Moving Towards an Improved Delaware Release Policy for June 1 , 2011 Implementation

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Presented to RFAC
March, 8 2011

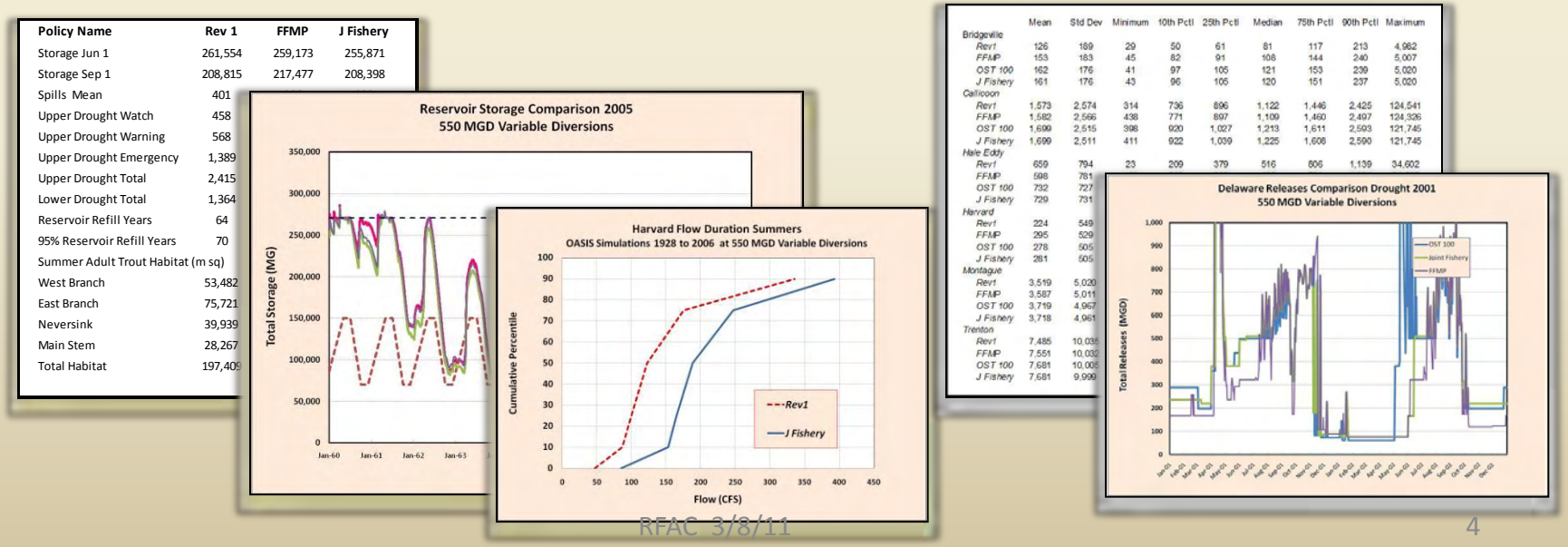
This is a partial report on work in process, some which was carried out in response to information received just prior to the RFAC meeting of March 8, 2001. As such it is preliminary.

Our Goal for Today

- To encourage the Decree Parties to adopt a release program based on the recommendation in the joint PA/NY fisheries 'White Paper' when the FFMP expires on May 31.
- To dissuade the Decree Parties from reverting to Revision 1 which would be disastrous for the upper river ecology - and indeed be a disservice to all stakeholders --save perhaps New York City.

Background: How We Evaluate Release Policies
(Using the OASIS and DSS Models)

- Carry out OASIS and DSS analyses under a range of seasonally varying diversion scenarios, typically from 450 to 800 mgd. (98 runs to date.)
- Compute long run performance statistics (1928 to 2006) on storage levels, releases, flows, spills, reservoir refill, drought days and aquatic habitat.
- Focus on critical or 'interesting' time frames: 1960s drought, 2001 drought, the 1990s , summer 2005, recent years, etc. For such time fames do time-plots of important metrics.



Evaluating and Screening Release Proposals

- *There are many relevant metrics*

Reservoir Storage
- Mean
- Maximum
- Minimum
- Mean on Jun 1
- Mean on Sep 1 (Sept 1 Void)

- Mean NYC Diversions
- Mean NJ Diversions
- Mean Releases by Type
- Spills Mean
- Upper and Lower Basin Drought Days -- by Severity
- Reservoir Refills (Years)
- 95% Reservoir Refills (Years)

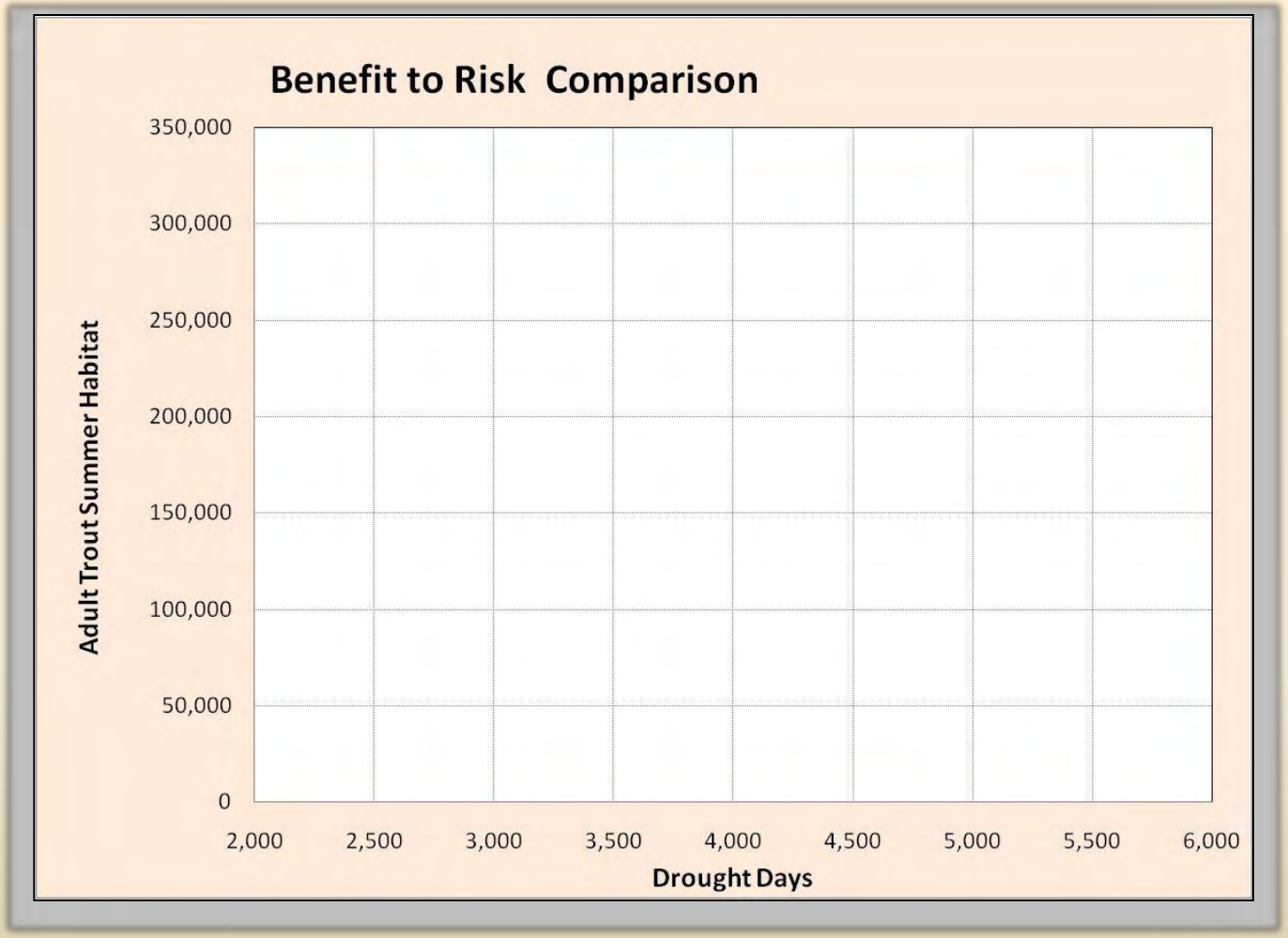
Trout Habitat by Season by Life Stage
- West Branch
- East Branch
- Neversink
- Main Stem
- Total Habitat

- *But, two dominate metrics are very useful in screening policies*

Total Upper Basin Drought Days

Total Summer Adult Trout Habitat

Looking at Drought Days and Habitat: A Useful 'Benefit to Risk' Overview of Release Policies

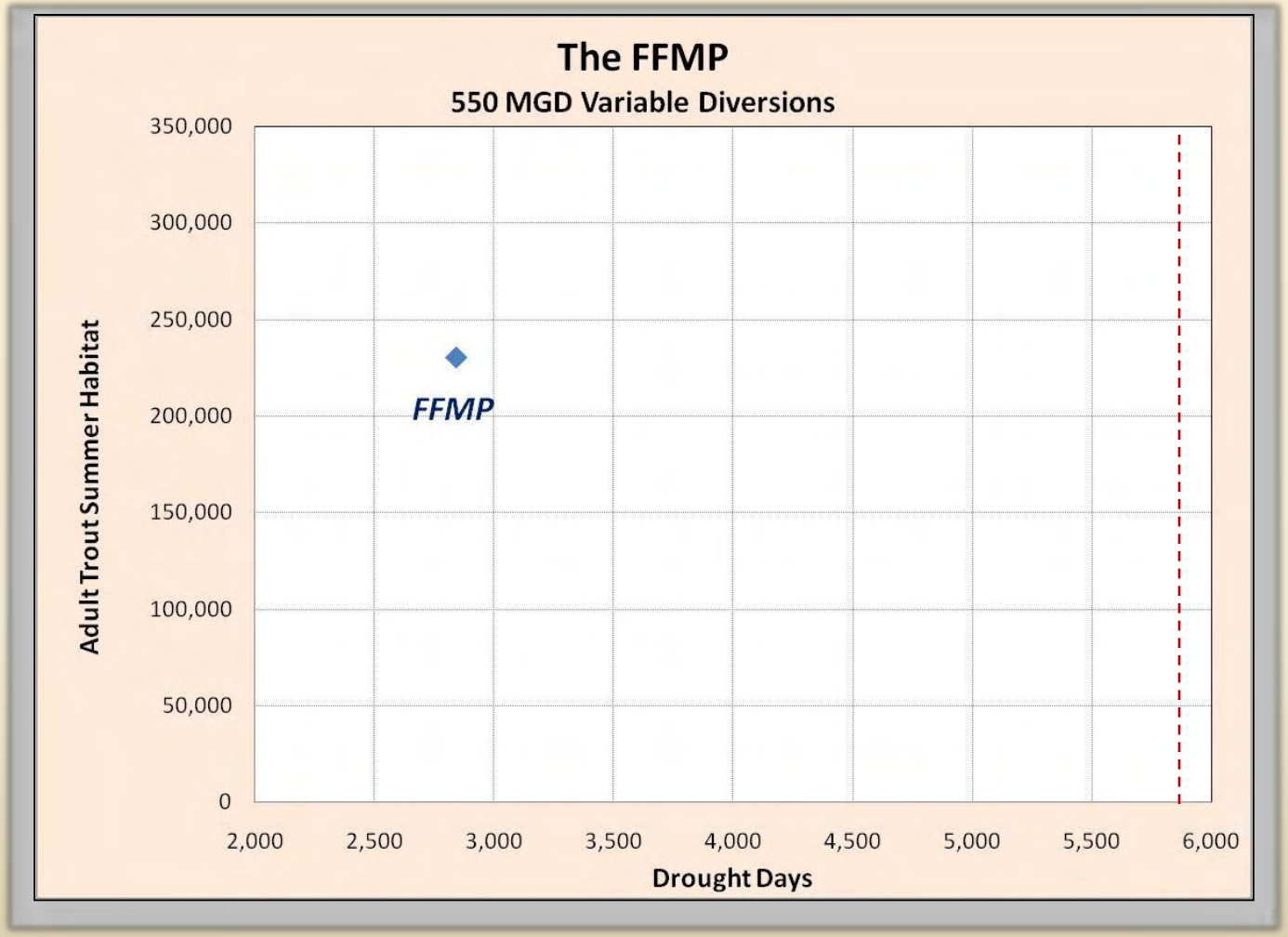


Benefit →

Risk →

For example: Where We Are Now

(The current FFMP: OASIS and DSS simulations from 1928 to 2006)



Part I. The Joint Fishery Recommendation is itself a 'Shovel Ready' Improvement

The White Paper Release Matrix

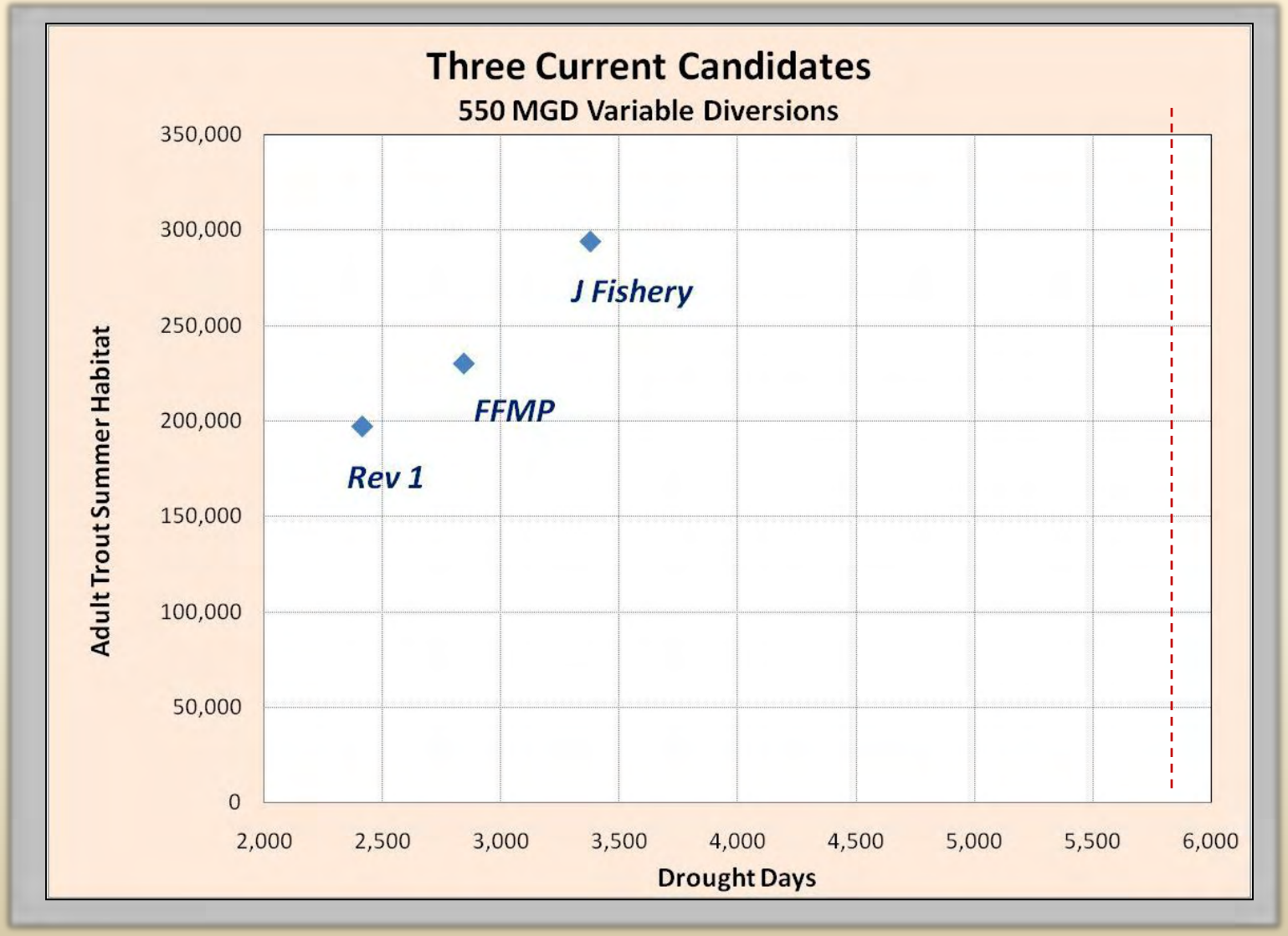
(Scenario 6)

	Winter			Spring		Summer			Fall		
Cannonsville Storage Zone	**Dec 1 to Mar 31**	**Apr 1 to Apr 15**	**Apr 16 to Apr 30**	**May 1 to May 20**	**May 21 to May 31**	**Jun 1 to Jun 15**	**Jun 16 to Jun 30**	**Jul 1 to Aug 31**	**Sep 1 to Sep 15**	**Sep 16 to Sep 30**	**Oct 1 to Nov 30**
L1-a	1500	1500	1500	*	*	*	1500	1500	1500	1500	1500
L1-b	250	*	*	*	*	*	*	525	400	300	250
L1-c	150	400	400	400	400	500	525	525	400	300	150
L2 High	150	400	400	400	400	500	525	525	400	300	150
L2 Low	150	400	400	400	400	500	525	525	400	300	150
L3	125	200	200	200	200	250	250	250	175	175	125
L4	55	55	55	75	75	130	130	130	55	55	60
L5	50	50	50	50	50	120	120	120	50	50	50

	Winter			Spring		Summer			Fall		
Pepacton Storage Zone	**Dec 1 to Mar 31**	**Apr 1 to Apr 15**	**Apr 16 to Apr 30**	**May 1 to May 20**	**May 21 to May 31**	**Jun 1 to Jun 15**	**Jun 16 to Jun 30**	**Jul 1 to Aug 31**	**Sep 1 to Sep 15**	**Sep 16 to Sep 30**	**Oct 1 to Nov 30**
L1-a	700	700	700	*	*	*	700	700	700	700	700
L1-b	185	*	*	*	*	*	*	250	200	200	185
L1-c	125	125	125	125	125	150	150	150	125	125	125
L2 High	100	100	100	100	100	140	140	140	100	100	100
L2 Low	100	100	100	100	100	140	140	140	100	100	100
L3	80	80	80	80	80	100	100	100	80	80	80
L4	45	45	45	50	50	85	85	85	40	40	40
L5	40	40	40	40	40	80	80	80	30	30	30

	Winter			Spring		Summer			Fall		
Neversink Storage Zone	**Dec 1 to Mar 31**	**Apr 1 to Apr 15**	**Apr 16 to Apr 30**	**May 1 to May 20**	**May 21 to May 31**	**Jun 1 to Jun 15**	**Jun 16 to Jun 30**	**Jul 1 to Aug 31**	**Sep 1 to Sep 15**	**Sep 16 to Sep 30**	**Oct 1 to Nov 30**
L1-a	190	190	190	*	*	*	190	190	190	190	190
L1-b	125	*	*	*	*	*	*	125	125	125	125
L1-c	90	90	90	90	90	125	125	125	90	90	90
L2 High	90	90	90	90	90	125	125	125	90	90	90
L2 Low	90	90	90	90	90	125	125	125	90	90	90
L3	75	75	75	75	75	90	90	90	75	75	75
L4	35	35	35	40	40	60	60	60	30	30	30
L5	30	30	30	30	30	55	55	55	25	25	25

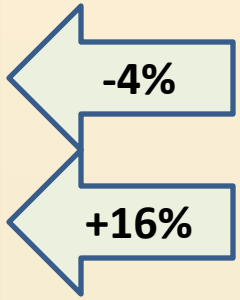
Where we have been and where we can get to with the White Paper:
(Estimated long-run performance 1928 to 2006)



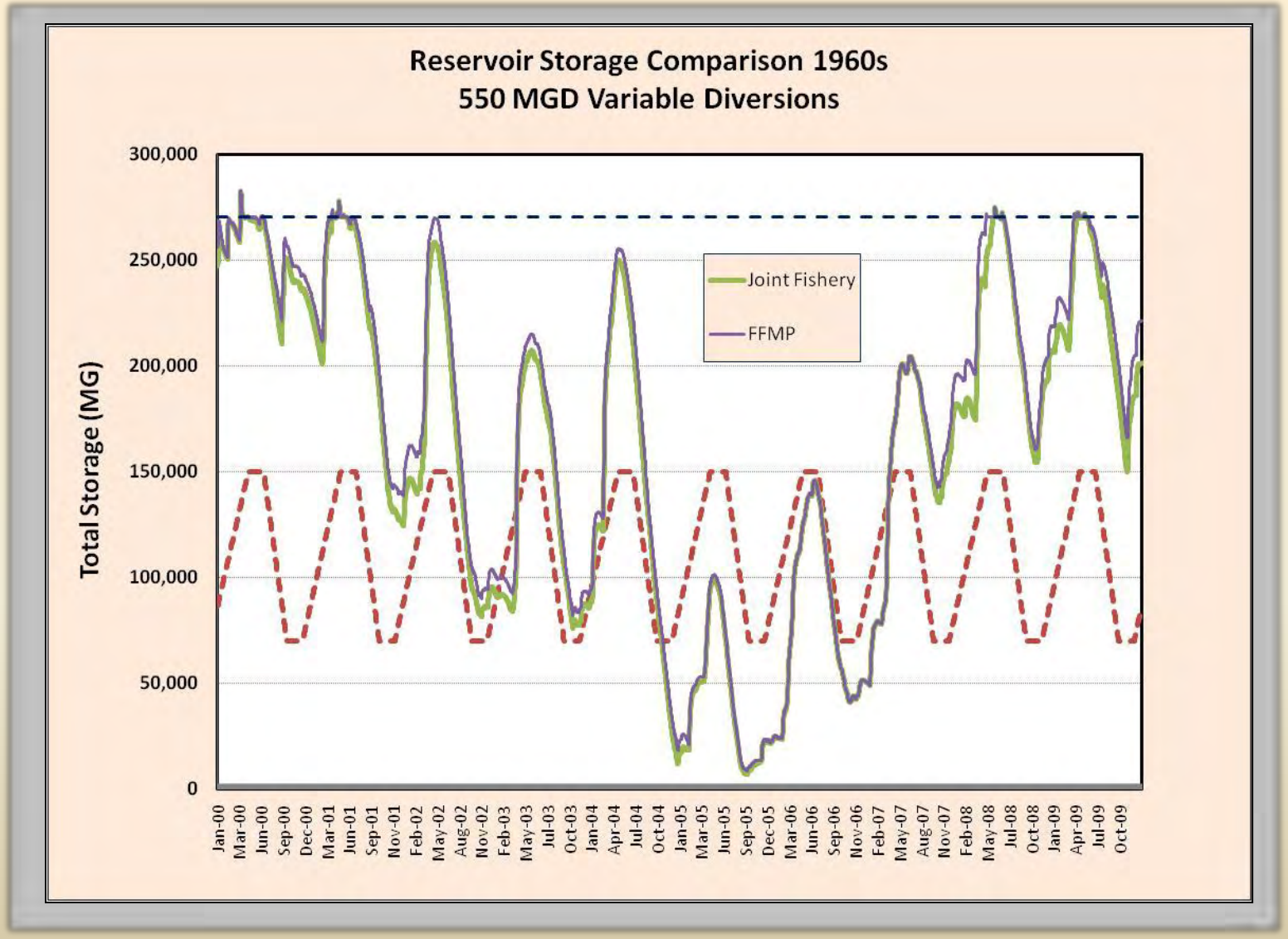
Long-run Performance: Substantial Improvement

1928 to 2006

	FFMP	J Fishery
Storage Mean	217,477	208,398
Storage Jun 1	259,173	255,871
Void Sep 1	53,523	62,602
Spills Mean	286	239
Upper Drought Watch	692	952
Upper Drought Warning	672	1,175
Upper Drought Emergency	1,480	1,757
Upper Drought Total	2,844	3,884
Lower Drought Total	1,216	1,156
95% Reservoir Refill Years	66	66
Summer Adult Trout Habitat (m sq)		
West Branch	64,586	88,795
East Branch	89,261	85,468
Neversink	50,252	50,661
Total Habitat	230,348	295,371
Drought Risk Neutrality @	721	659



And details matter: JFish handles the drought of the century



Linking Releases to Anticipated Diversions

(Our Augmented Adaptive Release Principle)

- We have estimated that J Fish is drought day neutral at about 660 mgd. (In the White Paper, the PA NY Fisheries task force simulated it at 658 mgd.)
- Historical NYC diversions over the last decade
  - Have averaged 512 MGD
  - The year-to-date average diversions, computed each month has been between 377 and 676 mgd, and the 90% percentile was 607 mgd.
- Annual diversions can be forecasted statistically using the forecasting methodology (Hirsh technique) being incorporated into the NYC OST system.

An Implementation Recommendation for June 1

(A very simple switching rule)

- Each month [quarter] NYC will statistically forecast diversions for the year ahead (in say mgd).
- Given a substantive reason and in good faith, NYC may make a judgment-based modification of the above statistical forecast.
- The forecast shall guide the specification of the release table to employ for the coming month [quarter] as follows:
  - If the forecast for the year ahead is 650 mgd or less, use the Joint Fishery Matrix.
  - If the forecast is between 650 and 765 mgd use the current FFMP 35 mgd table.
  - If the forecast is above 765 mgd use the current FFMP 0 mgd table.

Part II. Improving on the Joint Fishery Recommendation

(It is an improvement , but we can do even better)

The Serio Kolesar Enhanced JFish

- We base our recommendations on over 100 OASIS & DSS simulations of release polices and regression analyses done since January.
- Starting from the Joint Fishery recommendation (scenario 6) as our foundation, we arrived at the following modifications:
  - Increased most L2 releases as indicated by our regression model to maximize summer adult trout habitat without violating the drought day constraint.
  - Decreased most L3 and L4 releases, similar to the new OST approach to speed recovery to L2 conditions.
  - Reduced the IERQ to 9,423 cfs days -- similar to the new OST approach.
  - Kept L5 releases at the Joint Fishery recommendations to protect the ecology in severe drought

The Serio Kolesar Enhanced JFish

(With inputs by G. Pettinger of TU & C. Apse of TNC)

	Winter			Spring		Summer			Fall		
Cannonsville Storage Zone	**Dec 1 to Mar 31**	**Apr 1 to Apr 15**	**Apr 16 to Apr 30**	**May 1 to May 20**	**May 21 to May 31**	**Jun 1 to Jun 15**	**Jun 16 to Jun 30**	**Jul 1 to Aug 31**	**Sep 1 to Sep 15**	**Sep 16 to Sep 30**	**Oct 1 to Nov 30**
L1-a	1500	1500	1500	*	*	*	1500	1500	1500	1500	1500
L1-b	700	700	700	*	*	*	*	700	700	700	700
L1-c	225	475	475	525	525	650	650	650	400	375	225
L2 High	150	400	400	525	525	650	650	650	400	300	150
L2 Low	150	400	400	400	400	525	525	525	400	300	150
L3	55	55	55	85	85	135	135	135	85	85	55
L4	50	50	50	60	60	120	120	120	50	50	50
L5	50	50	50	50	50	120	120	120	50	50	50

	Winter			Spring		Summer			Fall		
Pepacton Storage Zone	**Dec 1 to Mar 31**	**Apr 1 to Apr 15**	**Apr 16 to Apr 30**	**May 1 to May 20**	**May 21 to May 31**	**Jun 1 to Jun 15**	**Jun 16 to Jun 30**	**Jul 1 to Aug 31**	**Sep 1 to Sep 15**	**Sep 16 to Sep 30**	**Oct 1 to Nov 30**
L1-a	700	700	700	*	*	700	700	700	700	700	700
L1-b	400	400	400	*	*	400	400	400	400	400	400
L1-c	150	150	150	150	150	200	200	200	150	150	150
L2 High	100	100	100	100	150	200	200	200	150	150	100
L2 Low	100	100	100	100	100	140	140	140	100	100	100
L3	45	45	45	60	60	80	80	80	45	45	45
L4	40	40	40	50	50	80	80	80	40	40	40
L5	40	40	40	40	40	80	80	80	30	30	30

	Winter			Spring		Summer			Fall		
Neversink Storage Zone	**Dec 1 to Mar 31**	**Apr 1 to Apr 15**	**Apr 16 to Apr 30**	**May 1 to May 20**	**May 21 to May 31**	**Jun 1 to Jun 15**	**Jun 16 to Jun 30**	**Jul 1 to Aug 31**	**Sep 1 to Sep 15**	**Sep 16 to Sep 30**	**Oct 1 to Nov 30**
L1-a	190	190	190	*	*	140	190	190	190	190	190
L1-b	125	110	110	*	*	140	140	150	150	150	125
L1-c	90	90	90	125	125	140	140	140	130	130	90
L2 High	90	90	90	125	125	130	130	130	130	130	90
L2 Low	90	90	90	90	110	125	125	125	90	90	90
L3	30	30	30	40	40	55	55	55	30	30	30
L4	30	30	30	30	30	55	55	55	25	25	25
L5	30	30	30	30	30	55	55	55	25	25	25

Three 'White Paper' Variants

- *J Fish*
- *OST 100*
- *Enh J Fish*

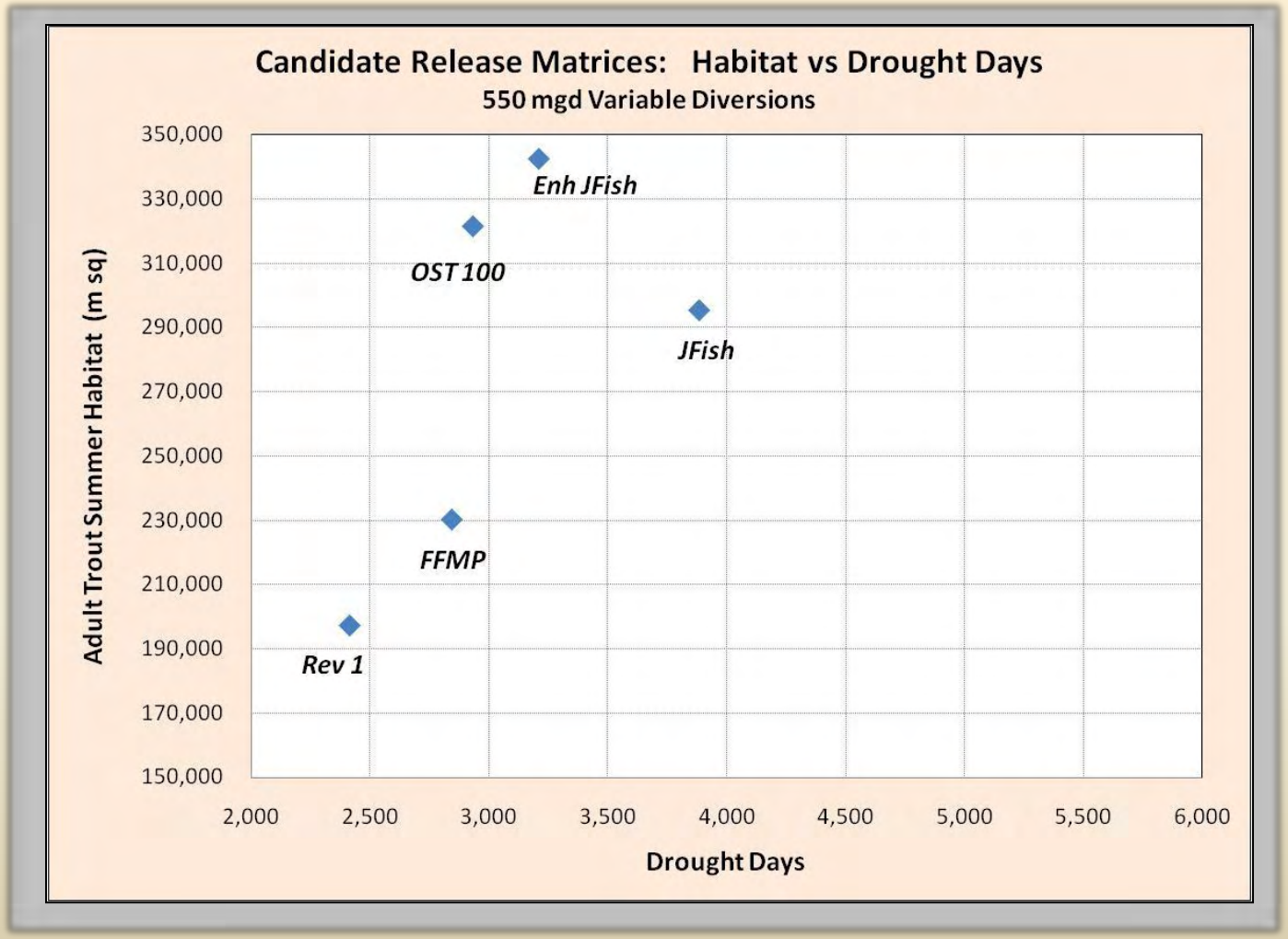
Comparison of Enh J Fish to FFMP, OST 100 and J Fish

(1928 to 2006)

Policy	FFMP	OST 100	En JFish	JFish
Storage Mean	217,477	213,117	207,799	211,504
Storage Min	8,746	45,036	41,996	7,162
Storage Jun 1	259,173	261,120	258,924	255,080
Void Sep 1	53,523	74,599	82,015	72,092
Spills Mean	286	220	204	233
Upper Drought Watch	692	910	957	548
Upper Drought Warning	672	1,159	1,404	1,075
Upper Drought Emergency	1,480	864	961	1,755
Upper Drought Total	2,844	2,933	3,322	3,378
Lower Drought Total	1,216	1,266	1,184	1,153
Reservoir Refill Years	61	57	56	55
95% Refill Years	66	67	66	65
Adult Trout Summer Habitat (m sq)				
West Branch	64,586	95,230	93,068	89,153
East Branch	89,261	84,991	92,353	85,344
Neversink	50,252	51,726	56,265	50,661
Main Stem	26,249	89,543	104,285	69,095
Total Habitat	230,348	321,489	345,970	294,253

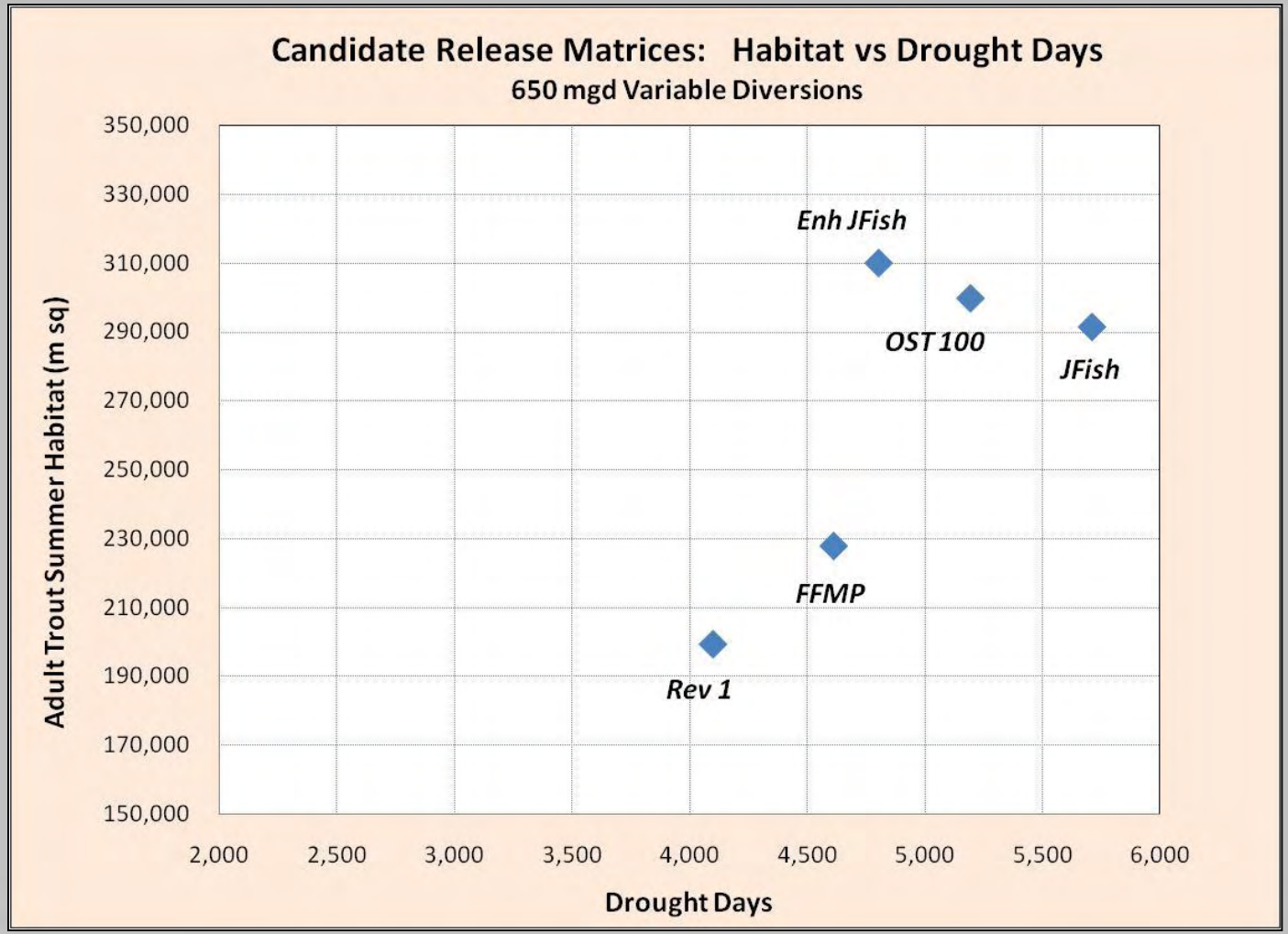
Habitat vs Drought Days

@ 550 Diversions



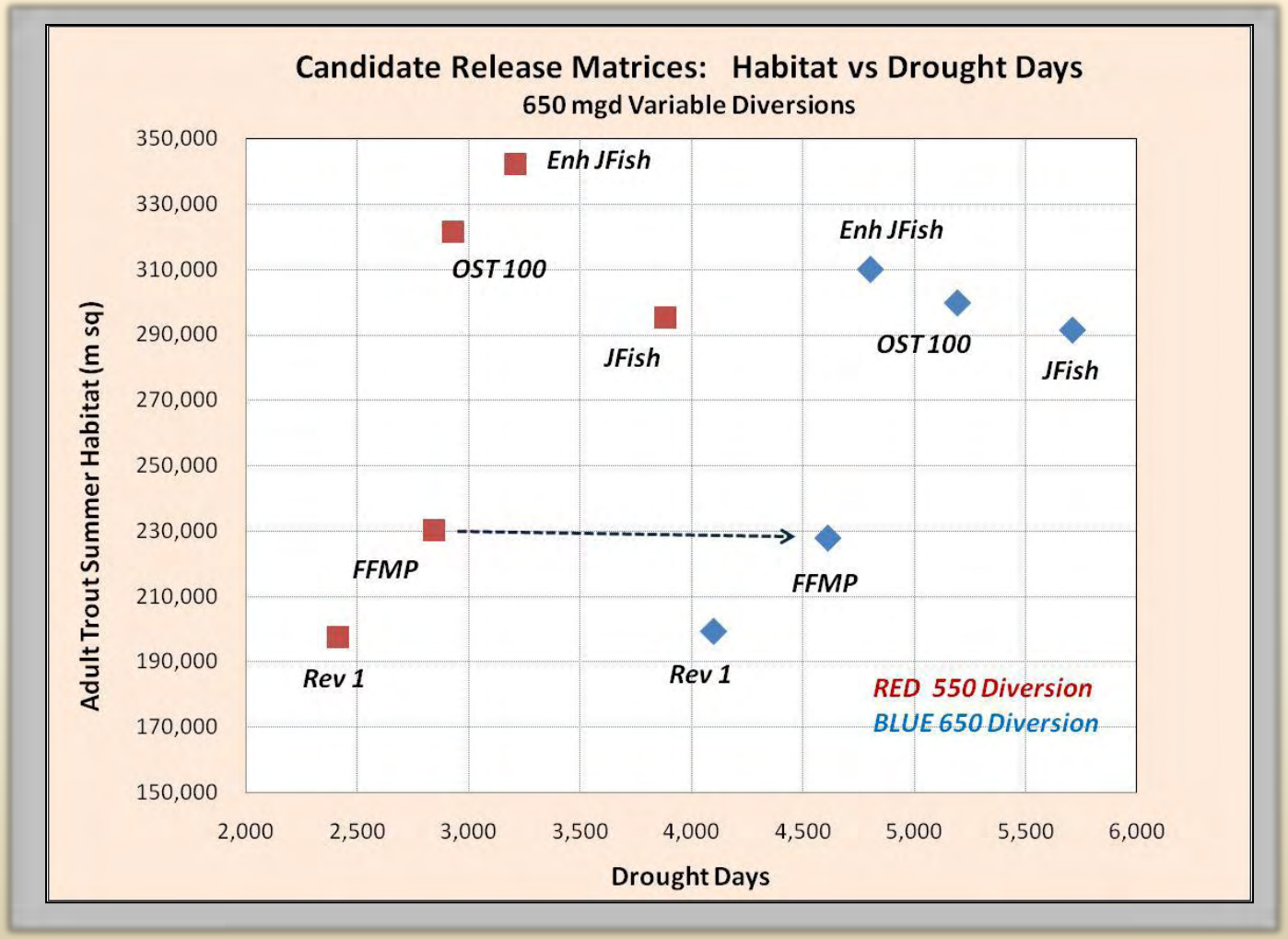
Habitat vs Drought Days

@ 650 Diversions



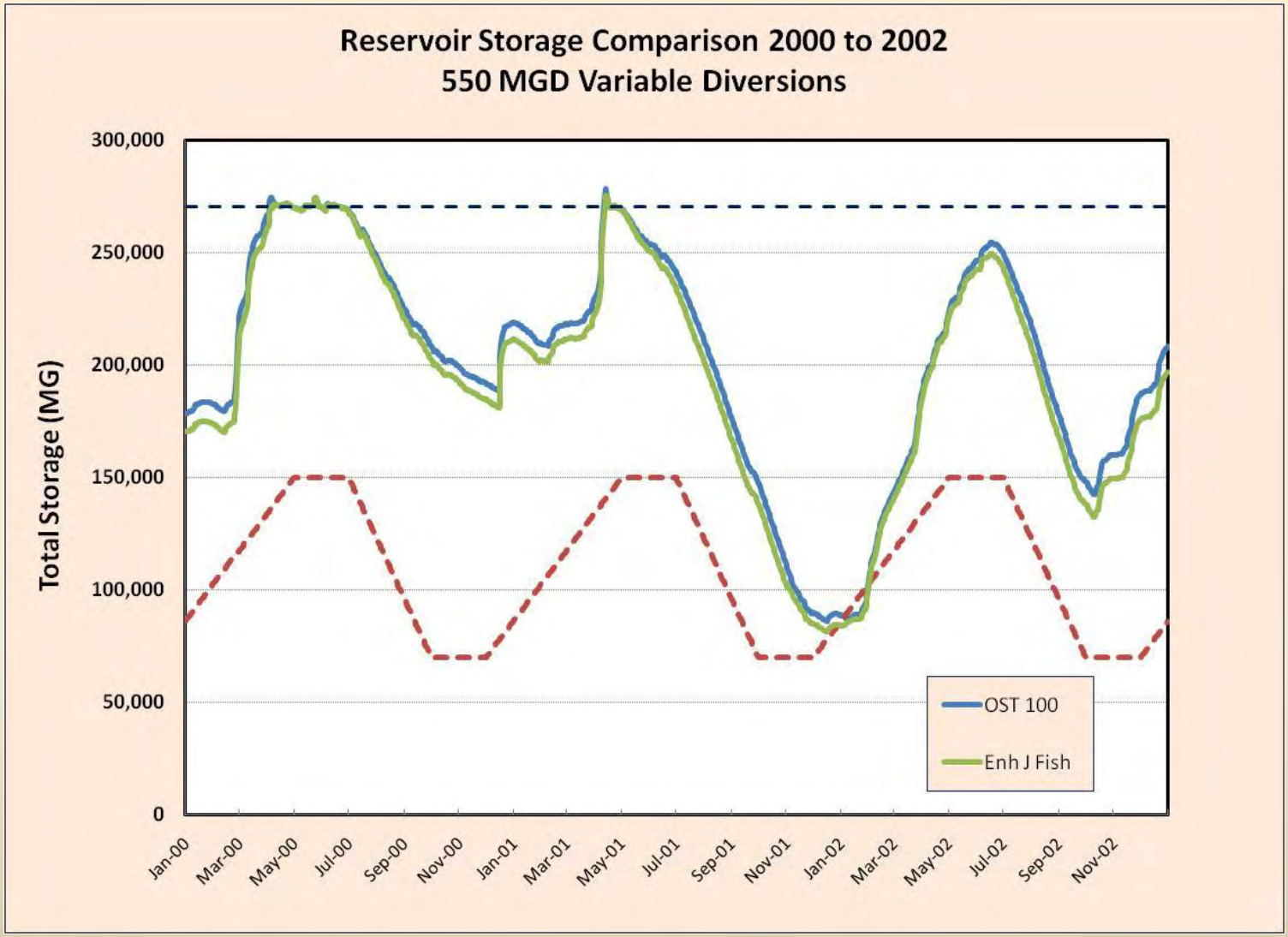
Habitat vs Drought Days

From 550 to 650 Diversions

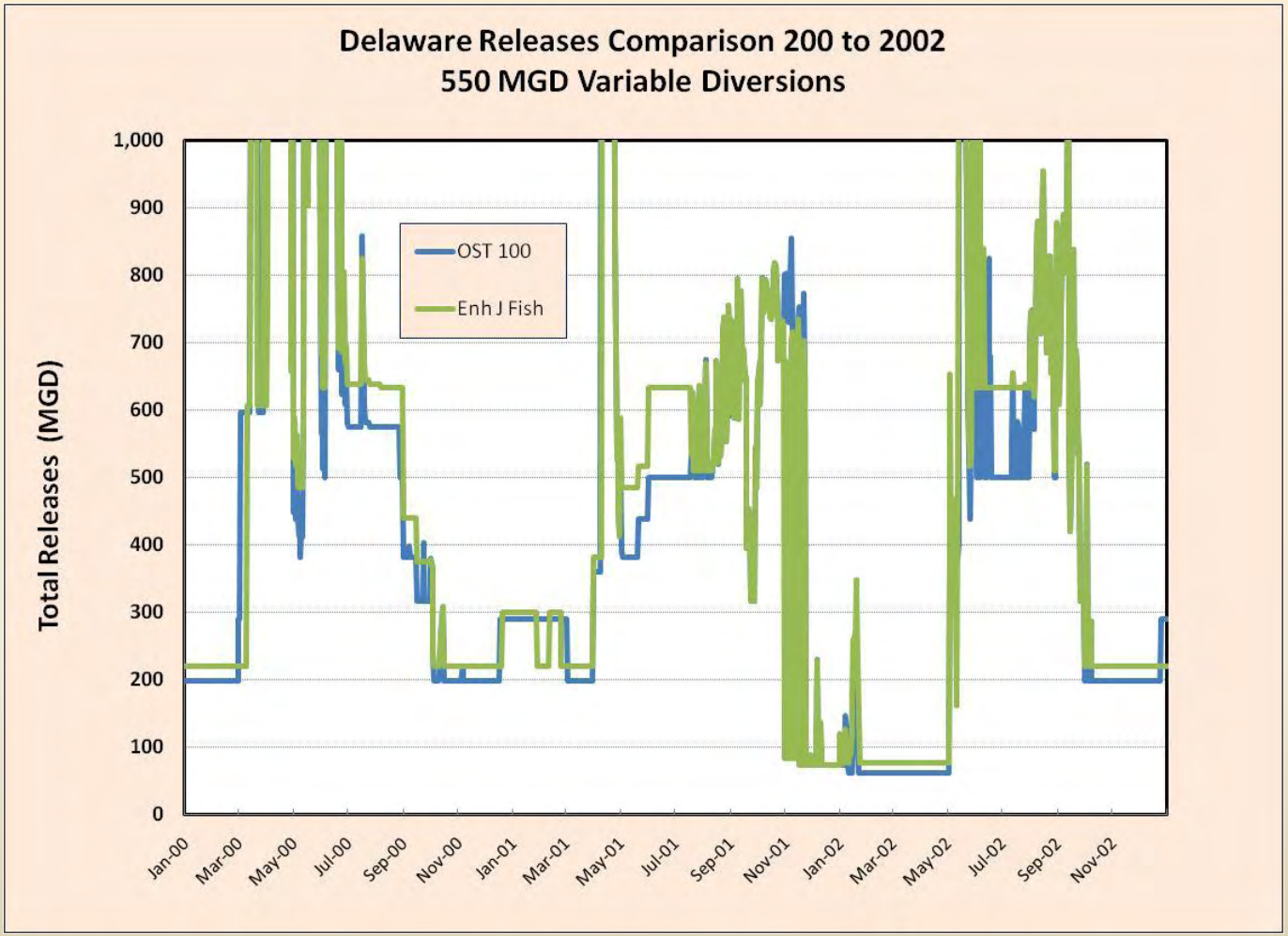


Comparative Performance in Drought

(Storage)



Comparative Performance in Drought (Releases)



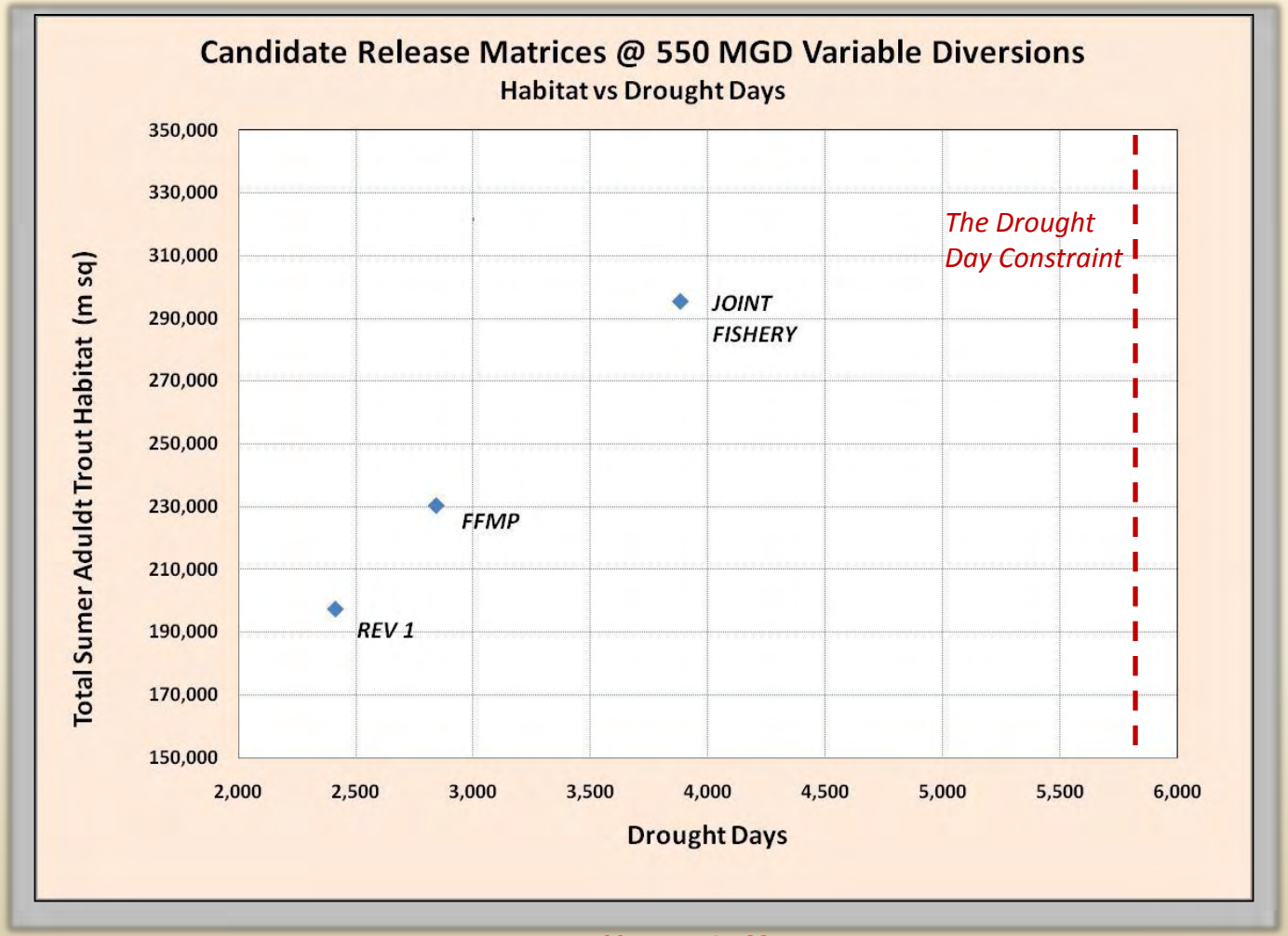
Part III. Negative Implications of a Return to Revision 1

The Bottom Line

- By every measure that matters to the fishing community, reverting to Revision 1 would be an unmitigated disaster!
- In addition, Revision 1 would also be worse for both New Jersey and Pennsylvania and the 'Flood Groups' interests.
- Revision 1 would, however provide some benefit to New York City. It would increase reservoir storage almost uniformly and make any program of water diversion to the City more, rather than less, feasible. It would in no way inhibit the implementation of the OST.

Rev 1 will needlessly save drought days while devastating the fishery.

"Reward"



"Risk"

An Overview Long-run Average Performance
(1928 to 2006)

	Rev 1	FFMP	J Fishery
Storage Jun 1	261,554	259,173	255,871
Storage Sep 1	208,815	217,477	208,398
Spills Mean	401	286	239
Upper Drought Watch	458	692	952
Upper Drought Warning	568	672	1,175
Upper Drought Emergency	1,389	1,480	1,757
Upper Drought Total	2,415	2,844	3,884
Lower Drought Total	1,364	1,216	1,156
Reservoir Refill Years	64	61	55
95% Reservoir Refill Years	70	66	66
Summer Adult Trout Habitat (m sq)			
West Branch	53,482	64,586	88,795
East Branch	75,721	89,261	85,468
Neversink	39,939	50,252	50,661
Main Stem	28,267	26,249	70,447
Total Habitat	197,409	230,348	295,371

Some Implications of Reverting to Rev 1 as Compared to the Joint Fishery Recommendation

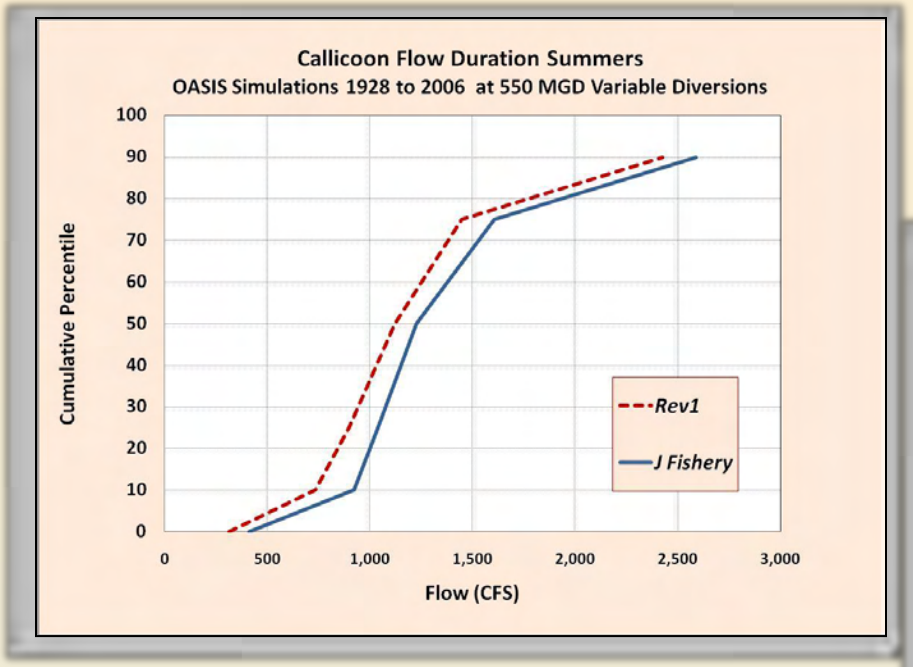
- ***A Fishery Perspective***
  - ***Adult trout summer habitat would decrease by 33% overall and 60% in the main stem.***
- ***A Flooding Perspective***
  - ***Spilling would increase by 68% and September 1 reservoir voids would go down by 1%.***
- ***A New Jersey Pennsylvania Perspective***
  - ***New Jersey diversions would be 1% lower. Trenton median flows would decrease by 6% and 10th percentile flows would decrease by 2%.***
- ***A New York City Perspective***
  - ***Average reservoir levels would be 7% higher, June 1 reservoir levels would be 2% higher and reservoirs would refill 16% more often.***

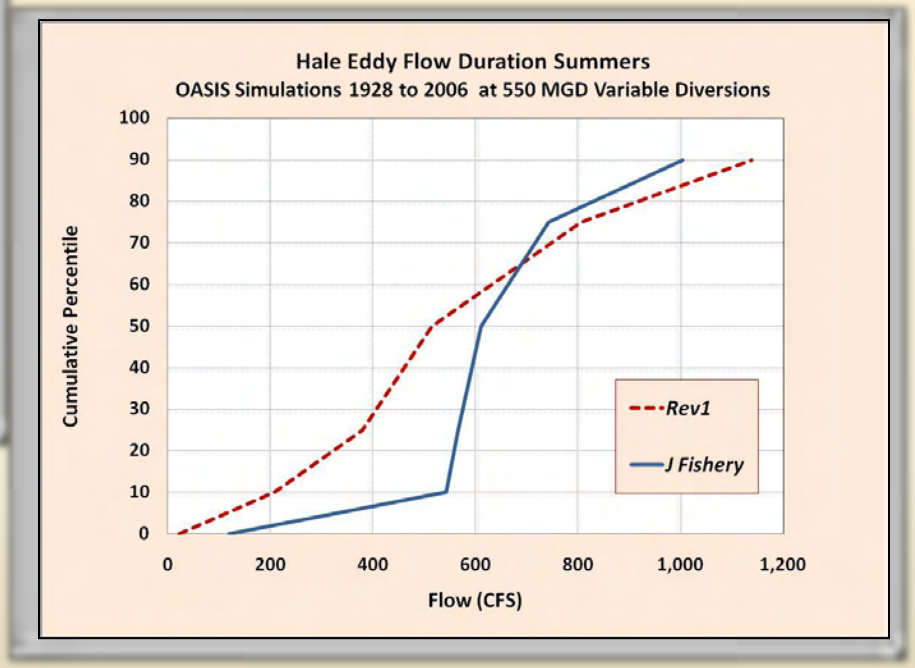
Summer Flows at Critical Gage Stations

1928 to 2006 (MGD)

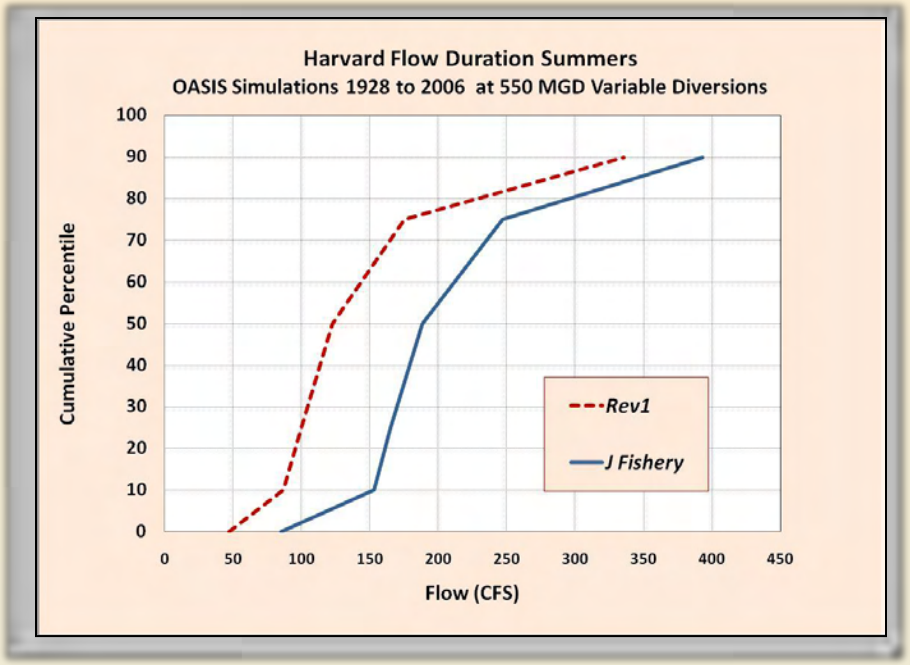
	Min	10th Pct	25th Pct	Median	75th Pct	90th Pct
Bridgeville						
Rev1	29	50	61	81	117	213
FFMP	45	82	91	108	144	240
J Fishery	43	96	105	120	151	237
Callicoon						
Rev1	314	736	896	1,122	1,446	2,425
FFMP	438	771	897	1,109	1,460	2,497
J Fishery	411	922	1,039	1,225	1,608	2,590
Hale Eddy						
Rev1	23	209	379	516	806	1,139
FFMP	120	299	330	408	704	1,034
J Fishery	120	543	566	611	743	1,004
Harvard						
Rev1	47	87	100	122	175	336
FFMP	93	154	166	191	262	422
J Fishery	85	153	165	188	247	393
Montague						
Rev1	822	1,718	1,857	2,232	3,497	6,163
FFMP	872	1,760	1,905	2,319	3,613	6,291
J Fishery	874	1,801	1,984	2,552	3,835	6,374
Trenton						
Rev1	2,021	2,943	3,520	4,931	7,924	13,785
FFMP	1,982	2,974	3,545	5,005	8,009	13,972
J Fishery	1,982	2,999	3,646	5,238	8,222	14,012

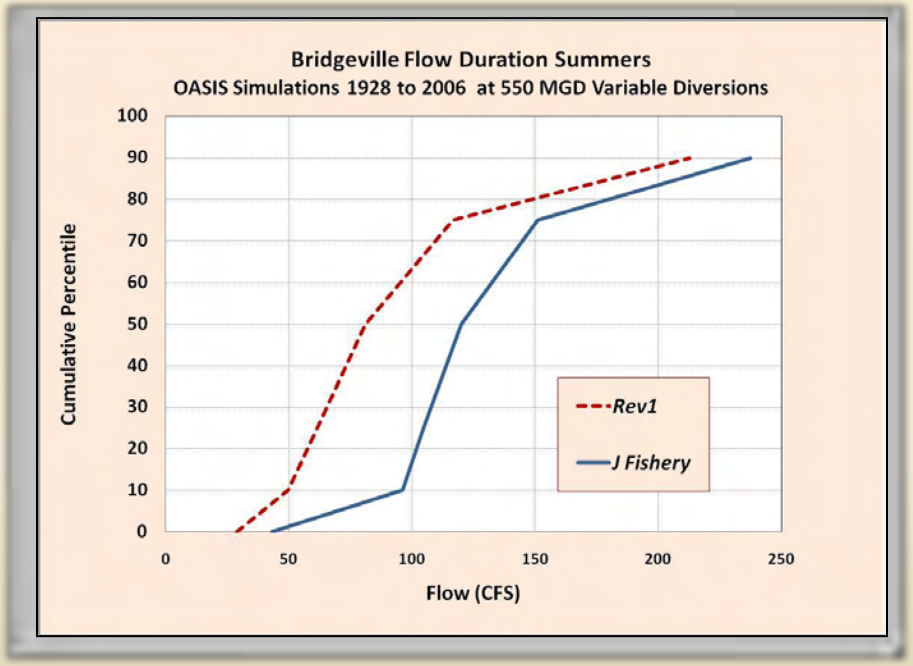
A Pictorial View: Callicoon and Hale Eddy



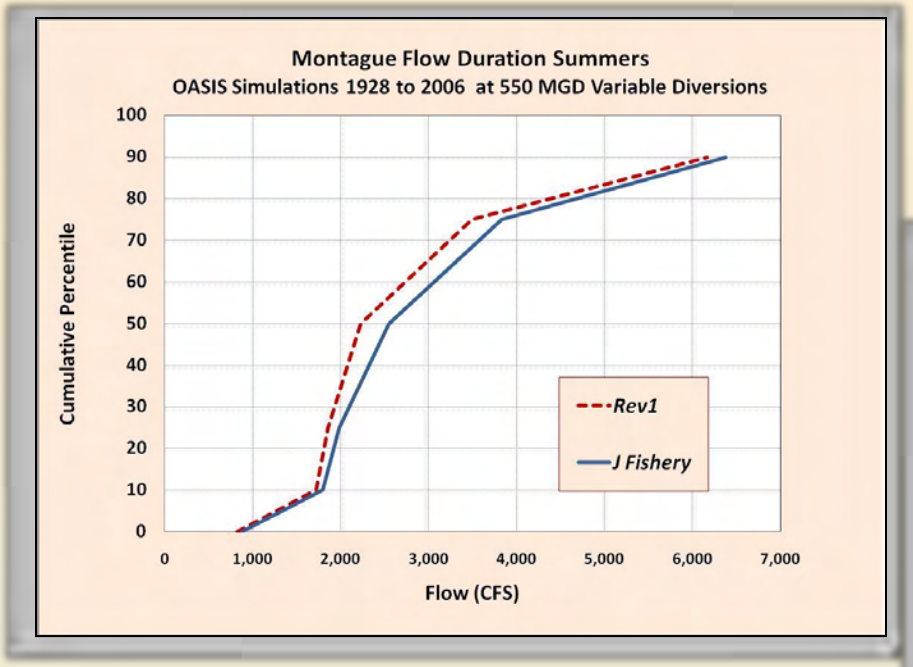


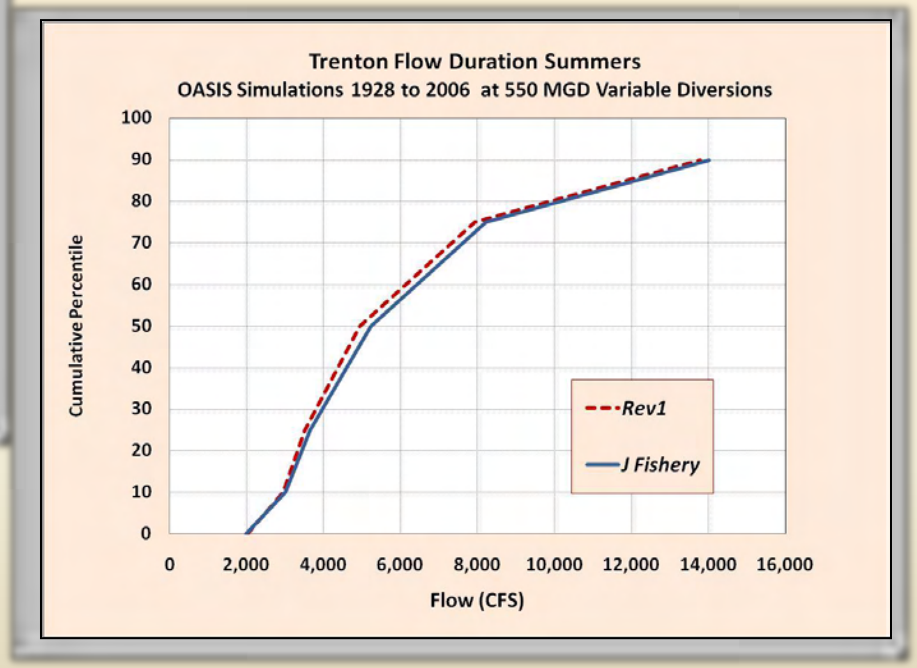
At Harvard and Bridgeville





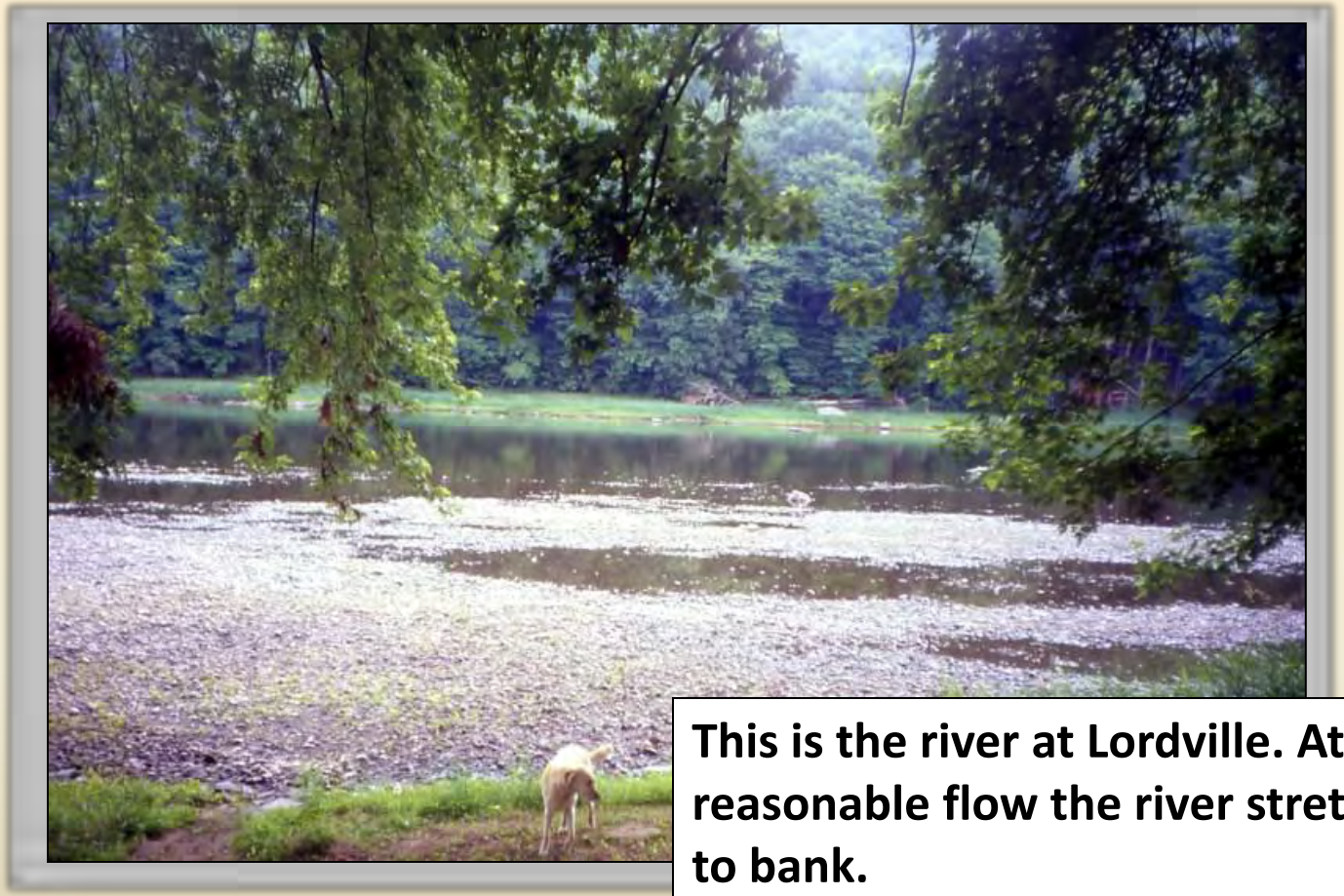
At Montague and Trenton





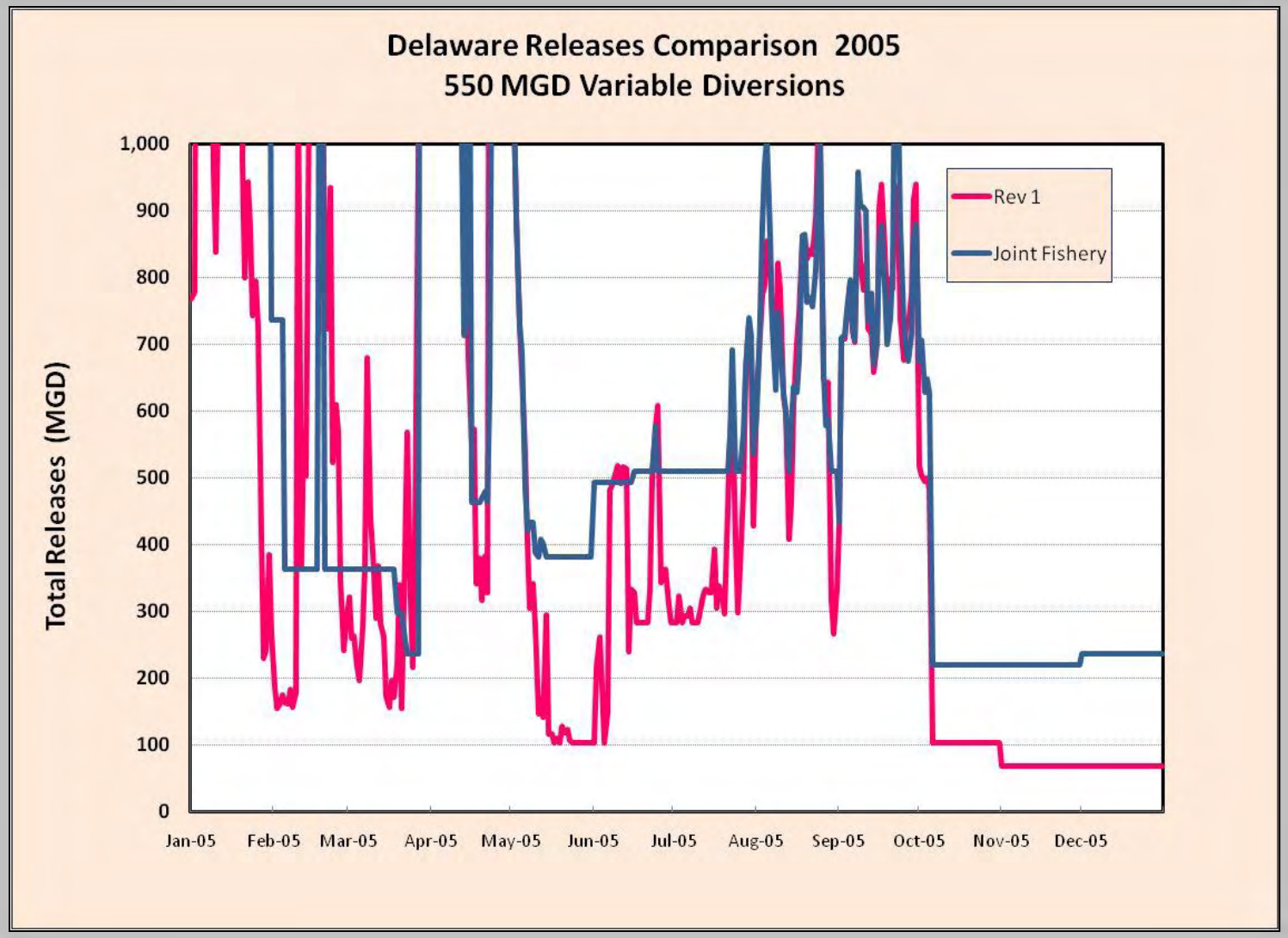
Performance During the Thermal Crisis of the Summer of 2005?

The Delaware reservoirs stood at 89% capacity in July 2005 yet the Cannonsville release was only 125 CFS

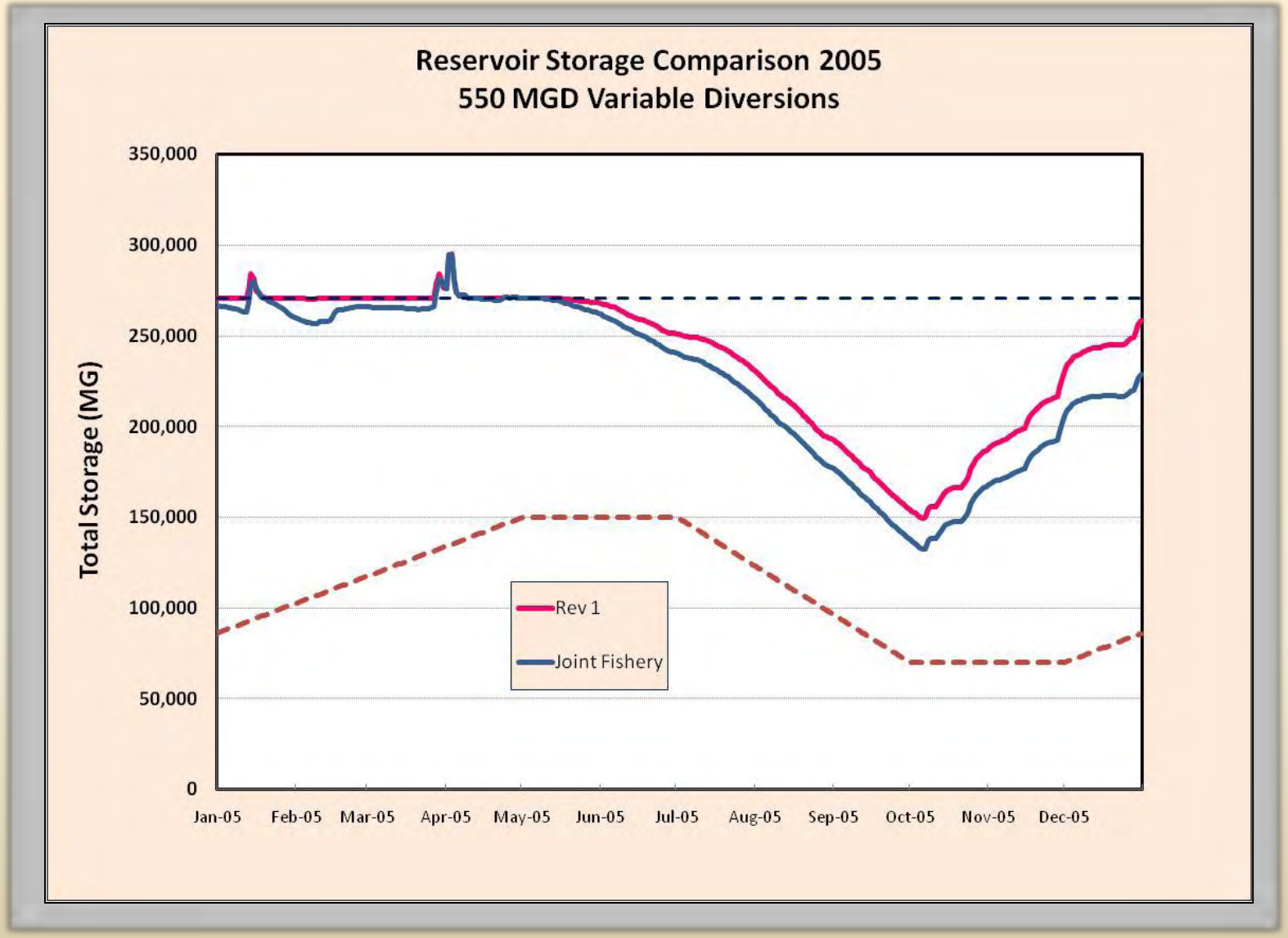


This is the river at Lordville. At a reasonable flow the river stretches bank to bank.

Revision 1 would repeat the disaster, while the Joint Fishery recommendation is one available solution



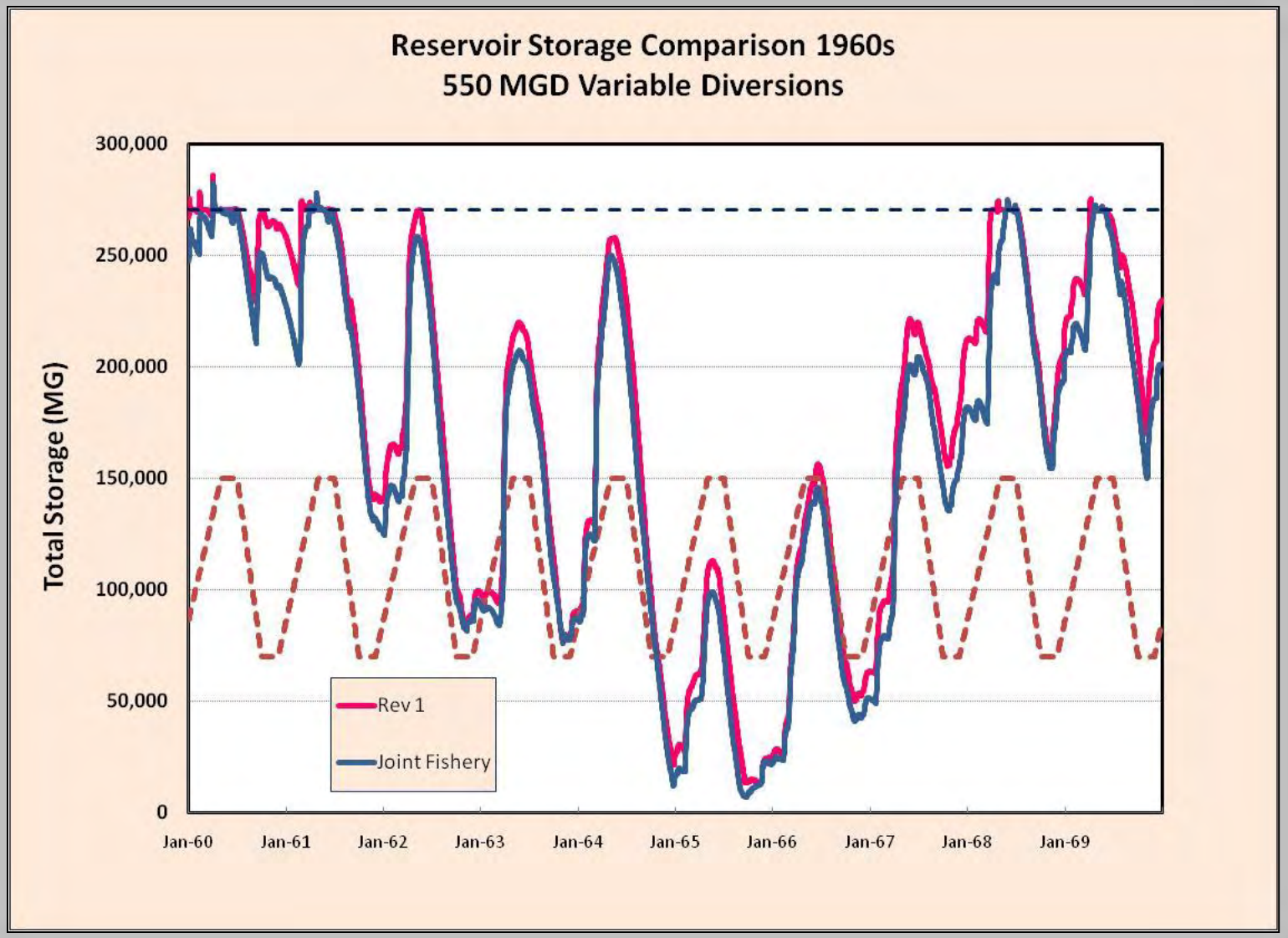
And at no increase in NYC water availability risk!



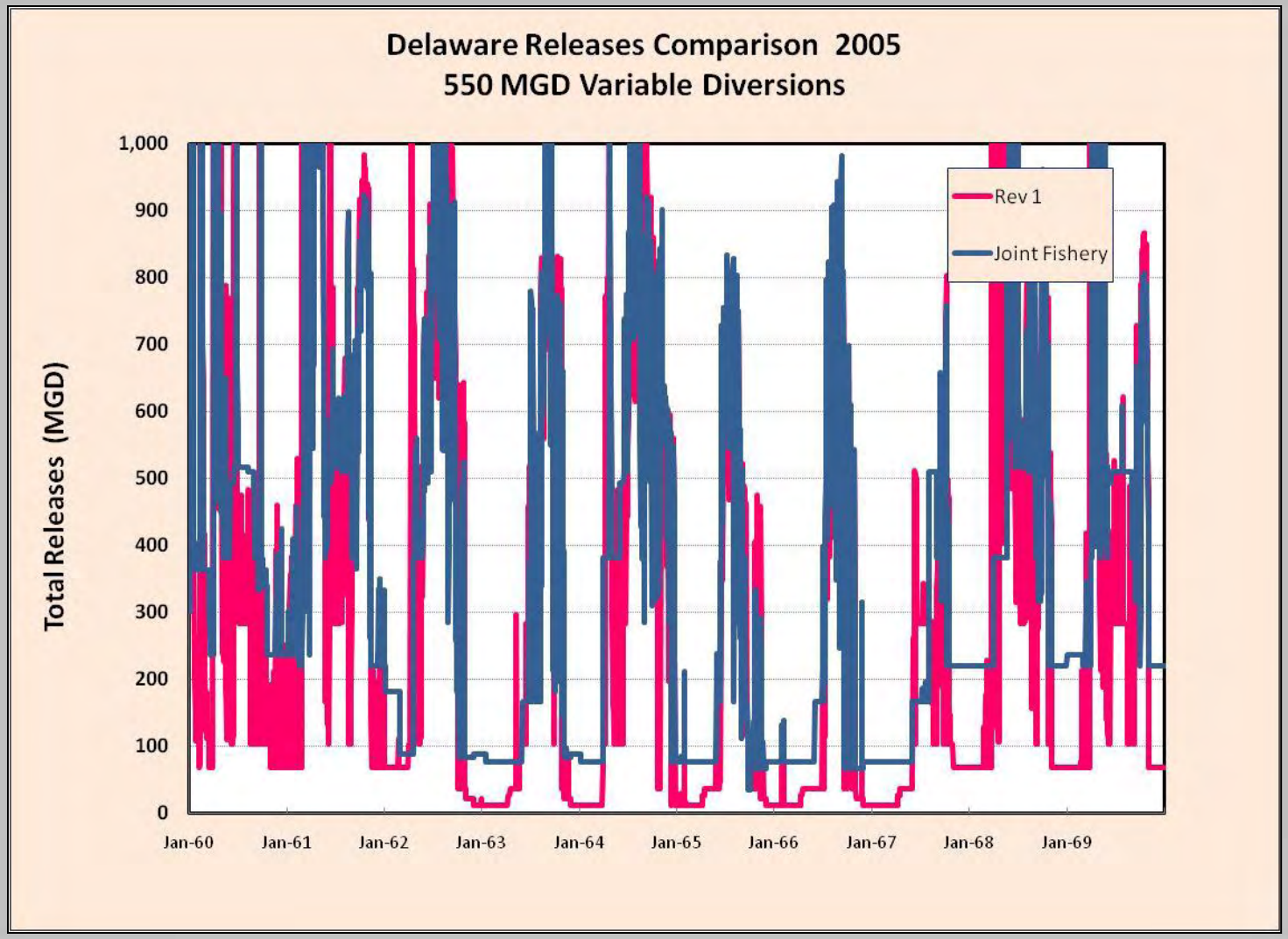
How about the drought of the century?

Reservoir Storage

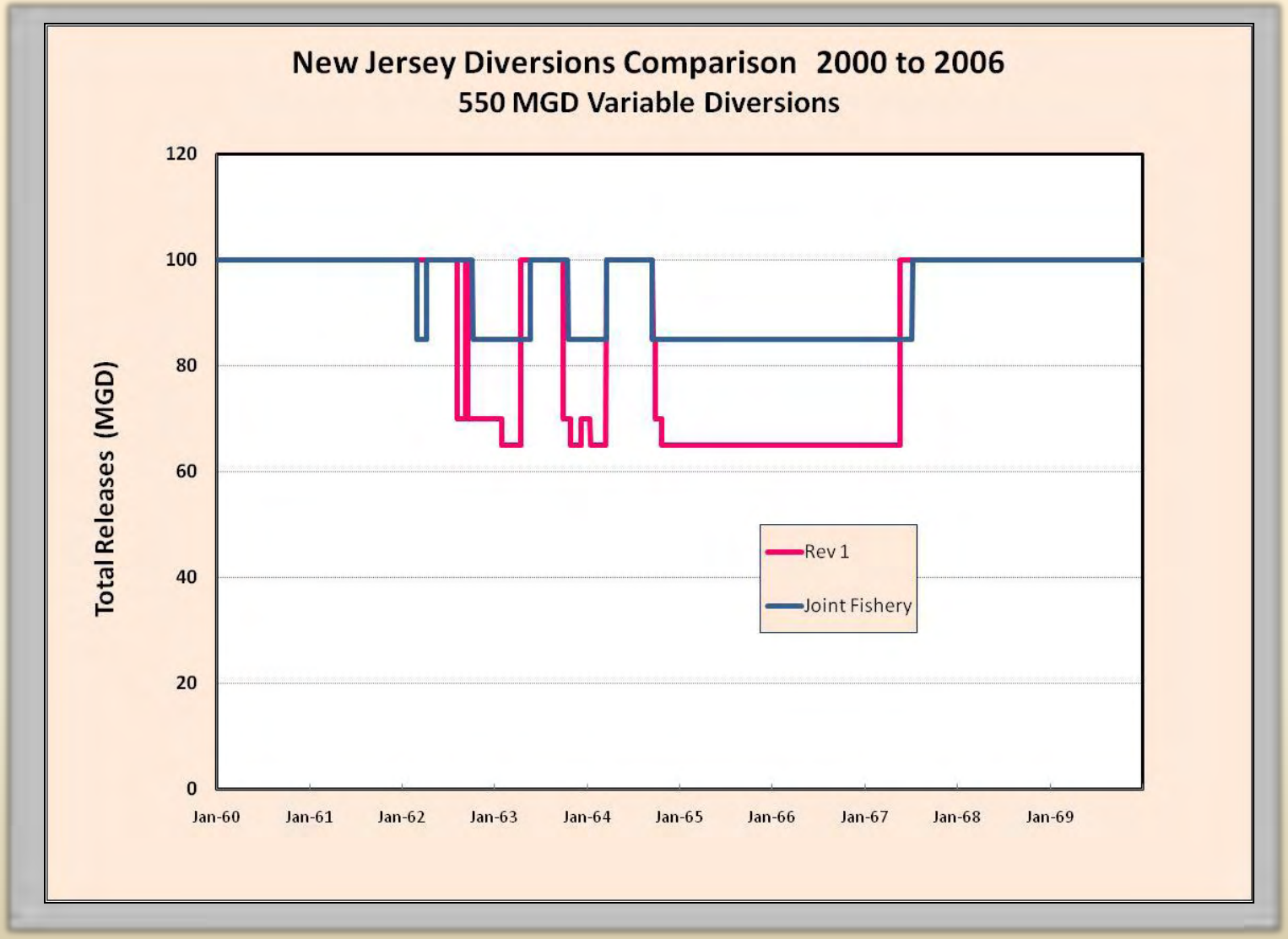
Is NYC water reliability threatened by Rev 1?



What is actually threatened most is the fishery!



And New Jerseys' diversions are reduced



Closing Thoughts

- These data show that Rev1 is clearly a major step backwards for the ecology of the Upper Delaware.
- Rev1 is also a step backward managerially and methodologically.
  - FFMP was a small first step toward bringing modern dam release methodology to the Delaware. We are now poised to take a next step by realistically recognizing the beneficial role of diversion and inflow forecasts.
  - Let's prepare for a future 'optimization' based release regime that balances all stakeholder interests . An enormous s body of science has been developed in this field -- shall we not use it?
- ***The Joint Fisheries recommendation provides a foundation for the future of the Delaware.***


The End