

# Tuckasegee River Project



CHEOPS™

*Operations and Planning Model*

**Developed By:**



**FRAMATOME ANP**

FRAMATOME ANP DE&S

**Developed For:**



*A Duke Energy Company*

# Meeting Agenda



- Introduction
- CHEOPS Model – Wet/Norm/Dry Years
- Tuckasegee River Project CHEOPS Model
  - Scenarios & Output
    - Base Case
    - Scenario 2 - Duke Power Trial Balloon
    - Scenario 3 - Glenville Homeowners Rule Curve
    - Scenario 4 - NCWRC Rule Curves
    - Scenario 5 - Angling and Boating Rec. Flows
    - Scenario 6 - USFWS Minimum Bypass Flows
    - Scenario 7 - Combo: Angling/Boating Rec. Flows & Min Bypass Flows
- Questions & Answers



# CHEOPS Model

## Wet / Normal / Dry Years



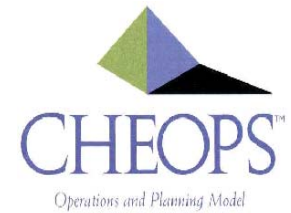
- Estimate (based on complete hydrology data ranked by year for each location)

**Wet = 1973**

**Normal = 1971**

**Dry = 1968**

# CHEOPS Model Scenarios



- Scenario 1 - Base Case Minimum Flows (Cedar Cliff 10cfs & Tuckasegee 20cfs)
- Scenario 2 - Duke Power Trial Balloon (3/21/02)
- Scenario 3 - Lake Glenville Homeowners Assoc. Lake Levels
- Scenario 4 - NCWRC Lake Level Modifications
- Scenario 5 - Angling & Boating Recreational Flows
- Scenario 5A - Angling & Boating Rec. Flows (2x West Fork)
- Scenario 6 - USFWS Minimum Bypass Flow Modifications
- Scenario 7 - Combo: Angling/Boating Rec. Flows  
& USFWS Minimum Bypass Flow Modifications

# Scenario 5A



## Angling & Boating Recreational Flow Components

- **Recreational Flows**
  - Daily 5-hr Average Check for 500cfs Flows
  - Angling Periods (Apr - mid Jun & Labor Day - Oct)  
East & West Fork 5-hr Releases
  - Boating Periods (mid Jun - Labor Day) East & West  
Fork 5-hr Releases
  - Bonas Defeat Gorge (3<sup>rd</sup> Wknd March @ 325cfs  
10am-4pm)\*
  - DOUBLED Lake Glenville (Thorpe PH) Bypass  
(various releases Feb - Nov)\*

\* Powerhouse Hourly Flow Requirements - Averaged Daily for 24-hr Period.

# CHEOPS Model



## Scenario Output



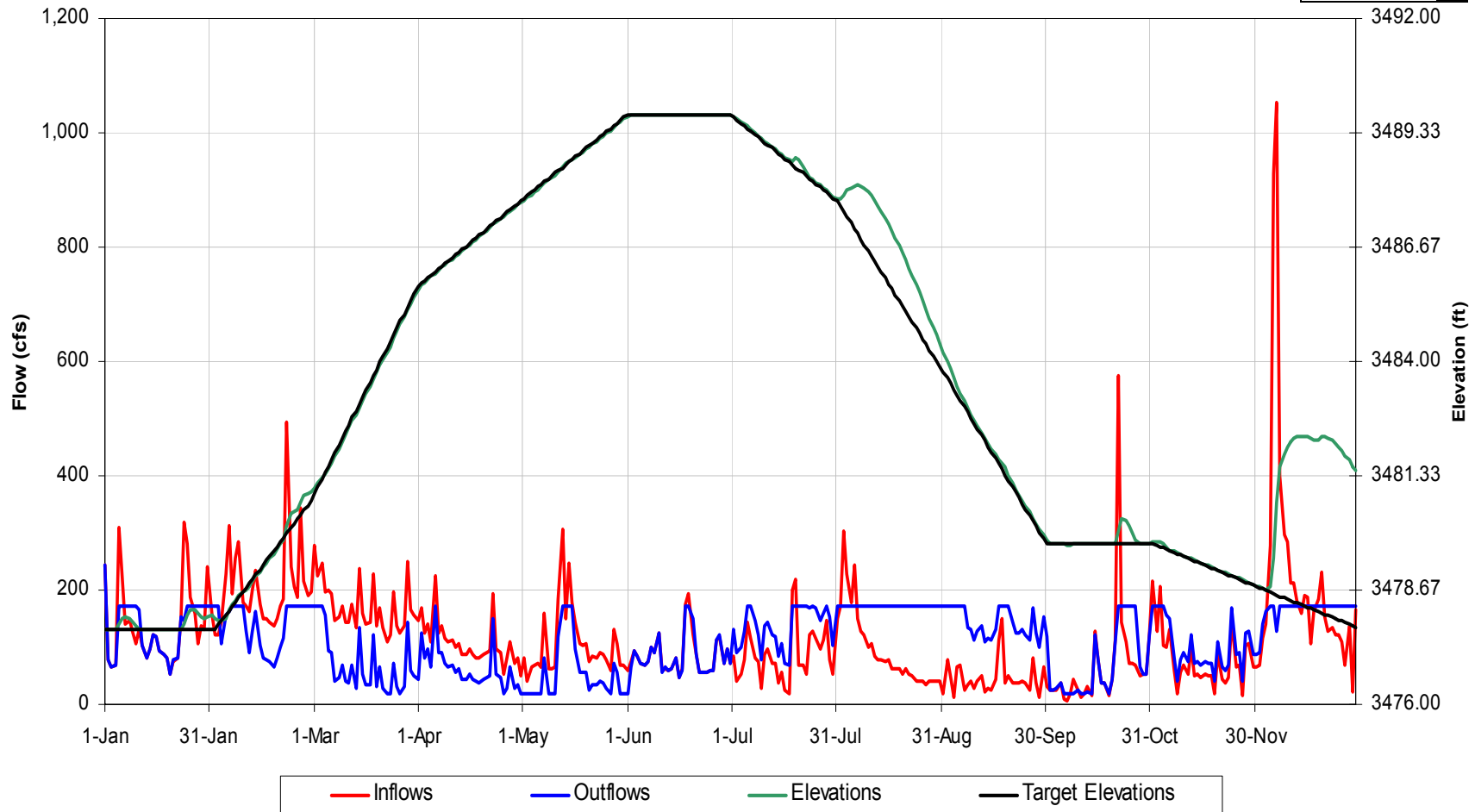
# Lake Glenville - Base Case

(Normal 1971)



Thorpe Reservoir Operational Details  
for 1971 Hydrology, Scenario 'Base Case'

Change Year

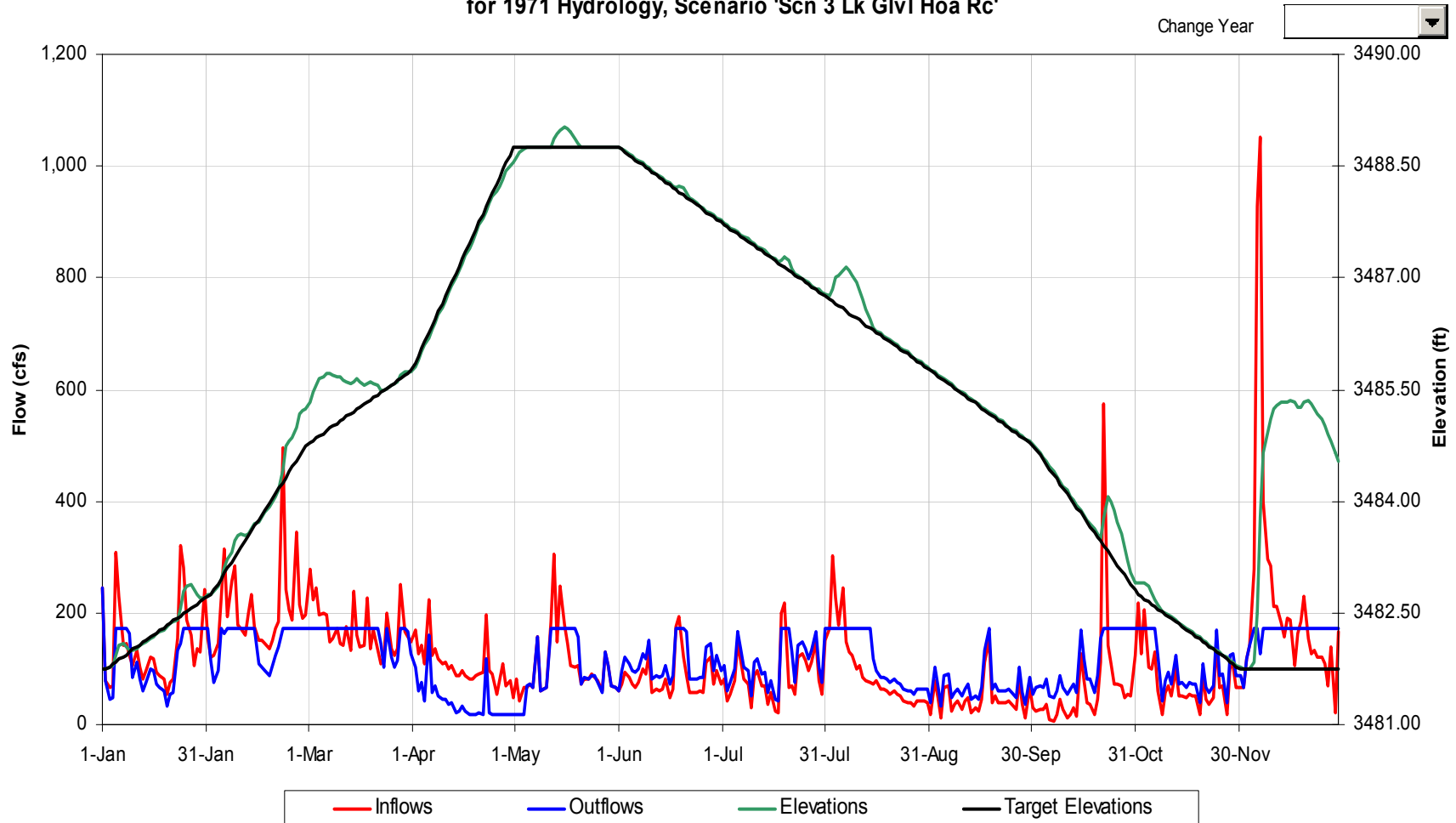


# Lake Glenville - Scenario 3

## (Normal 1971)



Thorpe Reservoir Operational Details  
for 1971 Hydrology, Scenario 'Scn 3 Lk Glvl Hoa Rc'

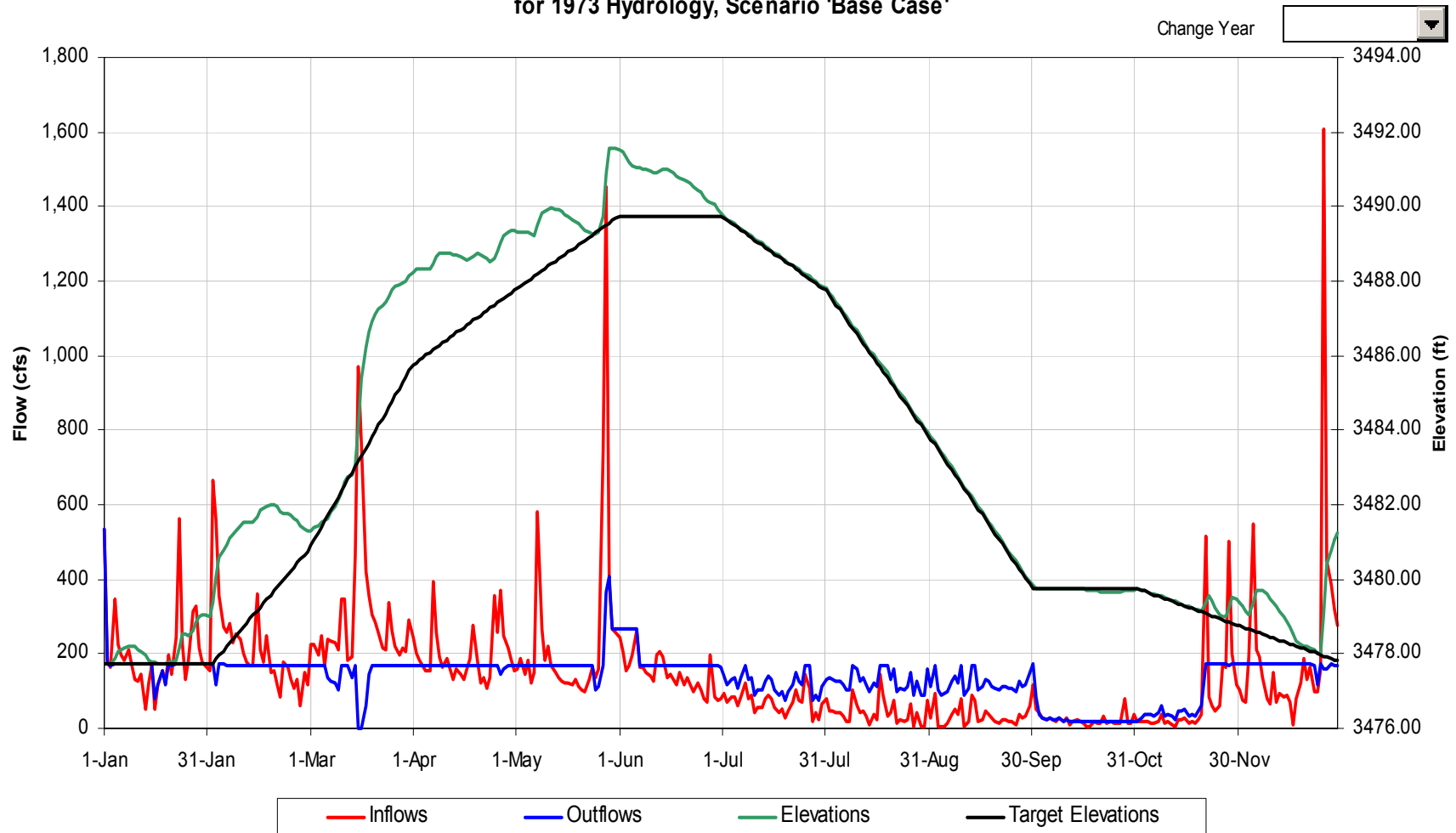


# Lake Glenville - Base Case

(Wet 1973)



Thorpe Reservoir Operational Details  
for 1973 Hydrology, Scenario 'Base Case'



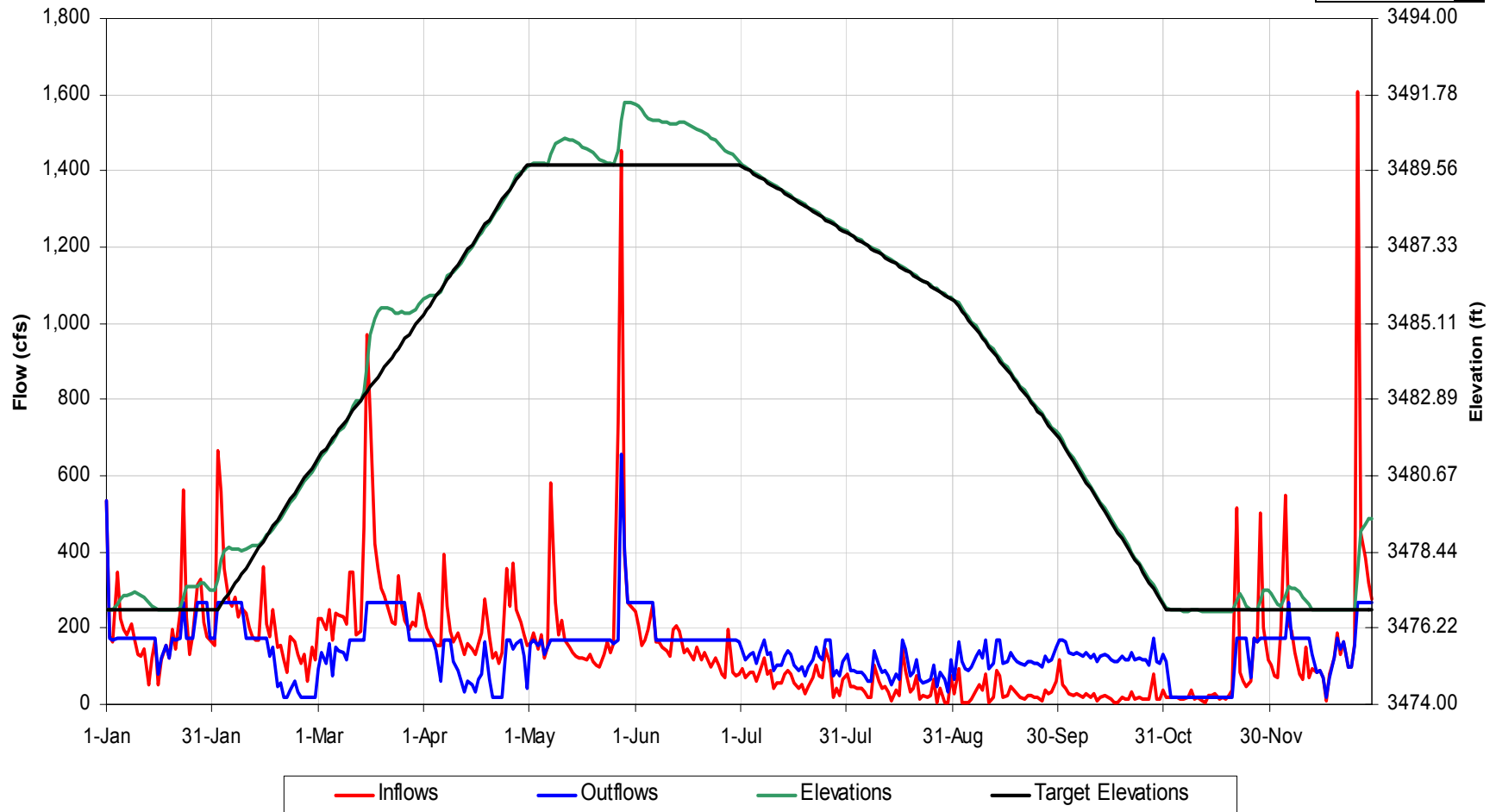
# Lake Glenville - Scenario 2

## (Wet 1973)



Thorpe Reservoir Operational Details  
for 1973 Hydrology, Scenario 'Scn 2 Duke Tb'

Change Year



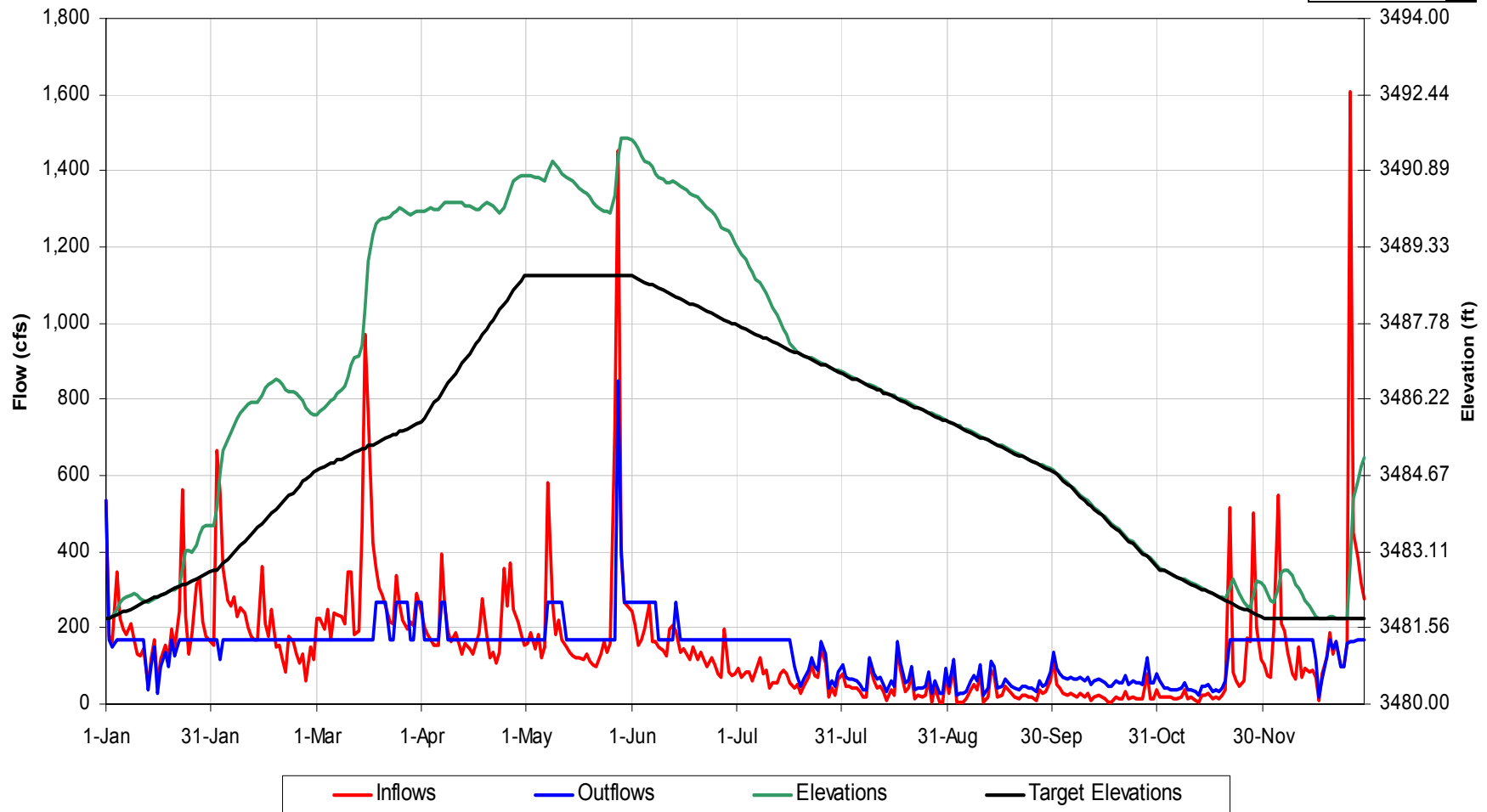
# Lake Glenville - Scenario 3

## (Wet 1973)



Thorpe Reservoir Operational Details  
for 1973 Hydrology, Scenario 'Scn 3 Lk Glvl Hoa Rc'

Change Year



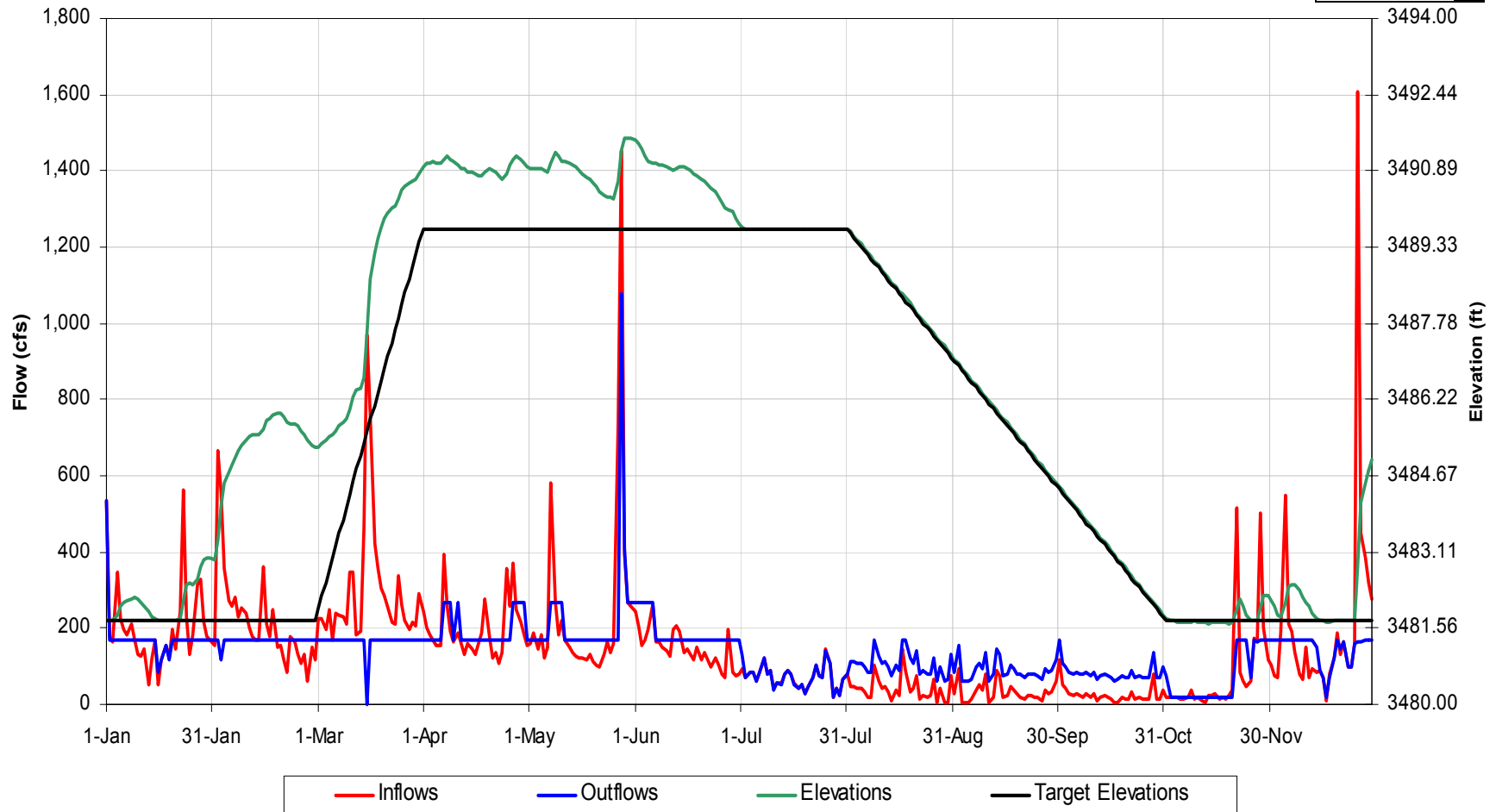
# Lake Glenville - Scenario 4

## (Wet 1973)



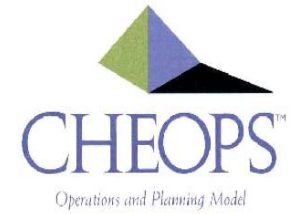
Thorpe Reservoir Operational Details  
for 1973 Hydrology, Scenario 'Scn 4 NcwrC Rc'

Change Year



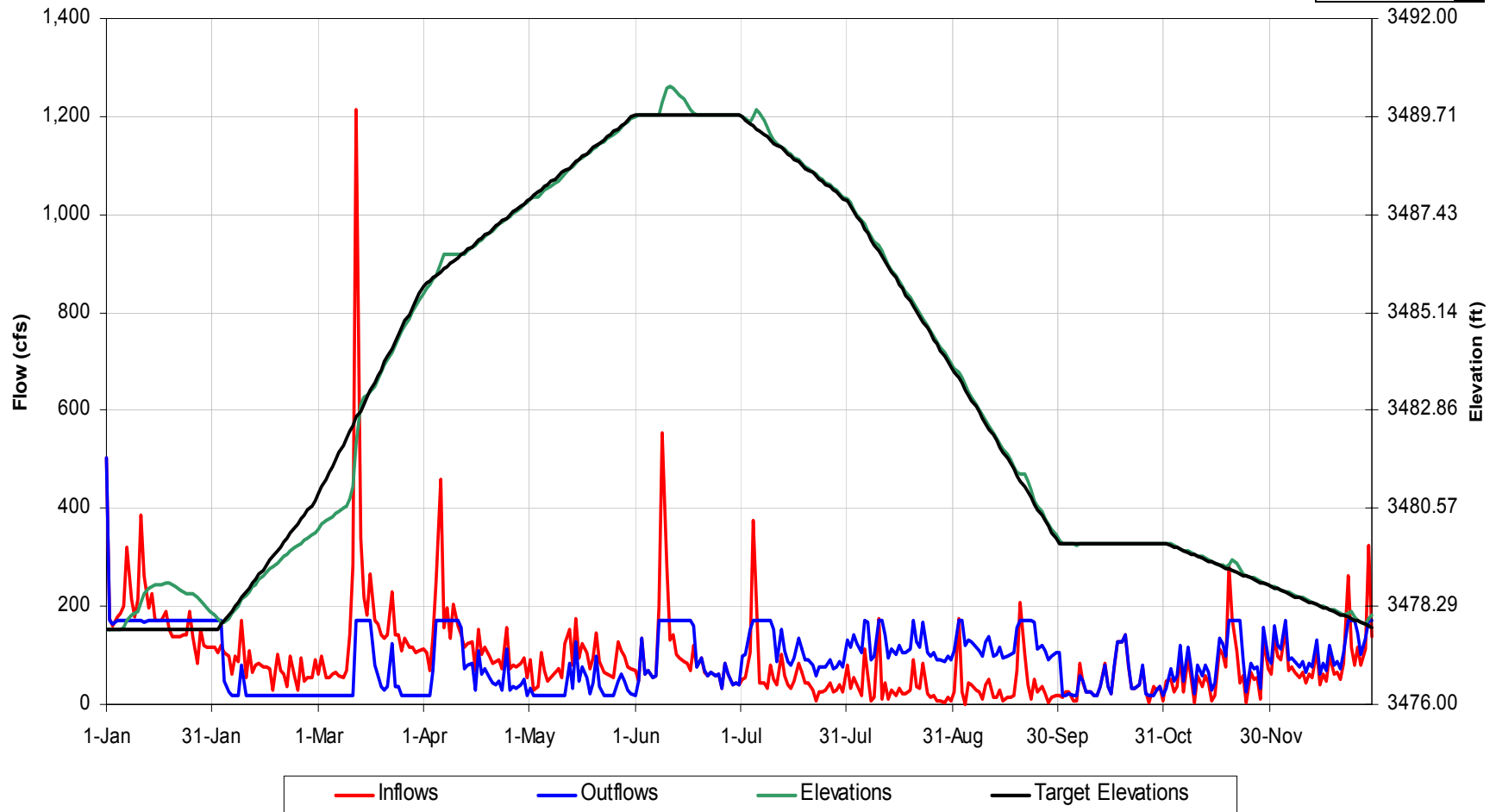
# Lake Glenville - Base Case

(Dry 1968)



Thorpe Reservoir Operational Details  
for 1968 Hydrology, Scenario 'Base Case'

Change Year



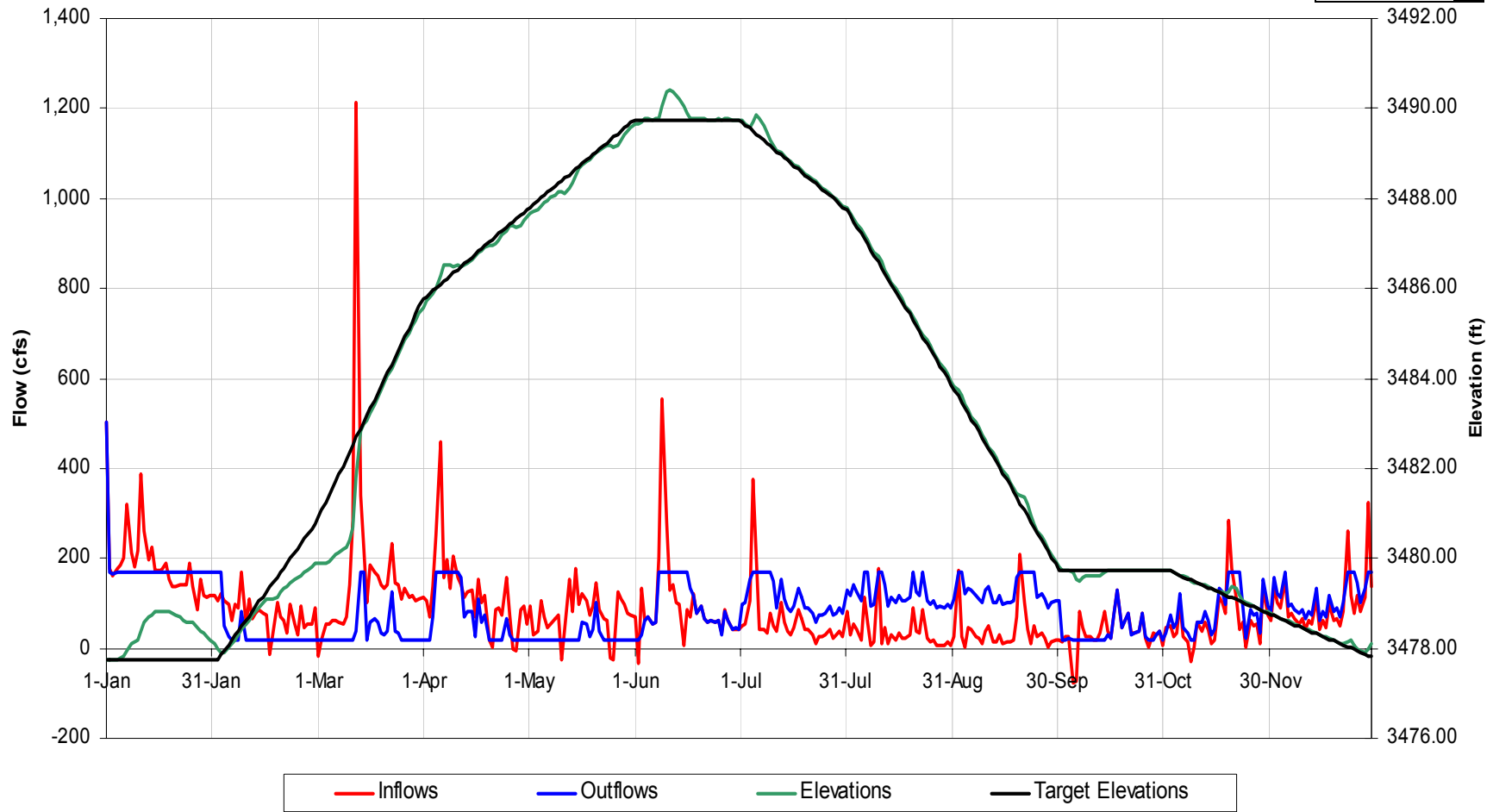
# Lake Glenville - Scenario 5

## (Dry 1968)



Thorpe Reservoir Operational Details  
for 1968 Hydrology, Scenario 'Scn 5 Rec Flows\_'

Change Year



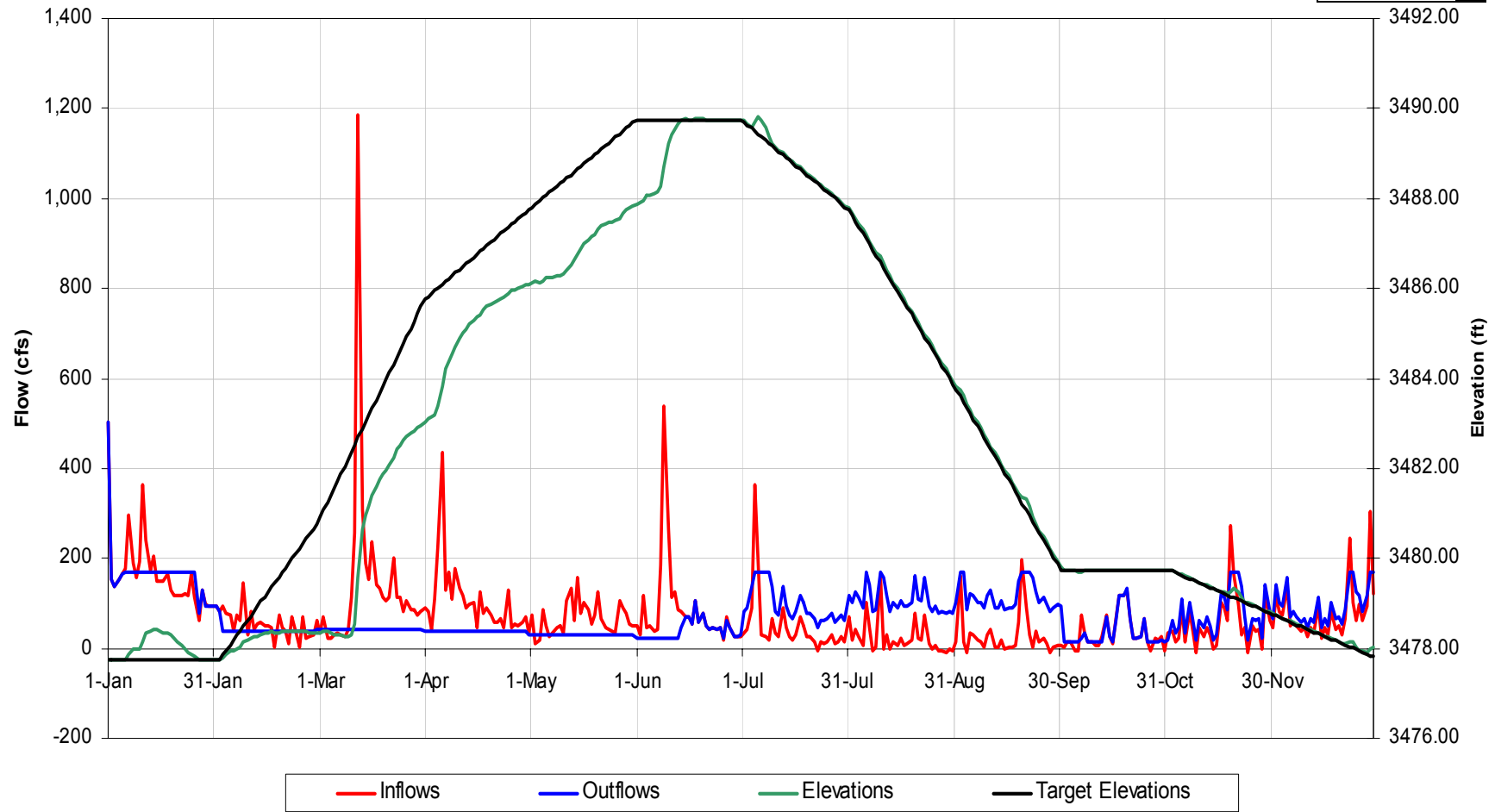
# Lake Glenville - Scenario 6

## (Dry 1968)



Thorpe Reservoir Operational Details  
for 1968 Hydrology, Scenario 'Scn 6 Bpf'

Change Year



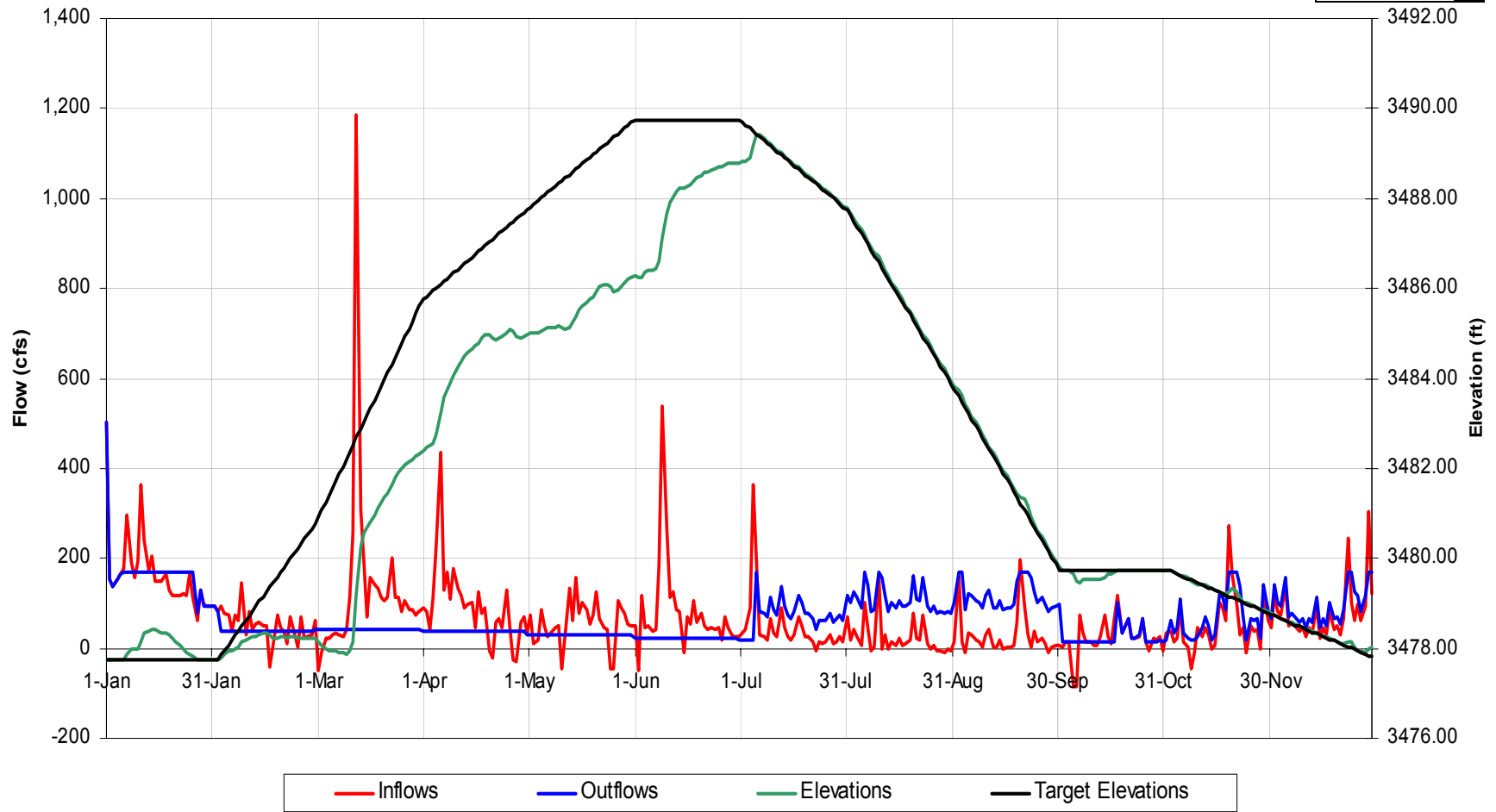
# Lake Glenville - Scenario 7

## (Dry 1968)



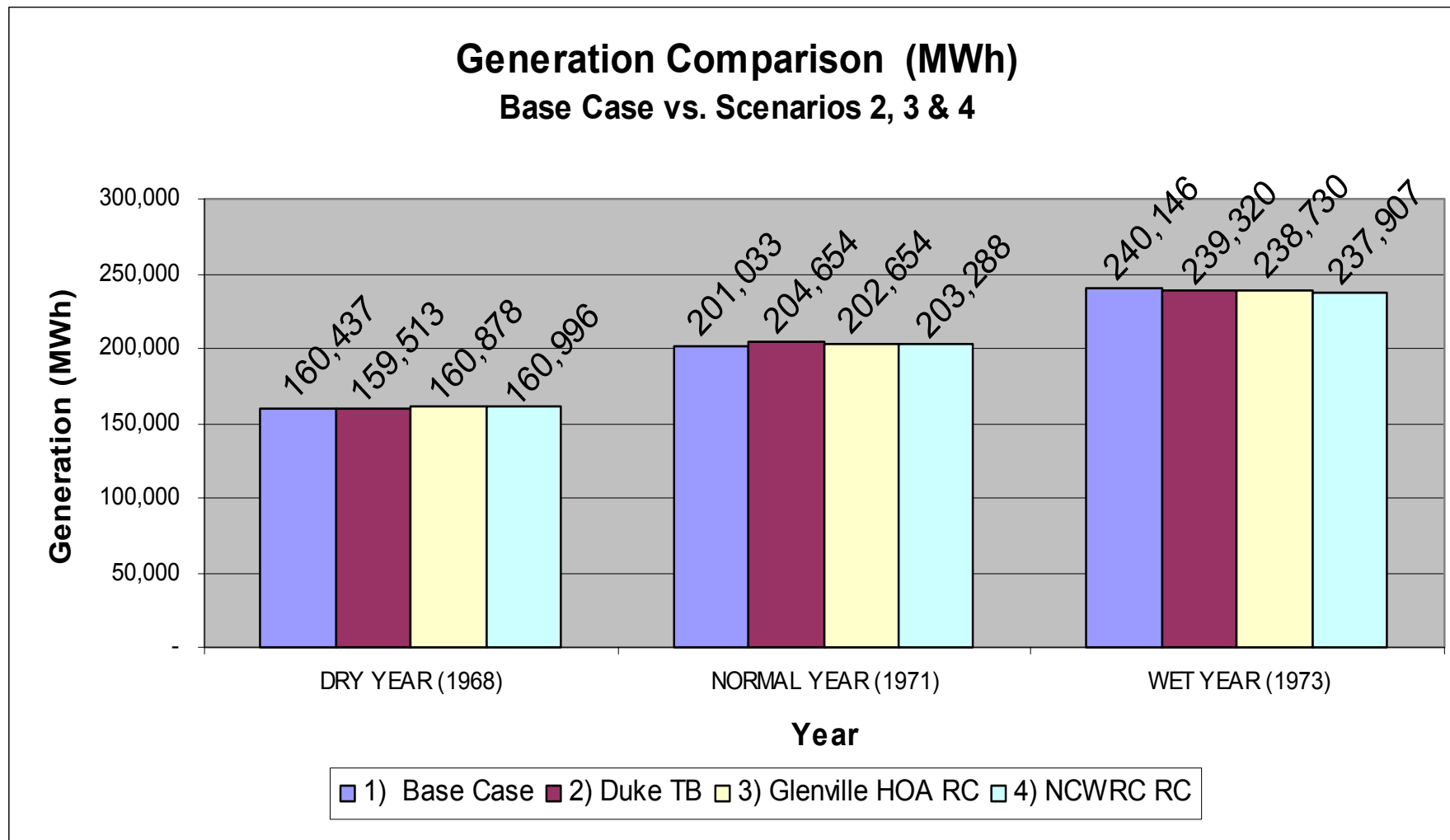
Thorpe Reservoir Operational Details  
for 1968 Hydrology, Scenario 'Scn7 Bpf\_'

Change Year



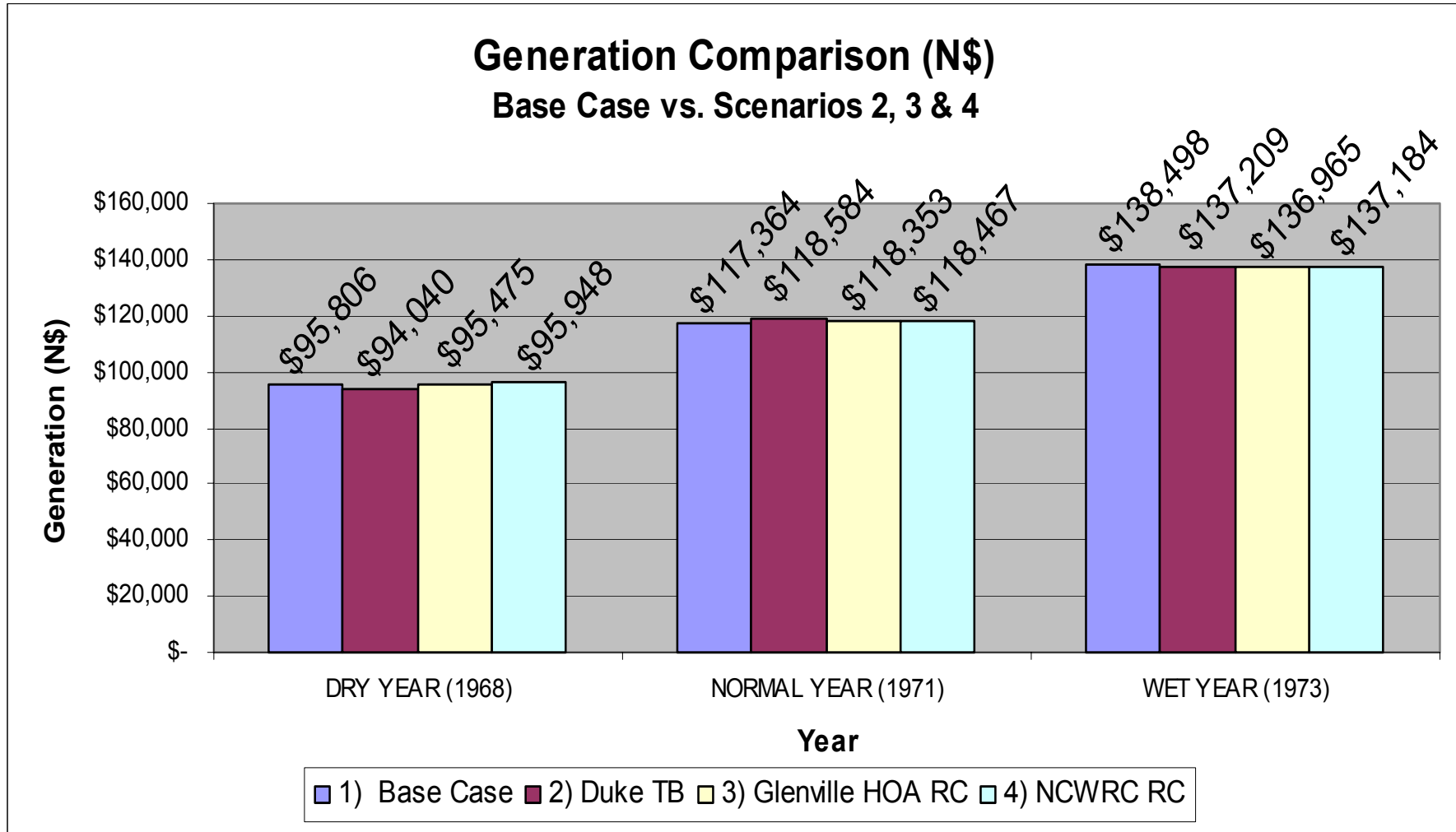
# Generation (MWh)

## Base Case vs. Scenarios 2, 3 & 4



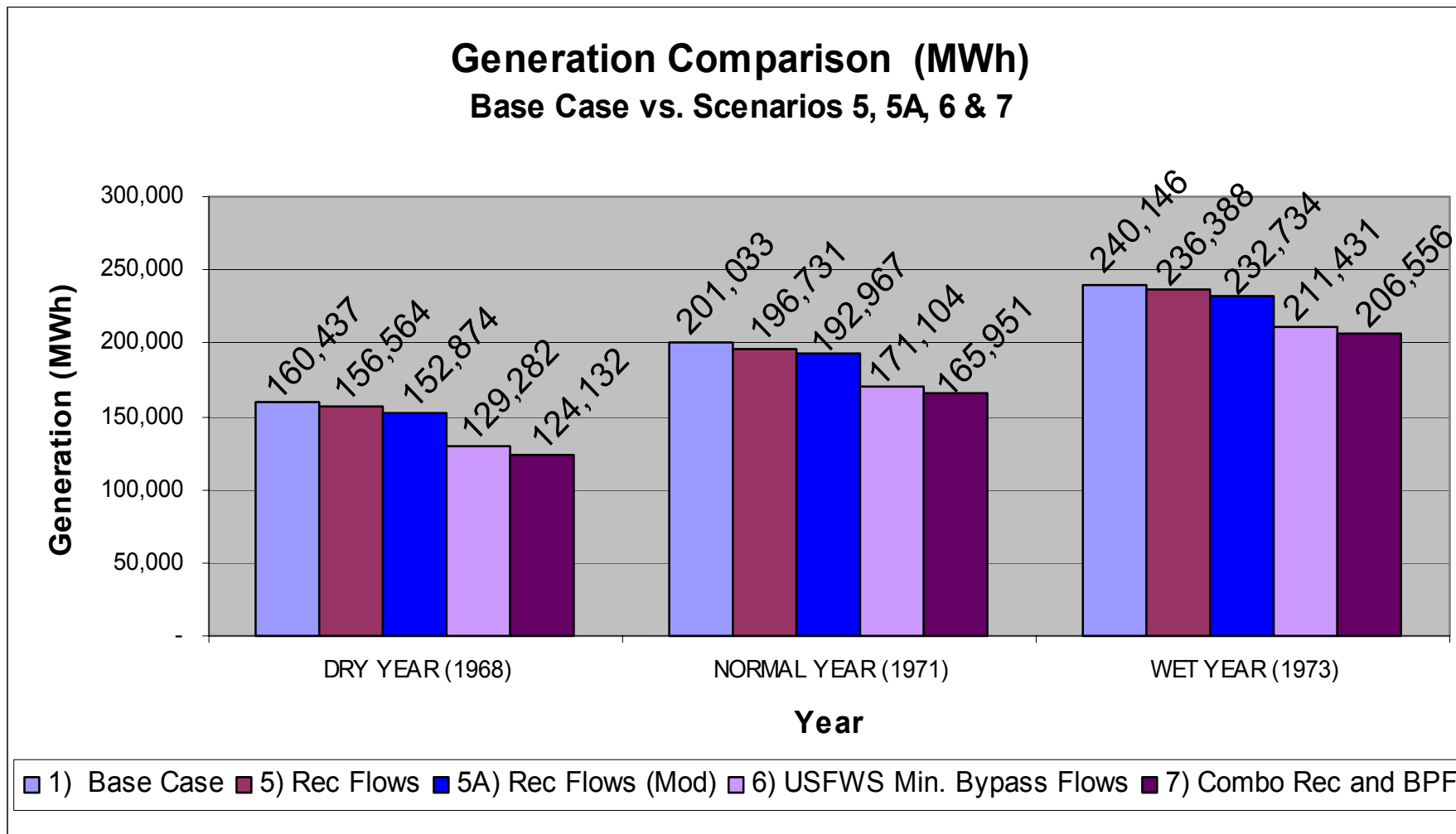
# Generation (N\$)

## Base Case vs. Scenarios 2, 3 & 4



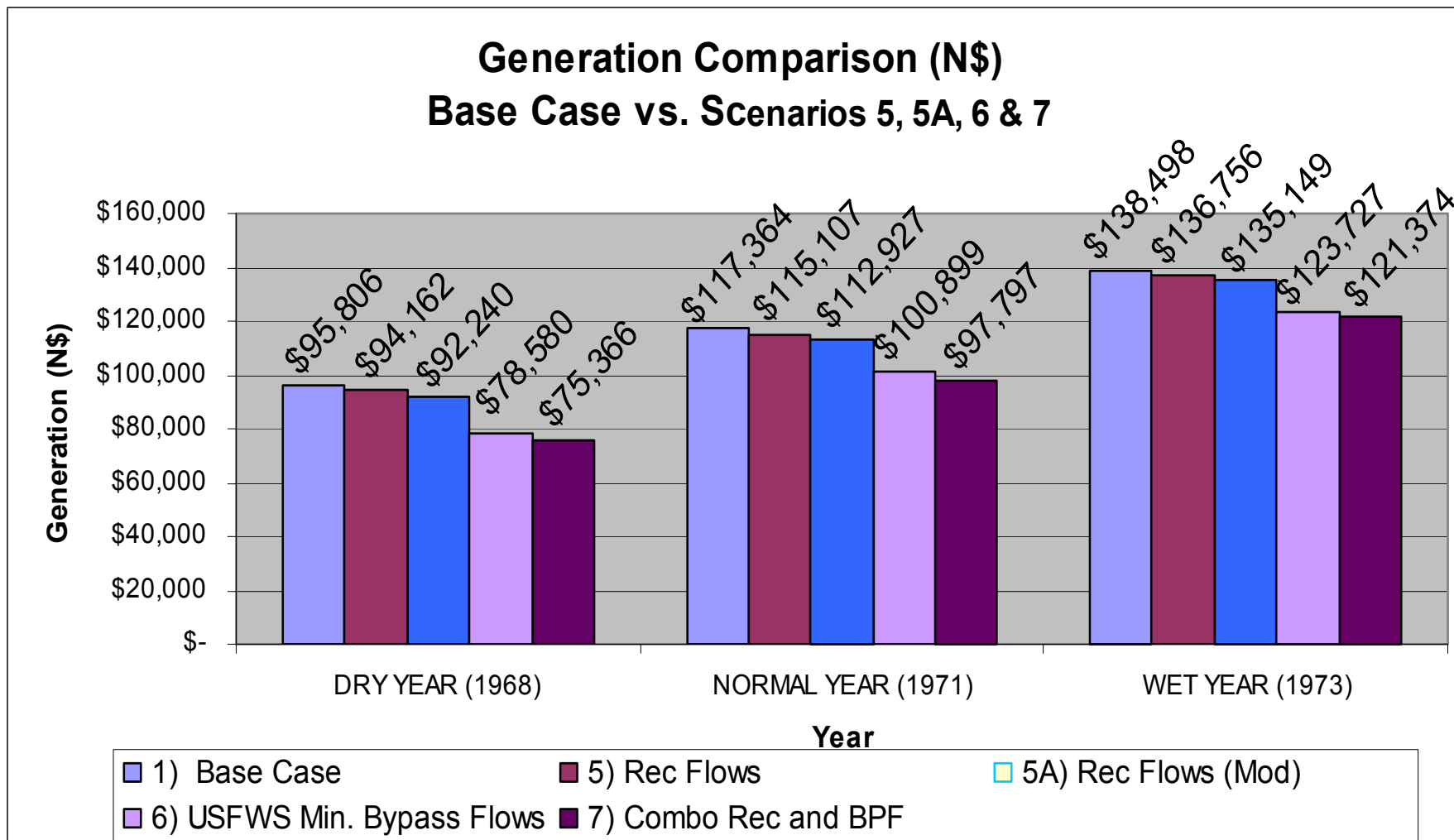
# Generation (MWh)

## Base Case vs. Scenarios 5, 5A, 6 & 7



# Generation (N\$)

## Base Case vs. Scenarios 5, 5A, 6 & 7



# Generation Comparison (MWh)

## Base Case vs. Scenarios 2, 3 & 4



SCENARIO	DRY (1968)	NORM (1971)	WET (1973)
1) Base Case	160,437	201,033	240,146
2) Duke TB	159,513	204,654	239,320
3) Glenville HOA RC	160,878	202,654	238,730
4) RC Changes	160,996	203,288	237,907

SCENARIO COMPARISON (N\$)	DRY (1968)	NORM (1971)	WET (1973)
Base Case	-	-	-
BC vs Scn 2 Duke TB	-0.6%	1.8%	-0.3%
BC vs Scn 3 Lk Glnvl HOA RC	0.3%	0.8%	-0.6%
BC vs Snc 4 NCWRC RC	0.3%	1.1%	-0.9%

# Generation Comparison (N\$)

## Base Case vs. Scenarios 2, 3 & 4



SCENARIO	DRY (1968)	NORM (1971)	WET (1973)
1) Base Case	\$ 95,806	\$ 117,364	\$ 138,498
2) Duke TB	\$ 94,040	\$ 118,584	\$ 137,209
3) Glenville HOA RC	\$ 95,475	\$ 118,353	\$ 136,965
4) NCWRC RC	\$ 95,948	\$ 118,467	\$ 137,184

SCENARIO COMPARISON (N\$)	DRY (1968)	NORM (1971)	WET (1973)
Base Case	-	-	-
BC vs Scn 2 Duke TB	-1.8%	1.0%	-0.9%
BC vs Scn 3 Lk Glnvl HOA RC	-0.3%	0.8%	-1.1%
BC vs Snc 4 NCWRC RC	0.1%	0.9%	-0.9%

# Generation Comparison (MWh)

Base Case vs. Scenarios 5, 5A, 6 & 7



SCENARIO	DRY (1968)	NORM (1971)	WET (1973)
1) Base Case	160,437	201,033	240,146
5) Rec Flows	156,564	196,731	236,388
5A) Rec Flows (Mod)	152,874	192,967	232,734
6) Min. Bypass Flows	129,282	171,104	211,431
7) Combo Rec and BPF	124,132	165,951	206,556

SCENARIO COMPARISON (N\$)	DRY (1968)	NORM (1971)	WET (1973)
BC vs Scn 5 Rec Flows	-2.4%	-2.1%	-1.6%
BC vs Scn 5A Mod Rec Flows	-4.7%	-4.0%	-3.1%
BC vs Scn 6 USFWS BPF	-19.4%	-14.9%	-12.0%
BC vs Scn 7 BPF & Rec Combo	-22.6%	-17.5%	-14.0%

# Generation Comparison (N\$)

## Base Case vs. Scenarios 5, 5A, 6 & 7



SCENARIO	DRY (1968)	NORM (1971)	WET (1973)
1) Base Case	\$ 95,806	\$ 117,364	\$ 138,498
5) Boating & Angling Rec Flows	\$ 94,162	\$ 115,107	\$ 136,756
5A) Rec Flows (Mod)	\$ 92,240	\$ 112,927	\$ 135,149
6) USFWS Min. Bypass Flows	\$ 78,580	\$ 100,899	\$ 123,727
7) Combo Rec Flows & USFWS BPF	\$ 75,366	\$ 97,797	\$ 121,374

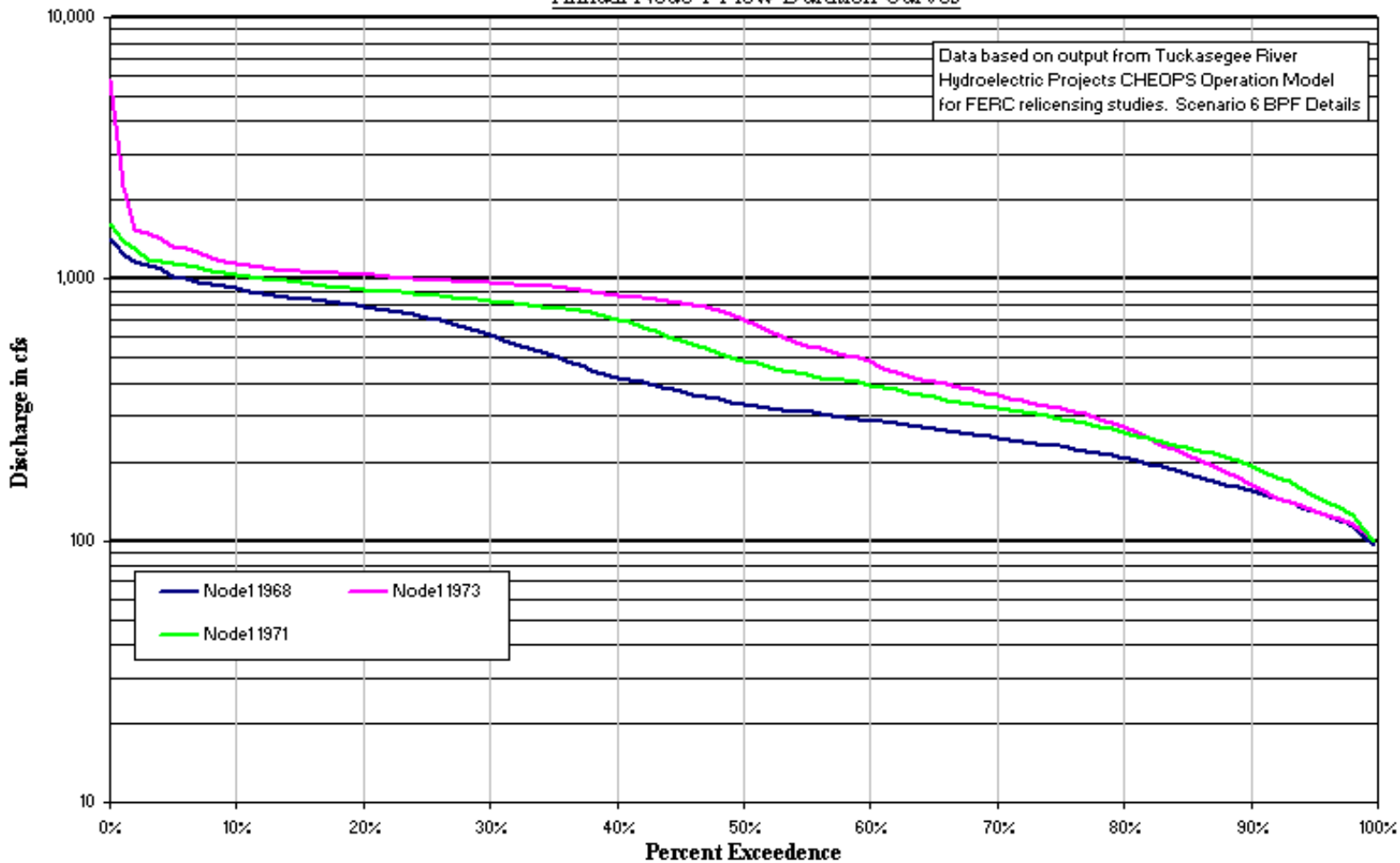
SCENARIO COMPARISON (N\$)	DRY (1968)	NORM (1971)	WET (1973)
BC vs Scn 5 Rec Flows	-1.7%	-1.9%	-1.3%
BC vs Scn 5A Mod Rec Flows	-3.7%	-3.8%	-2.4%
BC vs Scn 6 USFWS BPF	-18.0%	-14.0%	-10.7%
BC vs Scn 7 BPF & Rec Combo	-21.3%	-16.7%	-12.4%

# Scenario 6 – Node 1 Flow Duration Curves



## Tuckasegee River CHEOPS Model Output

### Annual Node 1 Flow Duration Curves

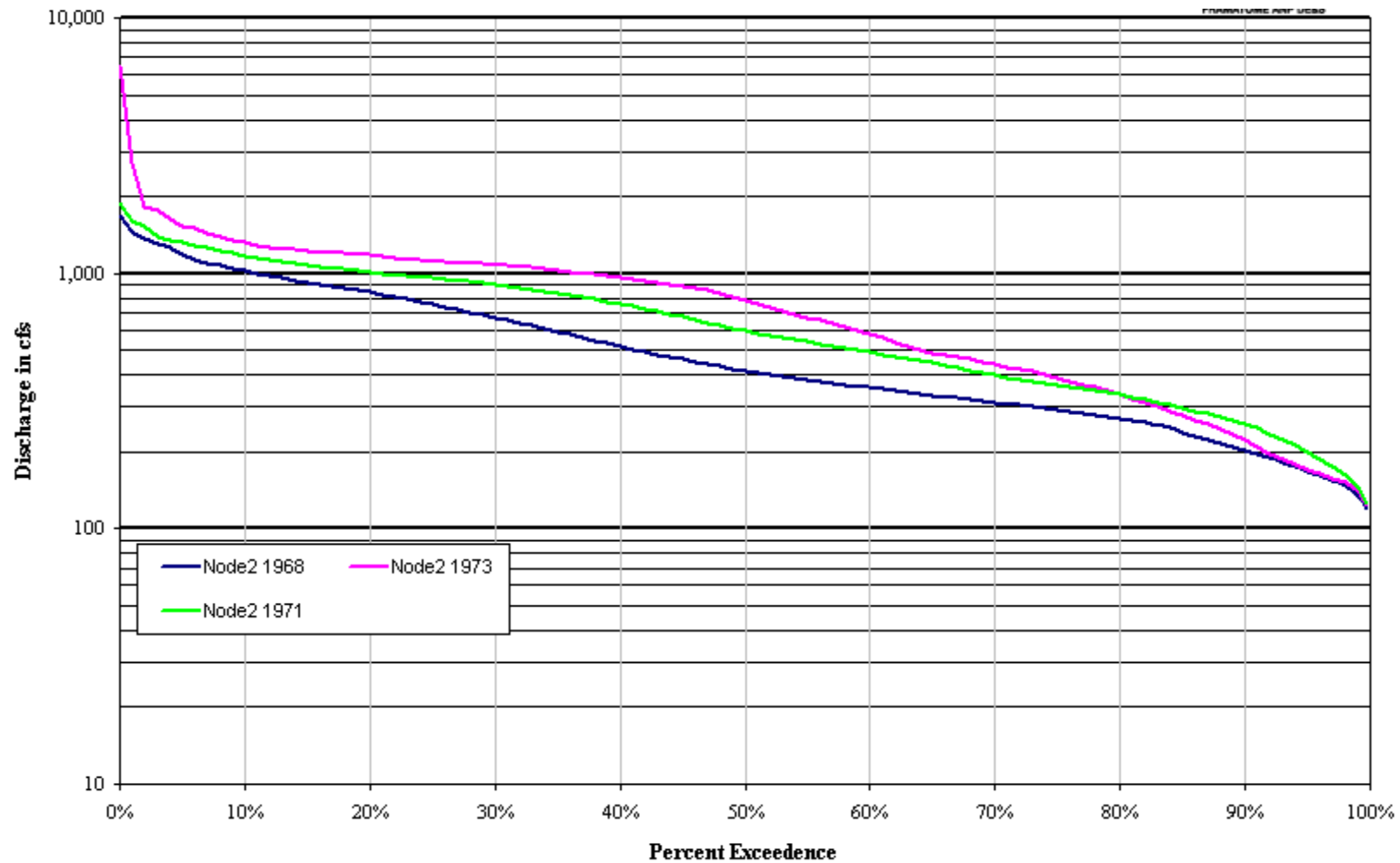


# Scenario 6 – Node 2 Flow Duration Curves



## Tuckasegee River CHEOPS Model Output

Annual Node 2 Flow Duration Curves

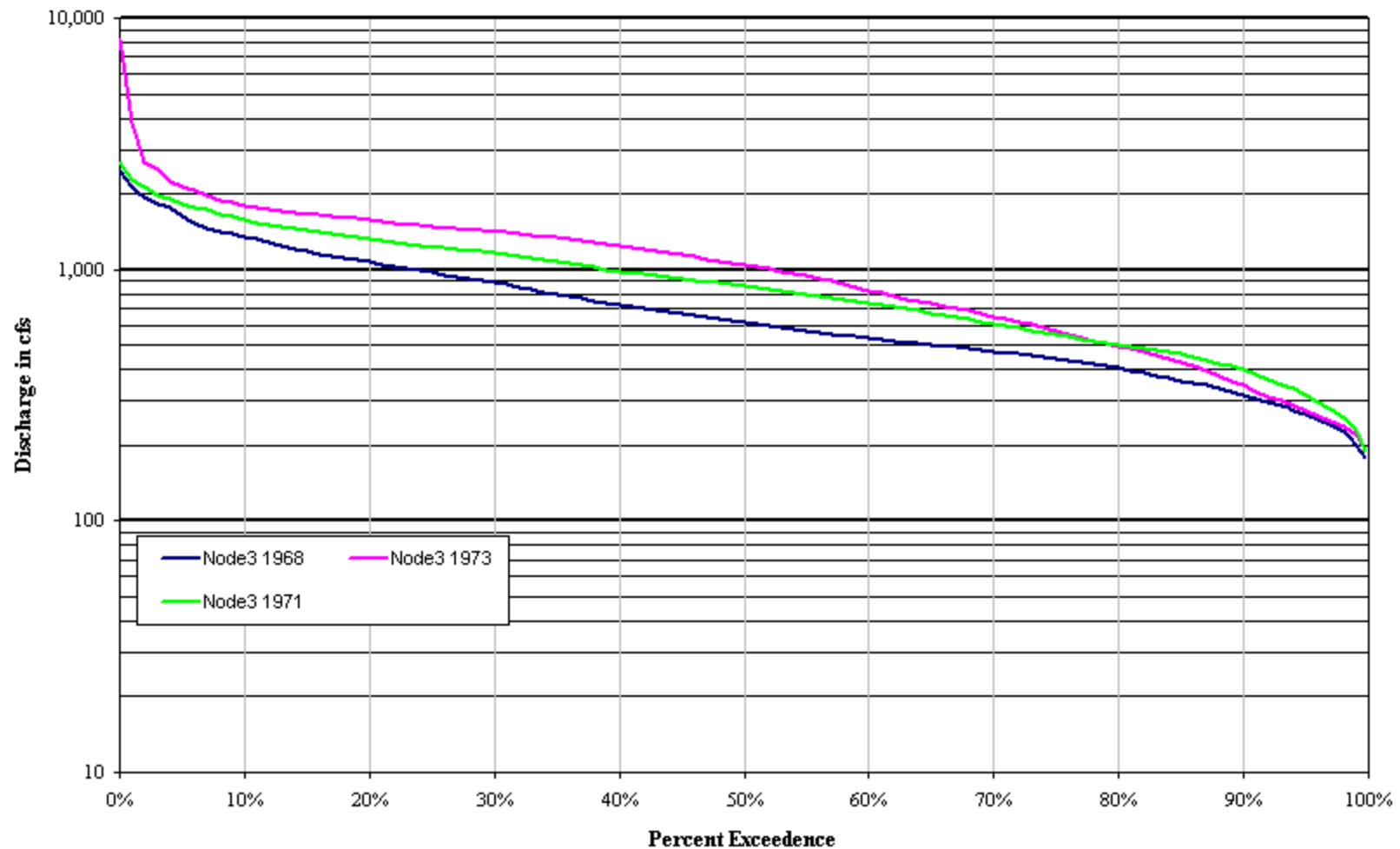


# Scenario 6 – Node 3 Flow Duration Curves



## Tuckasegee River CHEOPS Model Output

Annual Node 3 Flow Duration Curves

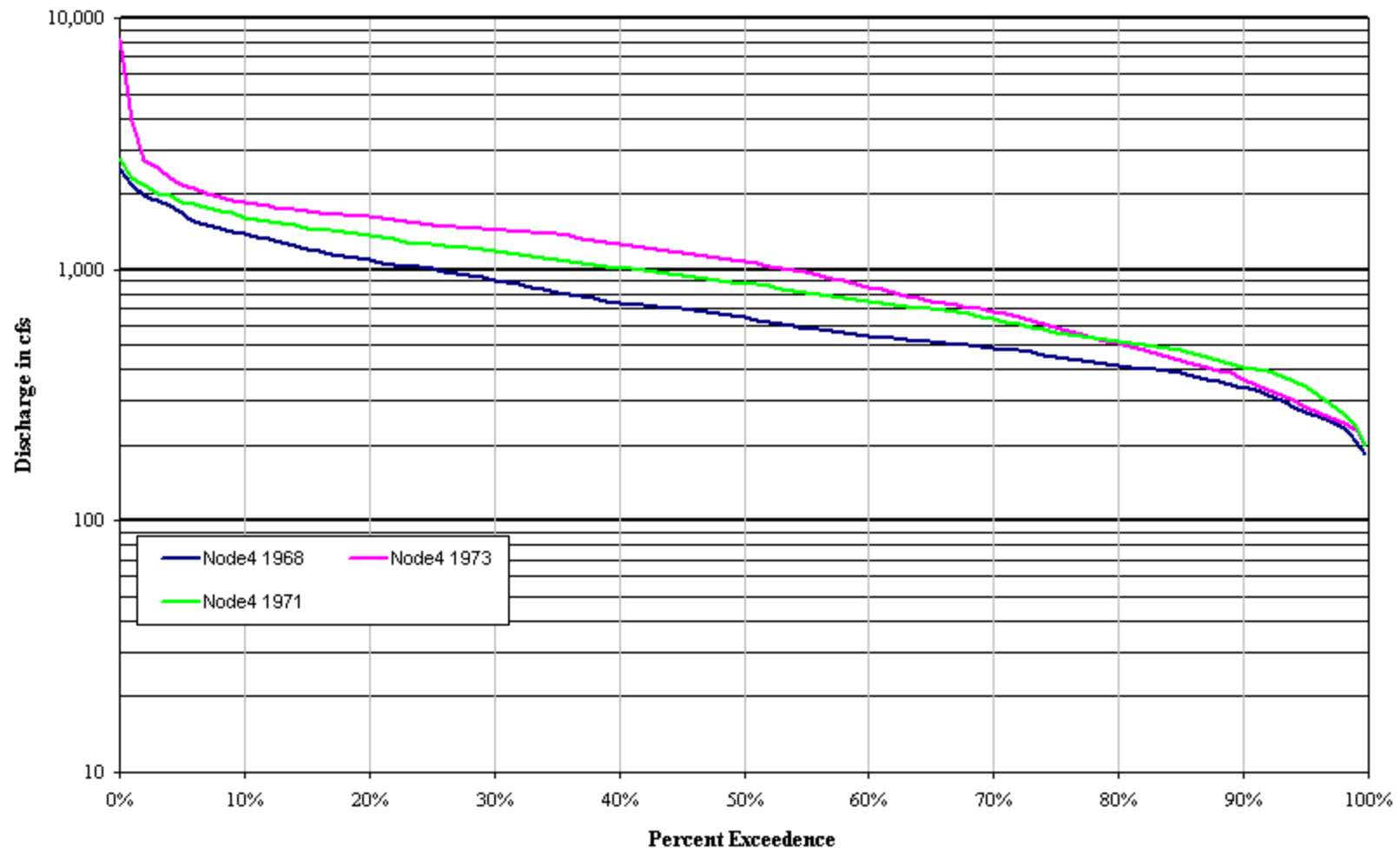


# Scenario 6 – Node 4 Flow Duration Curves



## Tuckasegee River CHEOPS Model Output

Annual Node 4 Flow Duration Curves

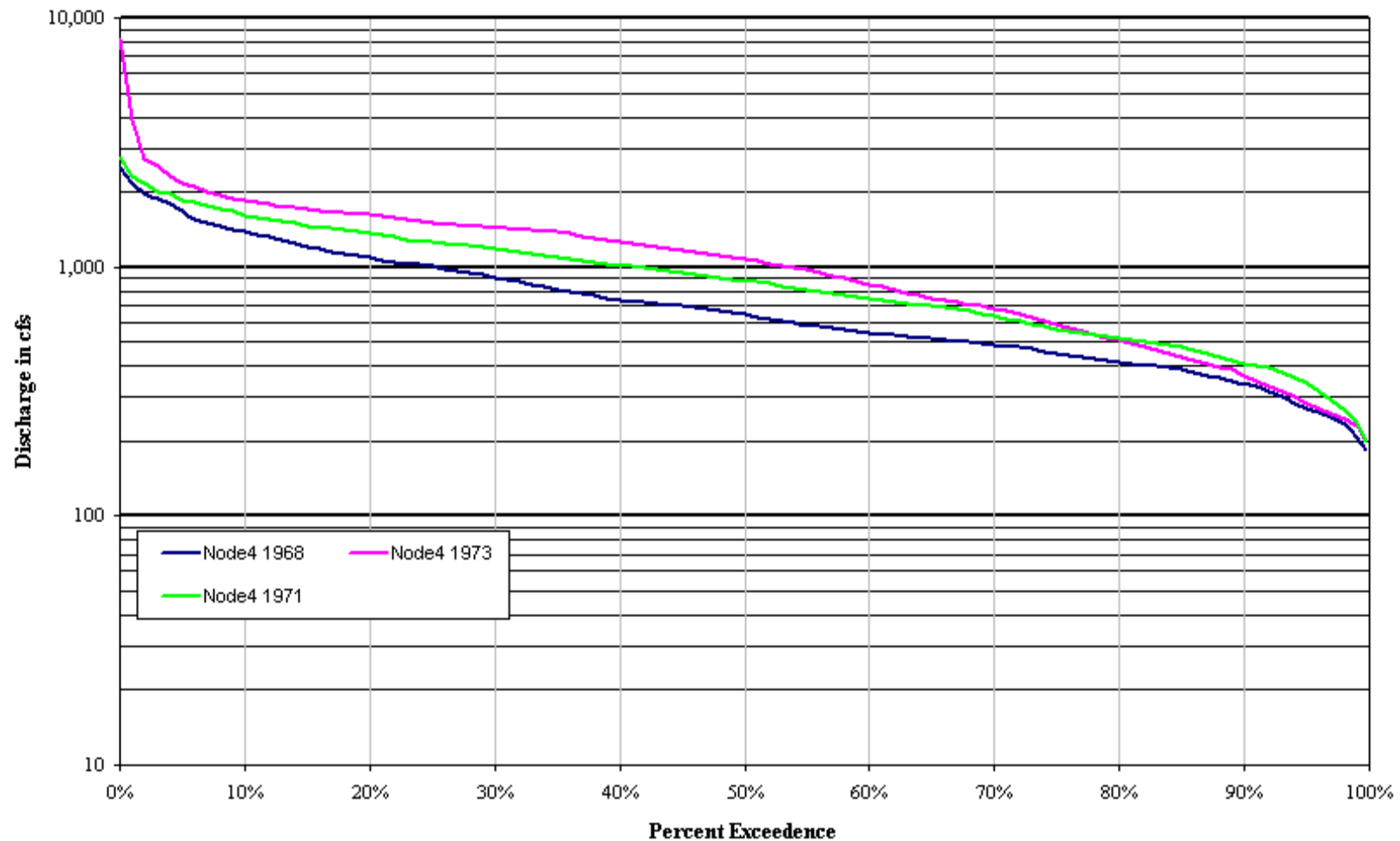


# Scenario 6 – Node 5 Flow Duration Curves



## Tuckasegee River CHEOPS Model Output

Annual Node 4 Flow Duration Curves



# Questions & Answers

