BAKER RIVER PROJECT RELICENSE

Economics/Operations Working Group
January 27, 2004

1:30 PM – 3:00 PM
USFS Office
Mountlake Terrace, WA

DRAFT MEETING NOTES

The Economics Working Group Mission Statement:

"To ensure that alternative project proposals, operations and emergency plans for the Baker River Project and its components provide for: (1) Public health and safety; and (2) Thorough analysis and evaluation of the economic costs and benefits (including non-market and economic impacts.)"

Team Leader: Lloyd Pernela (PSE), 425-462-3507; lloyd.pernela@pse.com

Note: Please let the team leader know if you are unable to attend a meeting. If something comes up at the last minute, please call Lyn prior to the meeting. Lyn's cell phone is 425-890-3613.

PRESENT

Cary Feldmann, Bob Barnes, Paul Wetherbee , Kris Olin, Connie Freeland (PSE), Chuck Howard (Independent Consultant), Laura Johnson (guest artist observer), Steve Fransen (NMFS), Ruth Mathews (TNC), Bob Helton (interested citizen), Jerry Louthain (EES for City of Anacortes, Skagit County PUD, and Town of Concrete), Jeff McGowan, Mike Stansbury, Dave Brookings and Lorna Ellestad (Skagit County Public Works), Jay Smith and Bill Fullerton (Tetra Tech), Stan Walsh (Skagit River Systems Cooperative), Jack Oelfke (National Parks), Arn Thoreen (Skagit Fisheries Enhancement Group), Rod Mace and Jon Vanderheyden (USFS), Rob Mohn (Louis Berger Group), Gary Sprague (WDFW), Mark Killgore (Louis Berger Group), Harry Hosey and Jennifer Jiu (PIE), Linda Smith, Ted Perkins, and Ken Brettmann (USACE), Dee Endelmann (Agreement Dynamics), facilitator, Mary Jean Bullock, note-taker, and Lyn Wiltse, facilitator (PDSA Consulting Inc.)

DATES OF 2004 MEETINGS

Feb. 11, Mar. 10, Apr. 14

AGENDA
January 27 at USFS Office in Mountlake Terrace
1:30 to 3:00 p.m.

1:30 - 1:35 Introductions
1:35 – 1:40 Review/revise October 8 minutes and agenda
1:40 – 2:00 Review Action Items
- Questions/feedback re: PDEA and Draft License Application
- PME Matrix Review

2:00 – 2:10 HYDROPS and TST update (including status of R2 Habitat Models)
2:10 – 2:25 High Level Update on Flood Control Feasibility Study by WA Group and Tetra Tech
2:25 – 2:30 Review Other Study Requests:
- R-01 –Low Flow Augmentation from Baker Project – Deferred for now

2:30 – 2:40 Set February 11, 2004 agenda (at PSE Office in Mt. Vernon)
2:40 – 2:45 Determine next steps (What can we accomplish by Feb 27 Solution Team Meeting?
2:40 – 2:45 Evaluate Meeting
- What's Hot?
- Studies Report for Baker Solution Team

NEW ACTION ITEMS
- All: Review PSE draft PME and be prepared to discuss at Feb.11 meeting. Send any comments to Lloyd for distribution prior to the meeting.
- Jerry: Be prepared to give update on low flow augmentation study request at our Feb. 11 meeting.
- Paul: Post Tetra Tech presentation on website.
- Dave: Send Pie Presentation to Lloyd to distribute.
- Linda: Check with USACE District Office re: hydro power information status.

INTRODUCTIONS
We welcomed many first-time visitors to this Working Group meeting (see list above).

REPORT ON OLD ACTION ITEMS
- ALL: Reviewed mission of this group as described in these notes and be ready to discuss at next meeting. Then draft Econ/Ops schedule for completion of critical path.
- ALL: Reviewed Mark's presentation and send any questions to Lloyd so Mark can be prepared to address them at our next meeting.
- ALL: By November 12th reviewed Chapter 6 of PDEA for PMEs and License Application for completeness and reviewed other sections of the PDEA of particular concern to your entity and provide analysis and comments.
- Lyn: Asked Team leaders to flag potential "big Ticket" PME measures for this group and also to note those that impact Project operations.
- Lloyd: Worked up status of PMEs listed in matrix from econ/ops perspectives and be ready to report at our next meeting. Dave is available to help.

- Lloyd: Developed high level scope/schedules for potential environmental assessment of flood management change impacts.

PME MATRIX REVIEW

Low Flow Augmentation

Jerry reported low flow is not PME as such. The Washington Department of Ecology and others will be looking to see if the low flow idea is possible, given instream flows (yet to be agreed to). We'll see if a request for a low flow augmentation study fits into our timeframe, once in stream flows are agreed to.

Flood Control

Kris walked us through the PME drafted by PSE and distributed January 26. This PME reflects the current flood control agreement with the addition of what would happen if we were asked to change it. Any modifications in the future would follow the standard FERC re-opener process. We decided to discuss the PME at our February 11th meeting to develop a strategy/action plan to complete our discussions of this by the Solution Team meeting on February 24, 2004.

USACE PROJECT MANAGEMENT PLAN UPDATE

Linda Smith of the USACE noted that they're partnering with Skagit County on a PMP to analyze the economic feasibility of increased flood storage. The PMP runs through December, 2004.

UPDATE ON ADDITIONAL FLOOD CONTROL STUDY TEAMLET BY TETRA TECH

Jay Smith of Tetra Tech gave a progress report the Teamlet study. Hydrologic and hydraulic analysis has been completed for Phases I and III. Phase II deals with the PMF and Phase IV evaluates flood control options at Upper and Lower Baker in various combinations. The Corps Skagit River flood damage assessment economic model has been extended to the Baker River confluence. Tetra Tech's cost/benefit analyses are awaiting receipt of power loss calculations from the Corps.

At the request of Skagit County, the Corps is reviewing the Baker basin inflow hydrology used in the study. During the meeting, Linda Smith checked with the Corps District Office and found that it will take them a couple of weeks to get the data to PSE once they receive direction on the Baker river inflow hydrology. It is not clear when they will receive it. One Tetra Tech gets the data, they estimate it will take them approximately a month to complete the cost side of the study (Cost/Benefit Analysis).

PIE PRESENTATION

Harry reviewed the infrastructure at risk in the Skagit River Flood Plain. He then walked us through a visual model that showed changes in flood control benefits as one keeps various amounts of storage at Baker Lake and Lake Shannon, including the effects of adding a spillway at Shannon.

At the conclusion of the presentations, Chuck Howard summarized the major findings as follows:

1. The additional flood control storage is less effective in reducing stage as you go further downstream from the Skagit River at Concrete.
2. The additional flood control storage has negligible value for events more severe than 1:100 year return periods.

3. The existing system has been able to cope with 1:10 to 1:25 year events.

NEXT STEPS

At our February 11 meeting, Skagit County shall bring a schedule showing the timeframe to get this project done. We'll also review the PSE flood PME and Skagit County's proposed license application language at that meeting.

HANDOUTS

- PME Status as of January 26, 2004
- PSE Draft Flood Control PME
- Presentation of Preliminary Draft Results of Baker Project Flood Control Feasibility Study Presentation by Tetra Tech, Inc.
- Skagit County Public Works Department, January 27, 2004 – Letter to Lloyd Pernela PSE Re: Request of Skagit County Regarding Flood Coordination with Aquatics Work Group, Baker River Project (P-2150) with attachments.

EVALUATION OF THE MEETING

Well Done

- Had information and shared it
- Huge participation
- Quick evaluation at end
- We met! (first meeting since October)

Change for Next Time

- Need Hotel!

TENTATIVE AGENDA FOR NEXT MEETING

February 11, 2003 at PSE Office, Mt. Vernon, WA

9:00 - 9:05 Introductions
9:05 – 9:10 Review/revise minutes and agenda
9:10 – 9:30 Review Action Items
- PME Matrix Review
- Schedule: Is it possible to fit flood control study into our schedule?
- Low flow augmentation study request status

9:30 – 10:50 Flood Control PME
- Review PME proposed by PSE
- Review draft application language proposed by Skagit County.

10:50 – 11:30 Update on Flood Control Feasibility Study by Tetra Tech
11:30 – 11:40 Set March 10, 2004 agenda (at PSE Office in Mt. Vernon)
11:40 – 11:50 Evaluate Meeting

Baker River Project Relicense

- Flood Control Feasibility Teamlet Meeting
- January 27th, 2004
- Presentation of Preliminary Draft Results of Baker Project Flood Control Feasibility Study
- Presentation by Tetra Tech, Inc.

Preliminary Draft Results for Discussion Purposes Only

Project Background

- Tetra Tech contracted by PSE to conduct a complete evaluation of flood control scenarios at the Baker Project
  - Evaluation to follow Seattle District USACE scope of work
  - Evaluation to be consistent with USACE regulations, manuals, and flood control operation procedures
  - Utilize hydrologic and hydraulic models accepted by USACE (i.e. HEC-5, UNET, HEC-FDA)
  - Analytical methodology and results prepared in a format suitable for future decision making by the USACE

Alternative Analysis

- Incremental Alternative Development
  - Alternatives for Upper Baker Only (Phase I)
  - Alternatives for Lower Baker Only (Phase III)
  - Alternatives for Both Dams (Phase IV - not yet completed)
  - Interim Technical Memos and Final Report
- Evaluation of Alternatives
  - Hydrologic Analysis
  - Hydraulic Analysis
  - Economic Analysis
    - Benefit Analysis – Flood Damage Reduction
    - Cost Analysis – Power Loss and Structural Improvements
- Product - Matrix of Alternatives and Associated Costs and Benefits

Upper Baker Alternative Descriptions

Table 1.
Phase I Upper Baker Alternative Summary

Alternative	Basis of Alternative	Features of Alternative
Existing Condition	Existing Condition	• **Existing condition flood control storage volume of 74,000 acre-feet.** • Minimum flood control pool elevation 707.8 feet (NGVD29) • Minimum mandatory release from Upper Baker during flood control equals 5,000 cfs • Primary control point for reservoir operation is Skagit River USGS gage at Concrete • Control flow for flood control regulation at Upper Baker project is 90,000 cfs at the Skagit River USGS gage at Concrete
Alternative 1	Maximize authorized flood control volume	• **Utilization of the maximum authorized flood control volume of 100,000 acre-feet.** This is equivalent to an additional 26,000 acre-feet of flood control volume • Reduce minimum flood control pool to elevation 701.1 feet (NGVD29) • Initial conditions - minimum flood control pool elevation • Minimum mandatory release from Upper Baker during flood control equals 0 cfs • Only a minor change in the spillway gate regulation schedule to accommodate the mandatory minimum 0 cfs release rate.
Alternative 2	Full use of available active storage volume	• **Increase authorized flood control volume to 125,000 acre-feet.** This is equivalent to an additional 51,000 acre-feet of flood control volume • Maximizes reduction of peak flow in Skagit River at Concrete for the 500-year event • Reduce minimum flood control pool to elevation 694.0 feet (NGVD29), which equals the crest of the existing spillway • Initial conditions - minimum flood control pool elevation • Minimum mandatory release from Upper Baker during flood control equals 0 cfs • Only a minor change in the spillway gate regulation schedule to accommodate the mandatory minimum 0 cfs release rate.
Alternative 3	Minimum flood control volume required to maximize peak flow reduction at Concrete for events with return periods equal to or less than 50-year	• **Increase authorized flood control volume to 84,500 acre-feet.** This is equivalent to an additional 10,500 acre-feet of flood control volume. • Minimum required flood control volume that maximizes peak flow reduction in Skagit River at Concrete for 50-year event (which is the event associated with the largest incremental flood damages for the existing condition), while at the same time not increasing peak flow in Skagit River at Concrete for larger events such as the 250-year and the 500-year events • Reduce minimum flood control pool to elevation 704.7 feet (NGVD29) • Initial conditions – minimum flood control pool elevation • Minimum mandatory release from Upper Baker during flood control equals 0 cfs • Only a minor change in the spillway gate regulation schedule to accommodate the mandatory minimum 0 cfs release rate.
Alternative 4	No change in flood control volume	• **Active flood control volume equal to existing conditions – 74,000 acre-feet**. • Minimum mandatory release from Upper Baker during flood control equals 0 cfs • Only a minor change in the spillway gate regulation schedule to accommodate the mandatory minimum 0 cfs release rate.

Preliminary Draft Results for Discussion Purposes Only

Spillway Gate Regulation Schedule

Preliminary Draft Results for Discussion Purposes Only

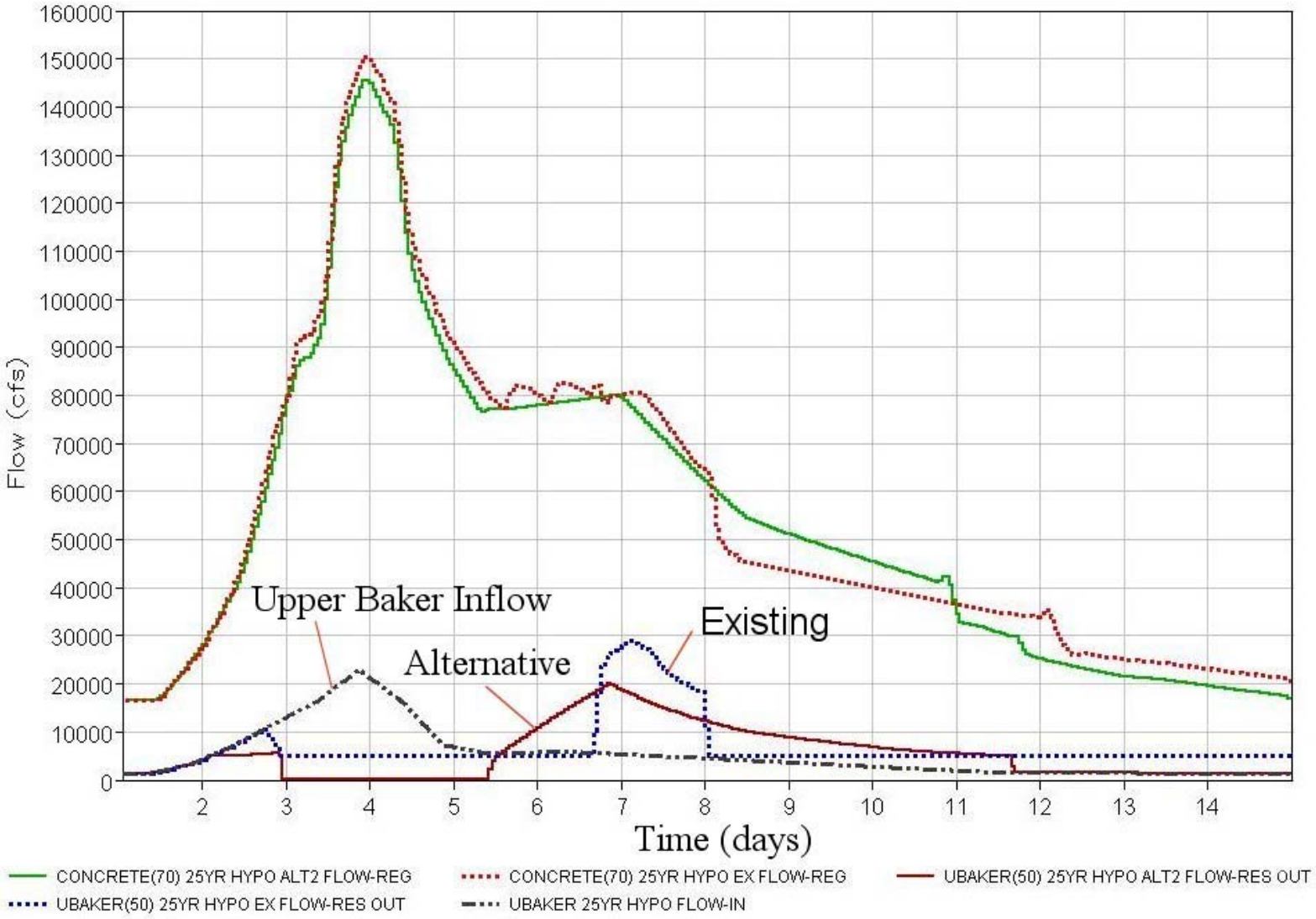
Summary of Upper Baker Hydrologic Results

Table 2. Summary of HEC-5 Hydrologic Results - Existing Conditions and Upper Baker Alternative Conditions															
	Existing Conditions			Alternative 1			Alternative 2			Alternative 3			Alternative 4		
Return Period	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev[1] (feet)	Release from Upper Baker at Peak[2] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev[1] (feet)	Release from Upper Baker at Peak[2] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev[1] (feet)	Release from Upper Baker at Peak[2] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev[1] (feet)	Release from Upper Baker at Peak[2] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev[1] (feet)	Release from Upper Baker at Peak[2] (cfs)
10-	123,850	715.0	5,000	118,849	713.8	0	118,849	708.9	0	118,849	716.7	0	118,849	719.3	0
25-	150,448	718.8	5,000	145,448	718.2	0	145,448	713.6	0	145,448	721.0	0	145,448	723.6	0
50-	185,074	724.2	5,000	180,074	725.2	0	180,074	724.1	0	180,074	725.3	0	180,074	725.3	0
75-	206,091	724.9	5,000	201,091	725.3	0	201,091	725.2	0	201,091	725.4	0	201,077	725.7	587
100-	221,510	725.1	5,000	216,510	725.4	0	216,510	725.3	0	216,510	725.6	0	217,934	726.1	3,924
250-	281,138	726.4	11,516	275,123	726.2	3,462	274,263	725.7	0	280,291	726.3	10,984	291,089	726.4	30,973
500-	350,206	726.7	36,595	339,222	726.5	30,040	327,062	726.3	4,558	351,983	726.6	38,244	361,663	726.7	41,921

- (1) Upper Baker reservoir pool elevations reference the NGVD29 vertical geodetic datum
- (2) Release from Upper Baker is that which is coincident with the peak flow in the main stem Skagit River at Concrete

Preliminary Draft Results for Discussion Purposes Only

Alternative 2 vs. Existing (25-Year Event)



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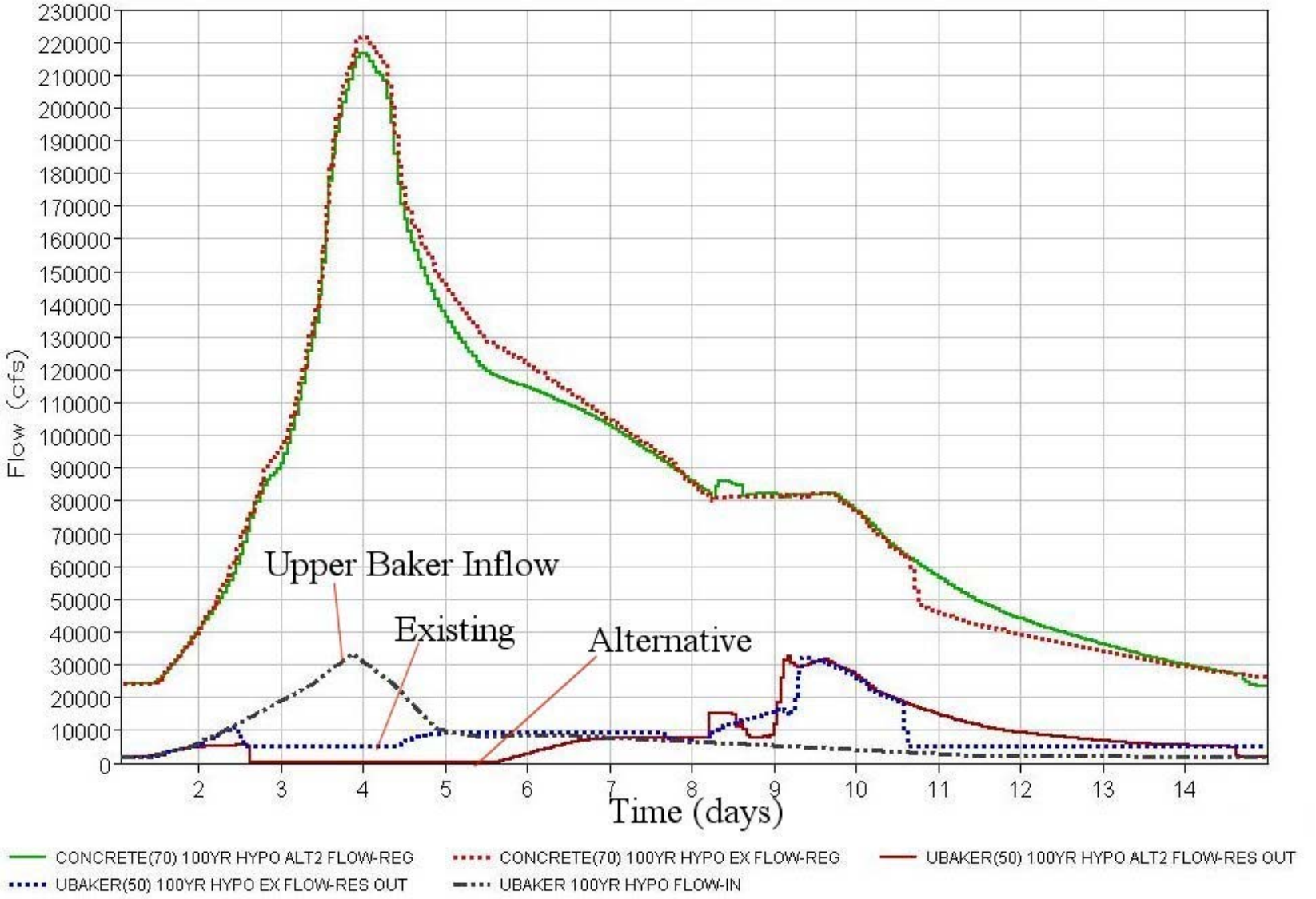
Alternative 2 vs. Existing (100-Year Event)



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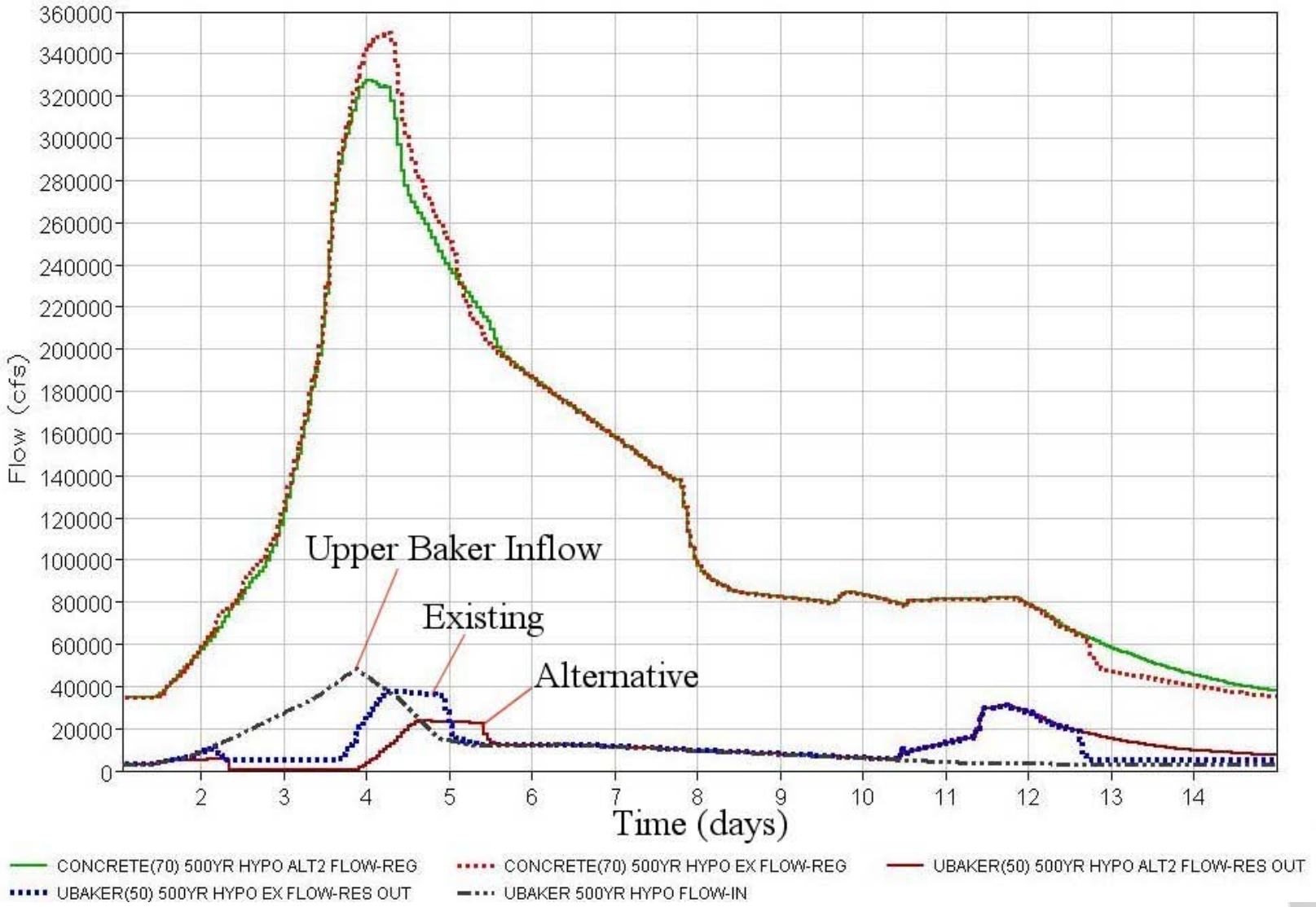
Alternative 2 vs. Existing (500-Year Event)



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Summary of Upper Baker Hydraulic Results

Table 3.
Predicted River Stage (in feet) at Specific Hydraulic Model Cross Sections on the Skagit River
Existing Conditions and Upper Baker Alternative Conditions

Return Period	Existing Conditions			Alternative 1			Alternative 2			Alternative 3			Alternative 4		
	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96
10-	166.7	40.1	28.1	166.2 (0.5)	39.6 (0.5)	27.8 (0.3)	166.2 (0.5)	39.6 (0.5)	27.8 (0.3)	166.2 (0.5)	39.6 (0.5)	27.8 (0.3)	166.2 (0.5)	39.6 (0.5)	27.8 (0.3)
25-	169.0	42.2	29.3	168.6 (0.4)	41.9 (0.3)	29.1 (0.2)	168.6 (0.4)	41.9 (0.3)	29.1 (0.2)	168.6 (0.4)	41.9 (0.3)	29.1 (0.2)	168.6 (0.4)	42.0 (0.2)	29.2 (0.1)
50-	171.5	43.1	29.5	171.2 (0.3)	43.0 (0.1)	29.5 (0.0)	171.2 (0.3)	43.0 (0.1)	29.5 (0.0)	171.2 (0.3)	43.0 (0.1)	29.5 (0.0)	171.2 (0.3)	43.0 (0.1)	29.5 (0.0)
75-	172.9	43.4	29.9	172.6 (0.3)	43.3 (0.1)	29.8 (0.1)	172.6 (0.3)	43.3 (0.1)	29.8 (0.1)	172.6 (0.3)	43.3 (0.1)	29.8 (0.1)	172.6 (0.3)	43.3 (0.1)	29.8 (0.1)
100-	173.7	43.5	30.0	173.5 (0.2)	43.5 (0.0)	30.0 (0.0)	173.5 (0.2)	43.5 (0.0)	30.0 (0.0)	173.5 (0.2)	43.5 (0.0)	30.0 (0.0)	173.5 (0.2)	43.5 (0.0)	30.0 (0.0)
250-	176.2	44.4	30.3	176.0 (0.2)	44.4 (0.0)	30.3 (0.0)	176.0 (0.2)	44.3 (0.1)	30.3 (0.0)	176.2 (0.0)	44.4 (0.0)	30.3 (0.0)	176.5 (+0.3)	44.4 (0.0)	30.3 (0.0)
500-	178.2	45.2	30.4	177.9 (0.3)	45.2 (0.0)	30.4 (0.0)	177.9 (0.3)	45.0 (0.2)	30.4 (0.0)	178.2 (0.0)	45.3 (+0.1)	30.4 (0.0)	178.4 (+0.2)	45.2 (0.0)	30.4 (0.0)

- All elevations reference NGVD29 vertical datum
- Hydraulic model results for Likely Failure Point (LFP) model
- Hydraulic model includes debris blockage at Burlington Northern Railroad Bridge
- Values in parentheses represent reduction in stage due to flood control alternative at Upper Baker. A plus sign indicates an increase in river stage

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Lower Baker Alternative Descriptions (Alternatives A through C)

Table 1.
Phase III Lower Baker Alternative Summary

Alternative	Alternative Summary	Features of Alternative
Existing Condition	Existing Condition	• **Existing condition flood control storage volume of 74,000 acre-feet at Upper Baker. No flood control storage at Lower Baker. Normal full pool elevation at Lower Baker equals 438.6 feet (NGVD29)** • Minimum Upper Baker flood control pool elevation 707.8 feet (NGVD29) • Mandatory minimum release from Upper Baker during flood control equals 5,000 cfs • Primary control point for reservoir operation is Skagit River USGS gage at Concrete • Control flow for flood control regulation at Upper Baker project is 90,000 cfs at the Skagit River USGS gage at Concrete
Alternative A	Use existing spillway configuration and maximize use of existing active storage volume	• **Provide 29,400 acre-feet of flood control volume at Lower Baker.** • Minimum flood control pool elevation at Lower Baker 425.0 feet (NGVD29) • Normal full pool elevation at Lower Baker 438.6 feet (NGVD29) • No modifications to the existing gated spillway configuration at Lower Baker • During flood control operations, mandatory minimum release from Lower Baker equals 100 cfs • Operate Lower Baker to Skagit River USGS gage at Concrete using the same 90,000 cfs control flow as Upper Baker • Develop Spillway Gate Regulation (SGR) curves for Lower Baker to provide an orderly procedure for reservoir filling
Alternative B	Use recommended PMF spillway and maximize use of existing active storage volume	• **Provide 29,400 acre-feet of flood control volume at Lower Baker.** • Minimum flood control pool elevation at Lower Baker 425.0 feet (NGVD29) • Normal full pool elevation at Lower Baker 438.6 feet (NGVD29) • Necessary modifications to Lower Baker spillway gates and Lower Baker Dam as per PMF analysis • During flood control operations, mandatory minimum release from Lower Baker equals 100 cfs • Operate Lower Baker to Skagit River USGS gage at Concrete using the same 90,000 cfs control flow as Upper Baker • Develop Spillway Gate Regulation (SGR) curves for Lower Baker to provide an orderly procedure for reservoir filling
Alternative C	Use recommended PMF spillway and maximize use of existing active storage volume. Allow induced surcharge.	• **Provide 29,400 acre-feet of flood control volume at Lower Baker.** • Minimum flood control pool elevation at Lower Baker 425.0 feet (NGVD29) • Normal full pool elevation at Lower Baker 438.6 feet (NGVD29) • Allow surcharge storage at Lower Baker to elevation 443.0 (NGVD29) • Necessary modifications to Lower Baker spillway gates and Lower Baker Dam as per PMF analysis • During flood control operations, mandatory minimum release from Lower Baker equals 100 cfs • Operate Lower Baker to Skagit River USGS gage at Concrete using the same 90,000 cfs control flow as Upper Baker • Develop Spillway Gate Regulation (SGR) curves for Lower Baker to provide an orderly procedure for reservoir filling

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Lower Baker Alternative Descriptions (Alternatives D through F)

Table 1 (cont.)
Phase III Lower Baker Alternative Summary

Alternative	Basis of Alternative	Features of Alternative
Alternative D	Use recommended PMF spillway and provide additional active flood control volume below existing spillway elevation	• **Provide 48,200 acre-feet of flood control volume at Lower Baker.** • Minimum flood control pool elevation at Lower Baker 415.0 feet (NGVD29) • Normal full pool elevation at Lower Baker 438.6 feet (NGVD29) • Necessary modifications to Lower Baker spillway gates and Lower Baker Dam as per PMF analysis • Replace three vertical lift gate bays with a single large vertical lift wheel gate. Provide a 20 foot wide gate opening with spillway crest at elevation 410.0 feet (NGVD29) • During flood control operations, mandatory minimum release from Lower Baker equals 100 cfs • Operate Lower Baker to Skagit River USGS gage at Concrete using the same 90,000 cfs control flow as Upper Baker • Develop Spillway Gate Regulation (SGR) curves for Lower Baker to provide an orderly procedure for reservoir filling
Alternative E	Use recommended PMF spillway and provide additional active flood control volume below existing spillway elevation	• **Provide 38,800 acre-feet of flood control volume at Lower Baker.** • Minimum flood control pool elevation at Lower Baker 420.0 feet (NGVD29) • Normal full pool elevation at Lower Baker 438.6 feet (NGVD29) • Necessary modifications to Lower Baker spillway gates and Lower Baker Dam as per PMF analysis • Replace three vertical lift gate bays with a single large vertical lift wheel gate. Provide a 20 foot wide gate opening with spillway crest at elevation 410.0 feet (NGVD29) • During flood control operations, mandatory minimum release from Lower Baker equals 100 cfs • Operate Lower Baker to Skagit River USGS gage at Concrete using the same 90,000 cfs control flow as Upper Baker • Develop Spillway Gate Regulation (SGR) curves for Lower Baker to provide an orderly procedure for reservoir filling
Alternative F	Use existing spillway configuration and maximize use of existing active storage volume. Power generation during flood control.	• **Provide 29,400 acre-feet of flood control volume at Lower Baker.** • Minimum flood control pool elevation at Lower Baker 425.0 feet (NGVD29) • Normal full pool elevation at Lower Baker 438.6 feet (NGVD29) • No modifications to the existing gated spillway configuration at Lower Baker • During flood control operations, mandatory minimum release from Lower Baker equals 3,800 cfs • Operate Lower Baker to Skagit River USGS gage at Concrete using the same 90,000 cfs control flow as Upper Baker • Develop Spillway Gate Regulation (SGR) curves for Lower Baker to provide an orderly procedure for reservoir filling

Summary of Lower Baker Hydrologic Results (Alternatives A through C)

Table 2.
Summary of HEC-5 Hydrologic Results – Existing Conditions and Lower Baker Alternative Conditions (Alternatives A through C)

	Existing Conditions					Alternative A				Alternative B				Alternative C			
Return Period	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Upper Baker (ft NGVD29)	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)
10-	123,850	715.0	--	5,000	10,050	116,420	438.7	5,000	2,932	116,407	438.7	5,000	2,919	115,535	439.9	5,000	1,961
25-	150,448	718.8	--	5,000	11,231	144,225	438.7	5,000	5,411	144,211	438.7	5,000	5,397	142,477	441.1	5,000	3,571
50-	185,074	724.2	--	5,000	12,692	180,616	438.7	5,000	8,714	180,600	438.7	5,000	8,696	177,742	441.1	5,000	5,778
75-	206,091	724.9	--	5,000	13,498	203,180	438.7	5,000	11,080	203,164	438.7	5,000	11,064	199,806	441.2	5,000	7,621
100-	221,510	725.1	--	5,000	14,088	219,673	438.7	5,000	12,713	219,657	438.7	5,000	12,697	215,670	441.2	5,000	8,611
250-	281,138	726.4	--	11,516	19,682	281,787	438.7	12,255	20,384[b]	281,787	438.7	12,255	20,384[b]	279,188	441.9	17,731	23,100
500-	350,206	726.7	--	36,595	44,636	351,173	439.1	37,305	44,091[b]	351,389	438.7	37,305	45,710[b]	349,456	442.3	37,340	45,656

- (a) Release from Upper Baker/Lower Baker is which is coincident with the occurrence of the peak flow in the main stem Skagit River at Concrete
- (b) Project releases equal to reservoir inflow during occurrence of the peak flow in the main stem Skagit River at Concrete

Preliminary Draft Results for Discussion Purposes Only

Summary of Lower Baker Hydrologic Results (Alternatives D through F)

Table 3.
Summary of HEC-5 Hydrologic Results – Existing Conditions and Lower Baker Alternative Conditions (Alternatives D through F)

	Existing Conditions					Alternative D				Alternative E				Alternative F			
Return Period	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Upper Baker (ft NGVD29)	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Lower Baker (ft. NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs))	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)	Regulated Peak Flow in Skagit River at Concrete (cfs)	Max. Reservoir Pool Elev at Lower Baker (ft NGVD29)	Release from Upper Baker at Peak[a] (cfs)	Release from Lower Baker at Peak[a] (cfs)
10-	123,850	715.0	–	5,000	10,050	113,773	437.9	5,000	100	113,855	438.6	5,000	260	117,473	438.0	5,000	3,800
25-	150,448	718.8	–	5,000	11,231	139,266	438.7	5,000	290	140,607	438.7	5,000	1,698	142,862	438.7	5,000	3,800
50-	185,074	724.2	–	5,000	12,692	173,942	438.7	5,000	1,895	175,985	438.7	5,000	3,991	177,815	438.7	5,000	5,860
75-	206,091	724.9	–	5,000	13,498	195,394	438.7	5,000	3,144	197,857	438.7	5,000	5,663	199,760	438.7	5,000	7,595
100-	221,510	725.1	–	5,000	14,088	211,144	438.7	5,000	4,017	213,872	438.7	5,000	6,799	215,877	438.7	5,000	8,840
250-	281,138	726.4	–	11,516	19,682	272,520	438.7	17,731	17,018	279,420	438.7	19,663	25,281[b]	281,323	438.7	13,447	21,393[b]
500-	350,206	726.7	–	36,595	44,636	351,375	438.7	37,305	45,710[b]	351,389	438.7	37,305	45,710[b]	351,983	439.1	37,305	44,124[b]

- (a) Release from Upper Baker/Lower Baker is that which is coincident with the occurrence of the peak flow in the main stem Skagit River at Concrete
- (b) Project releases equal to reservoir inflow during occurrence of the peak flow in the main stem Skagit River at Concrete

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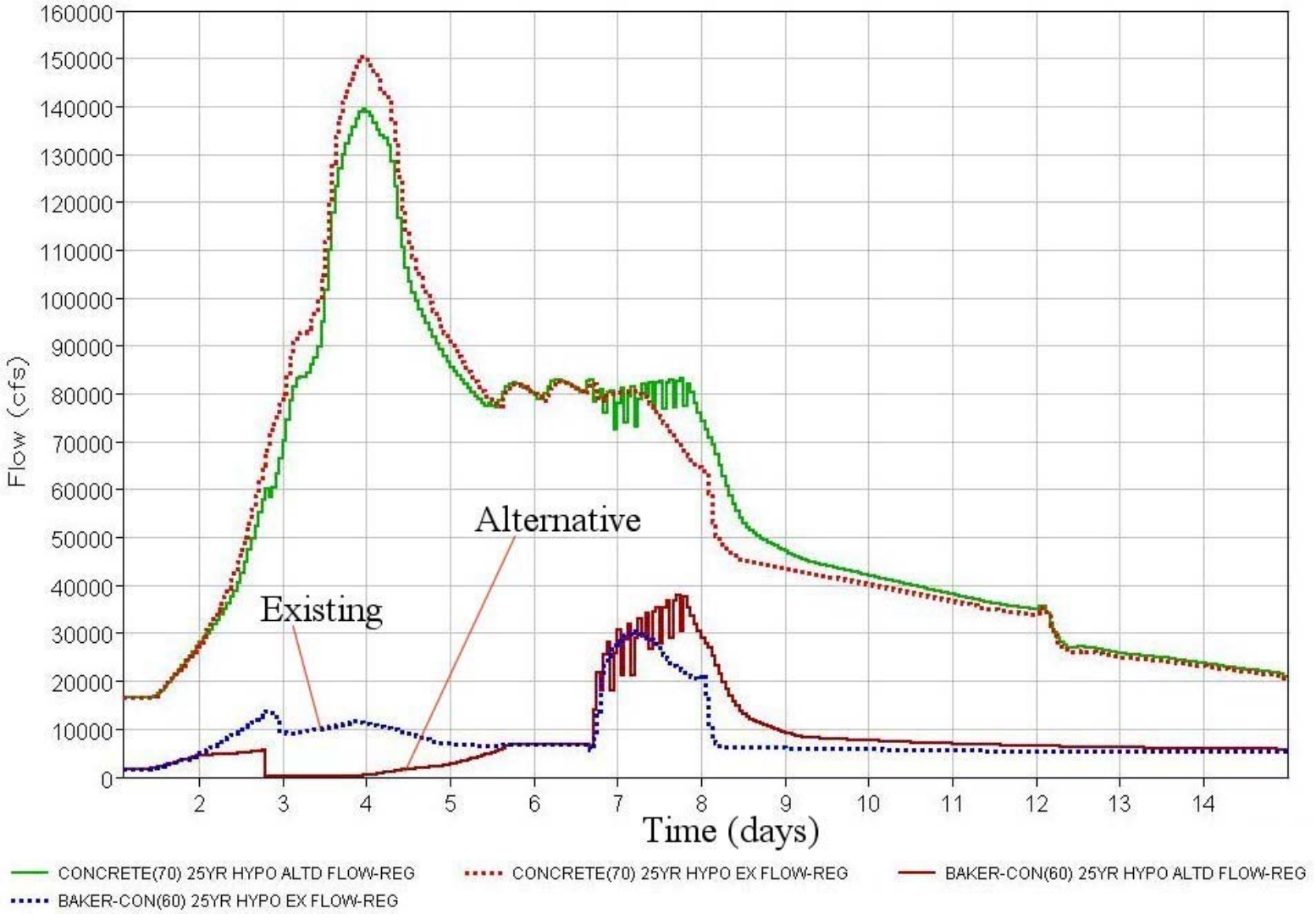
Alternative D vs. Existing (25-Year Event)



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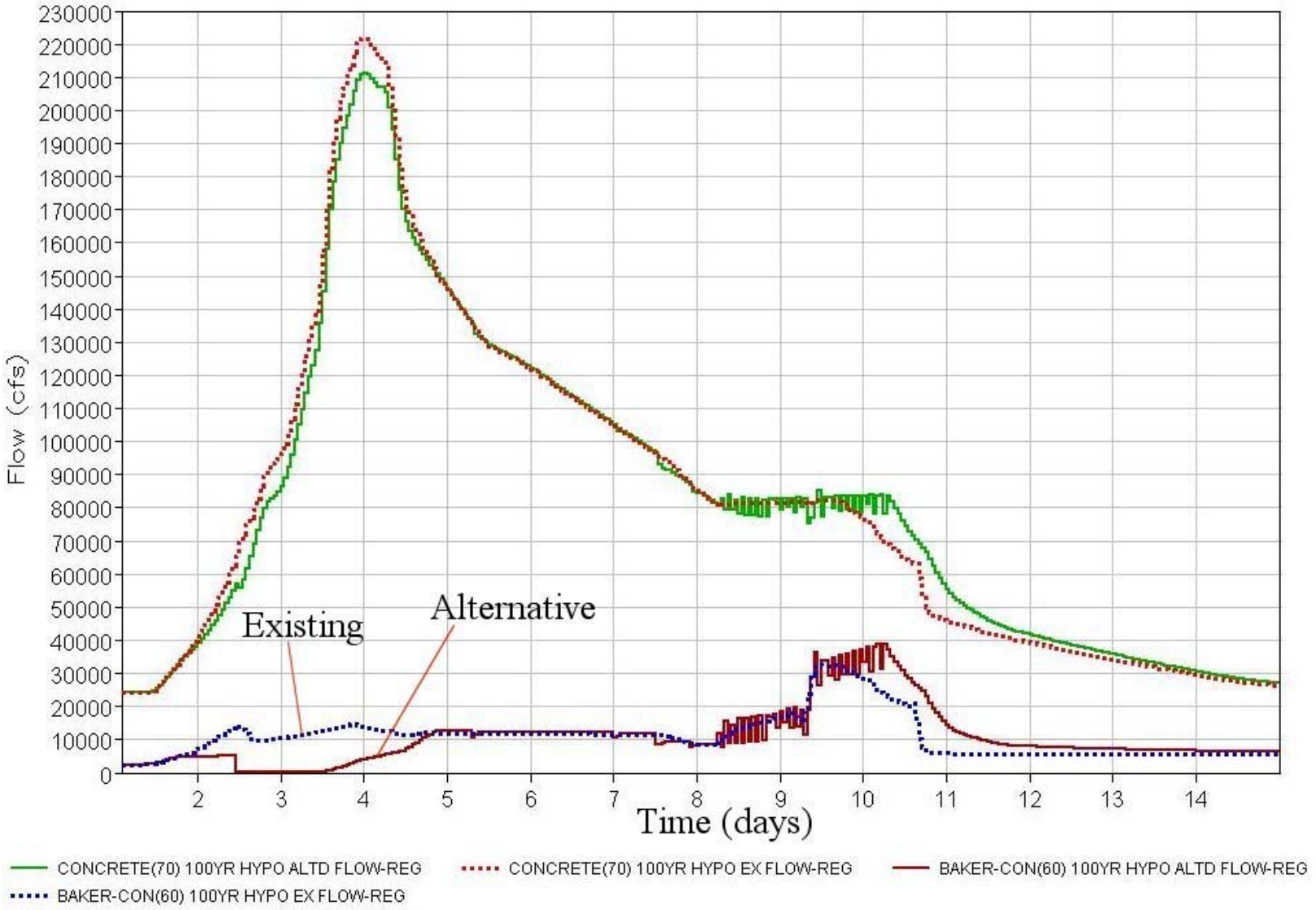
Alternative D vs. Existing (100-Year Event)



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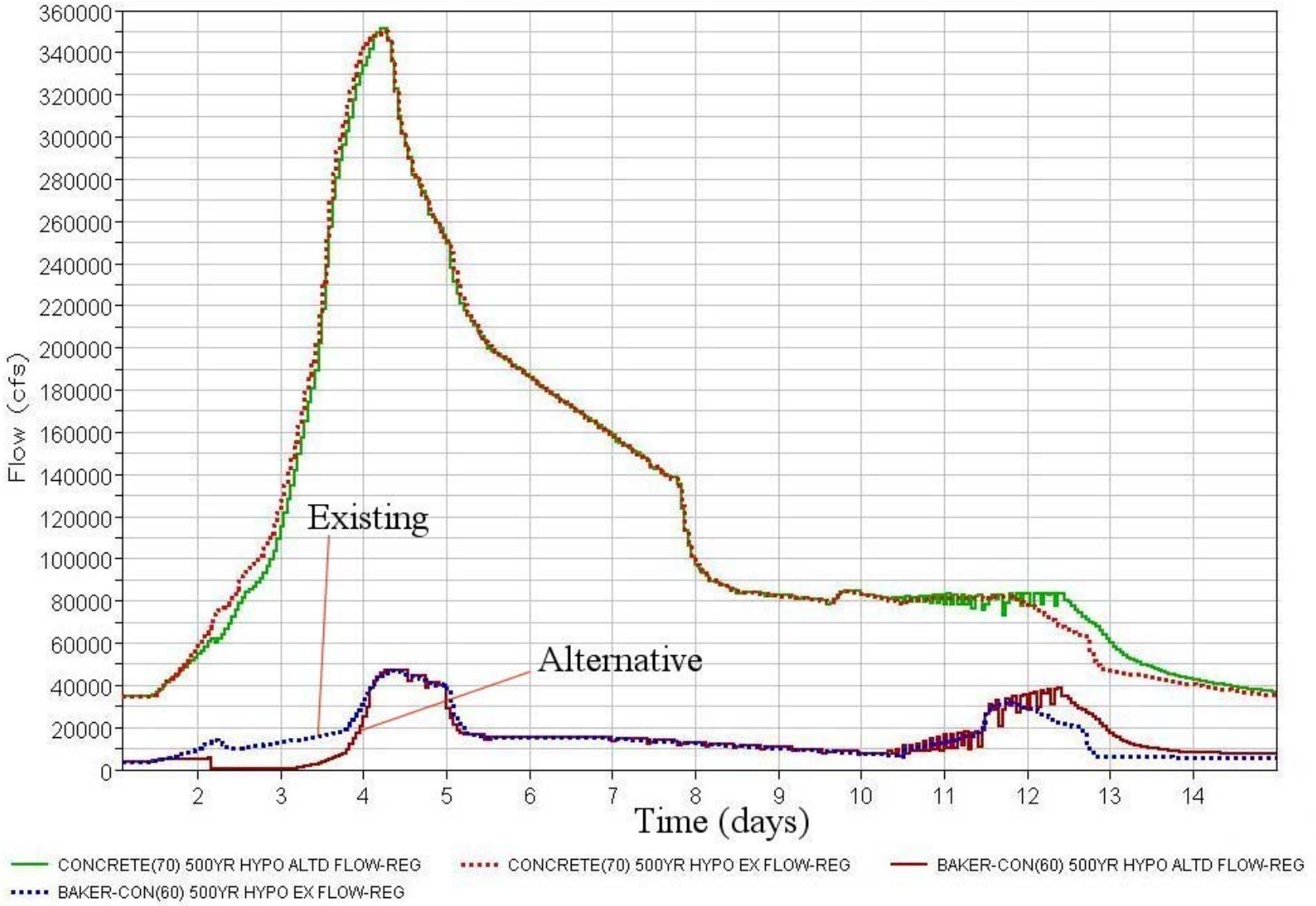
Alternative D vs. Existing (500-Year Event)



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Summary of Lower Baker Hydraulic Results

Table 4.
Predicted River Stage (in feet) at Specific Hydraulic Model Cross Sections on the Skagit River
Existing Conditions and Lower Baker Alternative Conditions

Return Period	Existing Conditions			Alternative A			Alternative B			Alternative C			Alternative D			Alternative E			Alternative F		
	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96	RM 54.1	RM 21.6	RM 12.96
10-yr	166.7	40.1	28.1	165.9 (0.8)	39.3 (0.8)	27.6 (0.5)	165.9 (0.8)	39.3 (0.8)	27.6 (0.5)	165.8 (0.9)	39.2 (0.9)	27.5 (0.6)	165.7 (1.0)	39.0 (1.1)	27.4 (0.7)	165.7 (1.0)	39.0 (1.1)	27.4 (0.7)	166.0 (0.7)	39.4 (0.7)	27.7 (0.4)
25-yr	169.0	42.2	29.3	168.5 (0.5)	41.8 (0.4)	29.1 (0.2)	168.5 (0.5)	41.8 (0.4)	29.1 (0.2)	168.3 (0.7)	41.7 (0.5)	29.0 (0.3)	168.0 (1.0)	41.4 (0.8)	28.9 (0.4)	168.2 (0.8)	41.5 (0.7)	29.0 (0.3)	168.4 (0.6)	41.7 (0.5)	29.0 (0.3)
50-yr	171.5	43.1	29.5	171.2 (0.3)	43.0 (0.1)	29.5 (0.0)	171.2 (0.3)	43.0 (0.1)	29.5 (0.0)	171.0 (0.5)	42.9 (0.2)	29.5 (0.0)	170.8 (0.7)	42.9 (0.2)	29.5 (0.0)	170.9 (0.6)	42.9 (0.2)	29.5 (0.0)	171.0 (0.5)	42.9 (0.2)	29.5 (0.0)
75-yr	172.9	43.4	29.9	172.7 (0.2)	43.3 (0.1)	29.8 (0.1)	172.7 (0.2)	43.3 (0.1)	29.8 (0.1)	172.5 (0.4)	43.3 (0.1)	29.8 (0.1)	172.2 (0.7)	43.2 (0.2)	29.7 (0.2)	172.4 (0.5)	43.2 (0.2)	29.7 (0.2)	172.5 (0.4)	43.3 (0.1)	29.8 (0.1)
100-yr	173.7	43.5	30.0	173.6 (0.1)	43.5 (0.0)	30.0 (0.0)	173.6 (0.1)	43.5 (0.0)	30.0 (0.0)	173.4 (0.3)	43.5 (0.0)	30.0 (0.0)	173.1 (0.6)	43.4 (0.1)	29.9 (0.1)	173.3 (0.4)	43.5 (0.0)	30.0 (0.0)	173.4 (0.3)	43.5 (0.0)	30.0 (0.0)
250-yr	176.2	44.4	30.3	176.2 (0.0)	44.4 (0.0)	30.3 (0.0)	176.2 (0.0)	44.4 (0.0)	30.3 (0.0)	176.1 (0.1)	44.4 (0.0)	30.3 (0.0)	175.9 (0.3)	44.3 (0.1)	30.2 (0.1)	176.1 (0.1)	44.4 (0.0)	30.3 (0.0)	176.2 (0.0)	44.4 (0.0)	30.3 (0.0)
500-yr	178.2	45.2	30.4	178.2 (0.0)	45.1 (0.1)	30.3 (0.1)	178.2 (0.0)	45.1 (0.1)	30.3 (0.1)	178.2 (0.0)	45.2 (0.0)	30.4 (0.0)	178.2 (0.0)	45.2 (0.0)	30.4 (0.0)	178.2 (0.0)	45.2 (0.0)	30.4 (0.0)	178.2 (0.0)	45.1 (0.1)	30.4 (0.0)

- All elevations reference NGVD29 vertical datum
- Hydraulic model results for Likely Failure Point (LFP) model
- Hydraulic model includes debris blockage at Burlington Northern Railroad Bridge
- Values in parentheses represent reduction in stage due to flood control alternative at Lower Baker.

RM 54.1 – USGS Gage at Concrete
RM 21.6 – Downstream of State Route 9 Bridge
RM 12.96 – Mt Vernon – Upstream of State Route 536 Bridge

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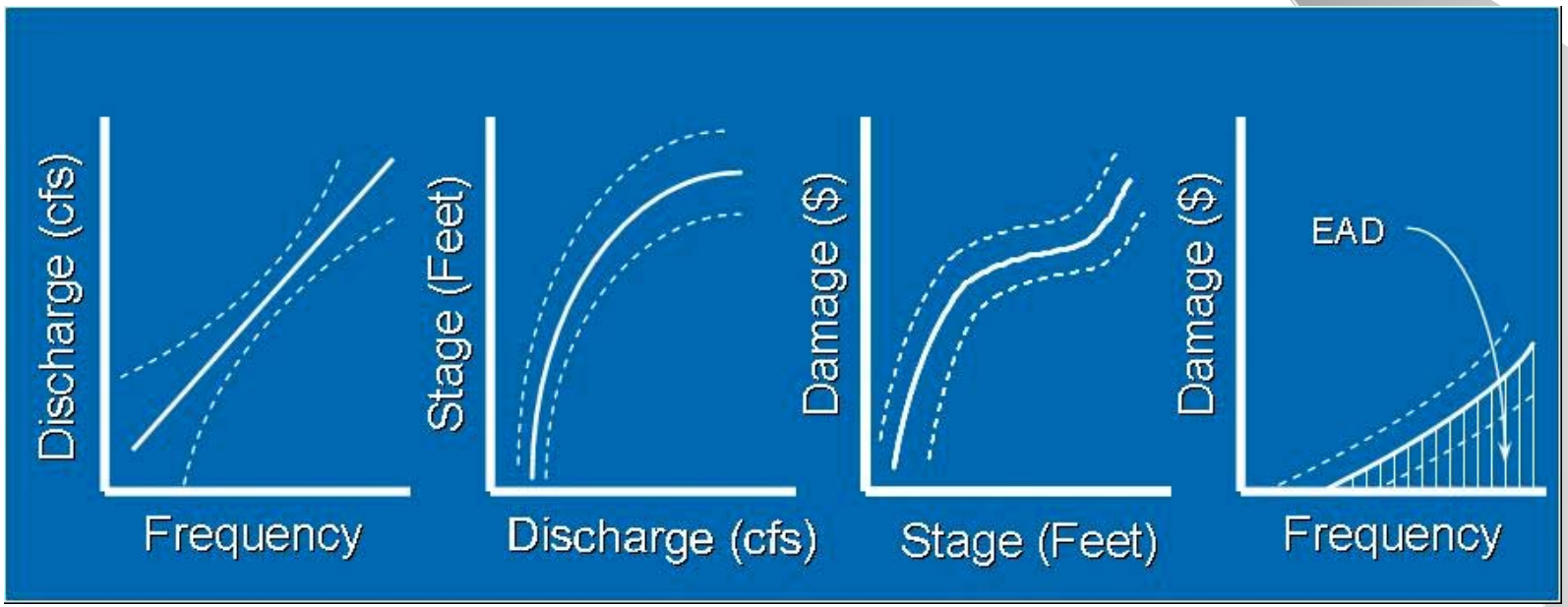
Economic Analysis - Background

- The Corps' HEC-FDA model was used to quantify estimates of expected annual damage for the with project and without project conditions
- HEC-FDA Model is a risk based model which incorporates uncertainty in input values
- Output from H&H models used as input to HEC-FDA model
- Damages based on structure data collected in field and then correlated to river stage

Determination of Expected Annual Damages (EAD)

- Expected Annual Damages (EAD) based on Monte Carlo simulation – a method to obtain the probability distribution of output given the probability distribution of the input



Skagit River HEC-FDA Model

- Extended the model that was previously developed for the Skagit River Flood Control Feasibility Study
  - Conducted field surveys of structures upstream of Sedro-Woolley
  - Structure sampling
  - Referenced every structure to a UNET section to develop relationship between flooding depth and frequency of occurrence
  - Identified three new damage reaches and referenced each structure to a damage reach
  - Populated HEC-FDA model
  - Included additional road delay and road damage estimates
  - Ran model to develop a new without project (existing) condition

Benefit/Cost Determination

- **Benefits and costs** will be compared as annualized values
- **Annual benefits** will be derived from HEC-FDA model
  - Without project damages minus with-project alternative residual damages
  - Net annual benefits
- **Annual costs** will be developed for the following categories:
  - Structural improvements - amortized over 50-year period @ 5 5/8% discount rate, current price levels
  - Power loss during flood control operations
  - Power loss associated with new rule curve conditions
  - Environmental mitigation and permitting costs will not be developed under current scope of work