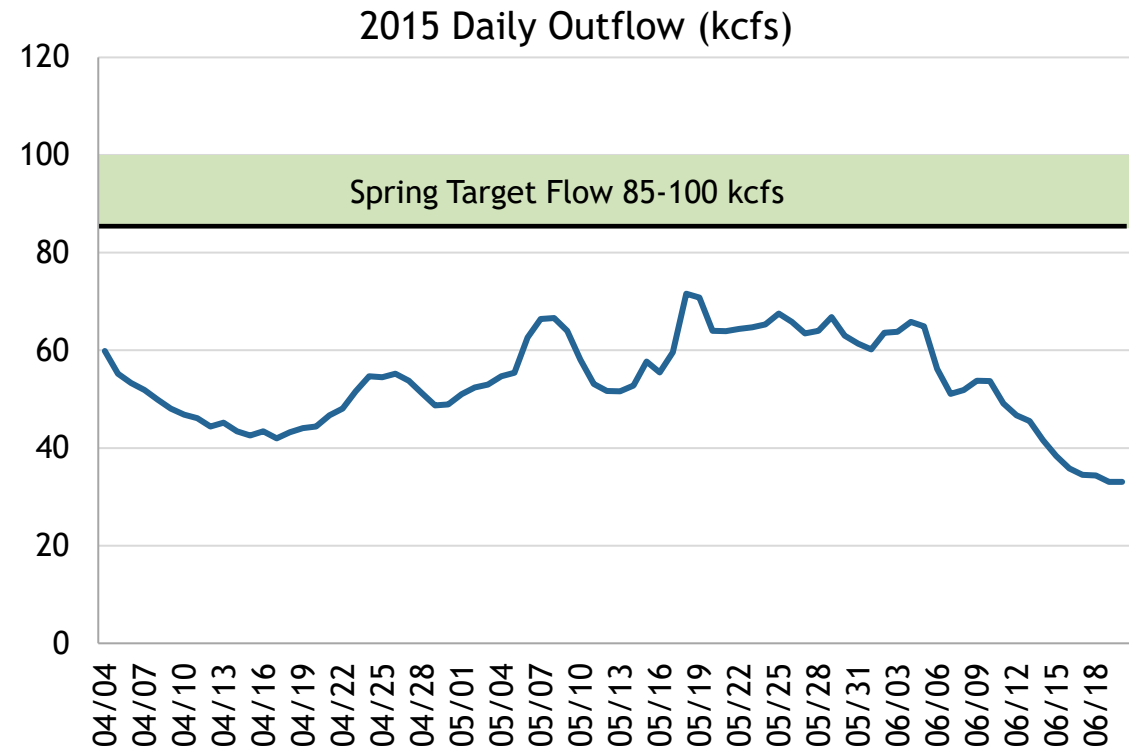
- Seasonal flow targets are driven by annual precipitation.
- Managers set a point target at each dam based on forecasts.
- McNary and Priest Rapids Dams often meet or exceed spring target flows.
- Lower Granite Dam meets or exceeds target flows less often.
- Managers use **adaptive in-season management** to work within annual water constraints.



Location of major dams (diamonds; red = federally owned, yellow = publicly or privately owned) in the Columbia River Basin. Map created in ArcGIS Pro (C) 2020 ESRI. All rights reserved.

Juvenile Migration Discussion - Spring season

- Targets create mechanisms to provide flows for migrating salmon in all water years
- Environmental conditions:
 - **Annual Upstream flows** and **runoff timing** affect how easy it may be to reach a seasonal target flow.
- Management decisions can benefit fish despite a lack of ideal flows. How do we sustain and improve this ability in the future?



Seasonal flows are just one part of effort to increase survival of juvenile salmon and decrease migration time.

Biological purposes

Juvenile Migration (salmon and steelhead)

Adult Migration (salmon, steelhead), Lamprey Migration

Mainstem Spawning and Rearing (resident and migratory fish)

Reservoir Rearing (resident fish)

Biological purposes

Action summary:

- Improve reservoir ecosystem conditions through management of flow (reservoir elevations)

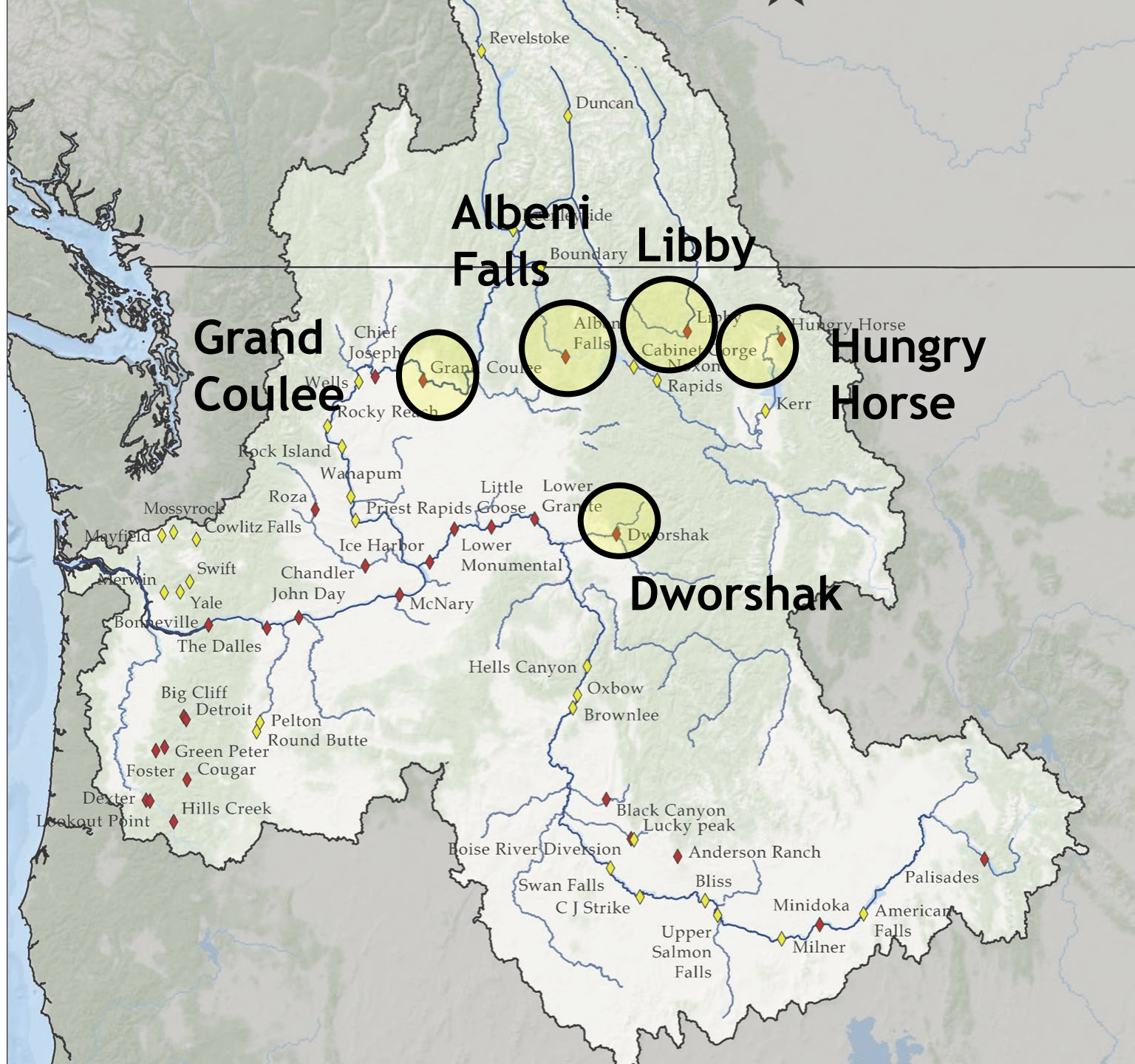
Focusing only on the effect of operations within the reservoir, not downstream

Species:

- Kokanee
- Cutthroat trout
- Rainbow trout
- All levels of food web, including shoreline vegetation

Reservoir Rearing
(resident fish)

Storage reservoirs with reservoir rearing actions

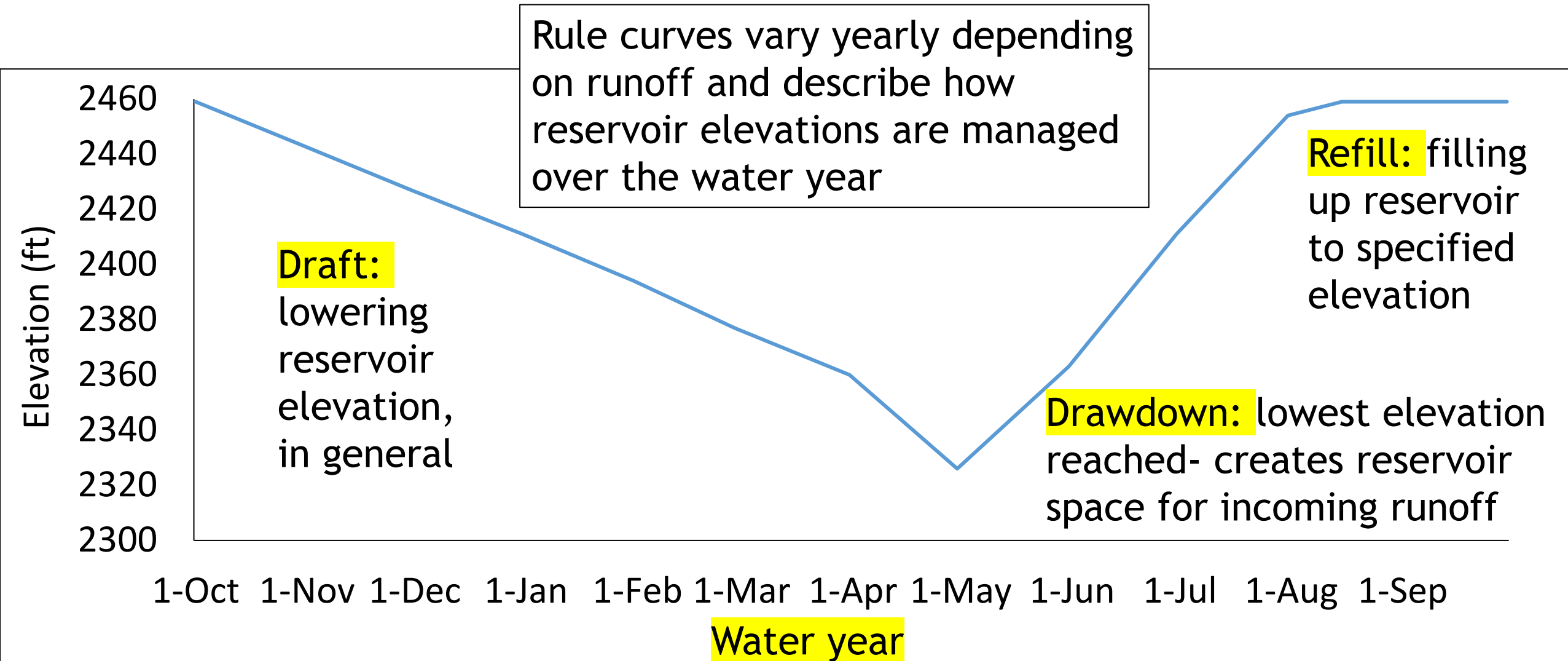


Reservoir rearing outline

- Reservoir management basics
- Timeline
- Graphs
 - Reservoir drawdown
 - Reservoir refill
 - Stable reservoir elevations
 - End of summer draft
- Key points
- Discussion



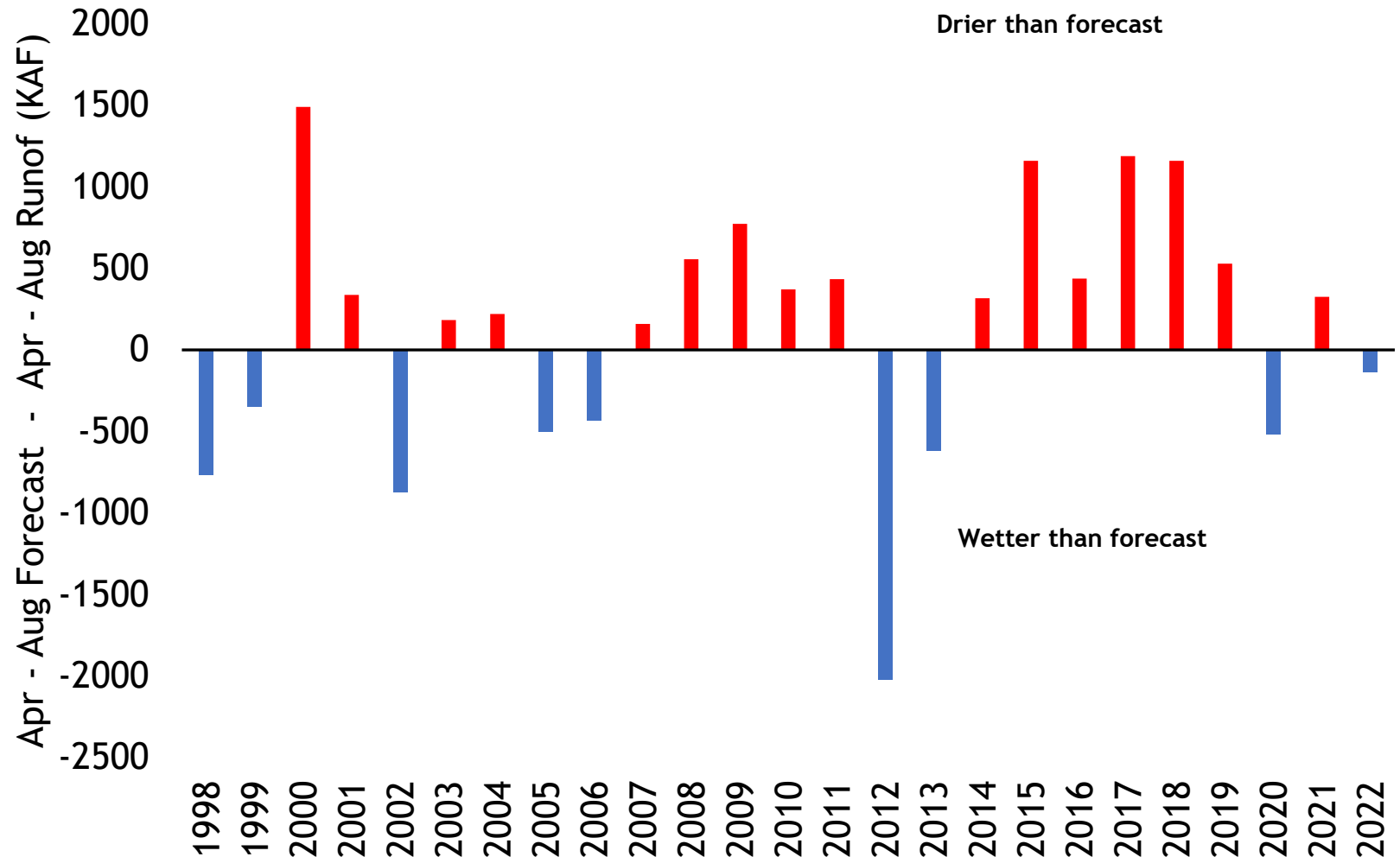
Reservoir management terminology used in examples



Forecasts shape storage reservoir management

- If actual runoff is lower than forecast, drawdown may be too deep to achieve refill
- If actual runoff exceeds forecast, there may be insufficient storage space for flood risk management and excess flow may be spilled (potential TDG issues)

Comparing May 1 forecast of Apr - Aug runoff to actual runoff



Reservoir rearing - Libby

1982 Program: Drawdown limits

1993: Montana develops Integrated Rule Curves (IRC)

1994 Program: IRCs adopted in Program

2002: Based on IRC, Corps develops new Flood Risk Management strategy called variable discharge (VarQ)

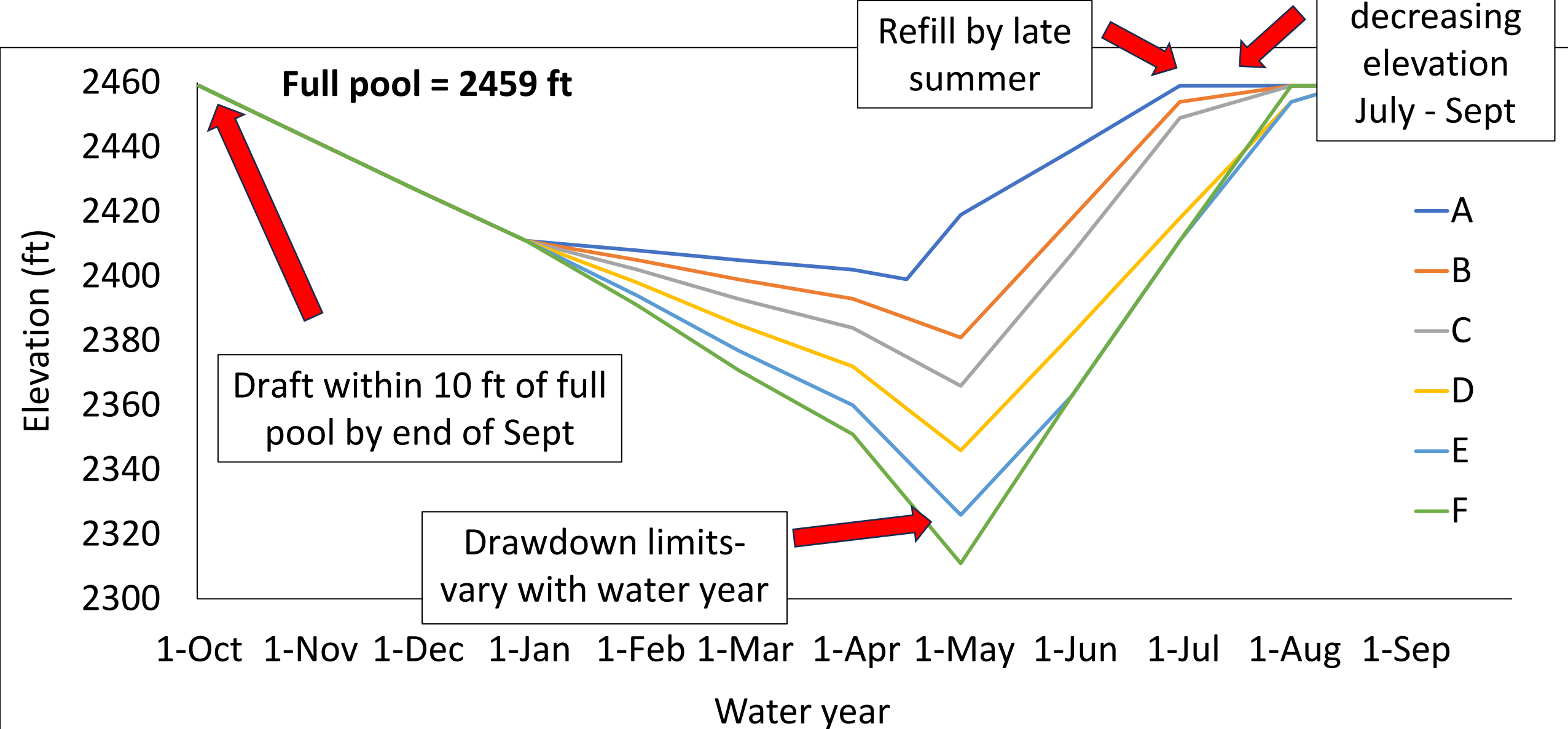
2003 Program: IRC/ VarQ adopted as experimental

2008 BiOp/ Accords: Incorporate above operations

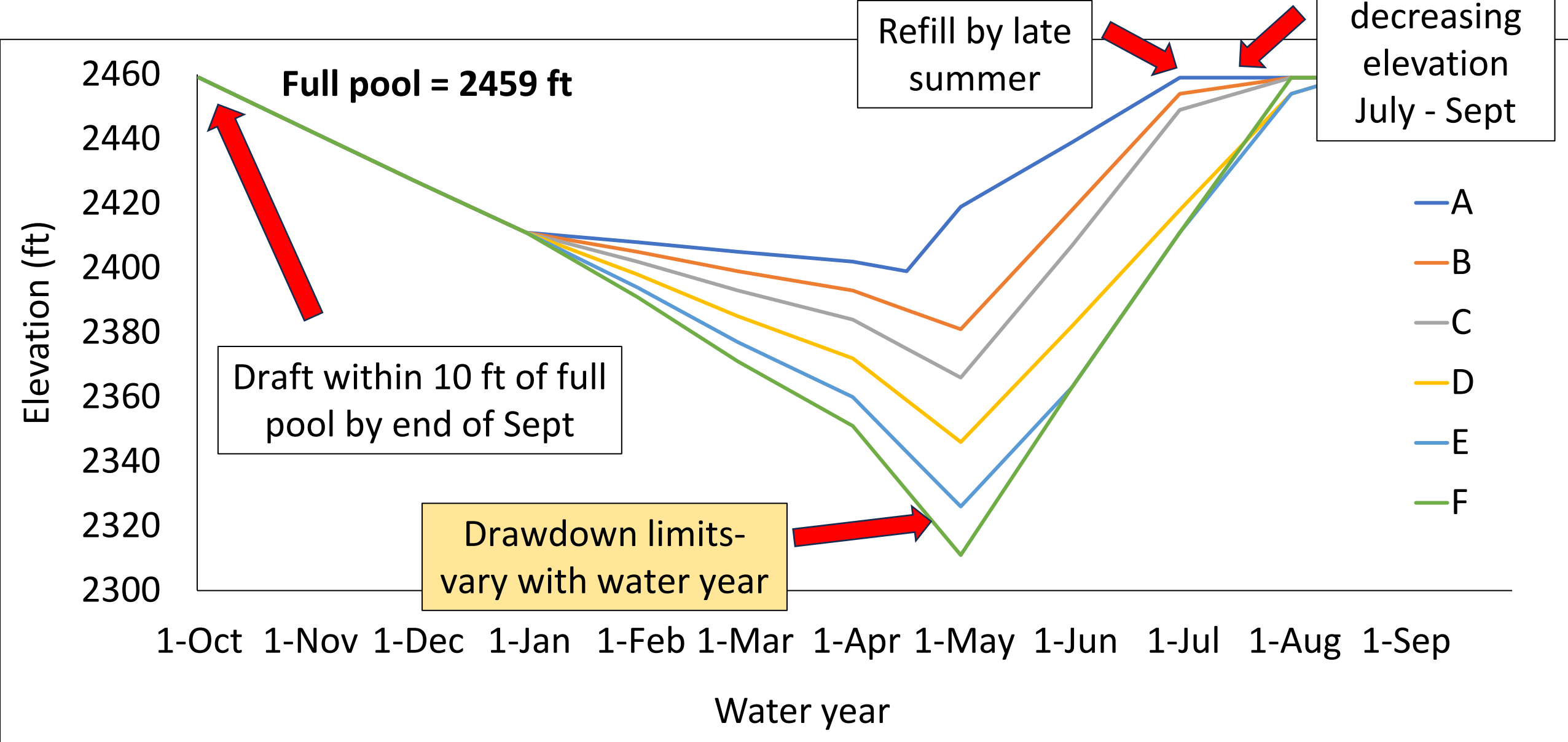
2009 Program: Implement 2003 amendments, IRC/ VarQ, actions in BiOps

2014/ 2020 Program: Operations no longer experimental; continue refinements

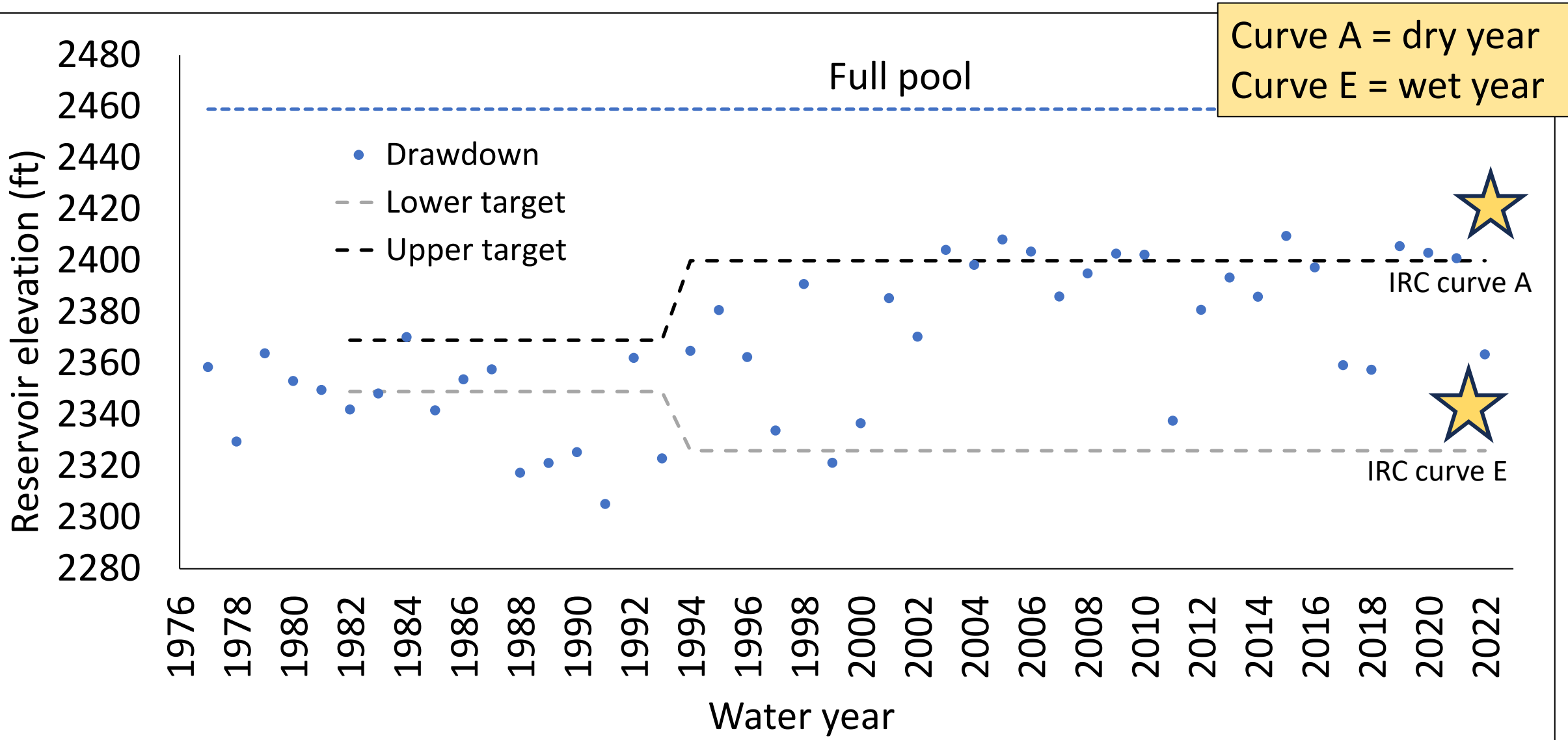
Libby Dam Integrated Rule Curves



Libby Dam Integrated Rule Curves

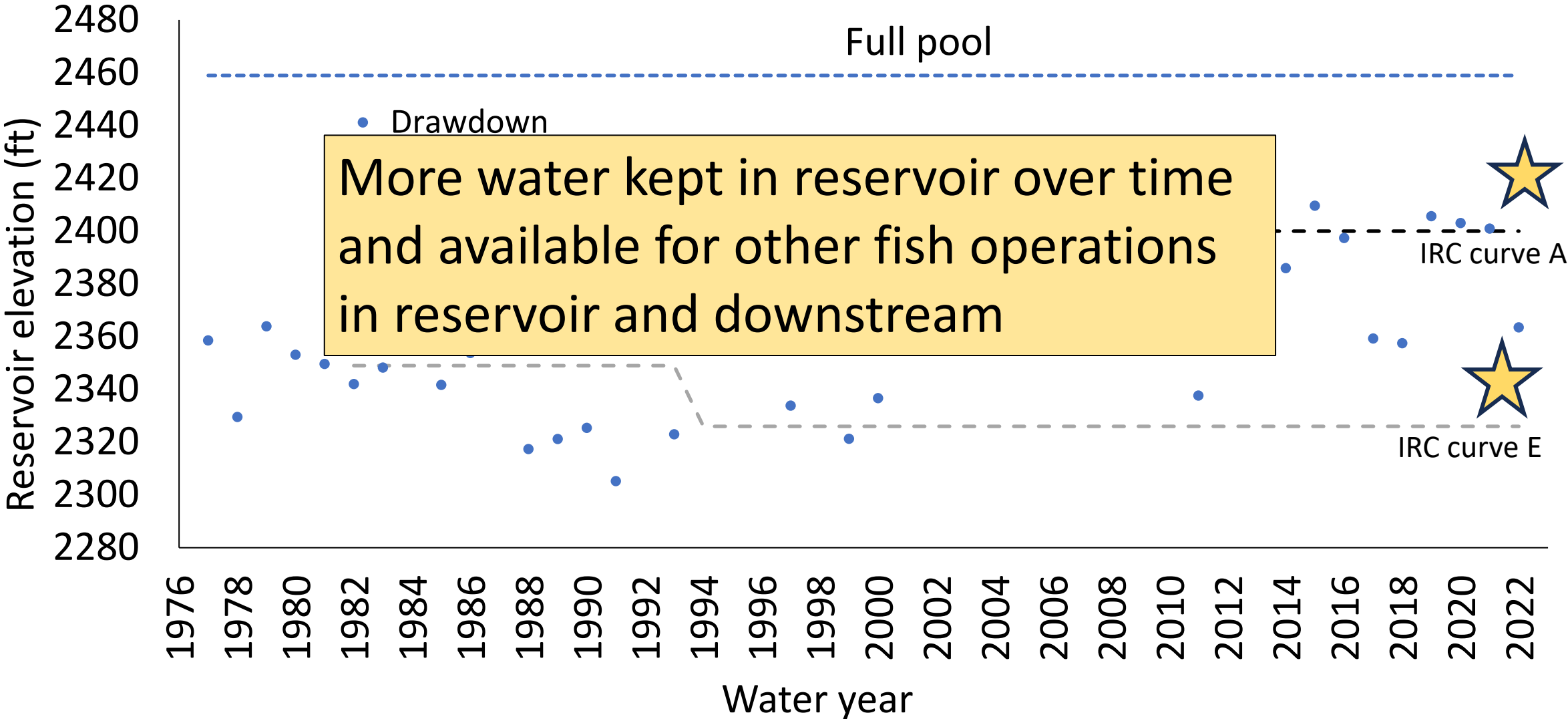


Reservoir drawdown Libby Dam

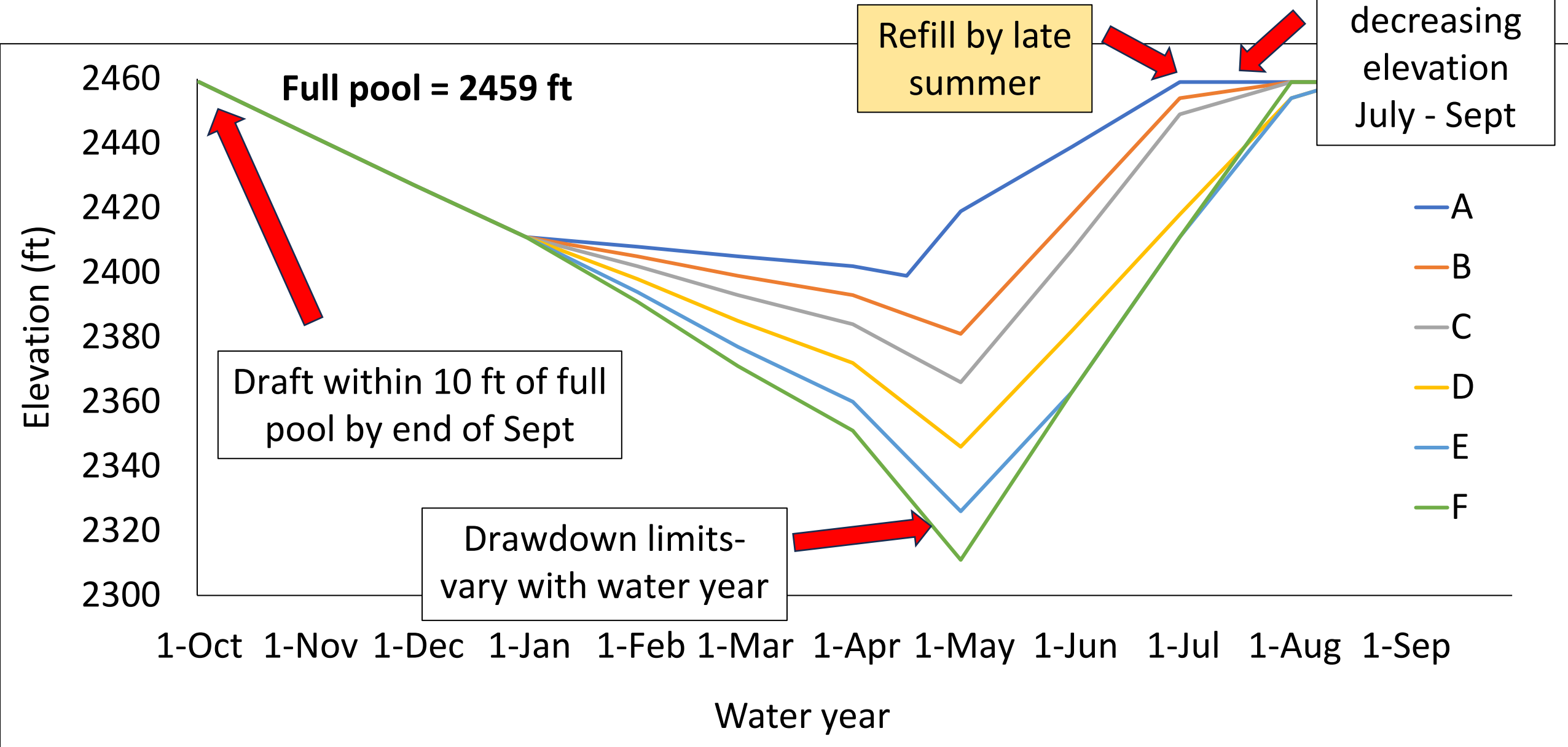


Drawdown should be no deeper than target for given year

Reservoir drawdown Libby Dam

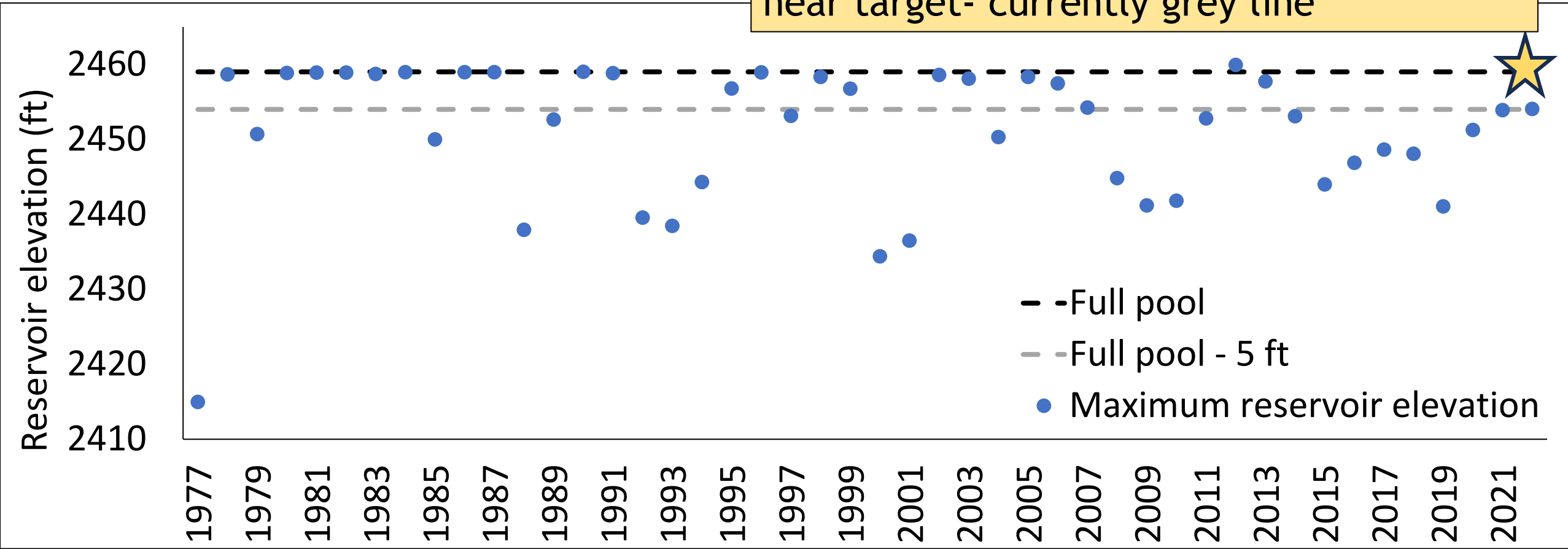


Libby Dam Integrated Rule Curves



Summer refill target (end of July) Libby Dam

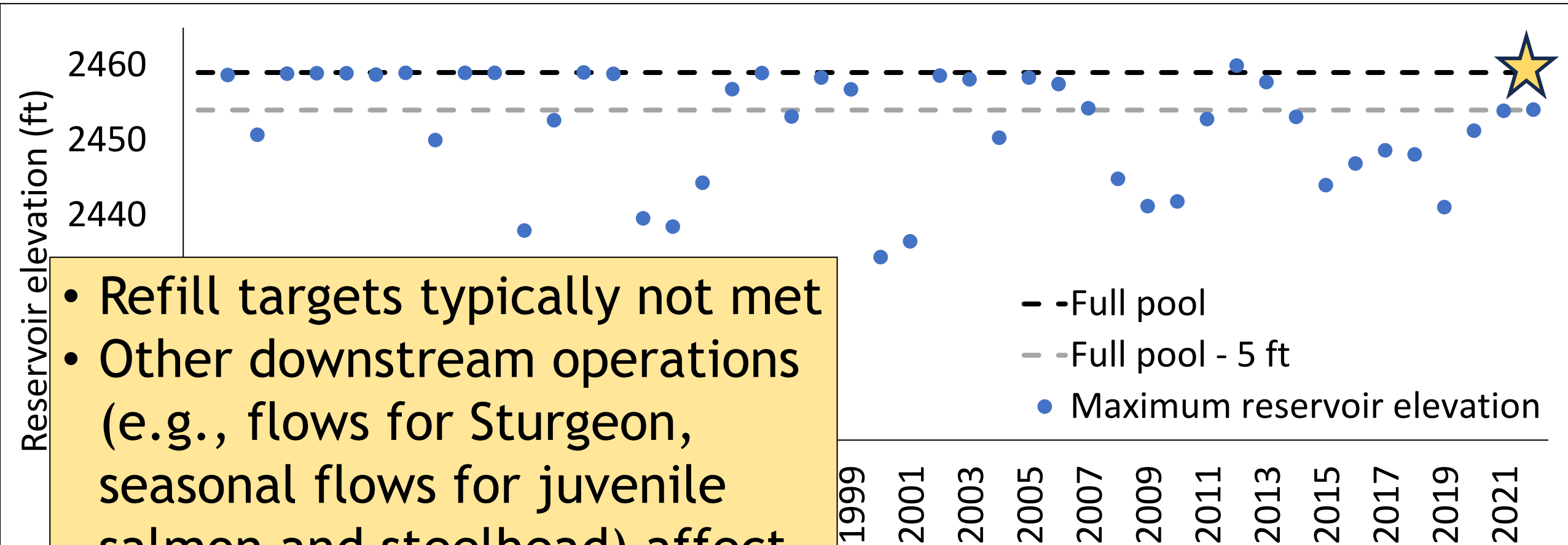
End of July reservoir elevations should be near target- currently grey line



Standard (2003 on) = reduce frequency of refill failure within 5 ft full pool

Contemporary standard = refill to 5 feet from full pool

Summer refill target (end of July) Libby Dam

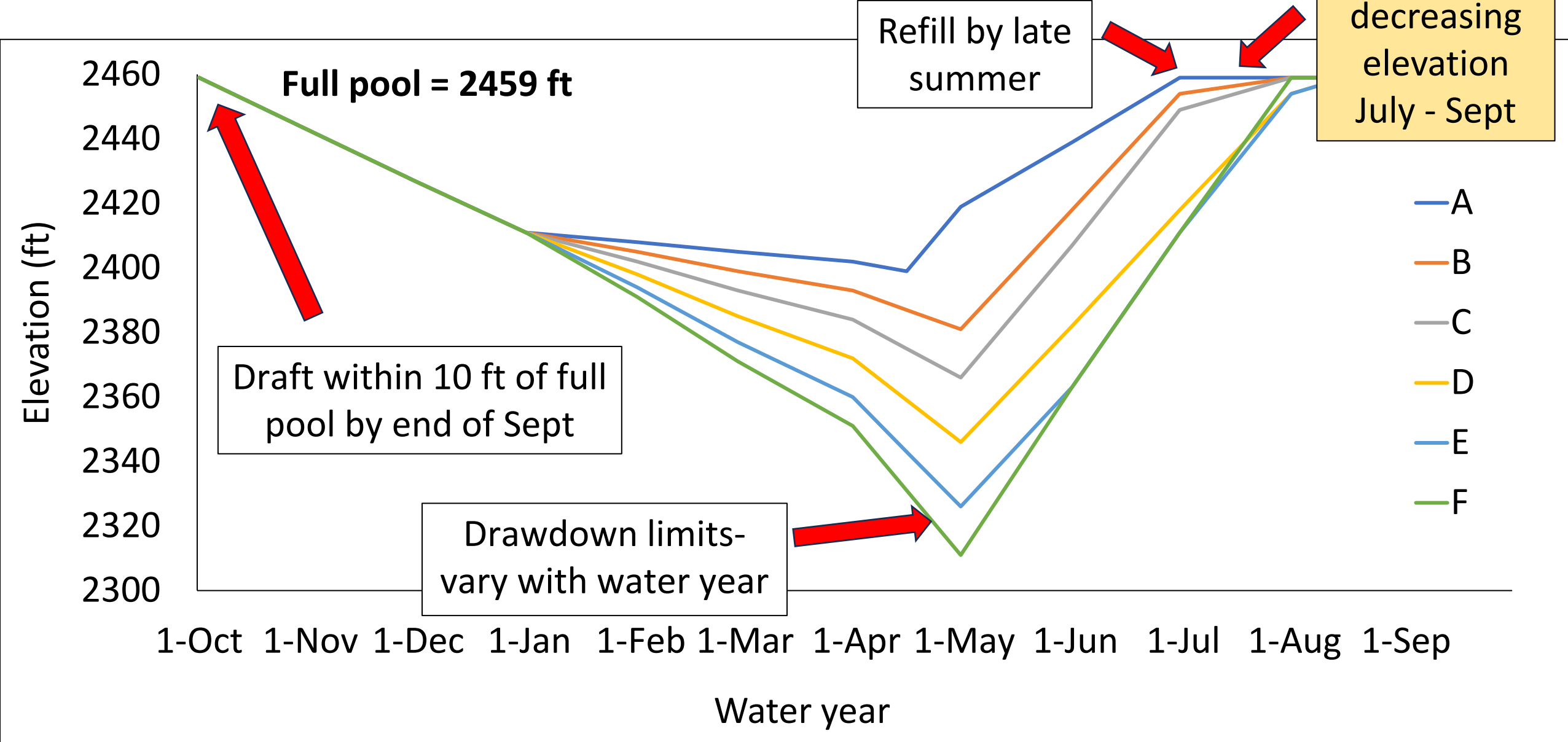


- Refill targets typically not met
- Other downstream operations (e.g., flows for Sturgeon, seasonal flows for juvenile salmon and steelhead) affect ability to reach refill target

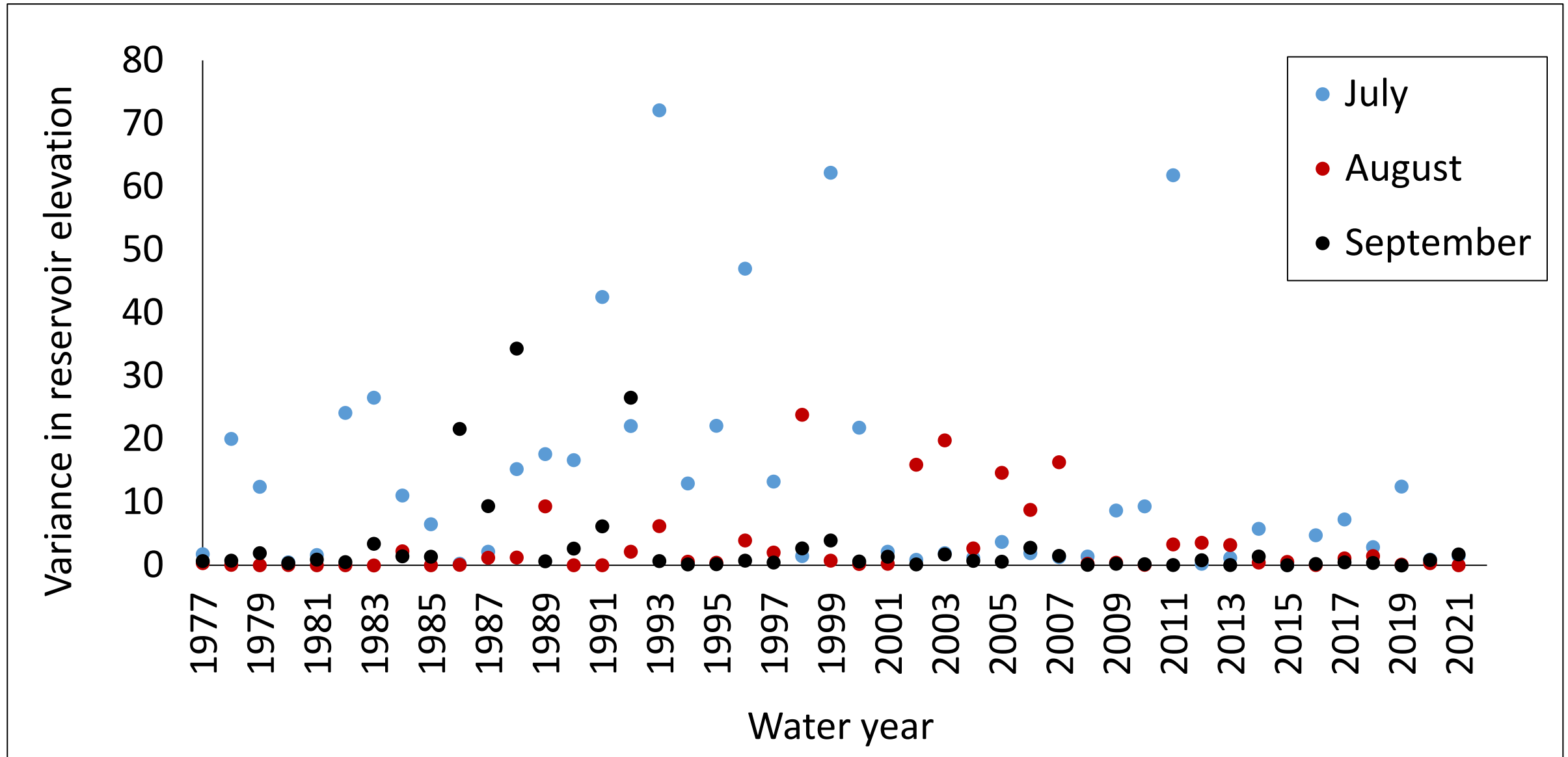
of refill failure within 5 ft full pool

Contemporary standard = refill to 5 feet from full pool

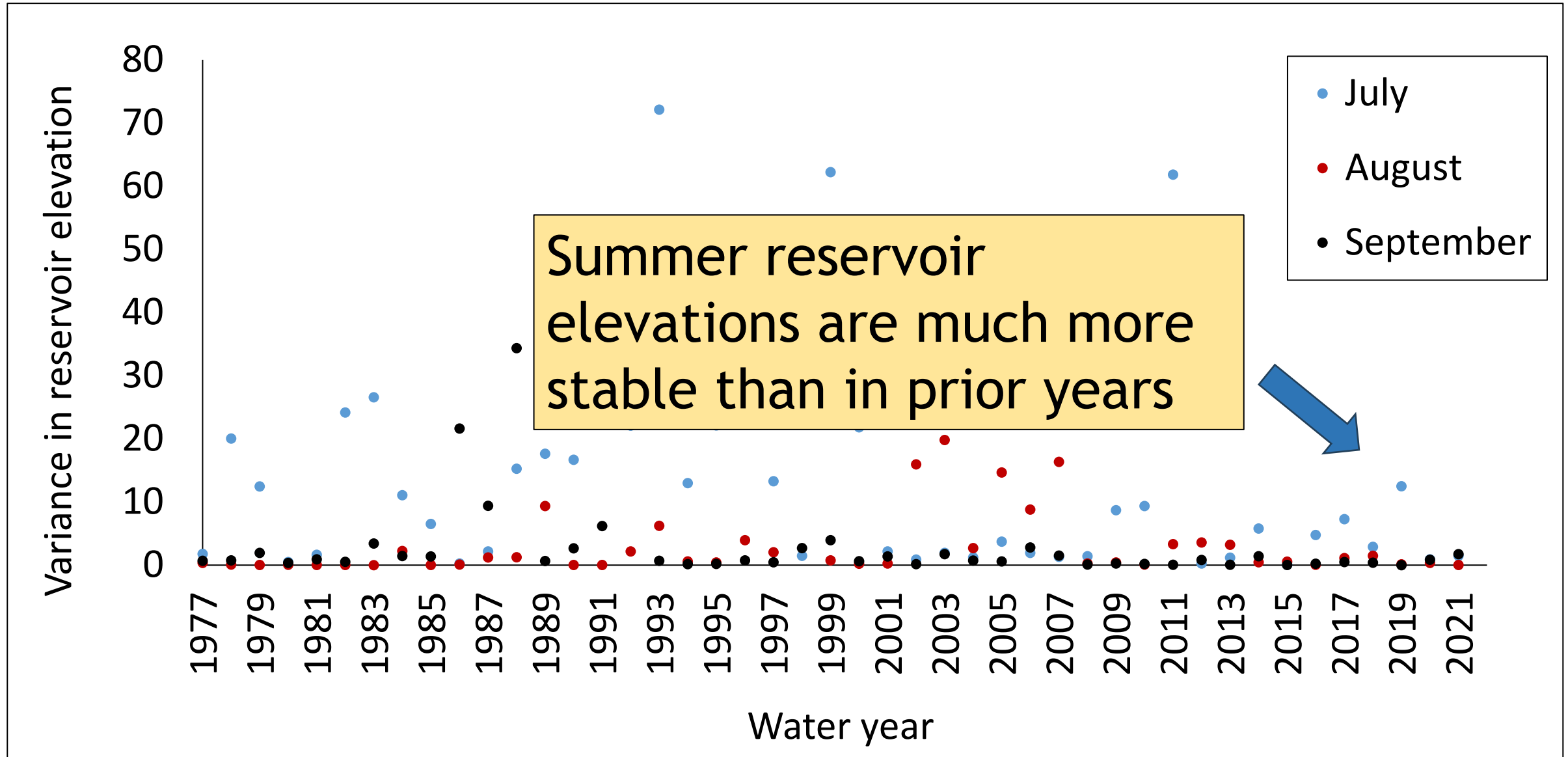
Libby Dam Integrated Rule Curves



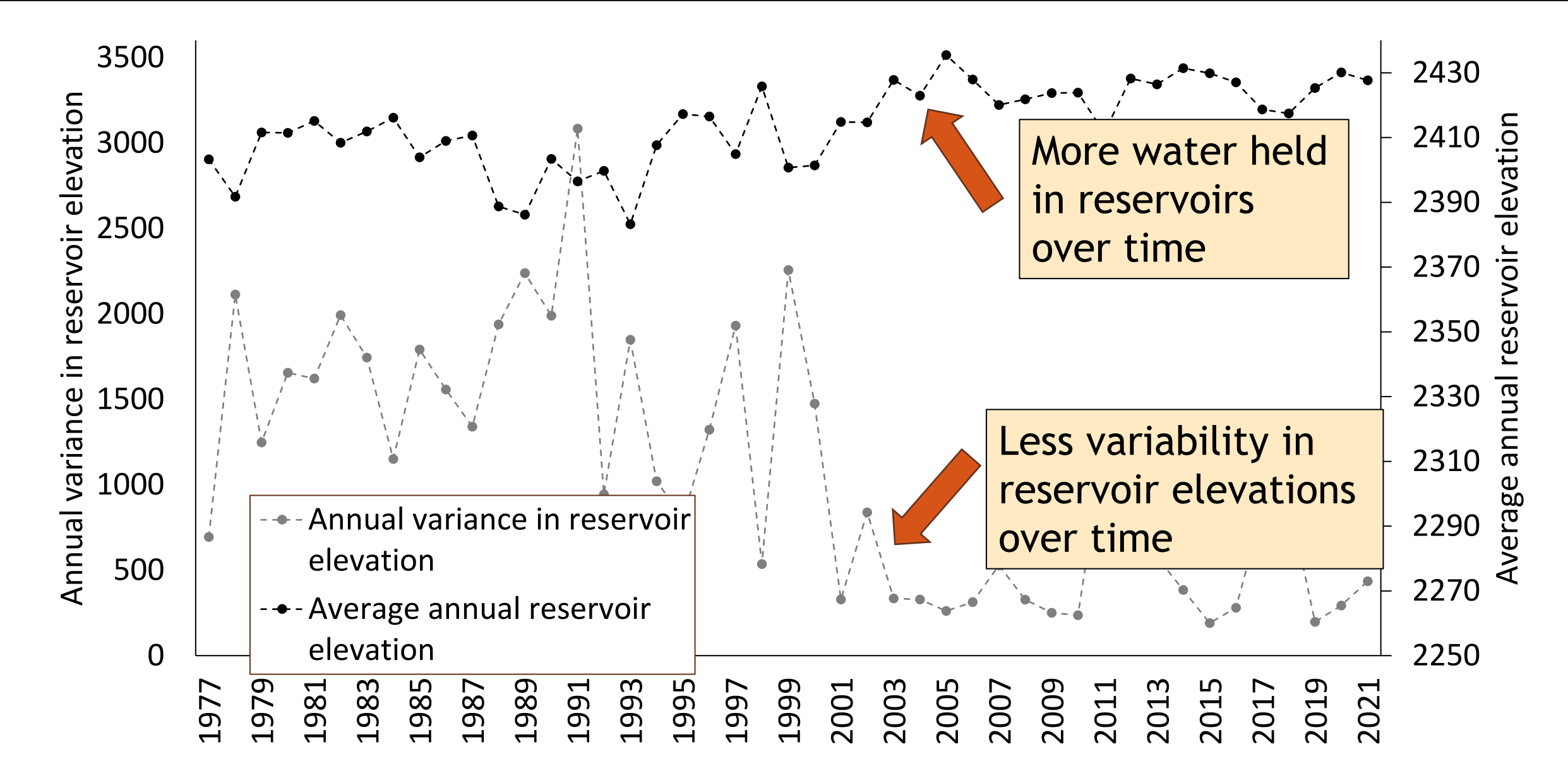
Stable reservoir elevations (Jul - Sept) Libby Dam



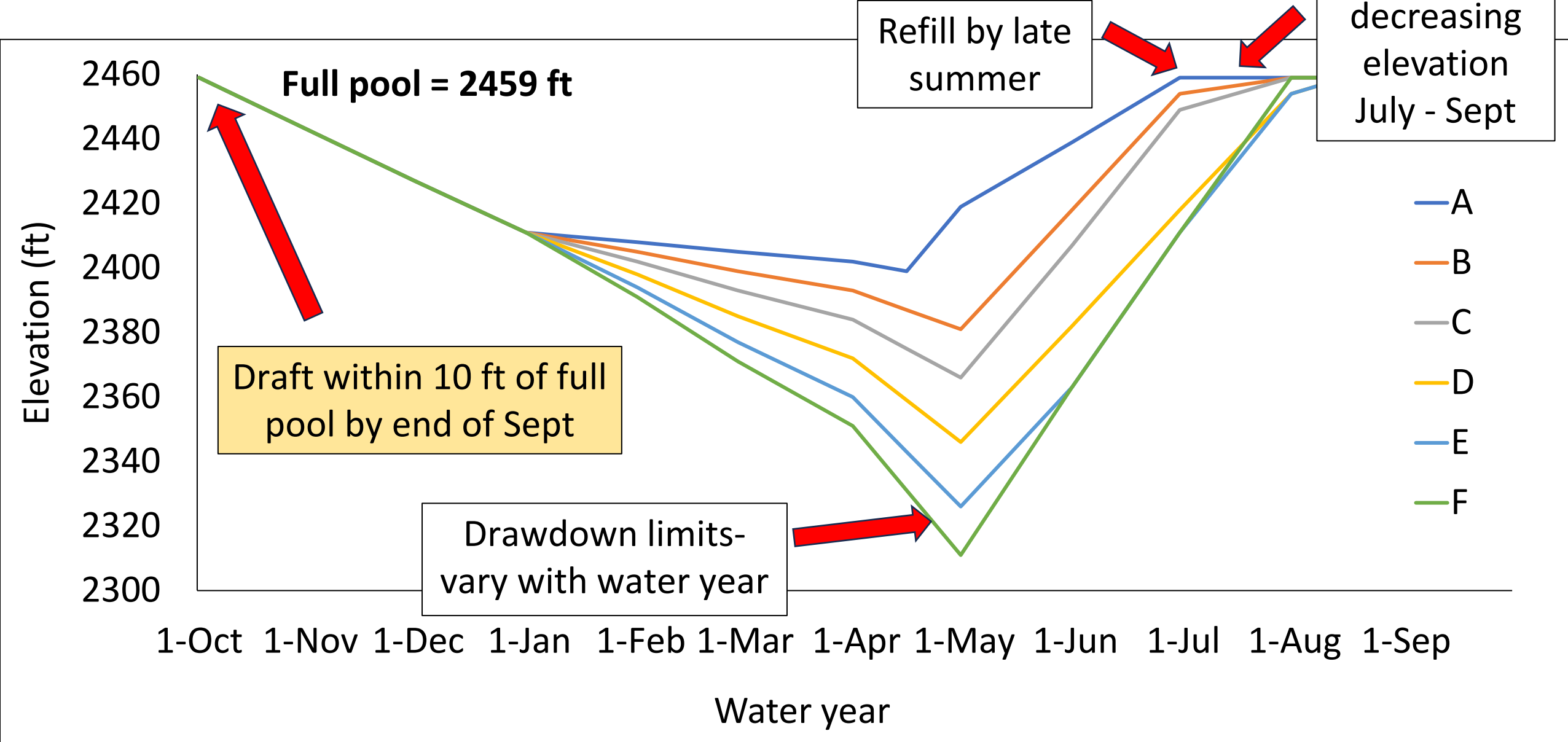
Stable reservoir elevations (Jul - Sept) Libby Dam



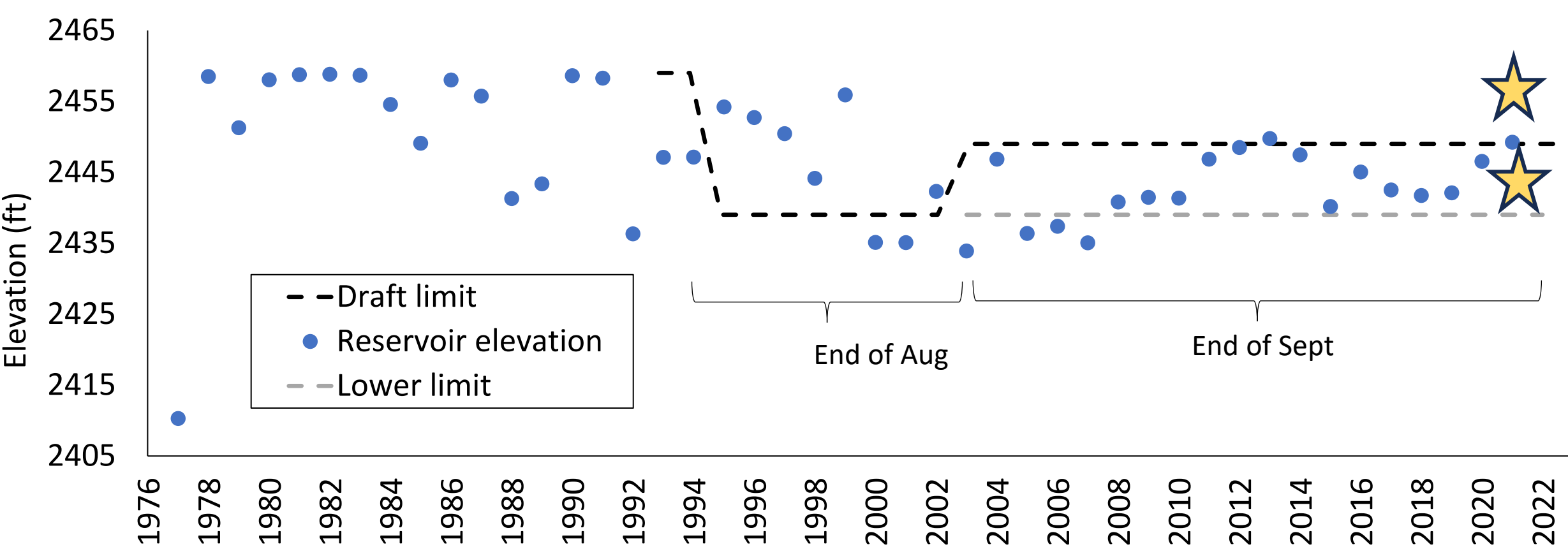
Reservoir elevations more stable- improves productivity



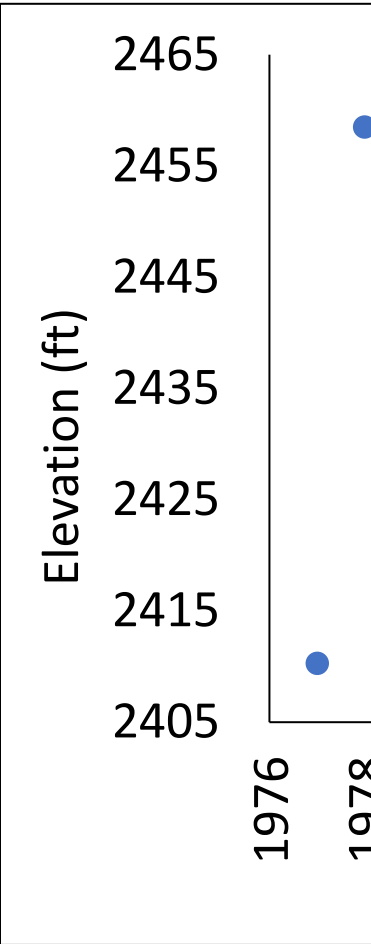
Libby Dam Integrated Rule Curves



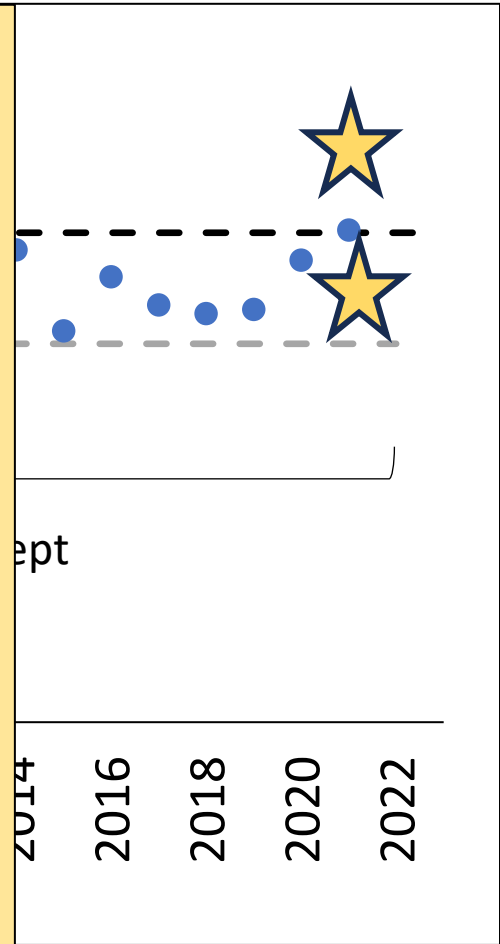
Summer draft limit (end of Aug/ Sept) Libby Dam



Summer draft limit (end of Aug/ Sept) Libby Dam



- If summer refill not met, difficult to stay above fall draft limit
- Until 2020, end of September target (either 10 or 20 ft draft) was determined by runoff forecast at The Dalles
- Now uses a variable draft limit based on Libby forecast to avoid abrupt transitions in elevation when close to dry year target



Summary of reservoir rearing results

- **Integrated rule curves-** adopted in Program and implemented
 - Council played role in helping operations gain regional support and implementation
- **Drawdown-** reservoirs no longer drawn down as deeply; more water kept in reservoirs
- **Summer refill targets** (5 feet below full pool) typically not met
 - New summer target
 - Keeping reservoir slightly lower decreases potential for involuntary spill which elevates total dissolved gas downstream of Libby Dam
 - Lower reservoir elevation also creates more favorable temperature conditions in reservoir
 - Achieving operations for Sturgeon and downstream flow targets affect ability to refill reservoir

Summary of reservoir rearing results

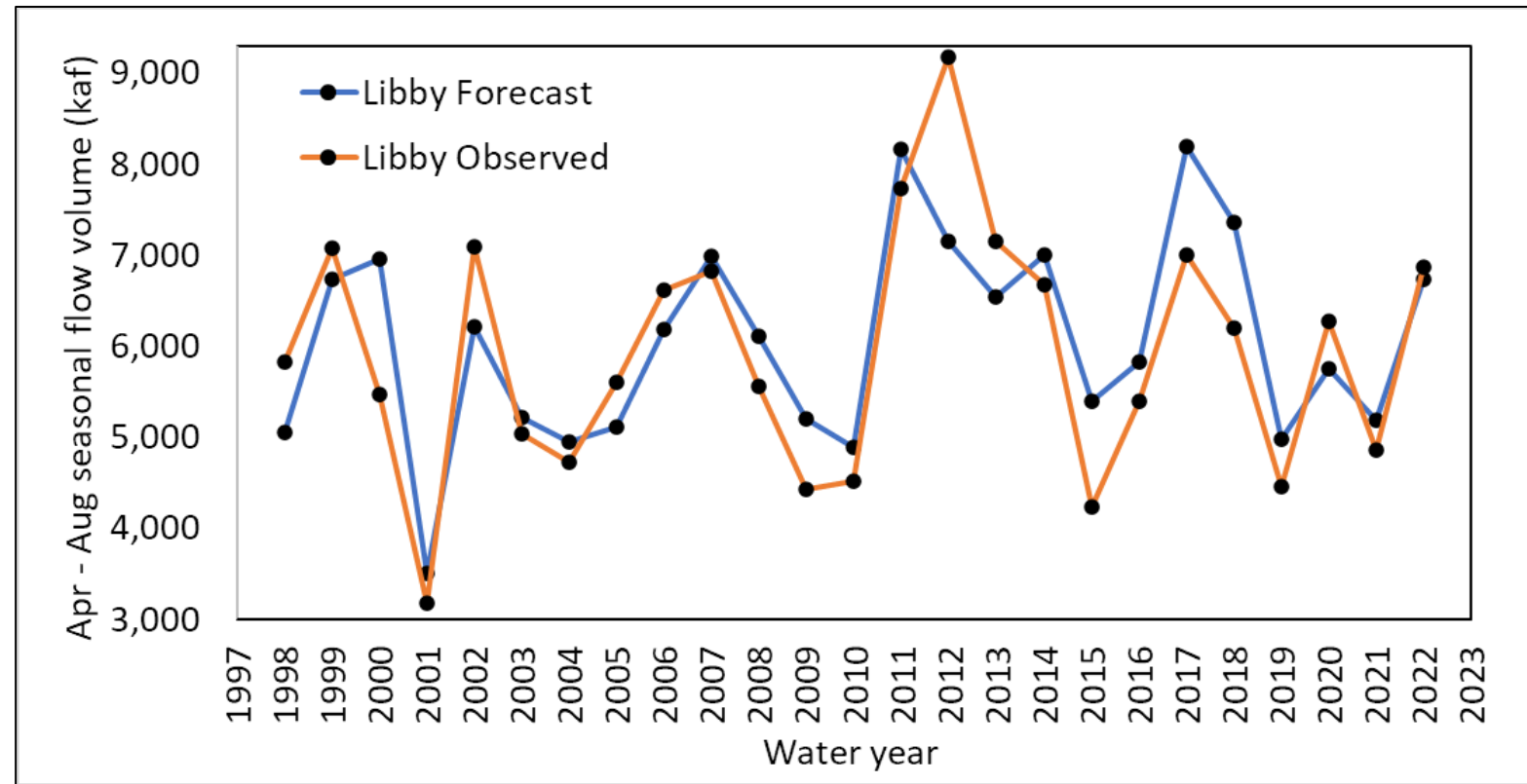
- **Stable reservoir elevations** are produced July - August with increasing frequency
 - Important for creating productive environment in reservoir
 - Also contributes to stable flow conditions downstream (not discussed today)
- **End of September draft** frequently above dry year limit, especially post 2010, but most draft falls below normal year limit
 - If refill not achieved, less water available to meet September draft limit
 - Normal vs dry year draft was driven by forecast at The Dalles (not always representative of local conditions).
 - Shifted to Libby forecast in 2020
 - Shifted from abrupt transition between normal and dry year operations to variable draft limit

Discussion of reservoir rearing

- Adaptive management-
 - Flexibility for in-season adjustments based on current conditions
- Priorities-
 - Stability > meeting specific targets
 - New information on how system works influences current priorities
 - Refill within 5 feet
 - Maintaining elevation
 - Support more favorable temperature conditions

Discussion of reservoir rearing

- Climate/ forecasting challenges
 - More precipitation falling as rain; difficult to forecast well
 - Runoff at low elevations occurring earlier
 - Summer precipitation below average-forecast model assumes average- less precipitation affects fish operations



- Improvements
 - Beginning 2020, local forecasts used to determine dry-year operations
 - Variable draft limits
 - Working to improve forecast models
 - TMT now reviews May forecast at June meeting

Status and next steps on hydrosystem assessment

- Completed:
 - Identified actions, their implementation, and associated benchmarks in hydrosystem category
- Next:
 - Continue to solicit and incorporate feedback from managers with topical expertise
 - Complete metadata for hydro assessment
 - Develop reporting tools
 - Identify key policy and technical issues, information gaps

Take home points



- Reviewed how operations have been implemented relative to how they are described in Programs
- Discussed what contributed to differences

Take home points

Adaptive management-

- Key to implementing hydro operations, given multiple priorities and environmental conditions
- Targets function as sideboards but actual implementation requires ongoing management decisions including in-season
- Programs called for adaptive management from beginning, called for evaluation, identified who could participate, set up processes for coordination

Priorities-

- Program does not contain priorities for how to implement multiple fish operations
- Water management plans do contain priorities (ex: reservoir refill vs seasonal flows)

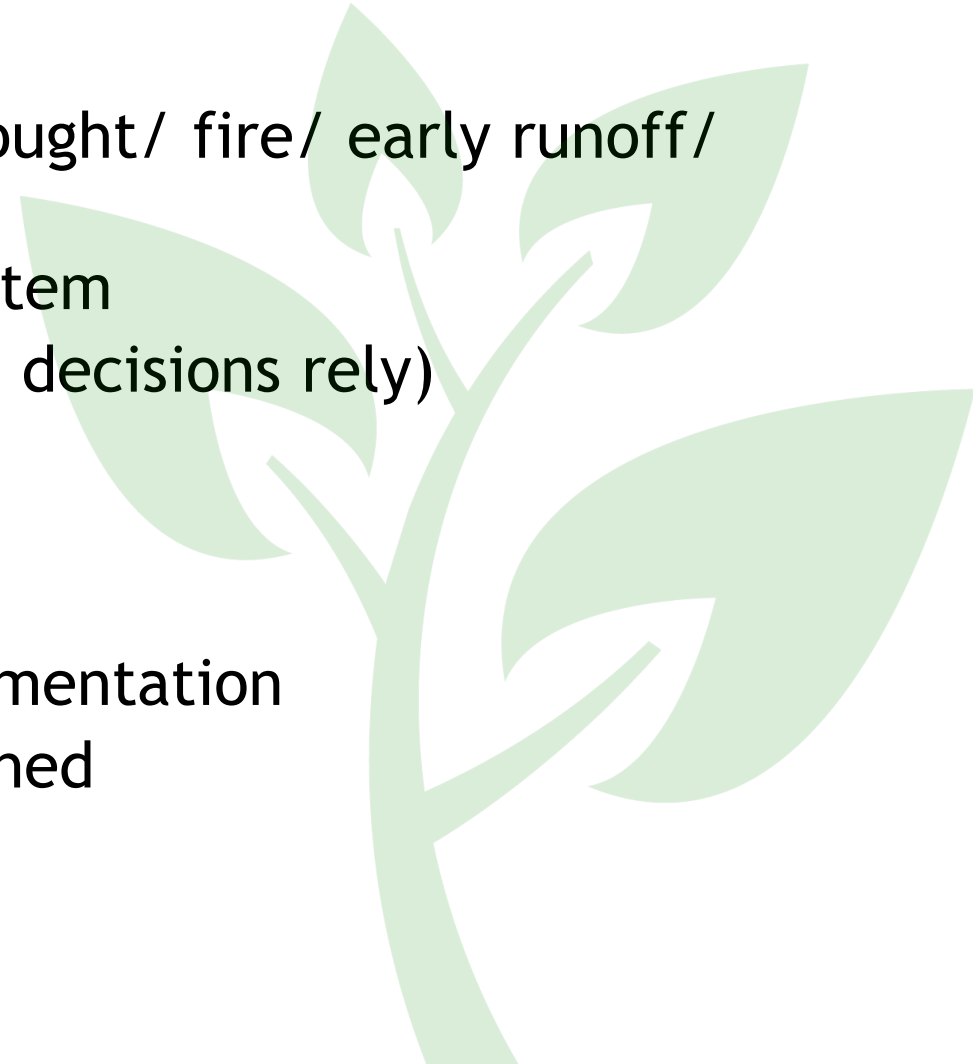
Take home points

Challenges in implementation-

- Changing environmental conditions (drought/ fire/ early runoff/ more precipitation as rain)
- Changing demands and operation of system
- Forecasting models (upon which all fish decisions rely)

Improvements that have occurred-

- Better modeling
- Lessons learned from 40 years of implementation
- Adaptive management systems established
- In-season operations refined



Discussion topics

A large, faint, lightbulb icon is centered in the background of the slide. The lightbulb is drawn with simple lines and has several short, radiating lines around it to suggest light or an idea.

- Options for communicating hydrosystem assessment to region?
 - Process to share and document remaining examples
- What do we need to think about leading up to the next amendment?
- As the priorities or conditions of the Basin change, are operations adaptable?

An aerial, sepia-toned photograph of a large, winding lake or reservoir. The water is a light, milky color. Several large, dark, forested islands and peninsulas are scattered throughout the water. On the left side, a dark, forested hillside slopes down to the water's edge, with a winding road or path visible. In the foreground, the dark silhouettes of evergreen trees and a small building are visible. The sky is filled with large, white, fluffy clouds. The overall scene is a vast, natural landscape.

Questions?