Environmental Protection

New York City's Operations Support Tool (OST)

Regulated Flow Advisory Committee Meeting

March 8, 2011

Presentation Outline

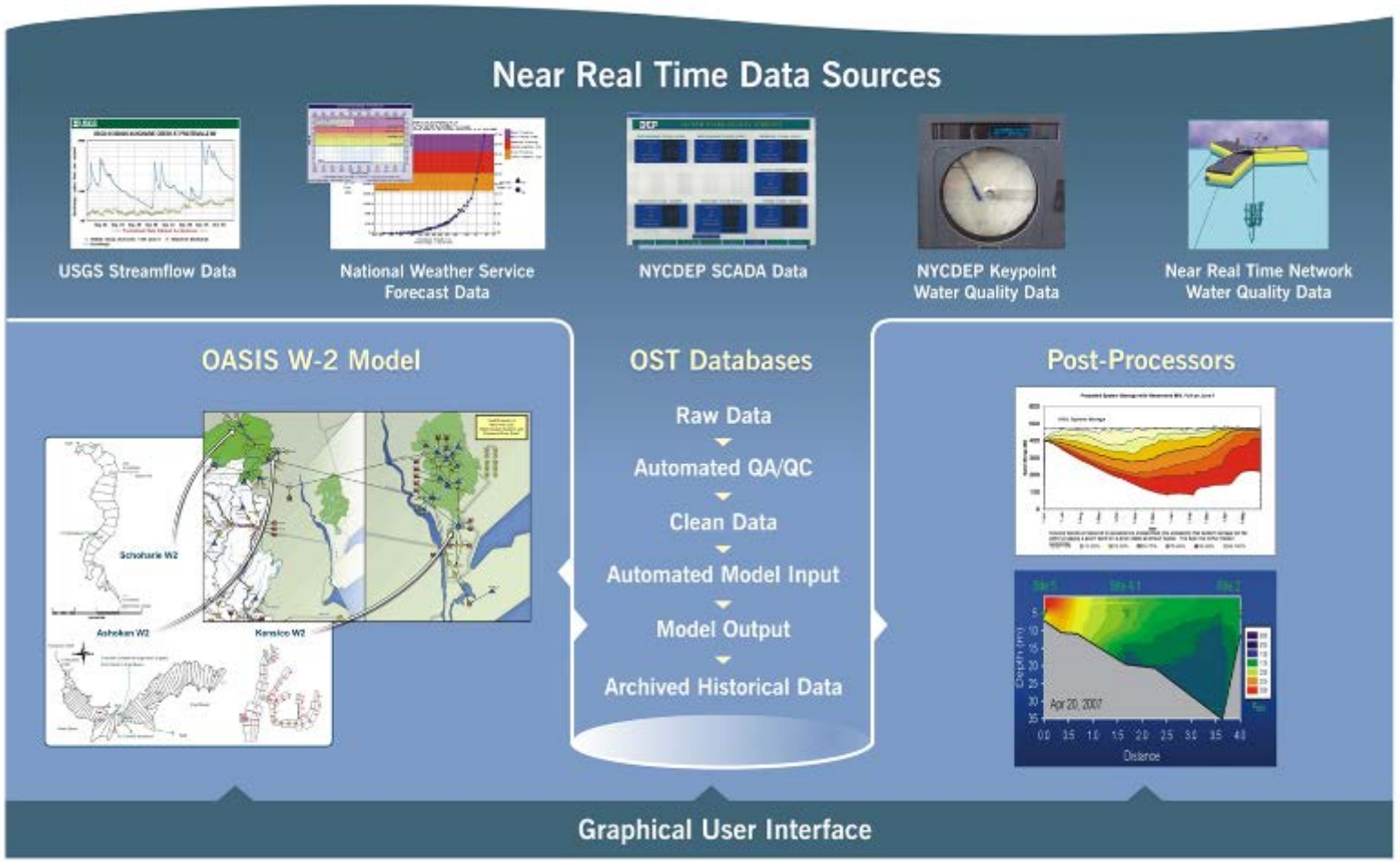
- **What is OST?**
- **OST-FFMP Release Rule**
- **Performance Examples**

OST Usage

- Refill Probability & Drought Risk Analysis
- Outage Planning & Emergency Management
- Operating Rule Development & Water Supply Planning
- Climate Change Planning / Demand Management Studies
- New Infrastructure

What is OST?

- Computer Decision Support System
  - Ingests real-time data
  - Links water quality and water quantity models
  - Assimilates streamflow *forecasts*



OST Forecast Sources

- OST has two modes:
  - Long-term simulation
  - Look-ahead operations (Position Analysis – PA)
- PA mode uses probabilistic inflow forecasts
- Currently using statistical forecasts
  - Based on historical inflows & recent conditions
- By ~2013 OST will use NWS forecasts
  - Will include meteorological drivers

What does OST do?

OST quantifies the performance of alternative operating decisions

Provide robust quantitative assessment of:

- Expected inflows
- Diversion needs
- Release requirements
- Spill rates
- Storage levels
- Drought risk

Better defines capacity of system to meet objectives:

- Water quantity (reliability)
- Water quality
- Enhanced reservoir flood mitigation
- Environmental / release objectives

OST Usage: Delaware Basin

- Develop & evaluate alternative release plans
- Predict amount of water available for release
  - Must maintain supply reliability
- Support Delaware Basin release programs
  - Probabilistic, risk-based approach
  - Requires commitment from other Decree Parties to long-term sustainable water supply sources
- Potential for increasing net system benefits
  - Provide enhanced downstream releases and reservoir flood mitigation while protecting NYC supply

OST Usage: Enhanced Reservoir Flood Mitigation

- OST can be used to mitigate spills
- Possible options:
  - Conditional storage objectives
  - Flexibility in managing snowpack
  - Proactive releases in anticipation of large events
- OST flood mitigation rule under development

OST-FFMP Framework

OST INPUT

Today's Conditions

- Reservoir Levels
- Infrastructure Status
- Water Quality
- Demand Projections

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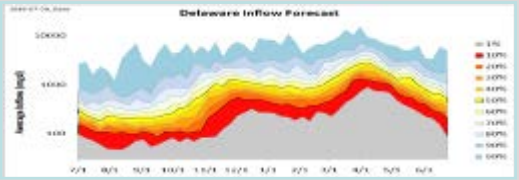
Operating Rules

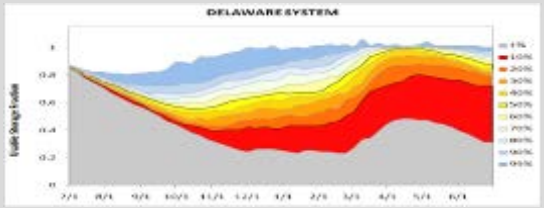
- System Reliability
- Reservoir Balancing
- Drinking Water Quality
- Releases

Ensemble Inflow Forecasts

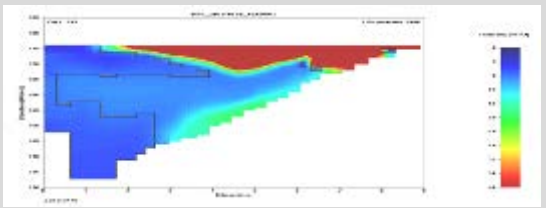


OST DECISION-MAKING

Storage Levels



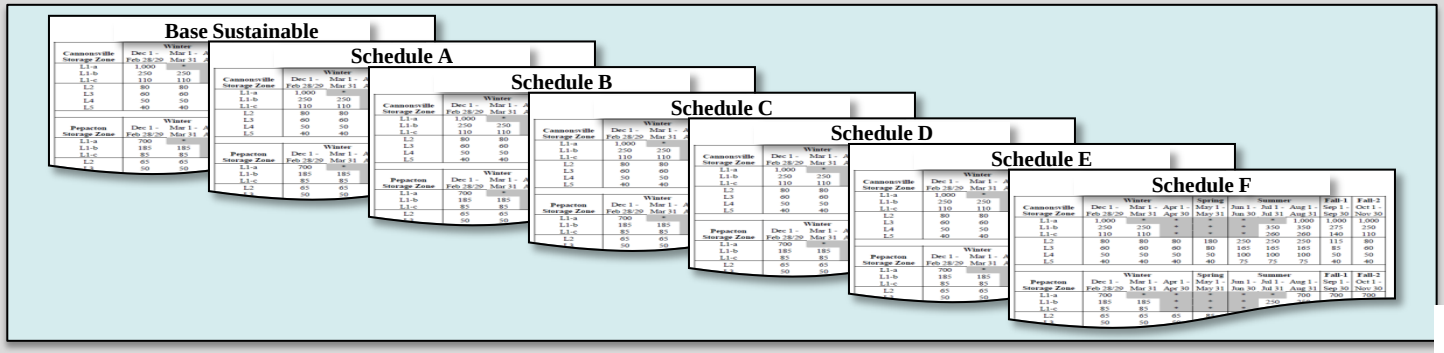
Water Quality



Refill Probability

DELAWARE RELEASE DECISIONS

Low Water Availability	Probability of Excess Water At Specified Risk Level	High Water Availability



Delaware Releases OST Approach

- Releases based on:
  - Current system status (PCN storage)
  - Expected PCN inflows
  - Expected PCN diversions
  - Water supply reliability (e.g. fill reservoirs by ~June 1)
  - Spill mitigation
  - Other system conditions (e.g. CAT turbidity event, infrastructure outage)
- OST provides:
  - Improved analytical tools for predicting water availability using inflow forecasts
  - Robust framework for quantifying risks and benefits (to NYC and downstream users) of release decisions
  - Capability of adapting/recalibrating decision basis (e.g. forecast probability) over time

Mass Balance Approach

	Today's Total PCN Storage	→	Current System Status
+	Cumulative PCN Inflows through June 1	→	Probabilistic Streamflow Forecasts
–	Cumulative PCN Diversions through June 1	→	Required to meet NYC Demand
–	Max PCN Usable Storage (Full Reservoirs on June 1)	→	Max Usable Storage
=	Cumulative **PCN Release Target** through June 1	→	Distribute over days to June 1 and re-evaluate decision regularly

Table Selection Example

- Today is August 1, a release decision day
- PCN usable storage is 70% (L2) (Cannonsville at L2-a)
- Based on mass balance, today's **PCN release target** is **680 cfs**
- Compare total PCN L2 release across all tables
  - Schedule D matches most closely (**640 cfs** total PCN release)
  - Make P / C / N Releases at 140 / 400 / 100
- Table selection re-evaluated on a regular basis
  - Maximize flexibility under changing conditions

OST-FFMP Schedule	L2 Storage Zone Summer: Jul 1 – Aug 31			
	Pepacton	Cannonsville	Neversink	Total
Base	100	225	75	400
A ("10 mgd Available")	100	225	75	400
B ("20 mgd Available")	125	275	90	490
C ("35 mgd Available")	140	325	100	565
D ("50 mgd Available")	140	400	100	640
E ("75 mgd Available")	140	525	110	775
F ("100 mgd Available")	140	525	110	775

Releases during Drought

- Releases at L3-L5 storage zones the same for all OST-FFMP tables
- During drought, releases defined by current storage and season (not inflow forecasts)

	Winter		Spring		Summer			Fall		
Cannonsville Storage Zone	Dec 1 - 31-Mar	Apr 1 - 30-Apr	May 1 - 20-May	May 21 - 31-May	Jun 1 - 15-Jun	Jun 16 - 30-Jun	Jul 1 - 31-Aug	Sep 1 - 15-Sep	Sep 16 - 30-Sep	Oct 1 - 30-Nov
L3	55	55	85	85	135	135	135	85	85	55
L4	50	50	60	60	100	100	100	50	50	50
L5	40	40	40	40	90	90	90	40	40	40

	Winter		Spring		Summer			Fall		
Pepacton Storage Zone	Dec 1 - 31-Mar	Apr 1 - 30-Apr	May 1 - 20-May	May 21 - 31-May	Jun 1 - 15-Jun	Jun 16 - 30-Jun	Jul 1 - 31-Aug	Sep 1 - 15-Sep	Sep 16 - 30-Sep	Oct 1 - 30-Nov
L3	45	45	60	60	75	75	75	45	45	45
L4	40	40	50	50	65	65	65	40	40	40
L5	35	35	35	35	60	60	60	35	35	35

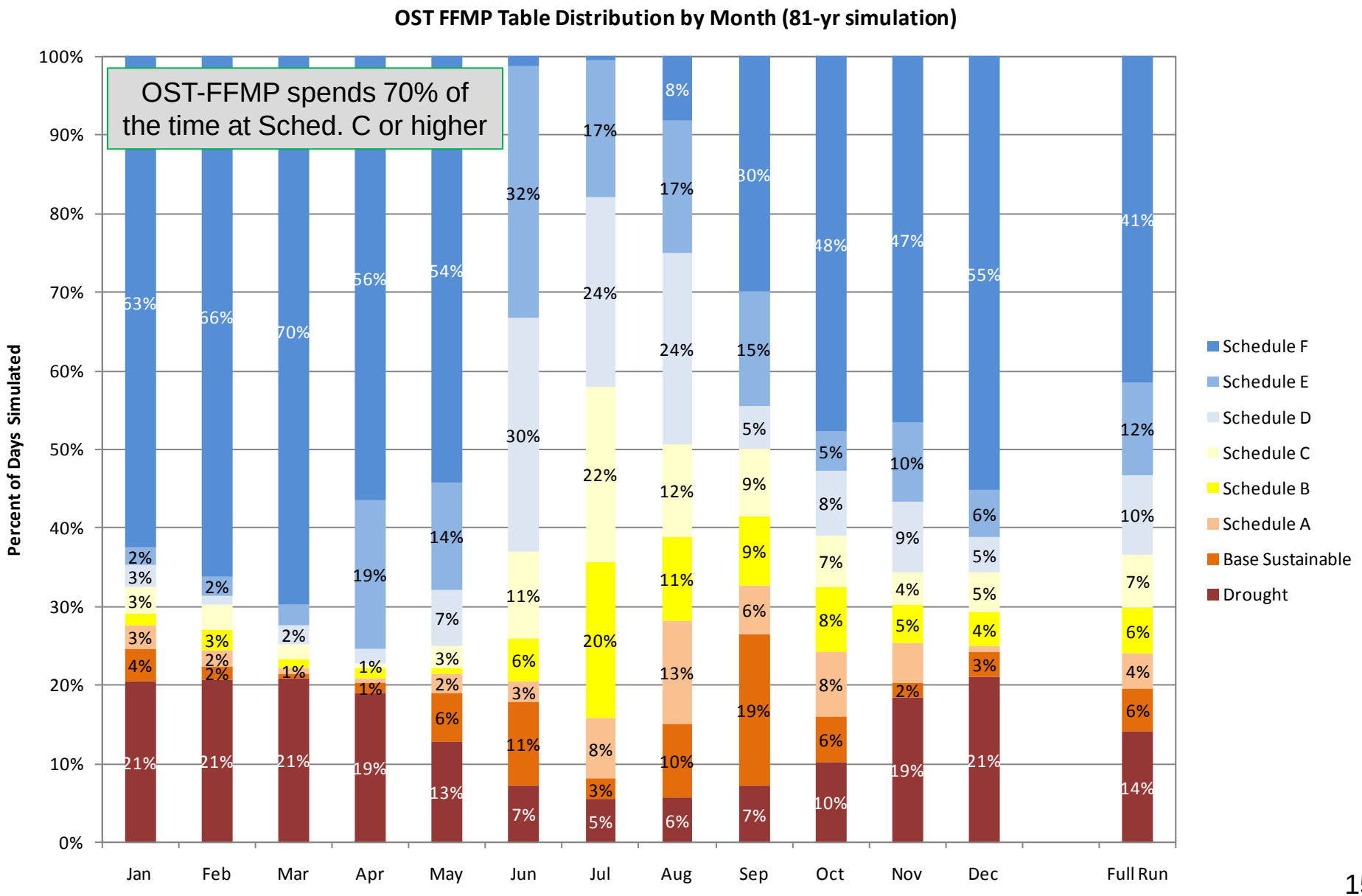
	Winter		Spring		Summer			Fall		
Neversink Storage Zone	Dec 1 - 31-Mar	Apr 1 - 30-Apr	May 1 - 20-May	May 21 - 31-May	Jun 1 - 15-Jun	Jun 16 - 30-Jun	Jul 1 - 31-Aug	Sep 1 - 15-Sep	Sep 16 - 30-Sep	Oct 1 - 30-Nov
L3	30	30	40	40	55	55	55	30	30	30
L4	25	25	30	30	45	45	45	25	25	25
L5	20	20	20	20	40	40	40	20	20	20

Possible Approach to Spill Mitigation

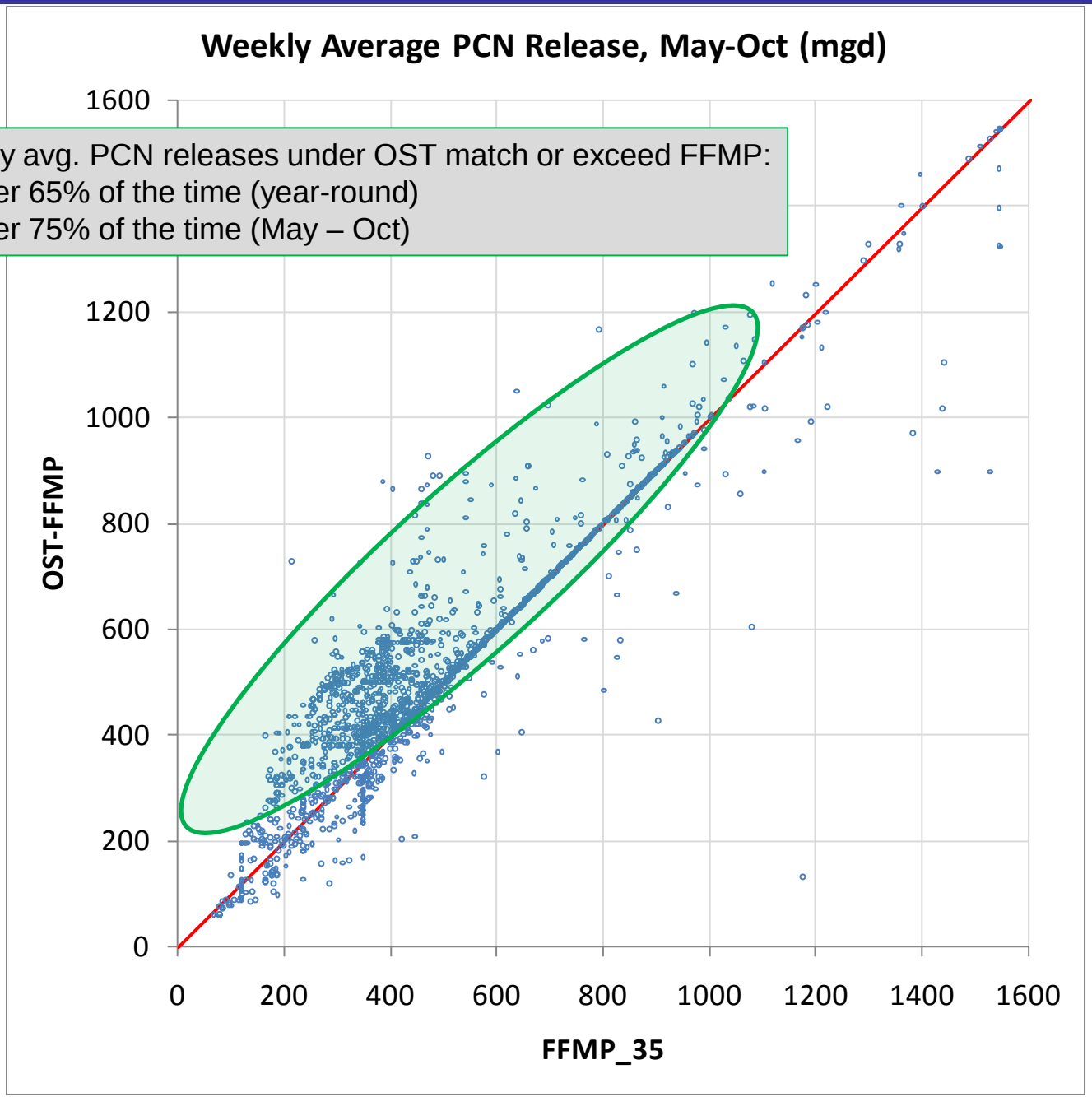
	Today's Total PCN Storage	→	Current System Status
+	Cumulative PCN Inflows through next 2 weeks	→	Probabilistic Streamflow Forecasts
+	Cumulative PCN Release through next 2 weeks	→	Based on mass balance table selection
–	Cumulative PCN Diversions through next 2 weeks	→	Required to meet NYC Demand
–	L1(c) Storage Curve	→	Conditional Storage Objective
=	Estimated PCN Spills	→	If nonzero, release from PCN at maximum L1-a rate

OST-FFMP Spill Mitigation Rule under development, not included in subsequent plots

OST-FFMP Preliminary Results: Table Duration



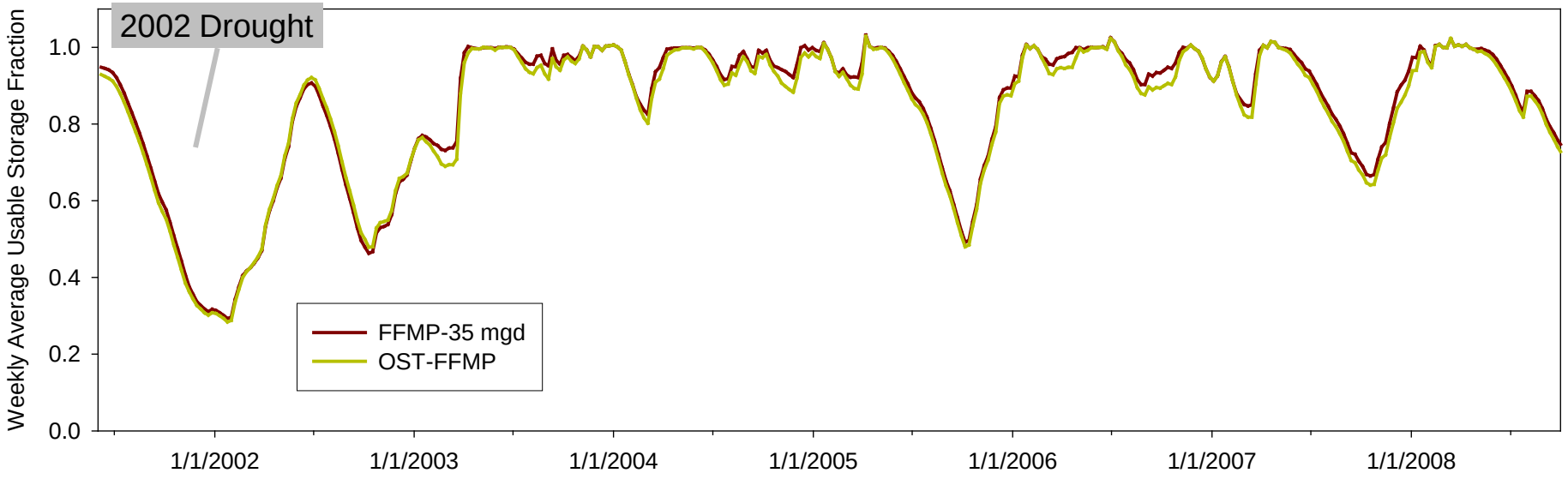
OST-FFMP versus FFMP



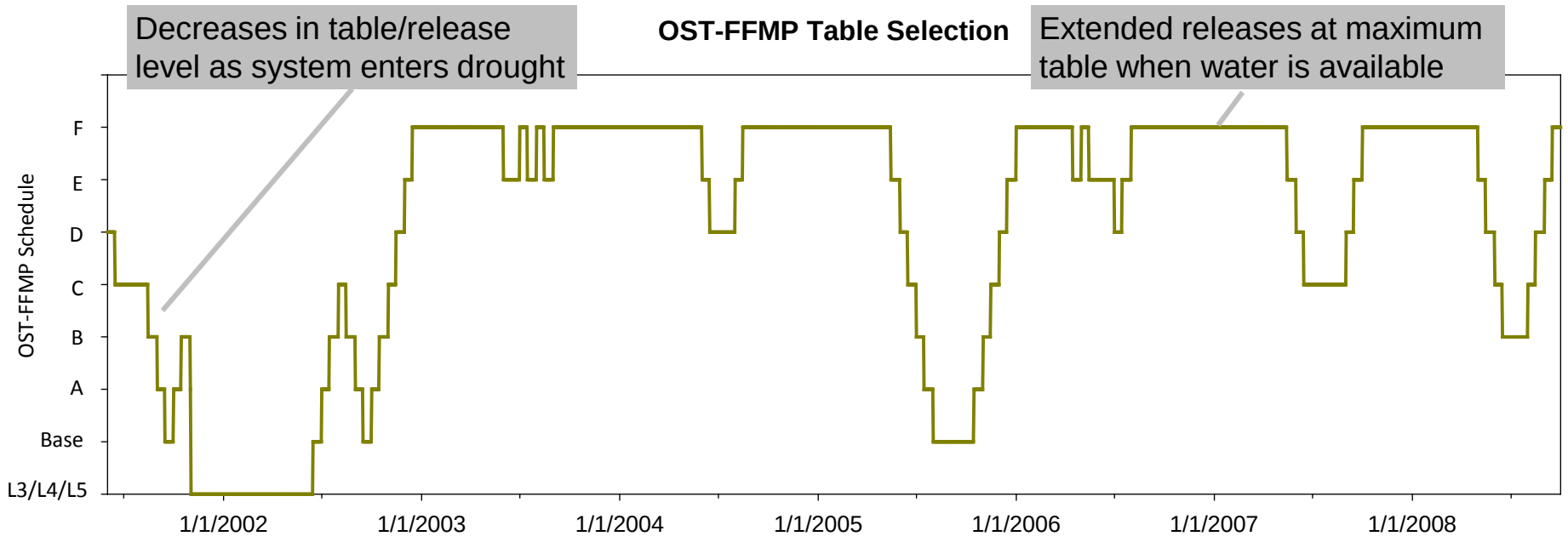
OST-FFMP Preliminary Results: Time Series Example

OST simulation, 6/1/01 – 9/30/08

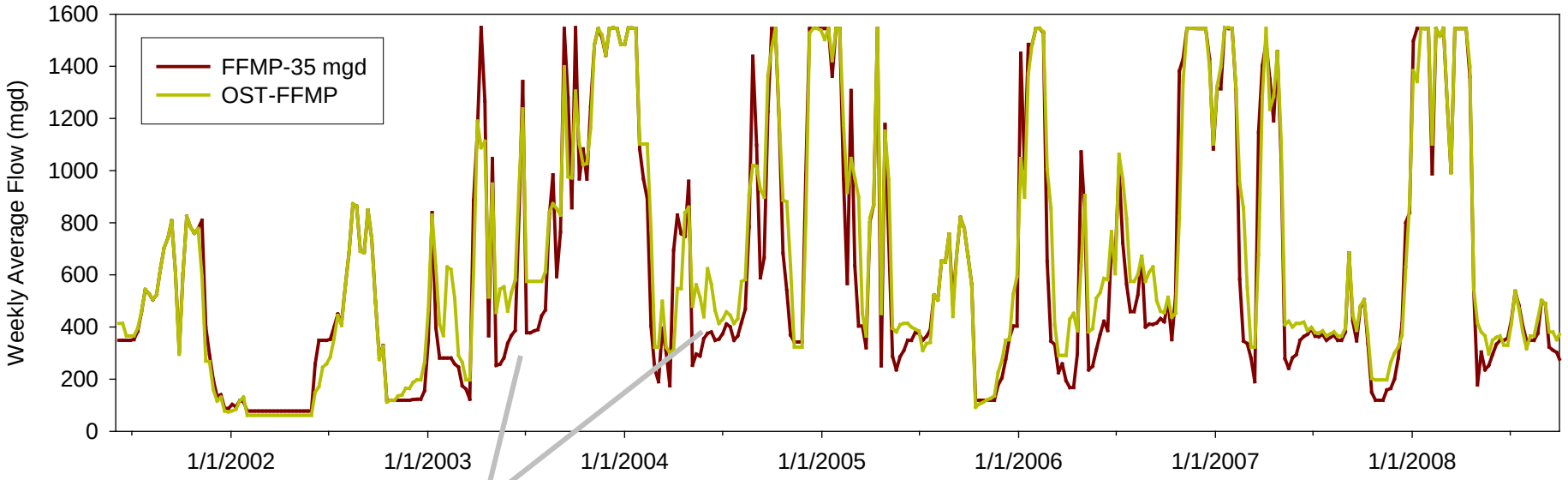
Weekly Average PCN Storage



OST-FFMP Table Selection

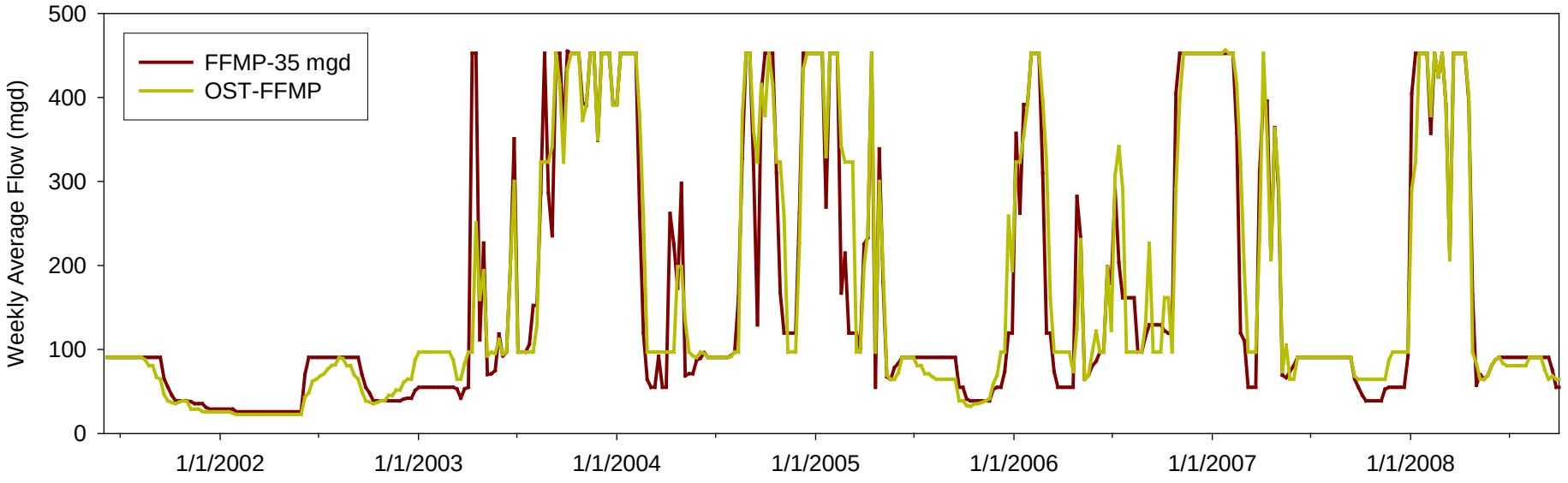


Weekly Average PCN Release

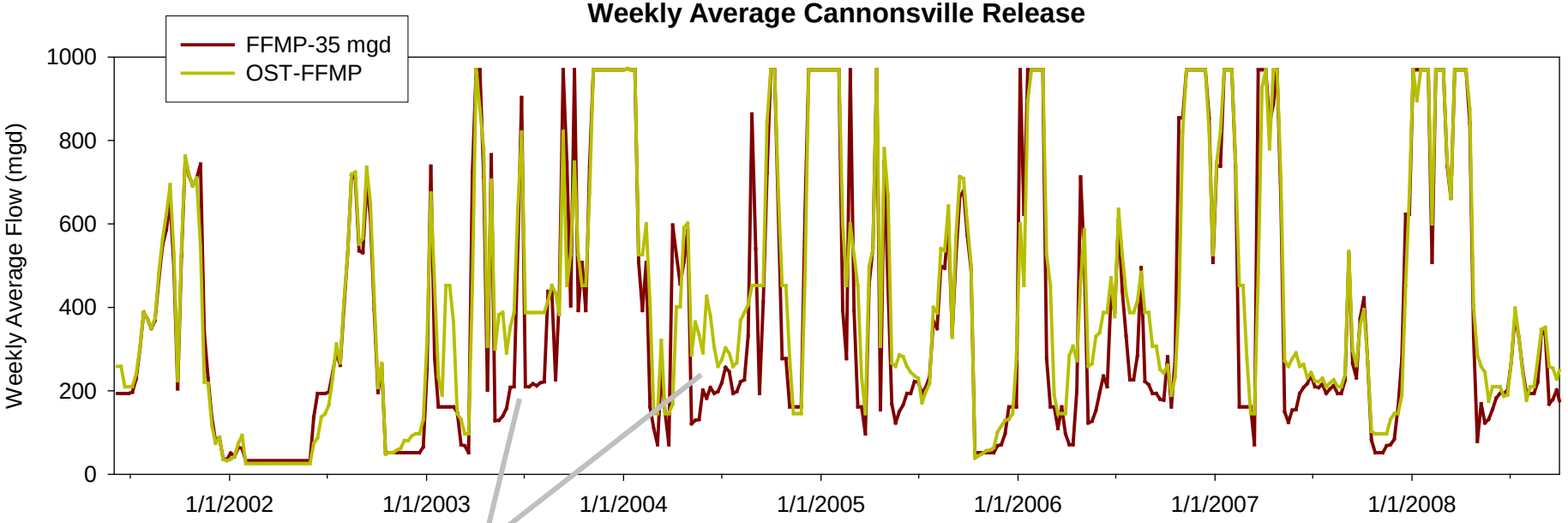


Higher spring/summer releases, lower peak releases

Weekly Average Pepacton Release

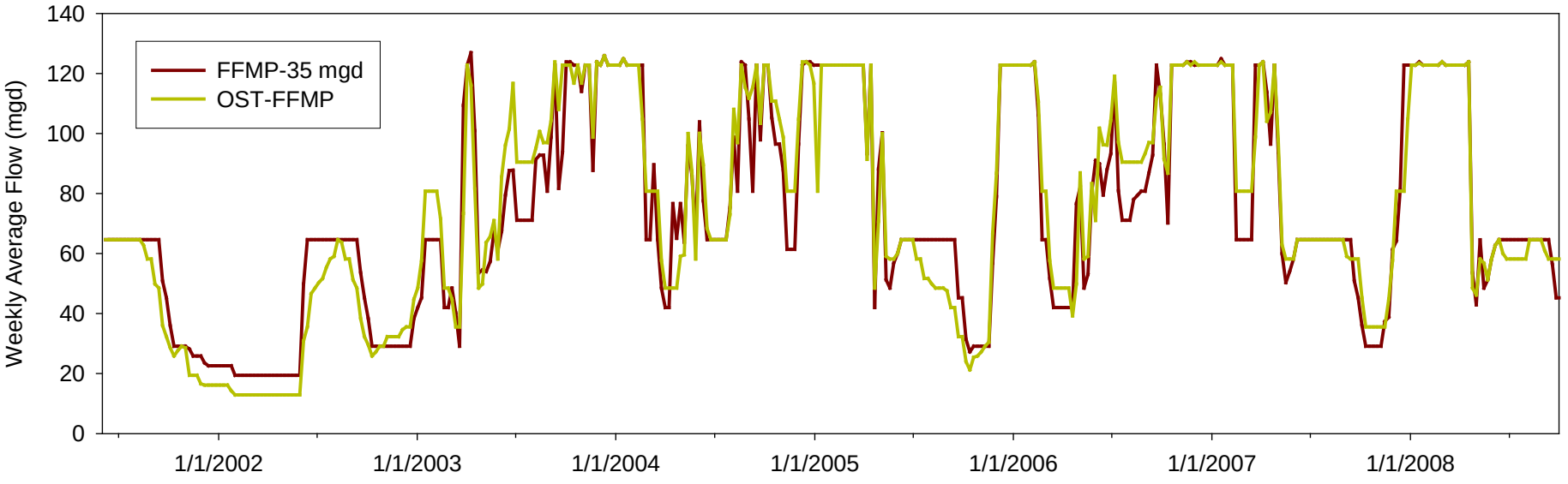


Weekly Average Cannonsville Release

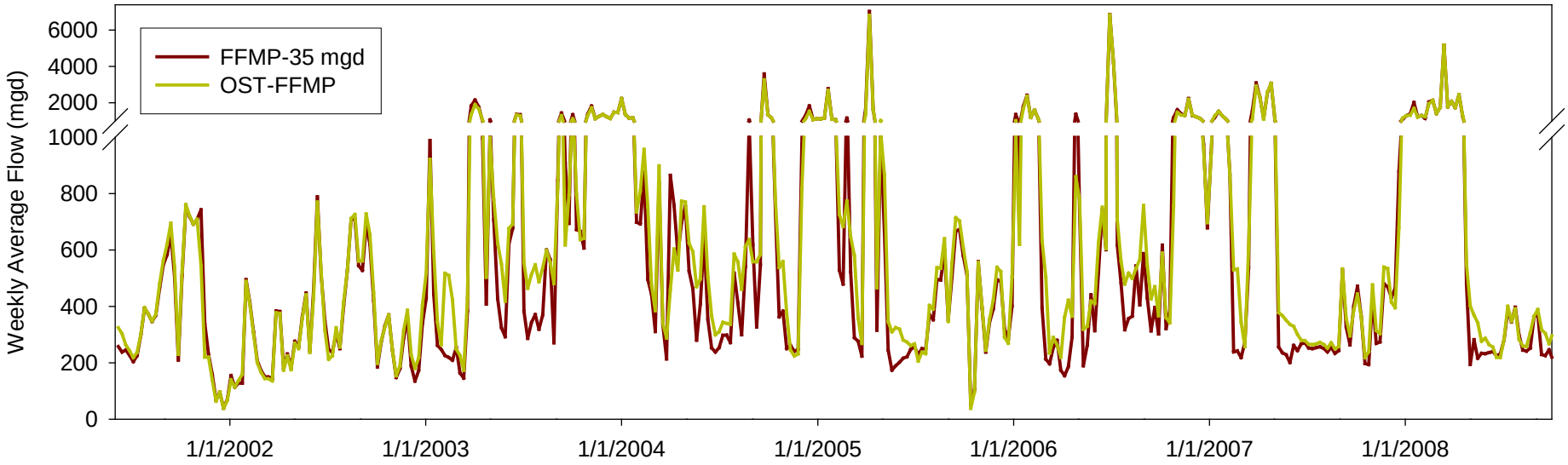


Higher spring/summer releases, lower peak releases

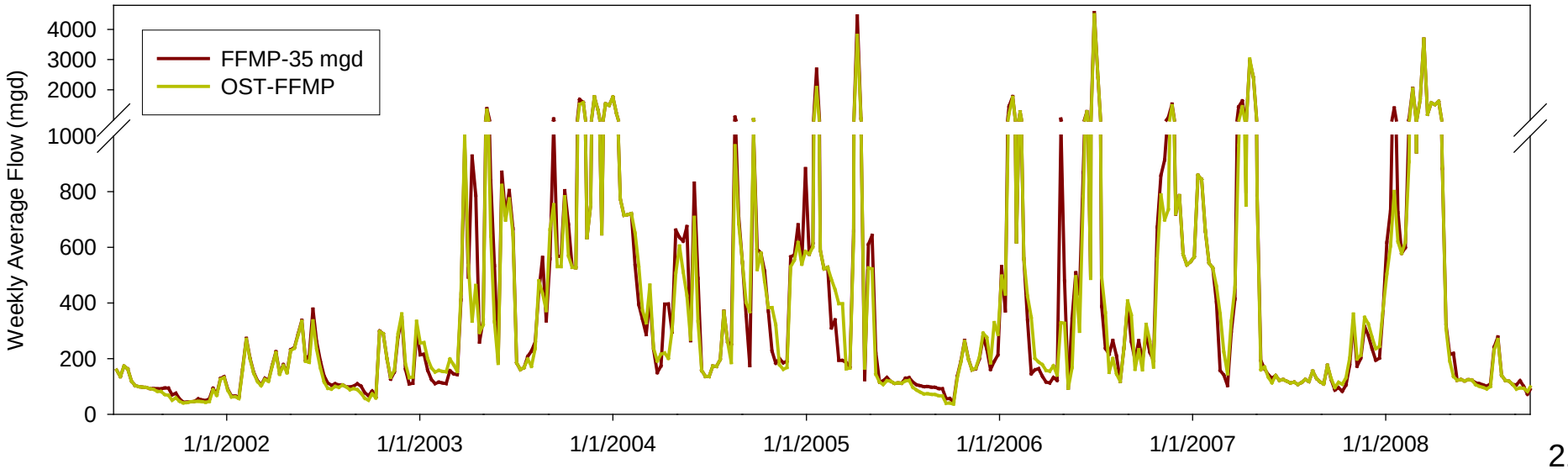
Weekly Average Neversink Release



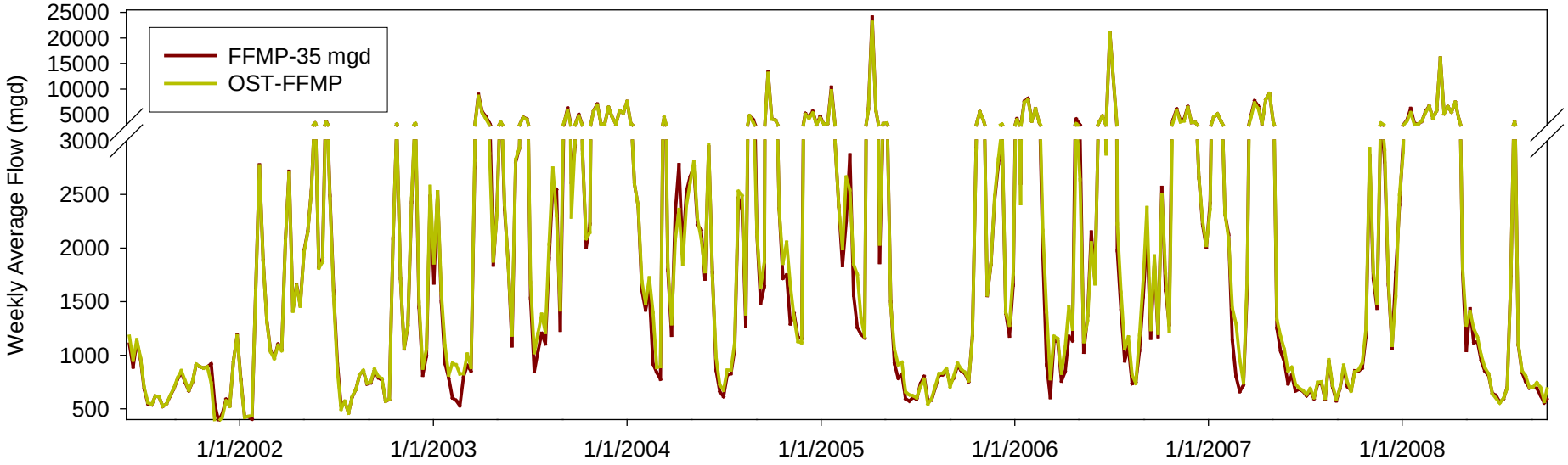
Weekly Average Flow at Hale Eddy



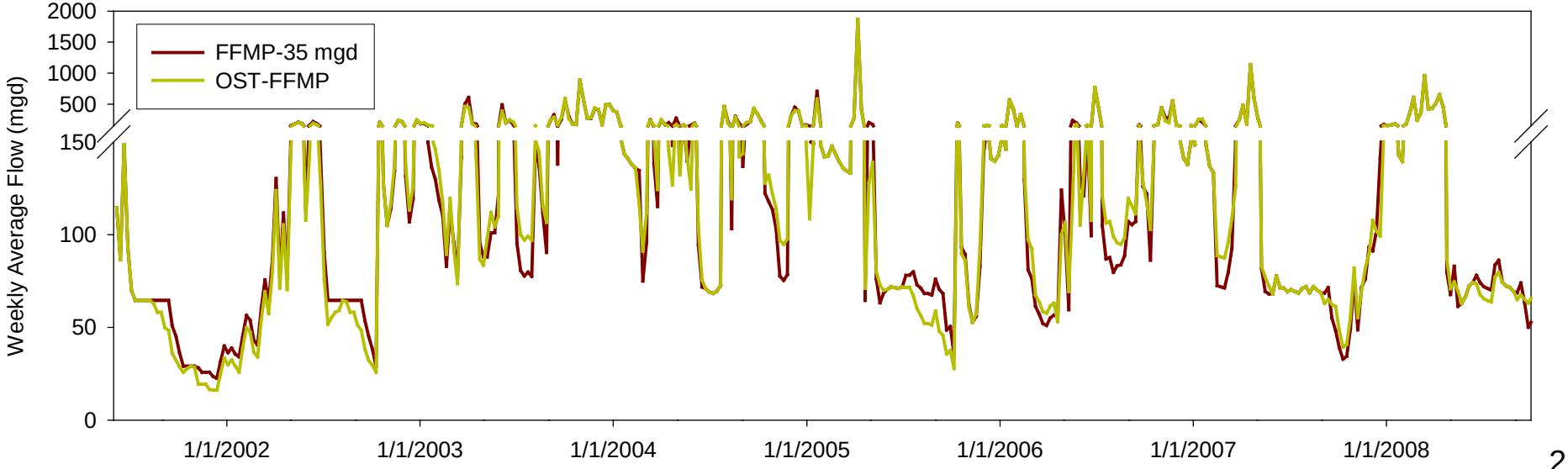
Weekly Average Flow at Harvard



Weekly Average Flow at Callicoon



Weekly Average Flow at Woodbourne/Bridgeville



Summary

- Proposed OST-FFMP Release program offers advances over FFMP and previous programs
- Releases water not needed for NYC supply
  - Convert spills to managed water
- Expanded releases in spring-summer-fall
  - Weekly avg. PCN releases under OST match or exceed FFMP over 75% of the time (May – Oct)
- Adaptive table/release levels reflect forecasted inflows and diversions
- Will be updated to include enhanced reservoir flood mitigation

Discussion