Economic and Financial Effects to Electrical Power Production from Experimentation at Glen Canyon Dam: LSSF, Sediment Conservation Flows and Non-Native Fish Suppression Flows (SC/NNFS)

Report by:
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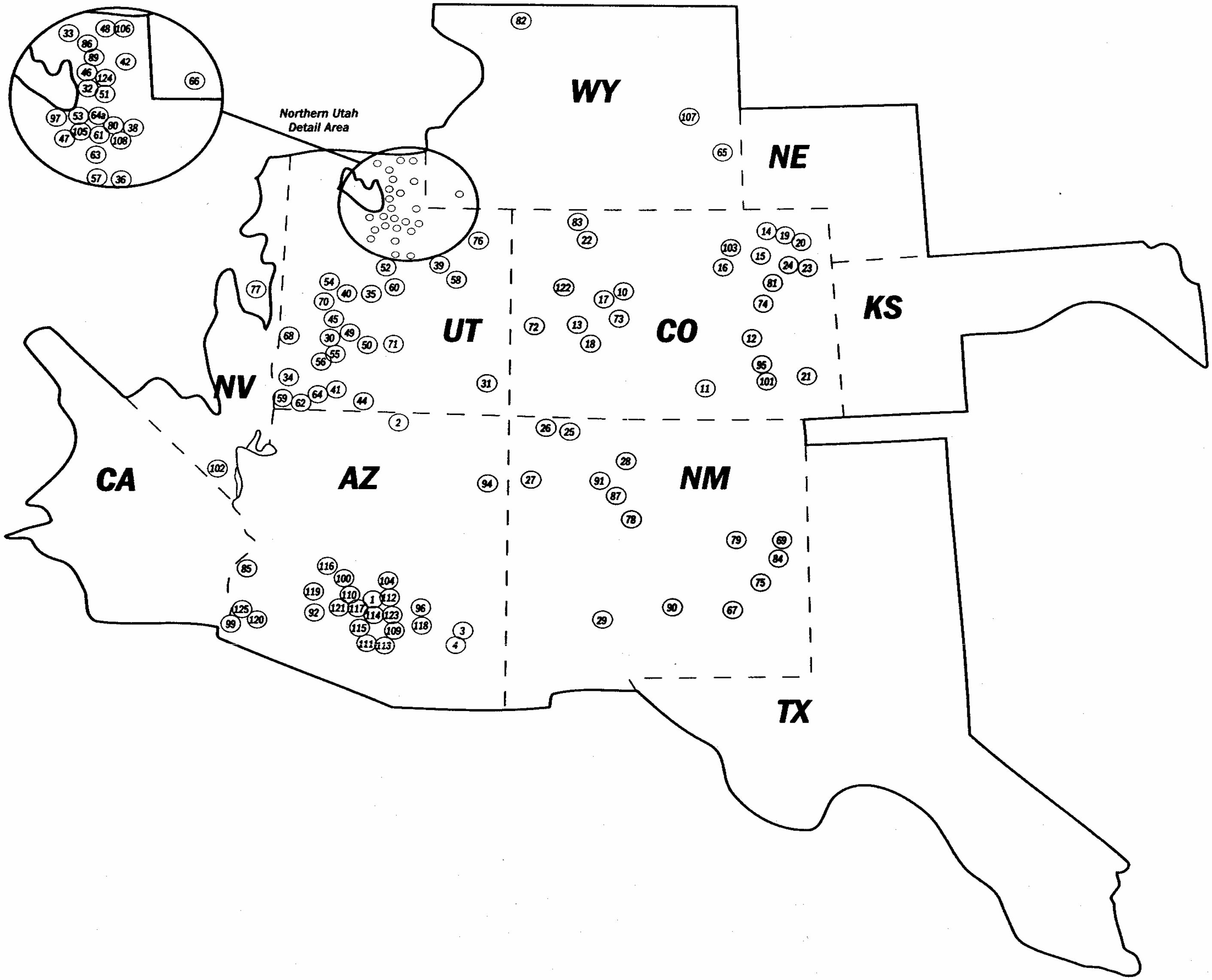
of the Western Area Power Administration

SALT LAKE CITY AREA INTEGRATED PROJECTS



Upcoming Modeling Events

(SC/NNFS)

- Stakeholder Review of Modeling Methods.
  - Comment Deadline October 31, 2003
- Peer Review of Modeling Methods.
  - To begin after completion of stakeholder review

(LSSF)

- Post Peer Review Modeling Completed.

Study Objectives and Background
(SC/NNSF and LSSF)

- Describe and explain the methods used to estimate the financial impact of the change in operations at Glen Canyon Dam on Western Area Power Administration
- Illustrate the change in Glen Canyon operations
- Describe power system impacts

The Colorado River Storage Project Transmission Grid

Hydro-LP/GTMax

- Model developed by Argonne National Laboratories for the CRSP Management Office of Western Area Power Administration.
- Simulates an optimized water release pattern for generation to meet customer load
- Maximizes revenues and minimizes costs
- Uses available water, market price, customer load, and unit environmental and operating constraints
- Used to analyze impacts of proposed constraints
- Forecasts available resources

Recent Hydro-LP Applications Outside of Western Area Power Administration

- Argonne National Laboratories, under the sponsorship of the U.S. Agency for International Development (USAID), used GTMax software to model the role of hydropower in Southeast Europe, especially within the context of a future regional electricity market (2005).
- Study carried out by Argonne National Laboratory in collaboration with numerous utility experts from the region.
- U.S. Bureau of Reclamation uses Hydro-LP to optimize water for certain aspects of the Flaming Gorge Environmental Impact Statement (EIS).

7 Balkan Countries Were Modeled in the Study

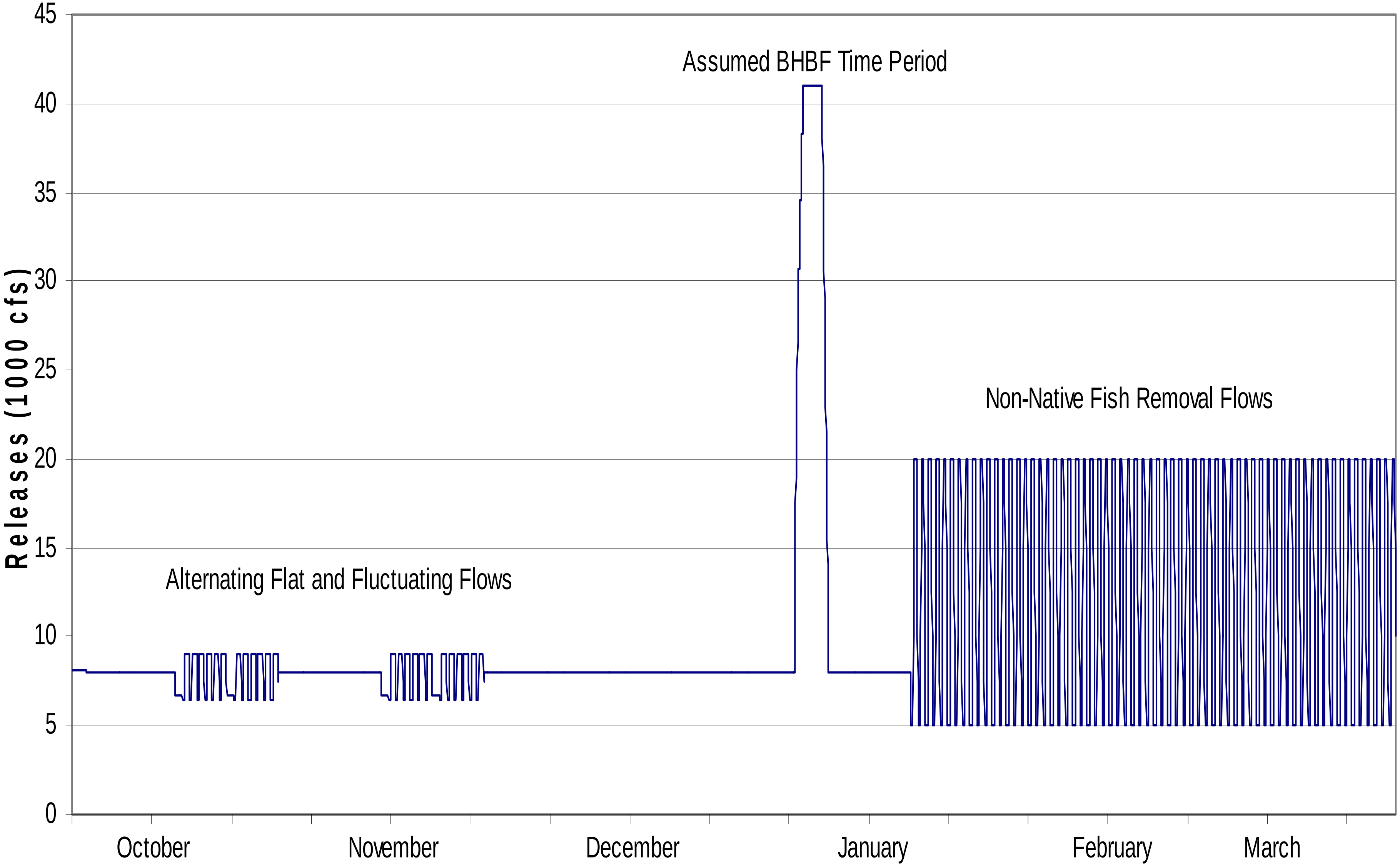
- Albania
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- Macedonia
- Romania
- Serbia and Montenegro

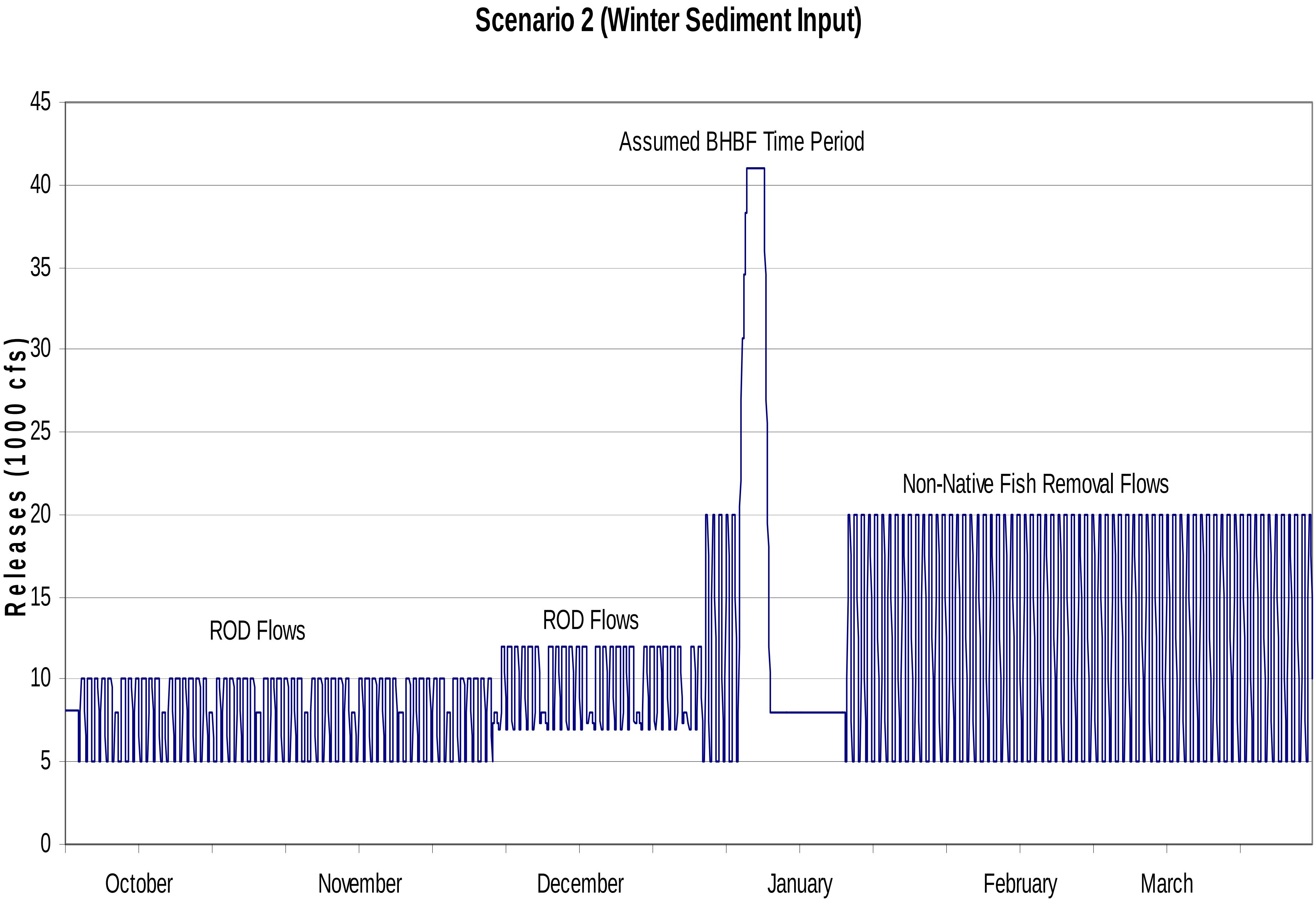
SC/NNFS

The Operations of the Six Major CRSP Units Were Analyzed for Four Scenarios

- Four scenarios were examined:
  - Autumn Sediment Input
  - Winter Sediment Input
  - No Sediment Input
  - Habitat Maintenance Flow (HMF)
- Hydro LP analysis performed on hourly basis for a typical week during the months of Record of Decision (ROD) operations and Non-Native Fish Suppression flows (fish flows).
- Hydro LP analysis performed weekly during Beach Habitat Building Flows (BHBF) and HMF.
- Analysis performed during WY 2003-2004 hydrological conditions.

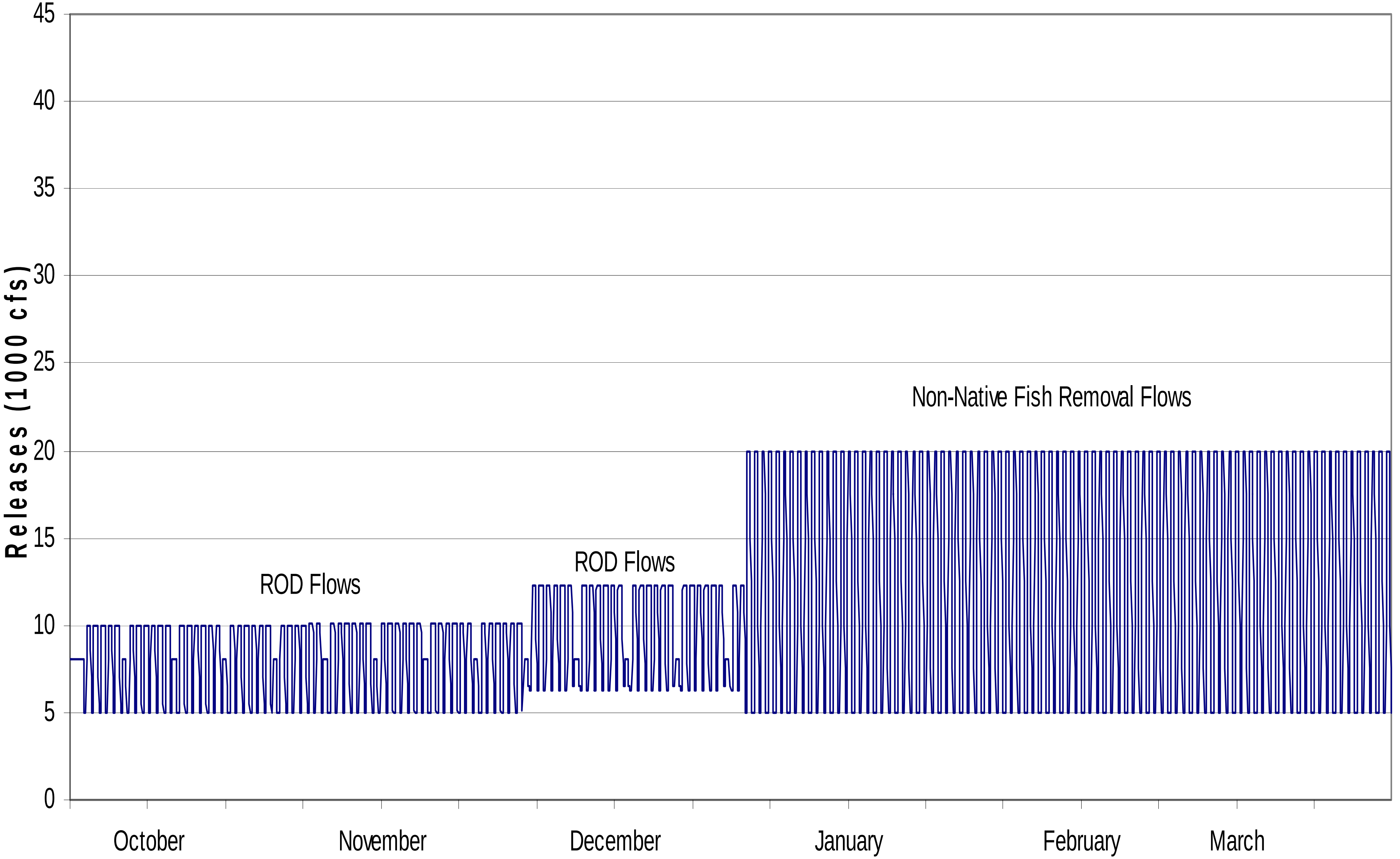
Scenario 1 (Autumn Sediment Input)

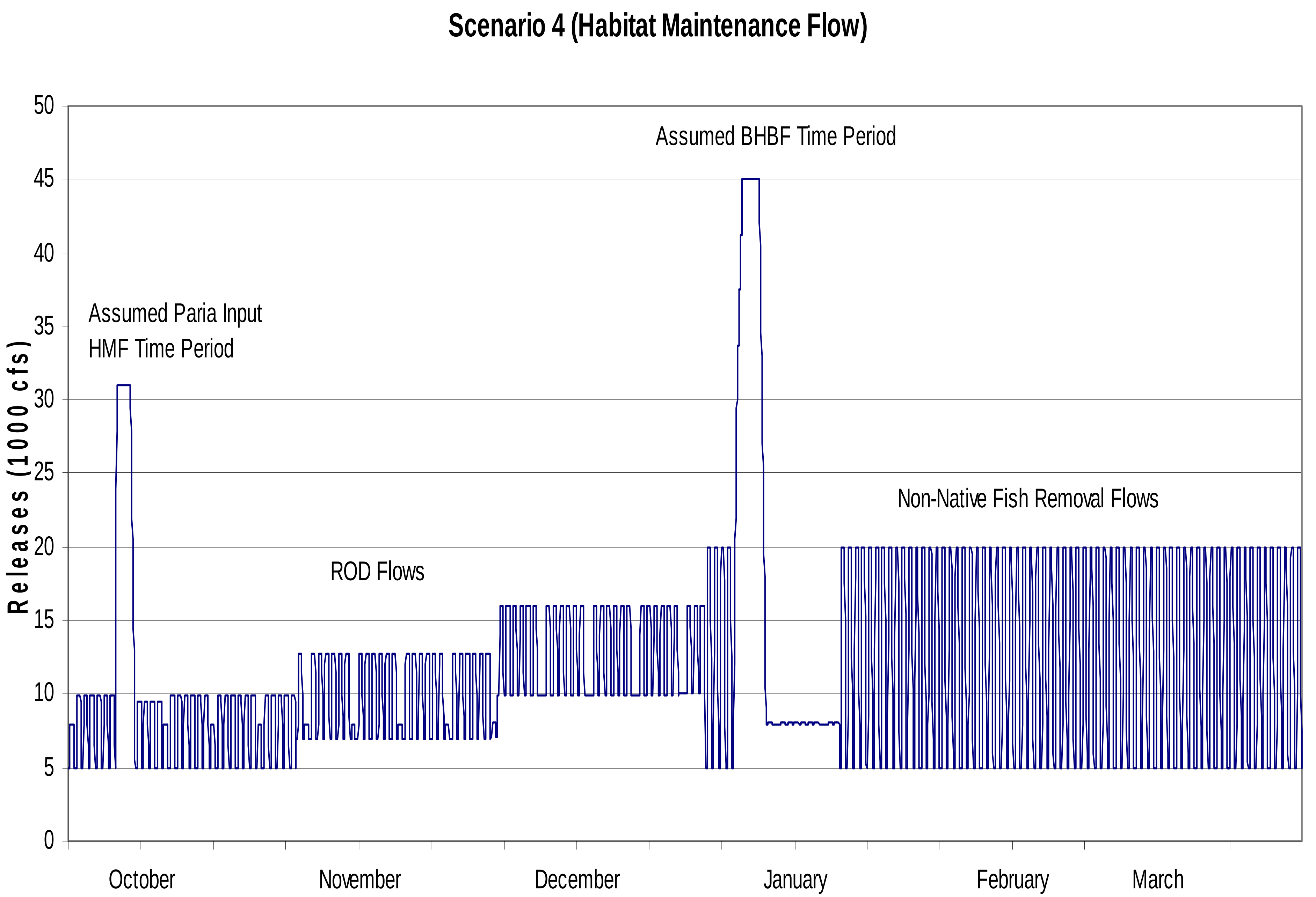




Scenario 2 (Winter Sediment Input)
Releases (1000 cfs)
0
5
10
15
20
25
30
35
40
45
ROD Flows
ROD Flows
Assumed BHBF Time Period
Non-Native Fish Removal Flows
October
November
December
January
February
March

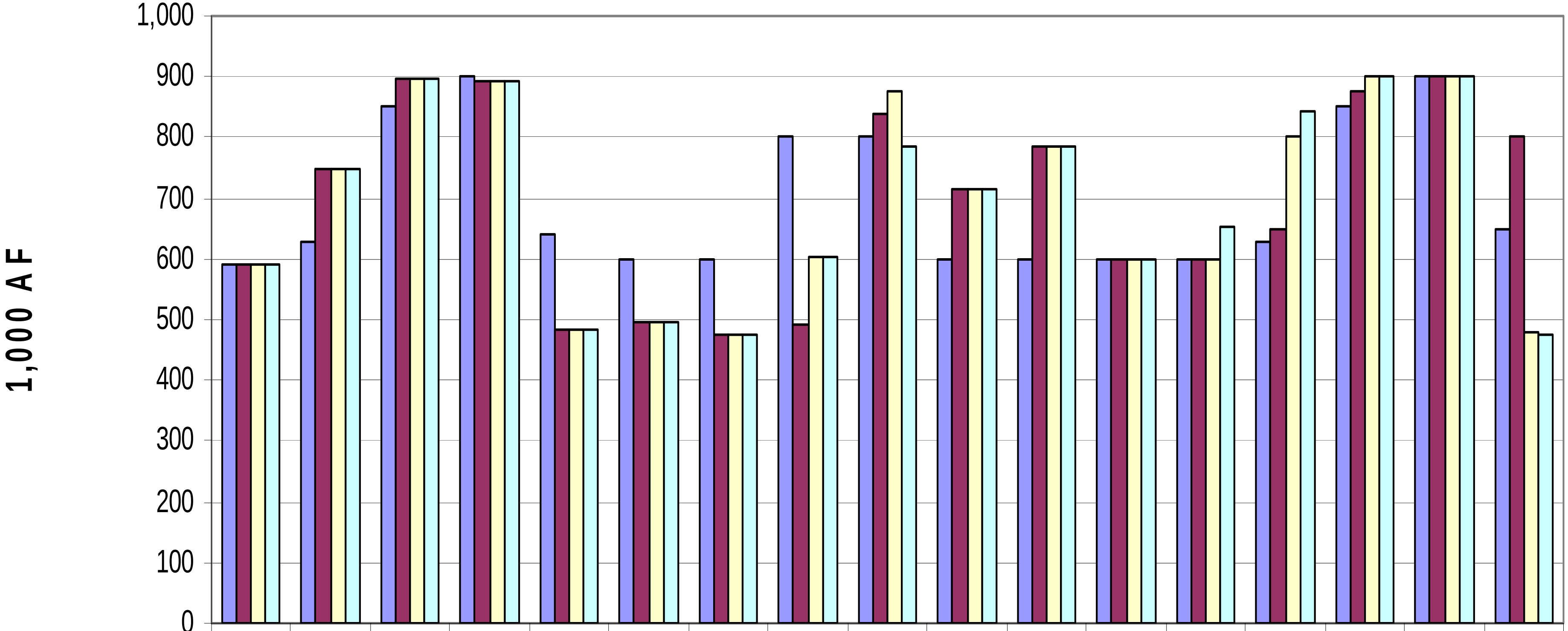
Scenario 3 (No Sediment Input)





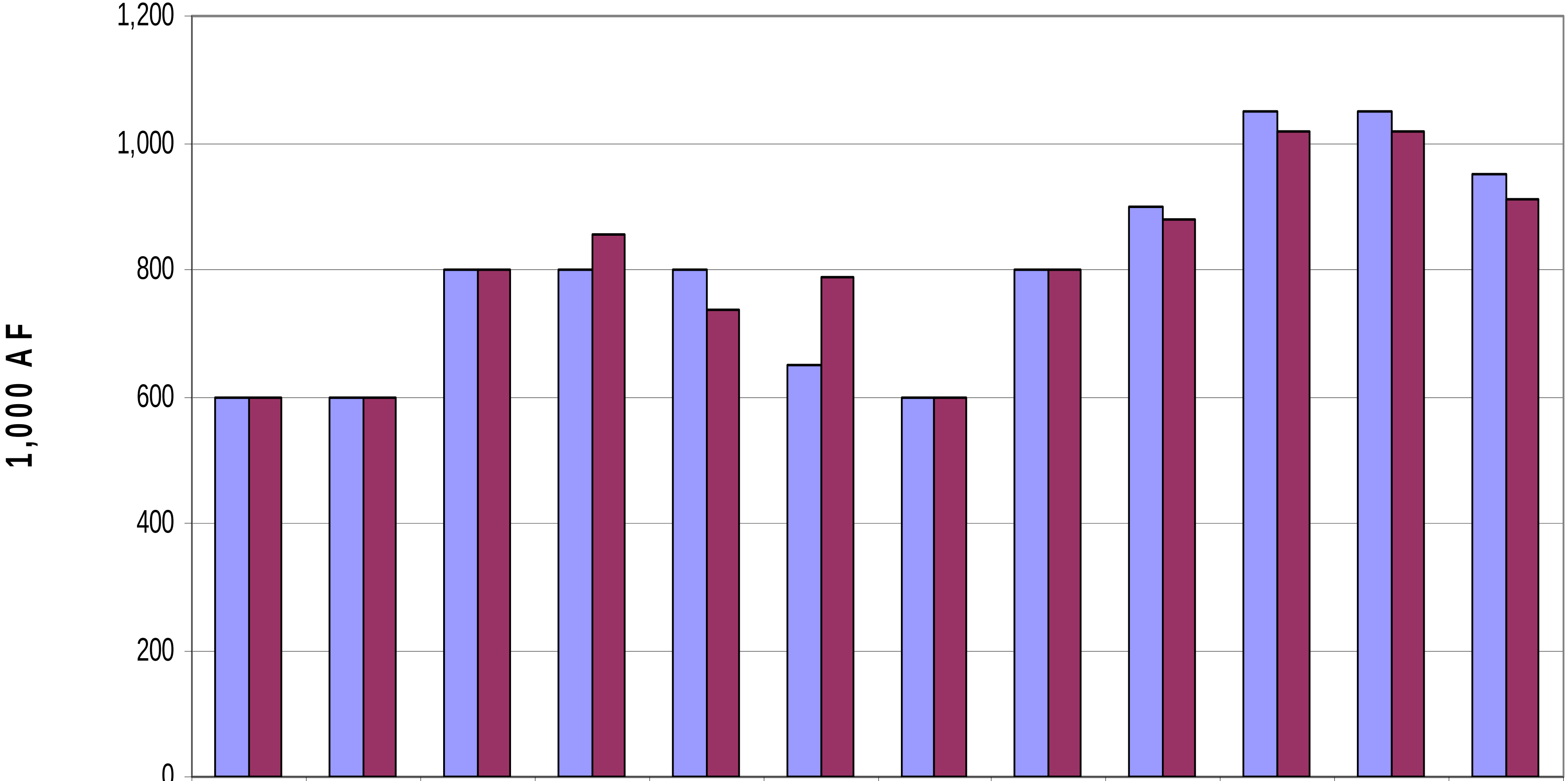
Scenario 4 (Habitat Maintenance Flow)
Releases (1000 cfs)
0
5
10
15
20
25
30
35
40
45
50
Assumed Paria Input
HMF Time Period
ROD Flows
Assumed BHBF Time Period
Non-Native Fish Removal Flows
October
November
December
January
February
March

Comparison of Water Releases for WY 2002-2003
(Autumn, Winter and No Sediment Input Scenarios)



	MAY 02	JUN 02	JUL 02	AUG 02	SEP 02	OCT 02	NOV 02	DEC 02	JAN 03	FEB 03	MAR 03	APR 03	MAY 03	JUN 03	JUL 03	AUG 03	SEP 03
Base Case	590	630	850	900	641	600	600	800	800	600	600	600	600	630	850	900	650
Autumn	590	748	897	893	483	496	476	492	839	714	786	600	600	650	876	900	801
Winter	590	748	897	893	483	496	476	602	876	714	786	600	600	802	900	900	478
No Sediment	590	748	897	893	483	496	476	602	784	714	786	601	652	842	900	900	476

Comparison of Water Releases for WY 2004
(Habitat Maintenance Flow)



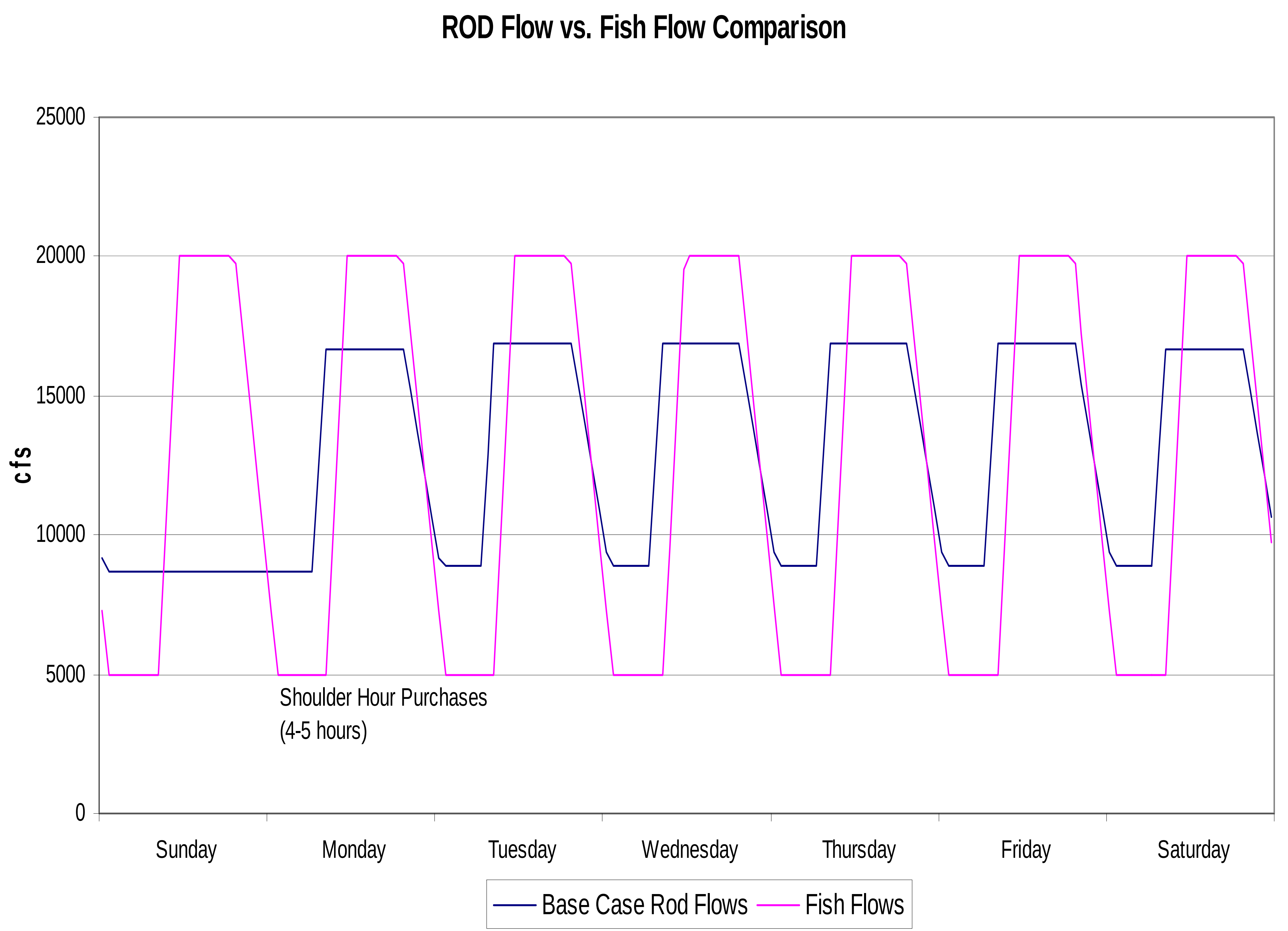
	OCT 03	NOV 03	DEC 03	JAN 04	FEB 04	MAR 04	APR 04	MAY 04	JUN 04	JUL 04	AUG 04	SEP 04
Base Case	600	600	800	800	800	650	600	800	900	1,050	1,050	950
HMF	600	600	800	854	737	788	600	800	878	1,016	1,017	910

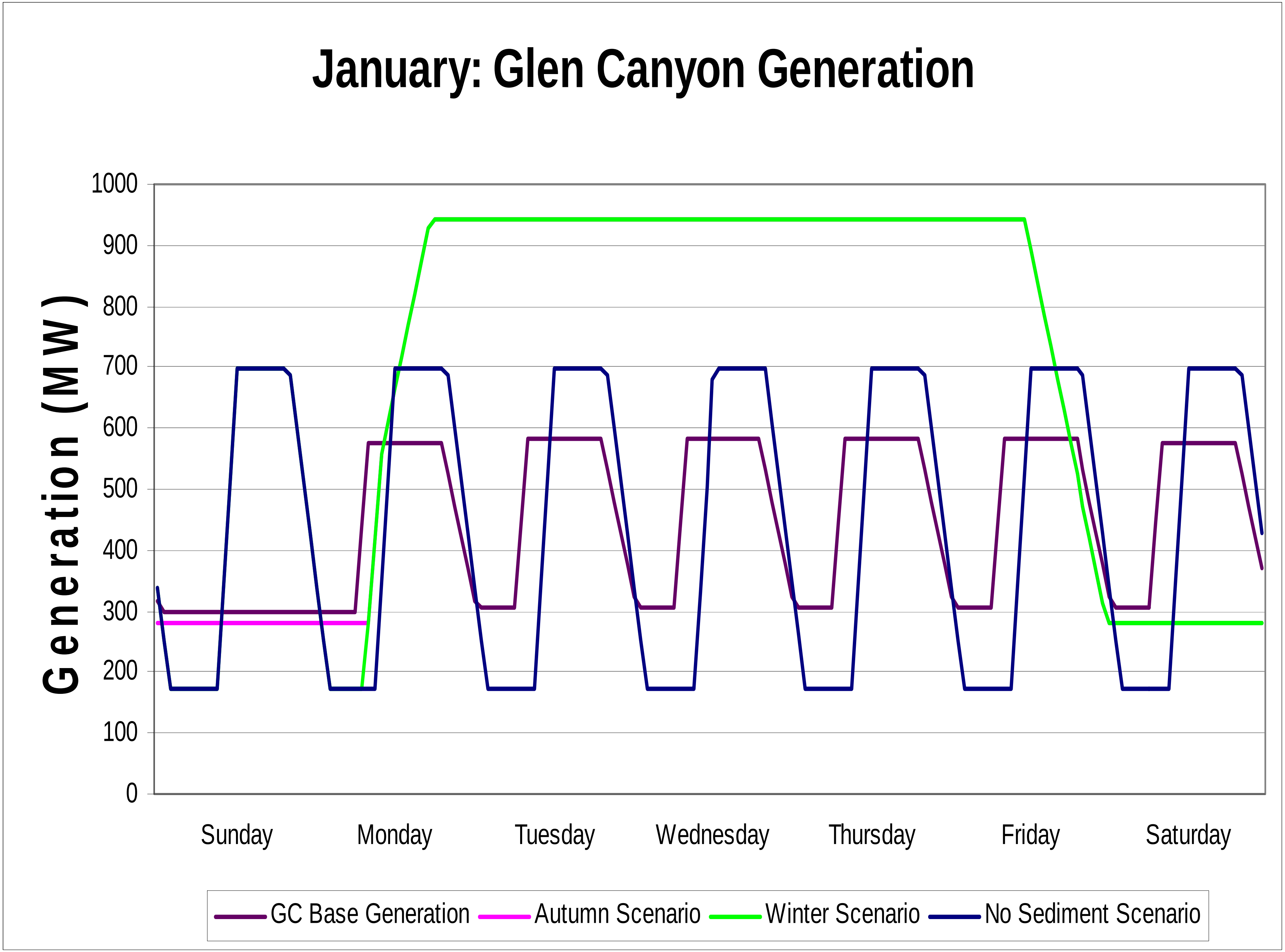
Base Case Assumptions

- Glen Canyon Record of Decision
- Normal Operations at other CRSP Units
- USBR No Test Monthly Water Estimates
  - WY 2003 8.23 maf year
  - WY 2004 average hydrological condition
- CRSP Customer Average Historical Load
- Estimated Average Hourly Purchase Prices
  - May 2002 to July 2003
- Forecast Average Hourly Purchase Prices
  - August 2003 to September 2004

Test Case Assumptions

- Autumn Sediment Input, Winter Sediment Input and HMF
  - Test Case Operating Constraints at GCD
  - Normal Operations at Other CRSP Units
  - USBR Test Monthly Water Volume Estimates
  - Base Case Load
  - Average Hourly Pre-Schedule and Day Ahead Prices
- No Sediment Input (Actually Occurred)
  - Actual Monthly Water Volumes
  - All other test variables the same
- $[(L - B) - (L - T)] = T - B$
- $[(L-B)P_B - (L-T)P_T] = [L(P_B-P_T) + TP_T - BP_B)]$


ROD Flow vs. Fish Flow Comparison
cfs
25000
20000
15000
10000
5000
0
Shoulder Hour Purchases
(4-5 hours)
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Base Case Rod Flows
Fish Flows


January: Glen Canyon Generation
Generation (MW)
1000
900
800
700
600
500
400
300
200
100
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
GC Base Generation
Autumn Scenario
Winter Scenario
No Sediment Scenario

Results: Total Financial Impact by Scenario

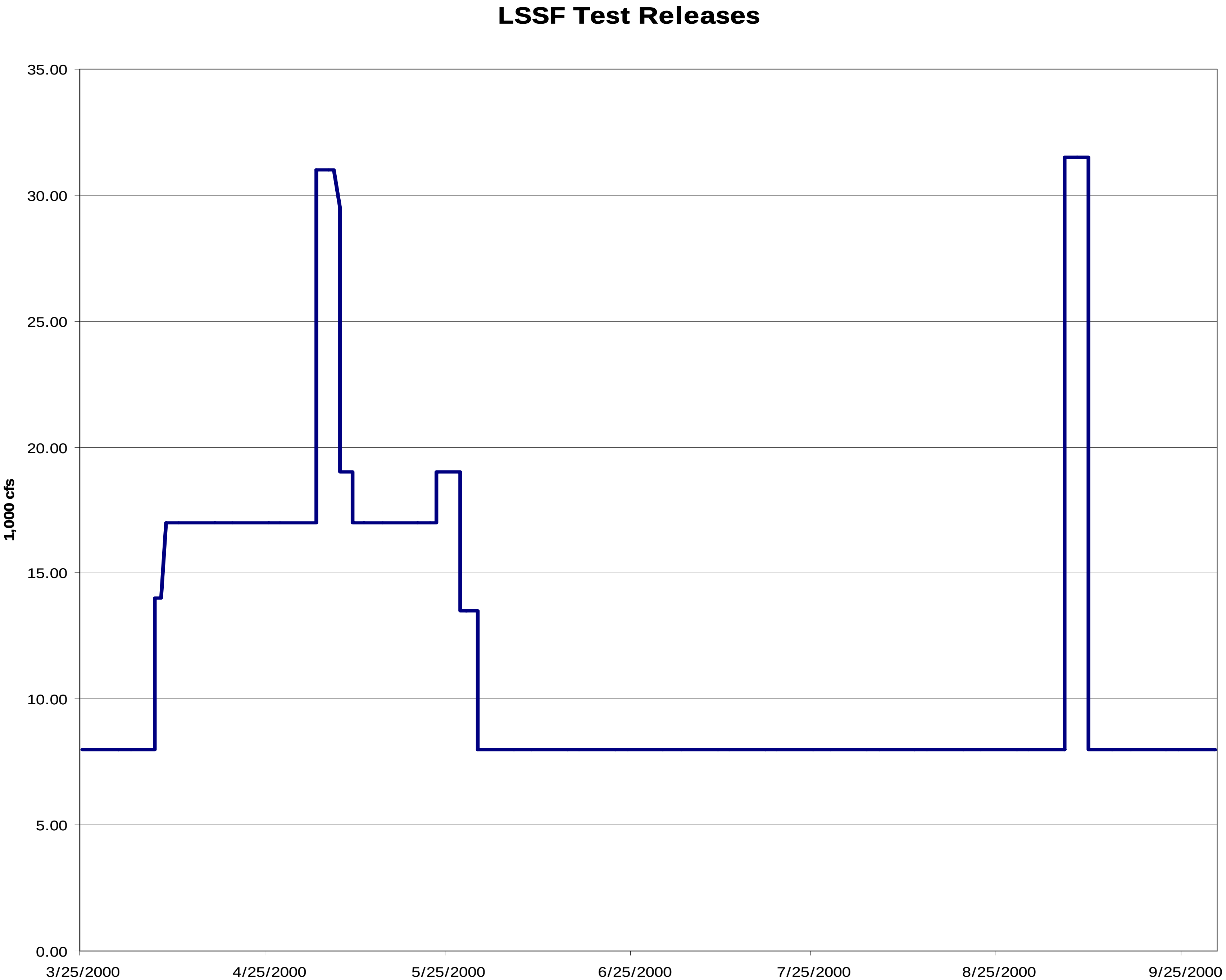
Scenario	Financial Impact
Autumn Sediment Input	($3,162,000)
Winter Sediment Input (January BHBF)	($6,573,000)
Winter Sediment Input (February BHBF)	($6,613,000)
Winter Sediment Input (March BHBF)	($6,240,000)
No Sediment Input	($4,978,000)
Habitat Maintenance Flow	($320,000)

- Comparison:
- Total purchases during the No Sediment Input Scenario (May 2002 – June 2003) totaled $76,354,243
  - This indicates how hydrological conditions are overwhelming

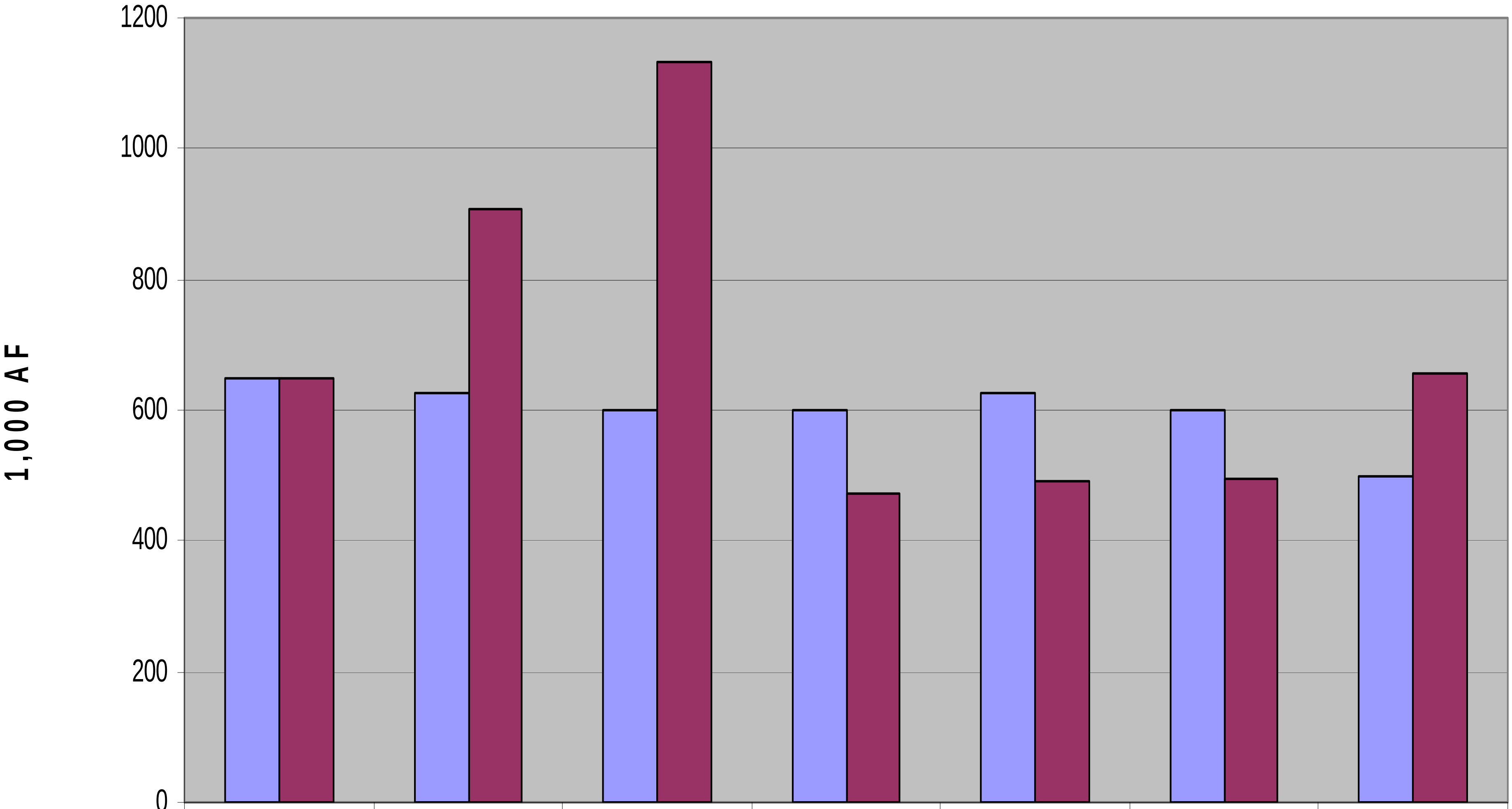
LSSF

Post Stakeholder and Peer-Review Analysis of LSSF Flow Scenario

- Hydro LP analysis performed on an hourly basis for every week during the LSSF study period.
- No Test Compared Against Hydro-LP Test Scenario and SCADA generation data
- Analysis performed from March 1, 2000 to September 30, 2000.
- Quantification of Water Volume needed to equalize No Test and Test Water Releases.


LSSF Test Releases
1,000 cfs
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
3/25/2000
4/25/2000
5/25/2000
6/25/2000
7/25/2000
8/25/2000
9/25/2000

LSSF: Comparison of Water Releases



	MAR	APR	MAY	JUN	JUL	AUG	SEPT
Base Water	650	625	600	600	625	600	500
Test Water	648	907	1131	474	493	495	656

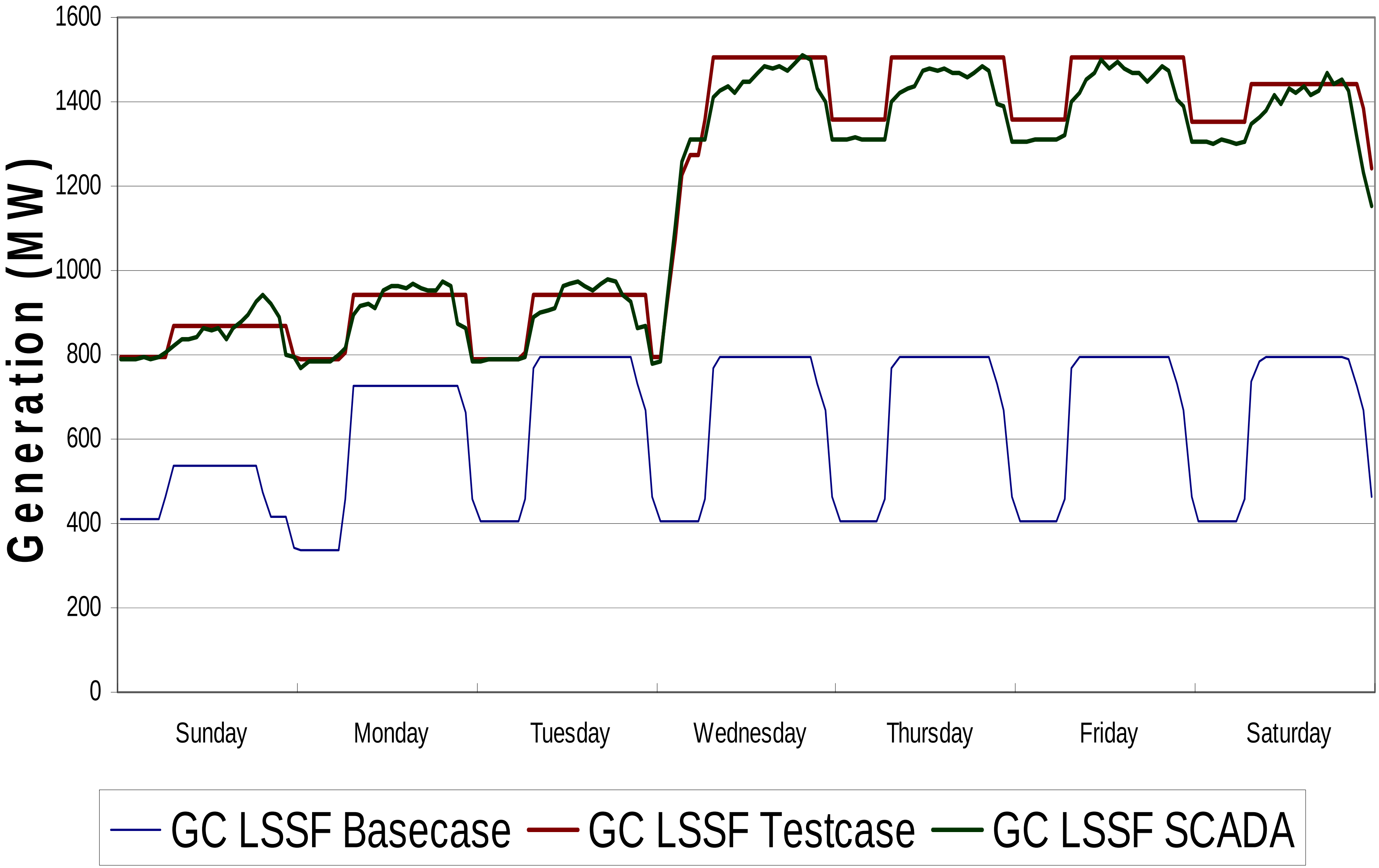
Base Case Assumptions

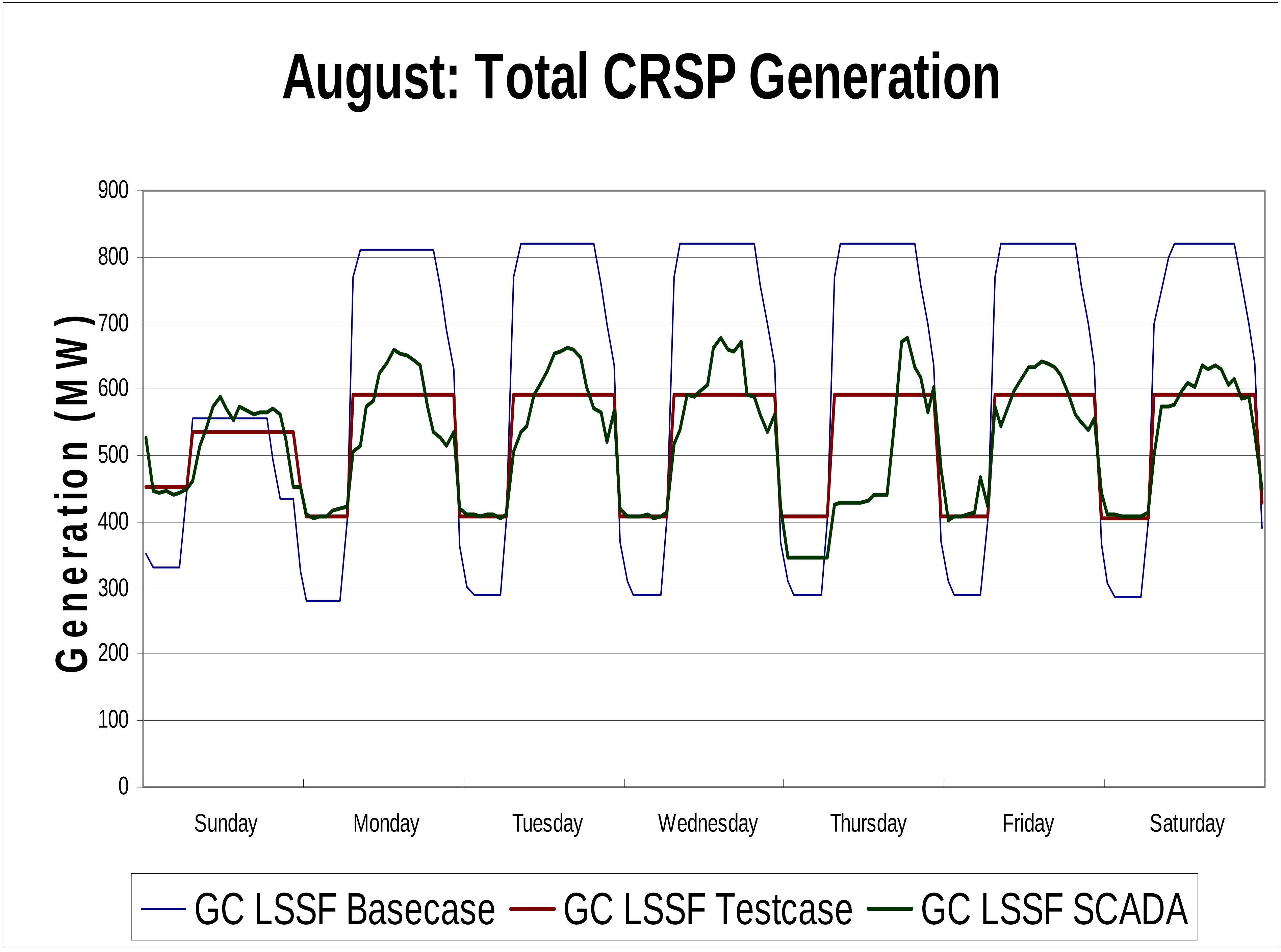
- Glen Canyon Record of Decision
- Normal Operations at other CRSP Units
- USBR No Test Monthly Water Estimates
- CRSP Customer Average Historical Load
- Average Hourly Pre-schedule and Day Ahead Prices

Test Case Assumptions

- Hydro-LP Assumptions
  - Actual Monthly Water Volume
  - Actual Hourly Release Pattern
  - Base Case Load
  - Base Case Prices
  - All Other CRSP Units Base Case Operating Constraints
- SCADA Assumptions
  - Supervisory Control and Data Acquisition System Generation Data

May: Total CRSP Generation




August: Total CRSP Generation
Generation (MW)
900
800
700
600
500
400
300
200
100
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
GC LSSF Basecase
GC LSSF Testcase
GC LSSF SCADA

Equalization

- 604 Thousand Acre-Feet Water Release to Comply with Equalization Regulations
- Calculations:
  - Six-month and one-year period using WY 2001 data
  - Average hourly conversion factor
  - Average hourly pre-schedule and day-ahead prices
  - Two-thirds of purchases at on-peak prices
  - One-third of purchases at off-peak prices

	Off-Peak Impact	On-Peak Impact	Overall Impact
Six Month Equalization Period	$(29,481,922)	$(14,984,408)	$(24,649,417)
One Year Equalization Period	$(30,727,911)	$(16,804,886)	$(26,086,902)

Results: Total Financial Impact by Month

Month	Year	Financial (Test – No Test)	Financial (SCADA – No Test)
March	2000	($207,000)	($275,000)
April	2000	$3,576,000	$3,622,000
May	2000	$6,831,000	$6,972,000
June	2000	($4,406,000)	($4,423,000)
July	2000	($6,398,000)	($6,351,000)
August	2000	($7,680,000)	($7,704,000)
September	2000	$2,474,000	$2,609,000
Equalization	One Year	($26,087,000)	($26,087,000)
Total		**($31,900,000)**	**($31,637,000)**

Conclusions

- The financial impact of poor hydrological conditions is much greater than the financial impact of experimental flows.
- There is a significant impact from experimental flows.
- Water reallocation outside of the experimental flow test period produces significant financial impacts.
- Unforeseen circumstances can materially effect the outcome of results.

Questions?

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