Joint State - Federal Public Informational Sessions

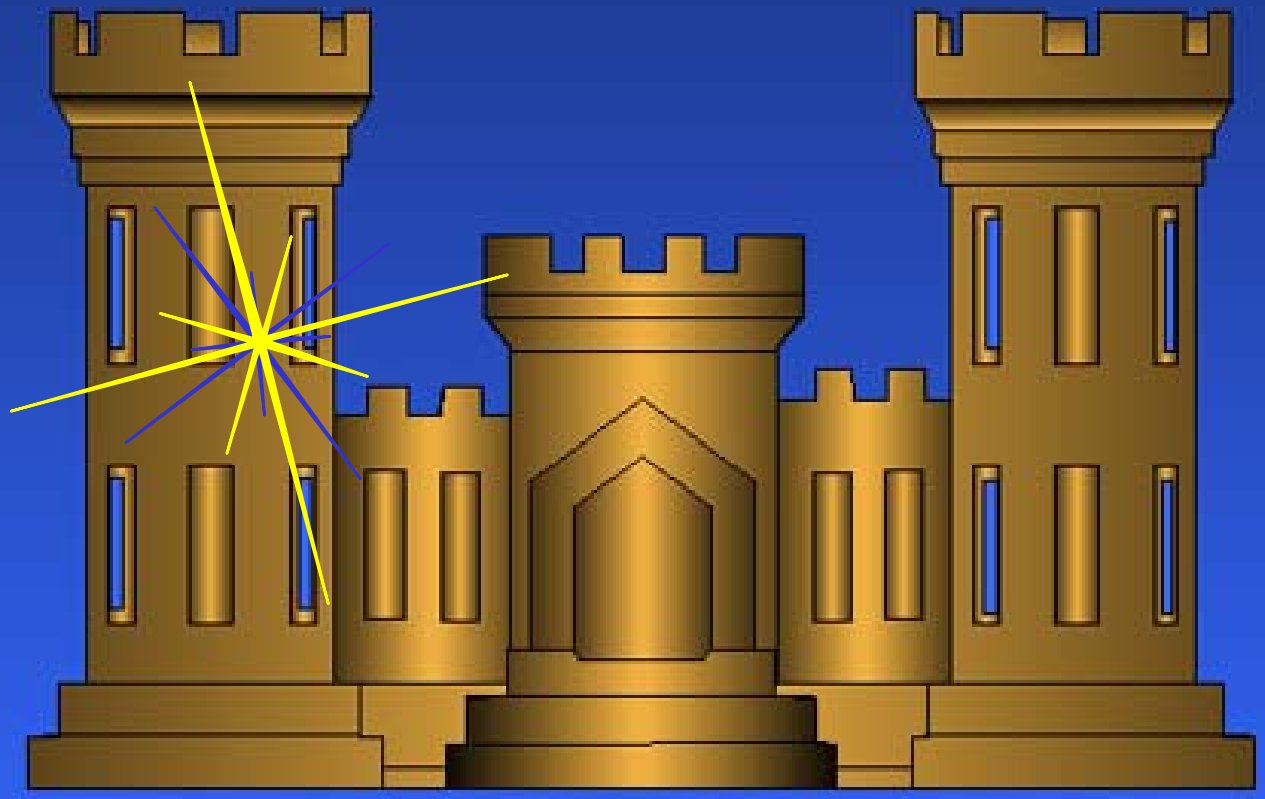
Welcome to the second in a series of four public informational sessions jointly sponsored by the States of Alabama, Florida, and Georgia and the Office of the Federal Commissioner for the ACT and ACF Compacts. Today's topic is hydropower.

The Session Series. These public sessions will explore a variety of topics related in general ways to the background of the ACT and ACF Basins. The goal is to enable a sharing of a common information base for not only the public but also the State and Federal technical teams. Recognizing the complexity of basinwide management factors, the sponsors hope that these sessions will provide a useful asset for those interested in the underlying topic.

Format. This series of public sessions will involve presentations by Federal and State technical representatives, as appropriate to the particular topic. Written questions will be invited during the session and forwarded to the presentation team for their response to the audience as a whole.

Distinguished from Comments on Compact Concepts. As mentioned, the focus of this series of sessions is the common background information. For that reason, they will not involve comment or evaluation of previous allocation concepts offered by the State teams. Throughout the period of negotiations, through both public sessions and public written comments, federal agencies have offered detailed comments on proffered concepts. With respect to prior allocation concepts, the sponsors would refer the public to prior comments and public discussions on those concepts.

CORPS OF ENGINEERS



Hydropower in the ACT and ACF Basins

Topics to be Covered

- Hydropower Assets
- Hydropower Principles
- Project Operations for Hydropower
- Marketing Hydropower
- Allocation Formula Implementation

Overview of Federal Hydropower Assets on the ACF and ACT River Systems

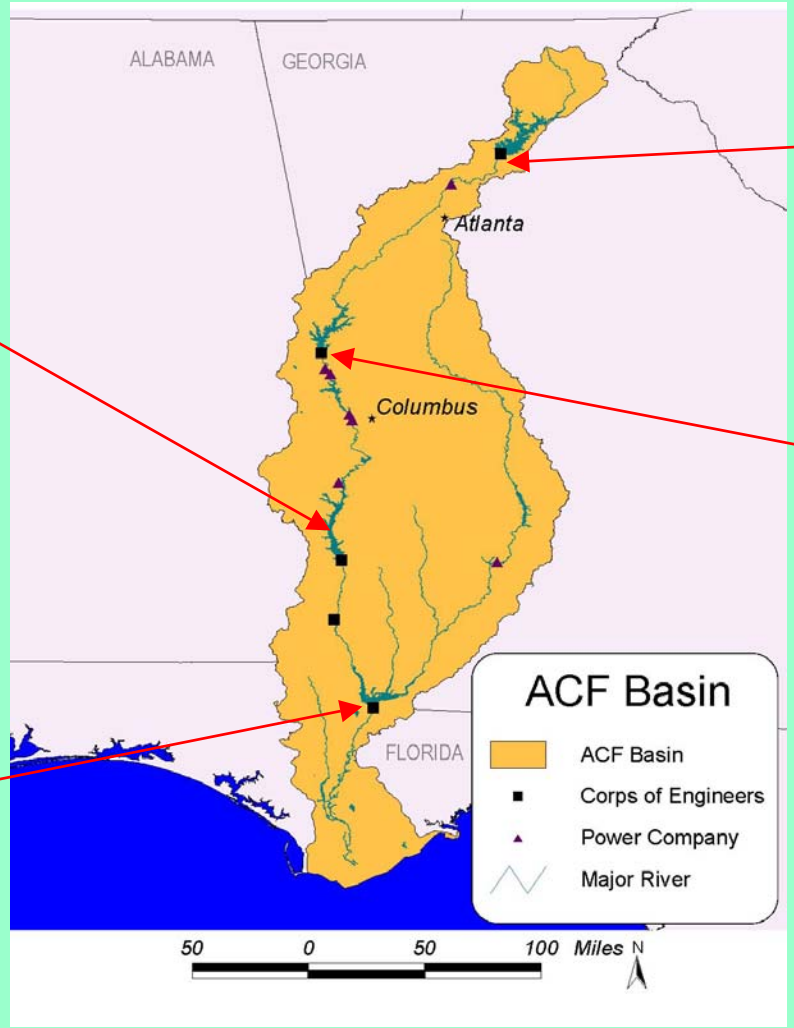
ACF River System
Federal Power Projects

Buford Dam

Walter F. George Dam

West Point Dam

Jim Woodruff Dam

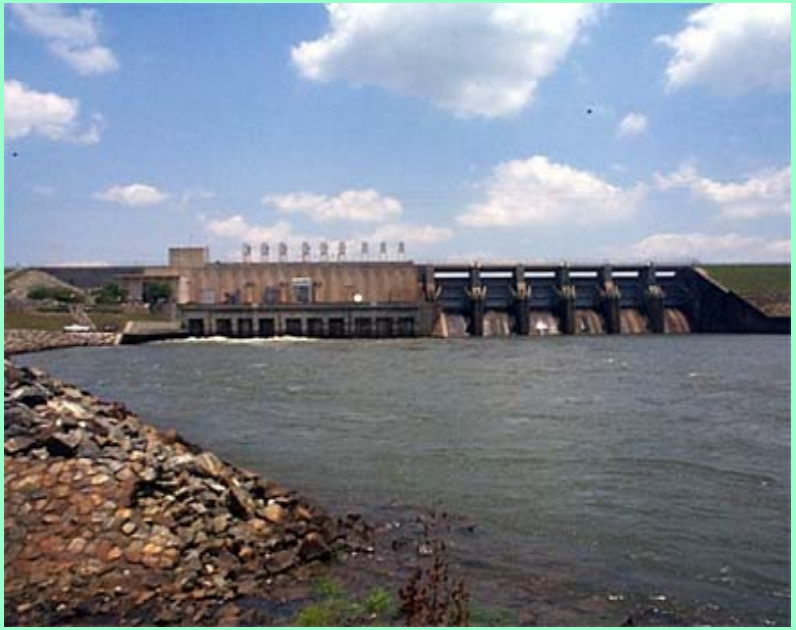


Buford Power Project
Lake Sidney Lanier

- Peaking operation
- Placed in service 1958
- 2- 40 MW and 1- 5 MW generators
- $27M rehabilitation effort underway with completion scheduled for 2004

West Point Power Project

West Point Lake

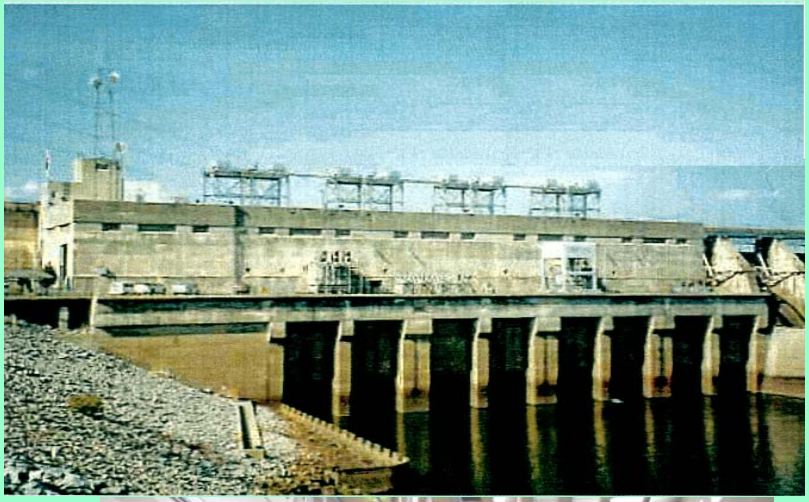


- Peaking operation
- Placed in service 1975
- 2- 35 MW and 1- 3 MW generators
- Rehabilitation study scheduled for 2004

Walter F. George

Lake Eufaula

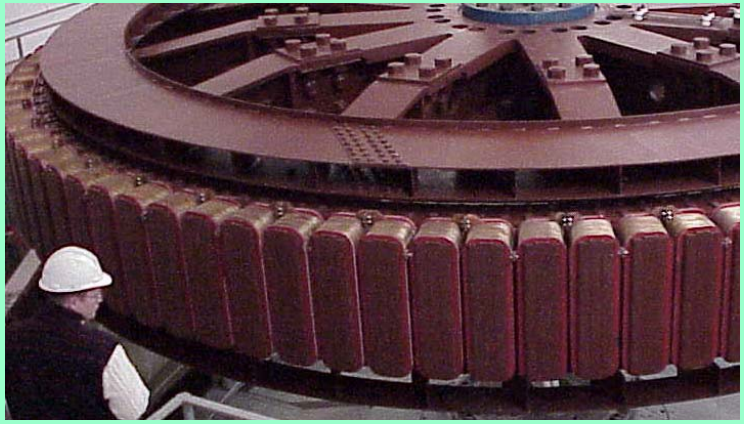
- Peaking operation
- Placed in service 1963
- 4 – 32.5 MW generators
- $31M rehabilitation effort underway with completion scheduled for 2006

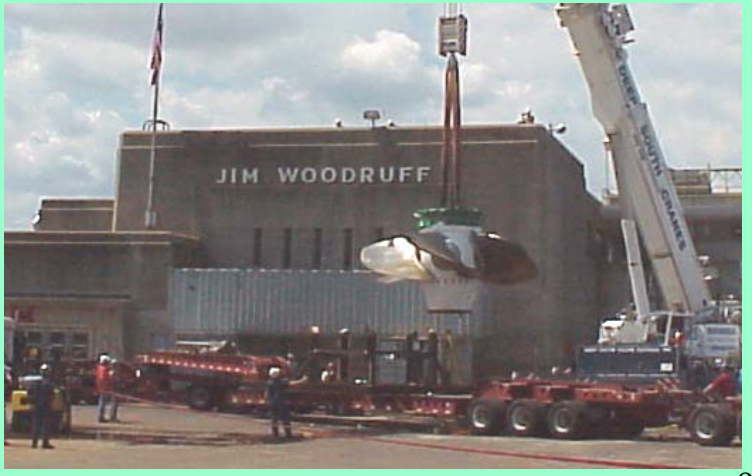


Jim Woodruff

Lake Seminole

- Run of river operation
- Placed in service 1957
- 3- 14.5 MW generators
- $30M rehabilitation effort nearing completion

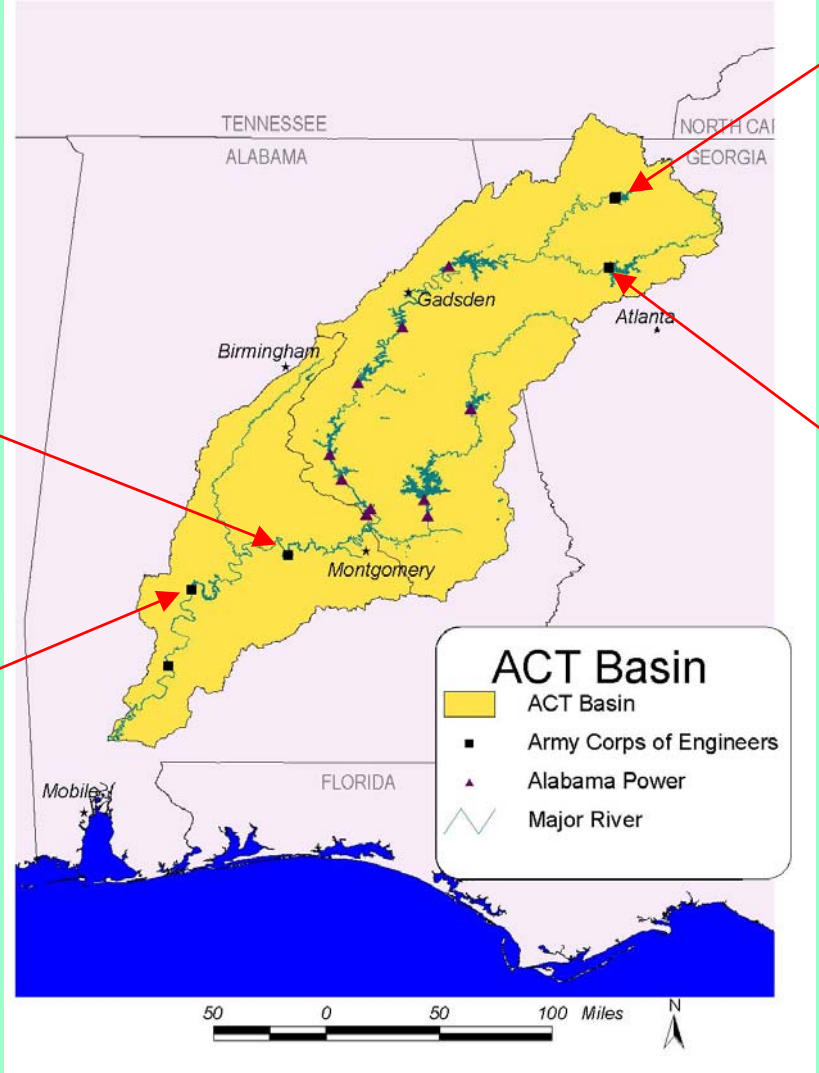




ACT River System
Federal Power Projects

Carters Dam

R.F. Henry



Allatoona Dam

Millers Ferry

Allatoona Power Project

Lake Allatoona

- Peaking operation
- Placed in service 1950
- 2- 40 MW and 1- 2 MW generators
- Rehabilitation report approved
- Rehabilitation design effort scheduled for 2004

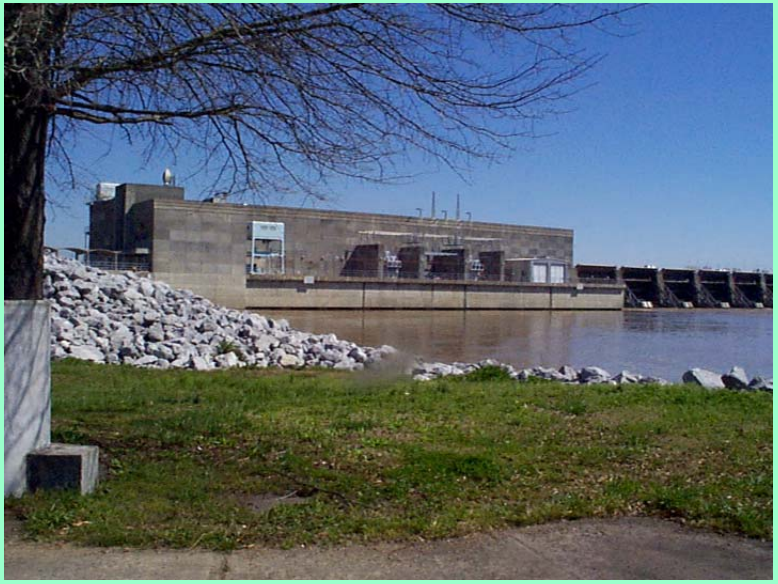
Carters Pumped Storage Facility

Carters Lake

- Pump/storage operation
- Placed in service 1975
- 2 - 125 MW generators
- 2 –125 MW pump/generators
- Major repairs currently underway on Unit 4

R. F. Henry Power Project

Woodruff Reservoir



- Run of river operation
- Placed in service 1975
- 4- 17 MW generators

Millers Ferry Power Project

William Dannelly Reservoir

- Run of river operation
- Placed in service 1969
- 3- 25 MW generators

Hydropower Principles

1. Purpose of Reservoirs
2. Reservoir Operations
3. Hydropower Principles
4. Power System Operation
5. Use of Hydropower
6. Dependable Capacity
7. Impact of Operational Changes
8. Cost Allocation

Hydropower Principles

1. **Purpose of Reservoirs**
2. Reservoir Operations
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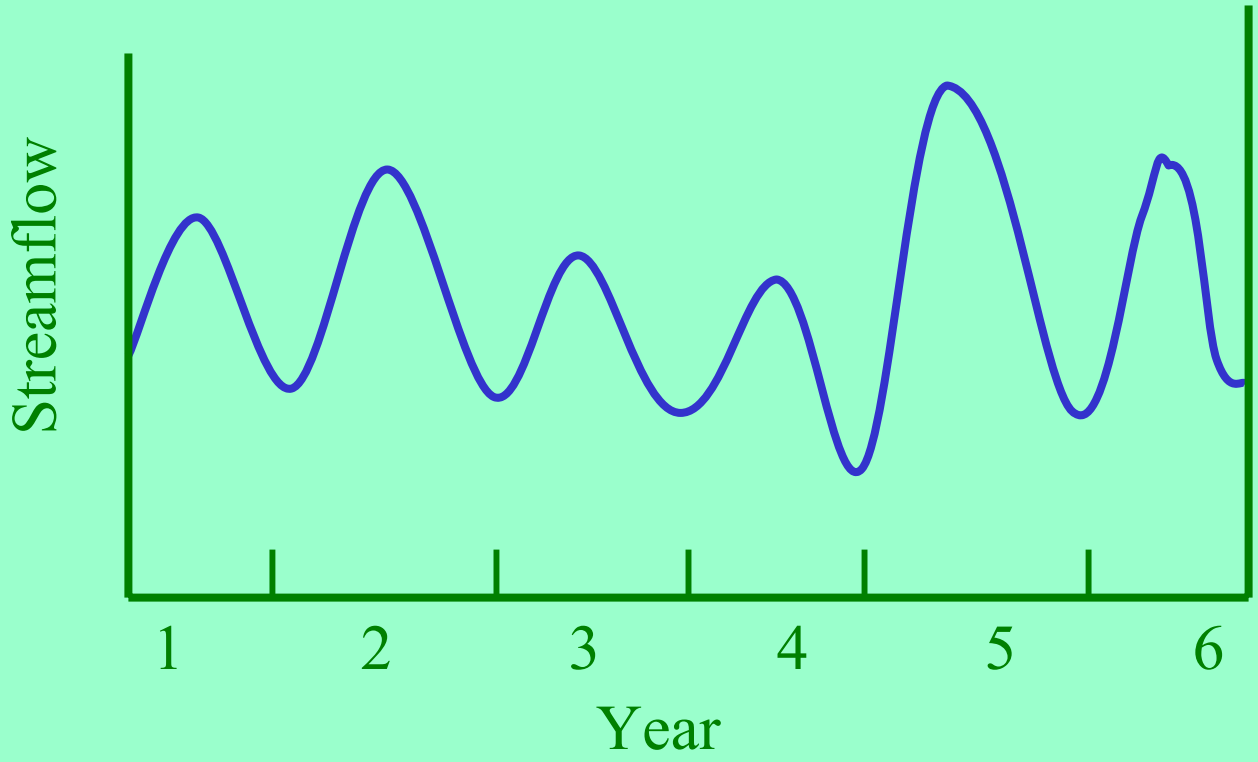
Natural Runoff Pattern



Needs of Different Water Users

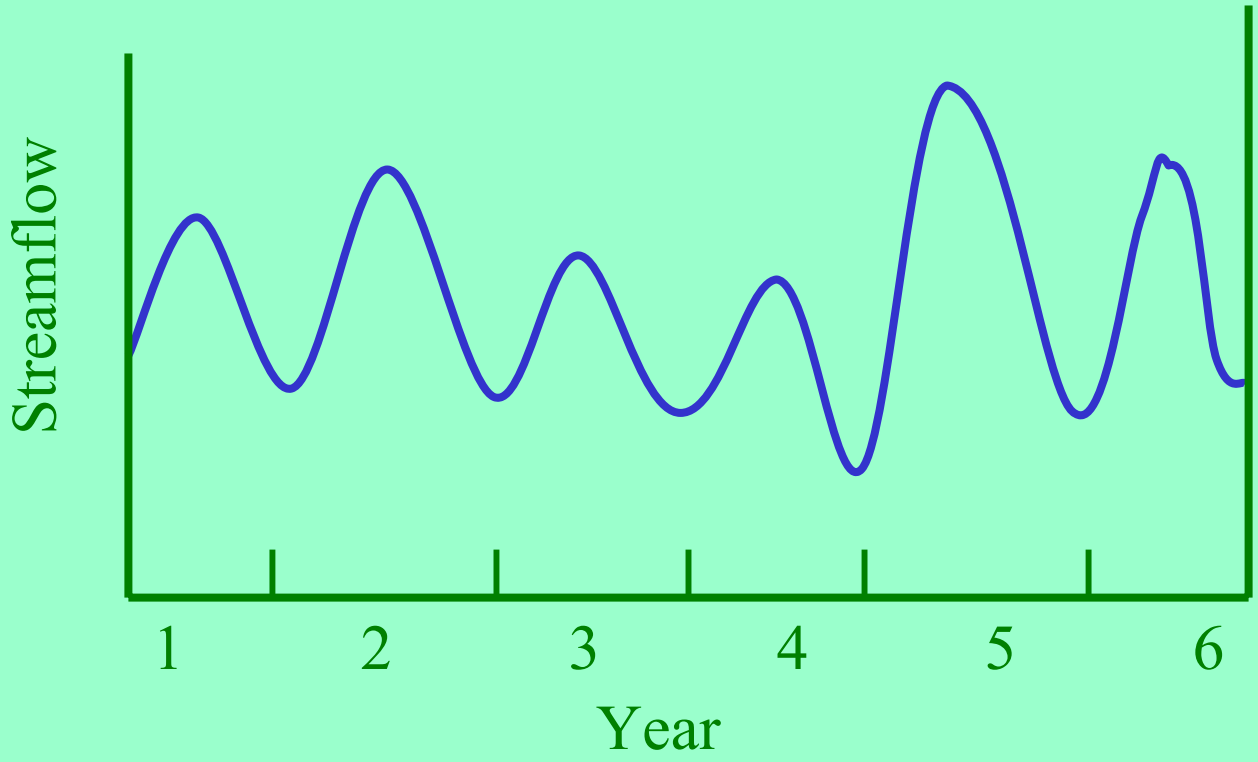
1. **Municipal & Industrial Water Supply**
2. **Irrigation**
3. **Navigation**
4. **Fish & Wildlife**
5. **Recreation**
6. **Water Quality**
7. **Flood Control**
8. **Hydropower**

Storage vs. Pondage

- Storage: Saves water in wet periods for use in low flow periods.

- Pondage: Limited storage used to re-shape flows on daily/hourly basis (hydropower)

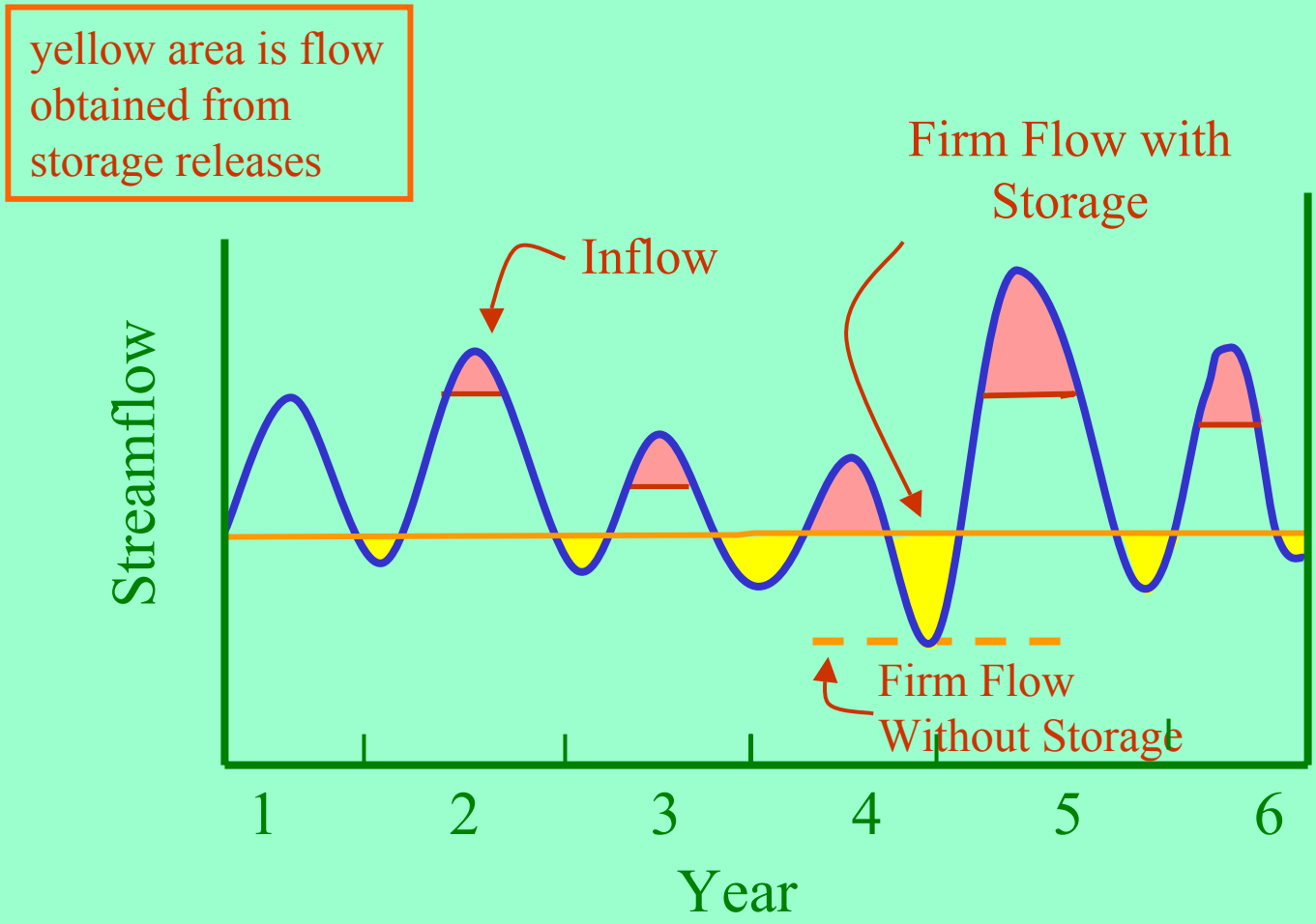
Natural Runoff Pattern



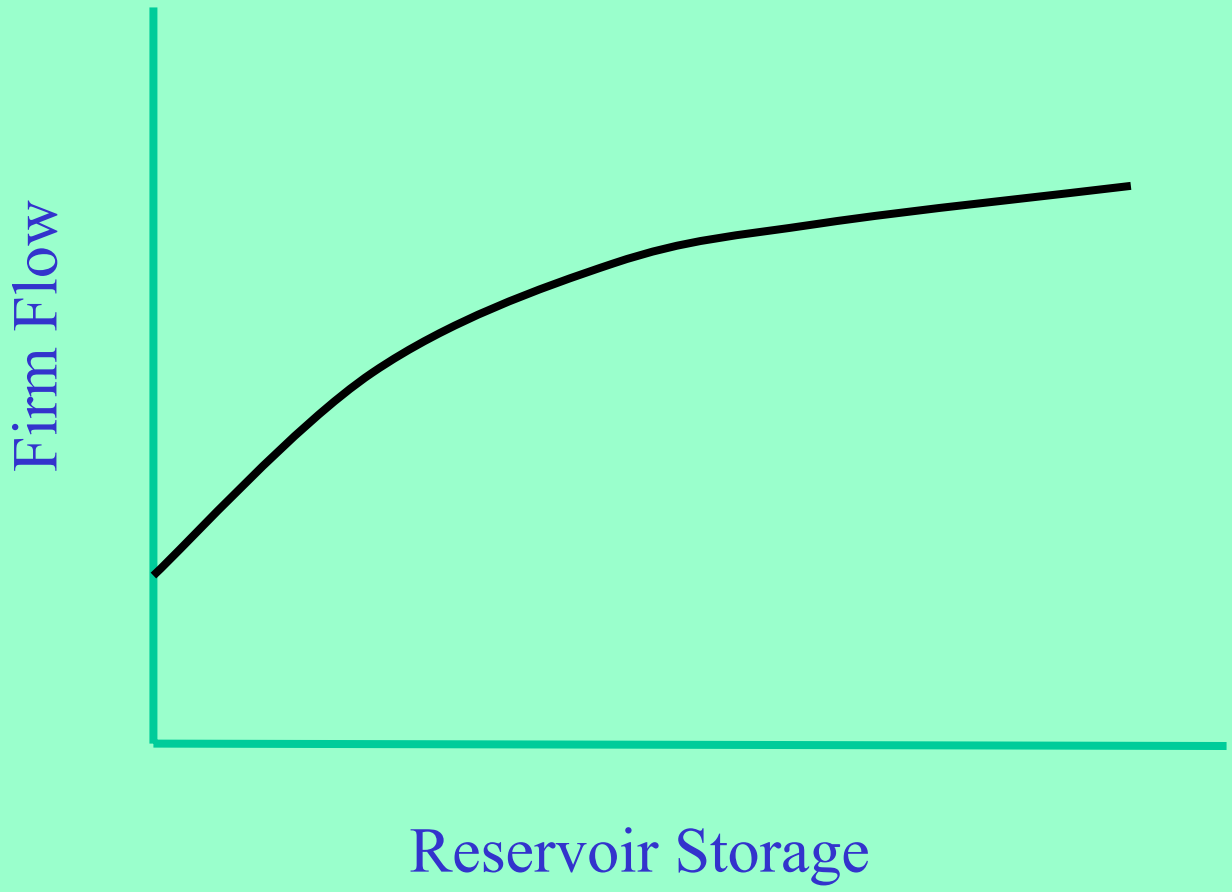
Firm Yield

The maximum amount of flow that can be “guaranteed” during dry periods.

How Storage Increases Firm Flow



Relationship of Firm Flow to Reservoir Storage



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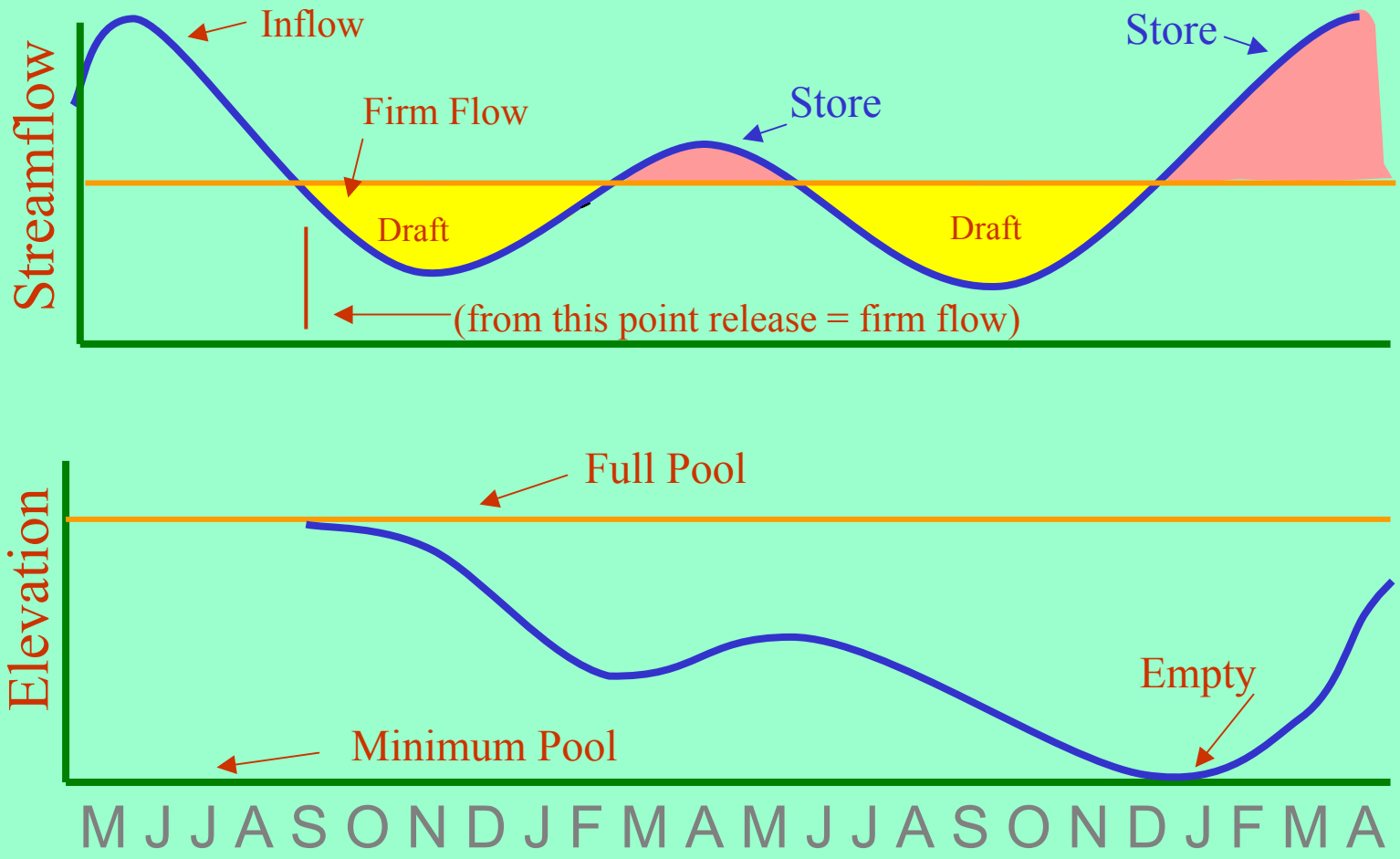
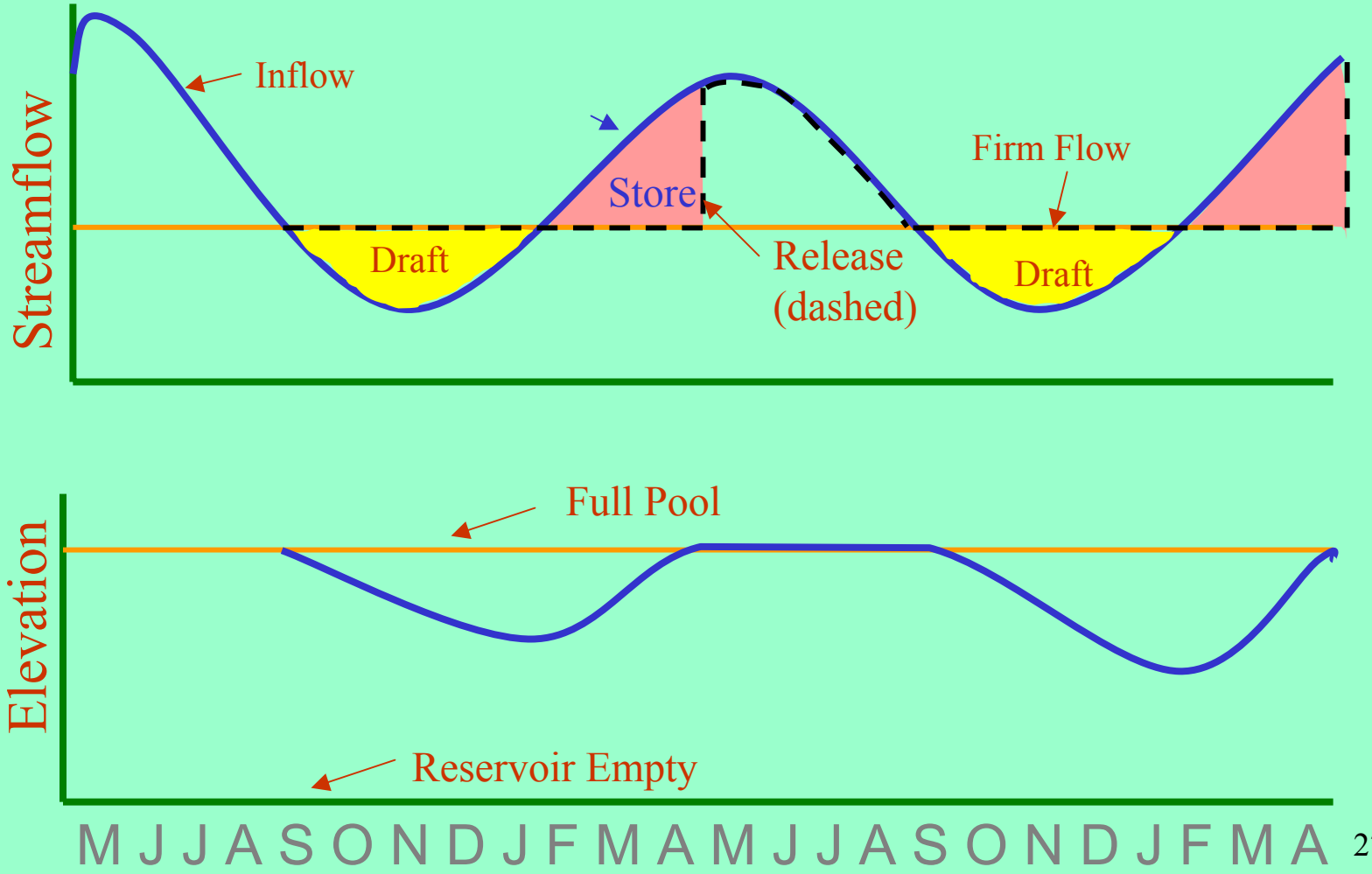
Operation Assumed During Planning of ACT and ACF Reservoirs

To be operated to meet firm requirements - drafted empty during extreme low flow periods, if necessary

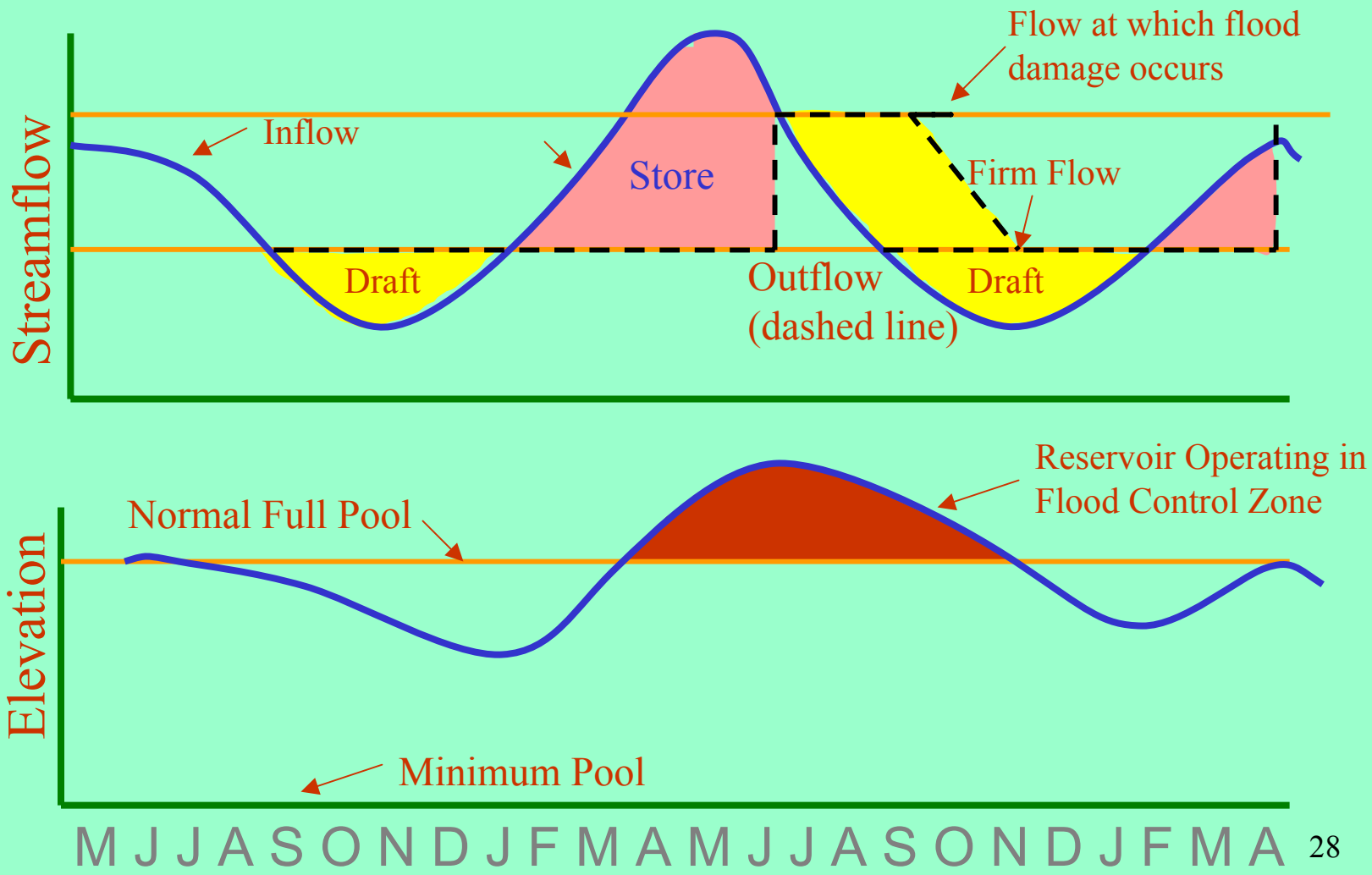
Traditional Operation in Severe Drought Year



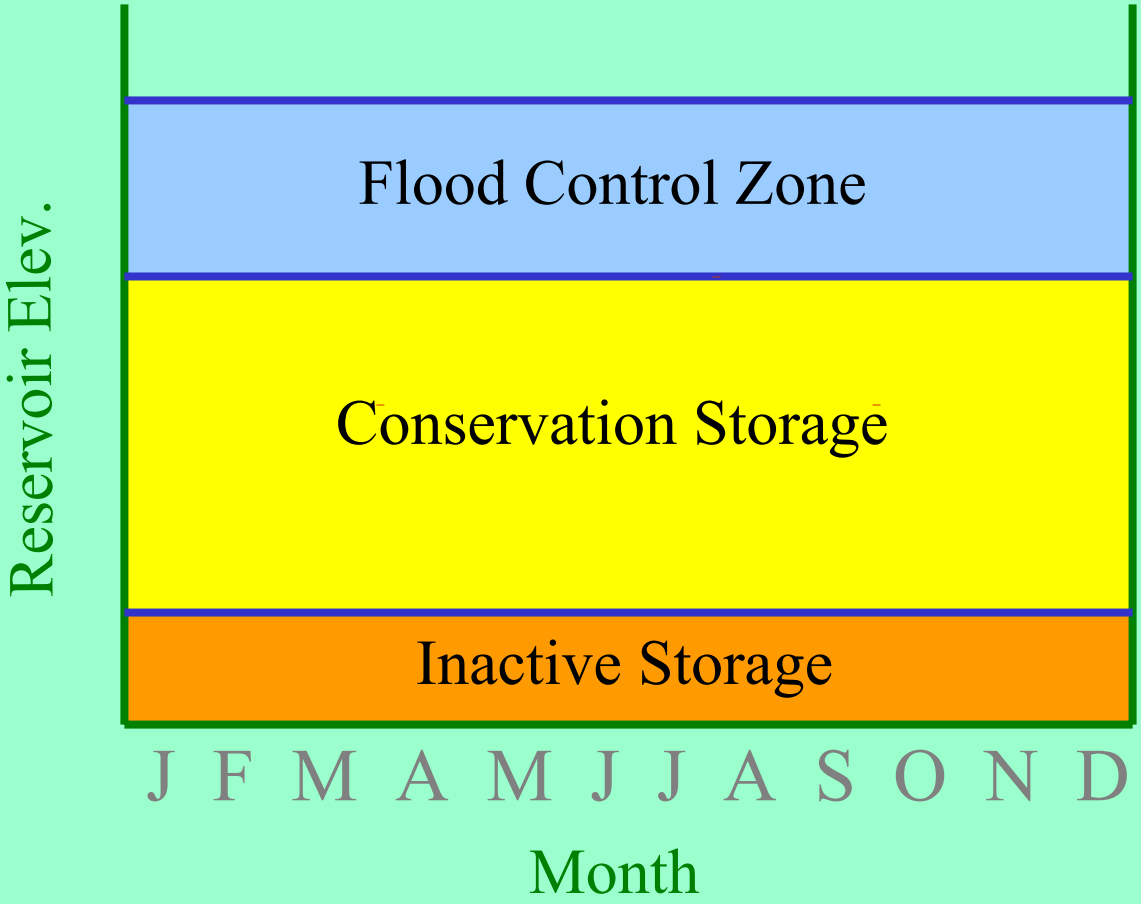
Traditional Operation in Year with Abundant Flow



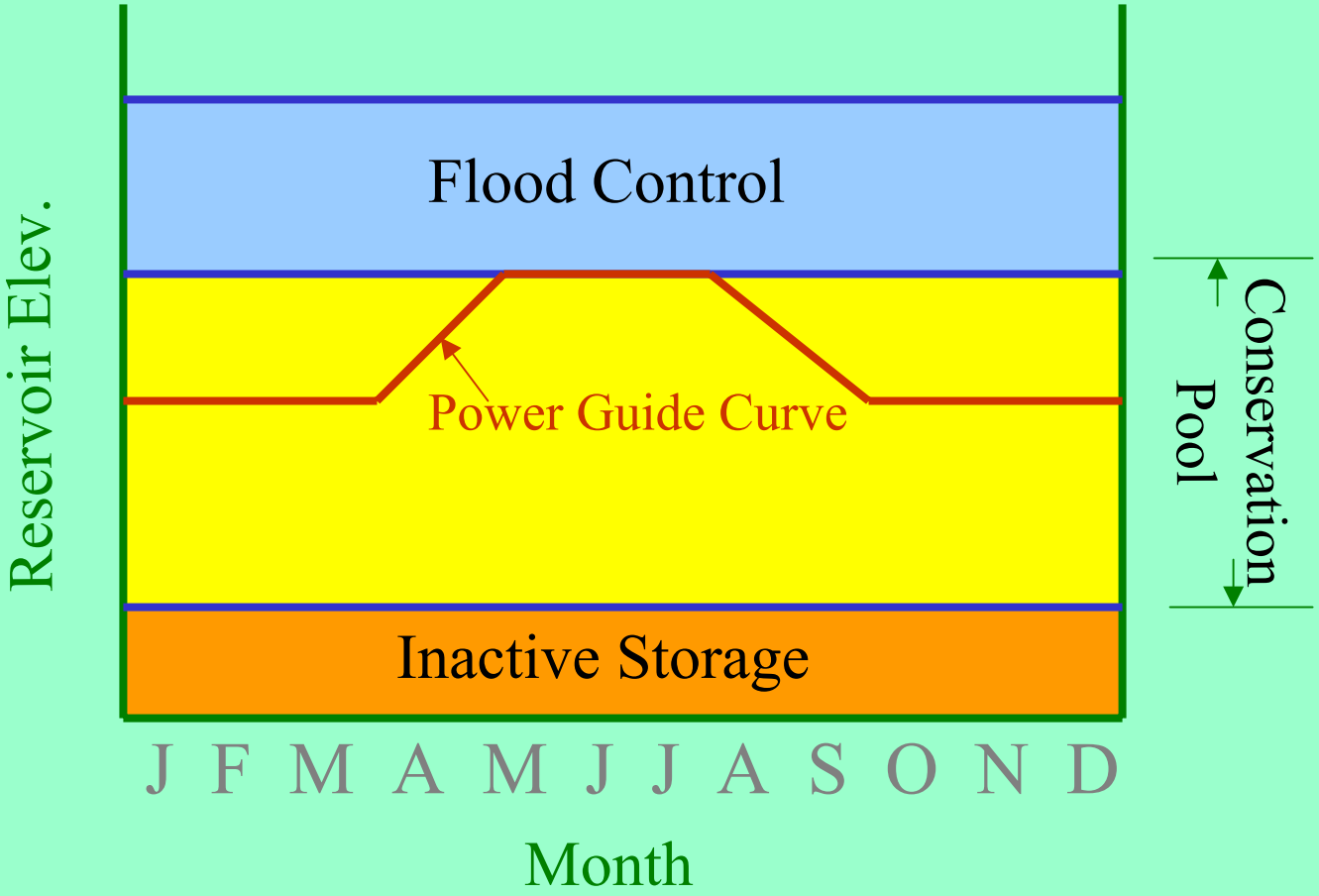
Flood Control Operation



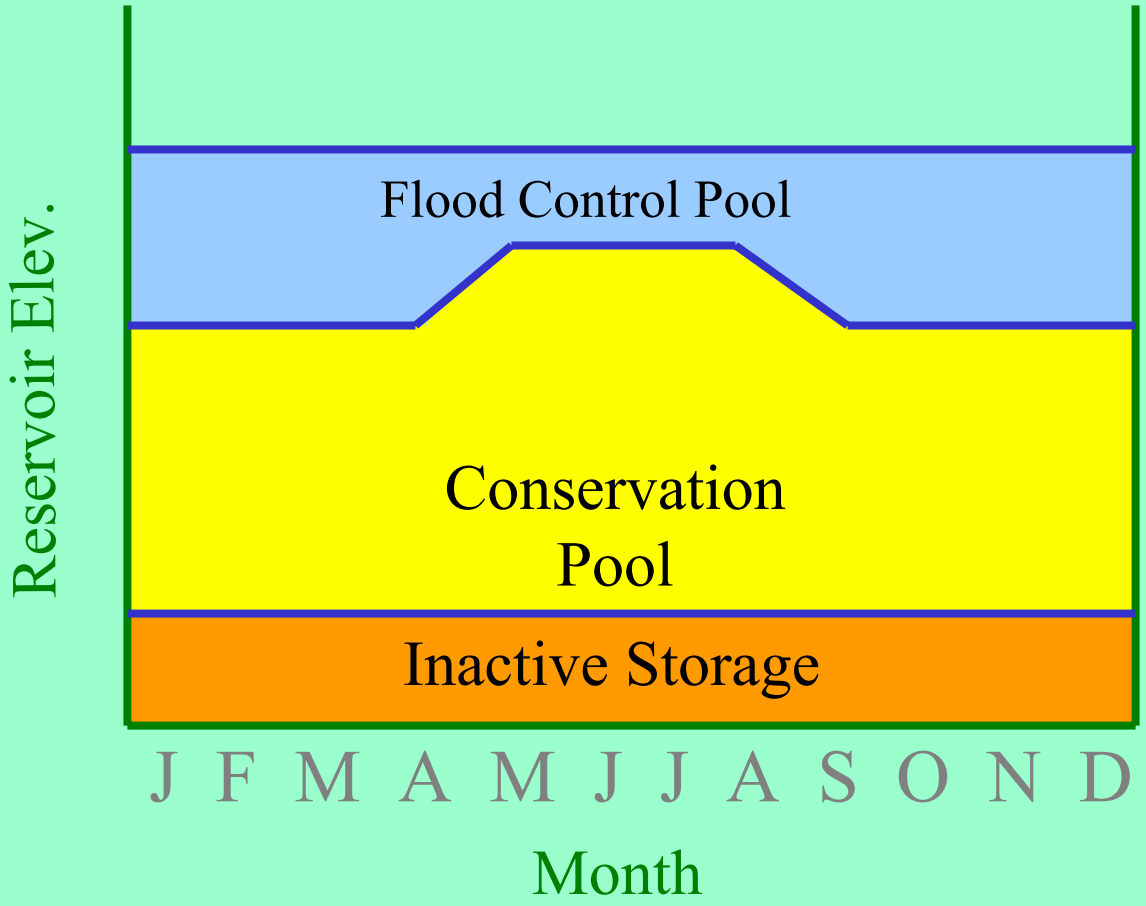
Reservoir Storage Zones



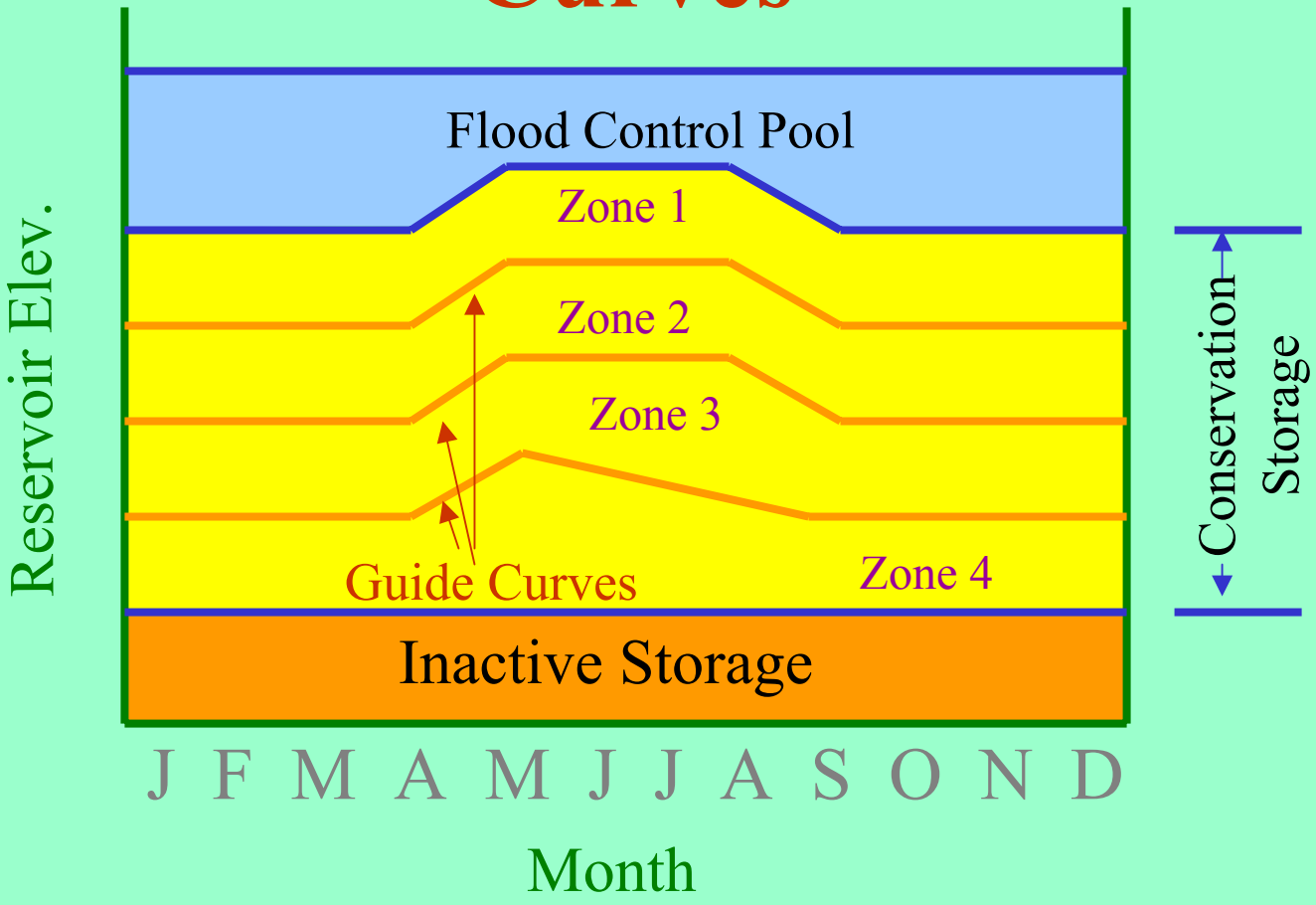
Firm Power Guide Curve (rule curve)



Variable Flood Control Pool



Conservation Storage Divided into Zones by Intermediate Guide Curves



Hydropower Principles

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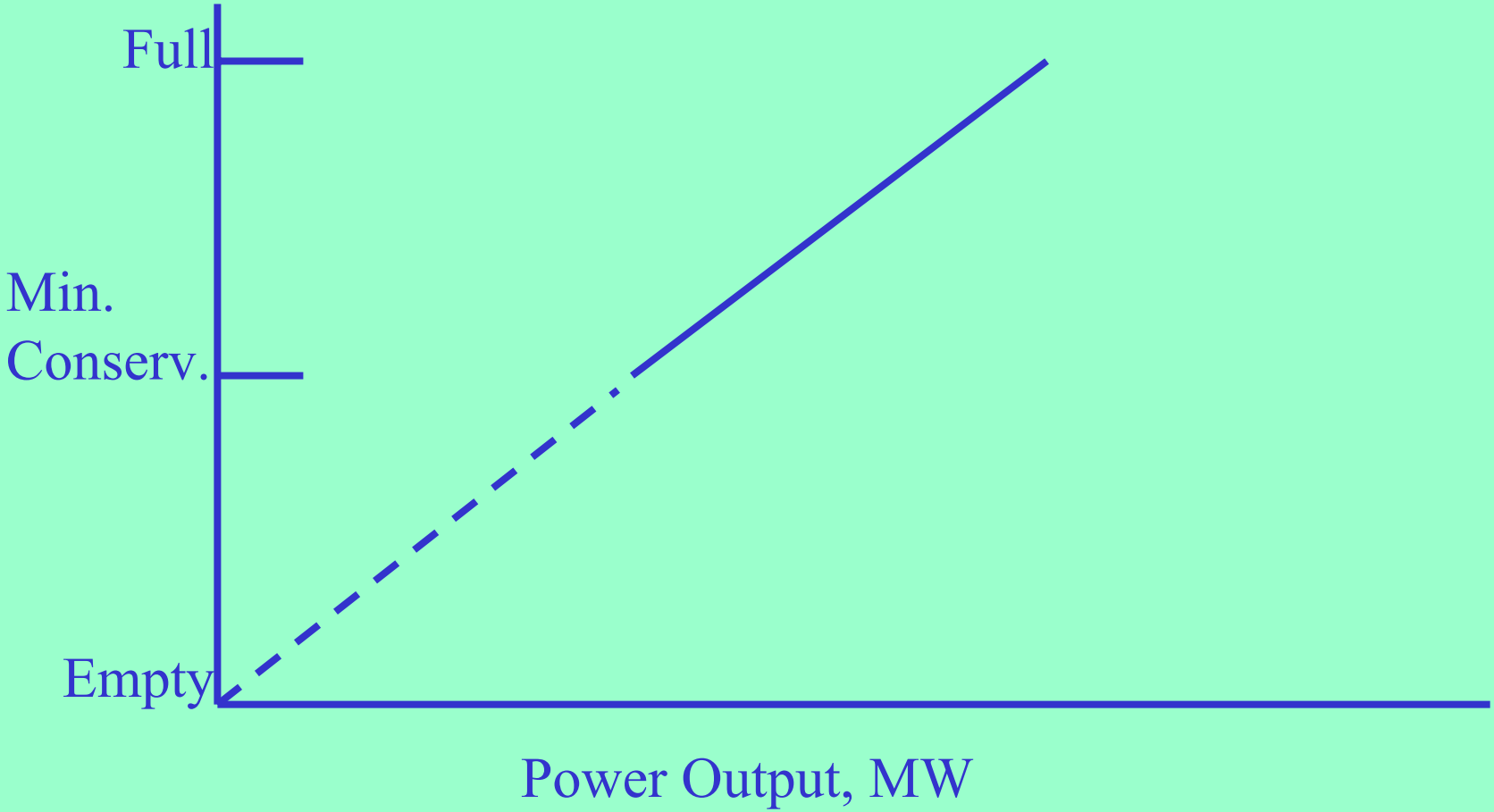
Water Power Equation

$$MW = \frac{Qhe}{11.81}$$

Q = flow, 1,000 cfs
h = head, ft.
e = efficiency,%.

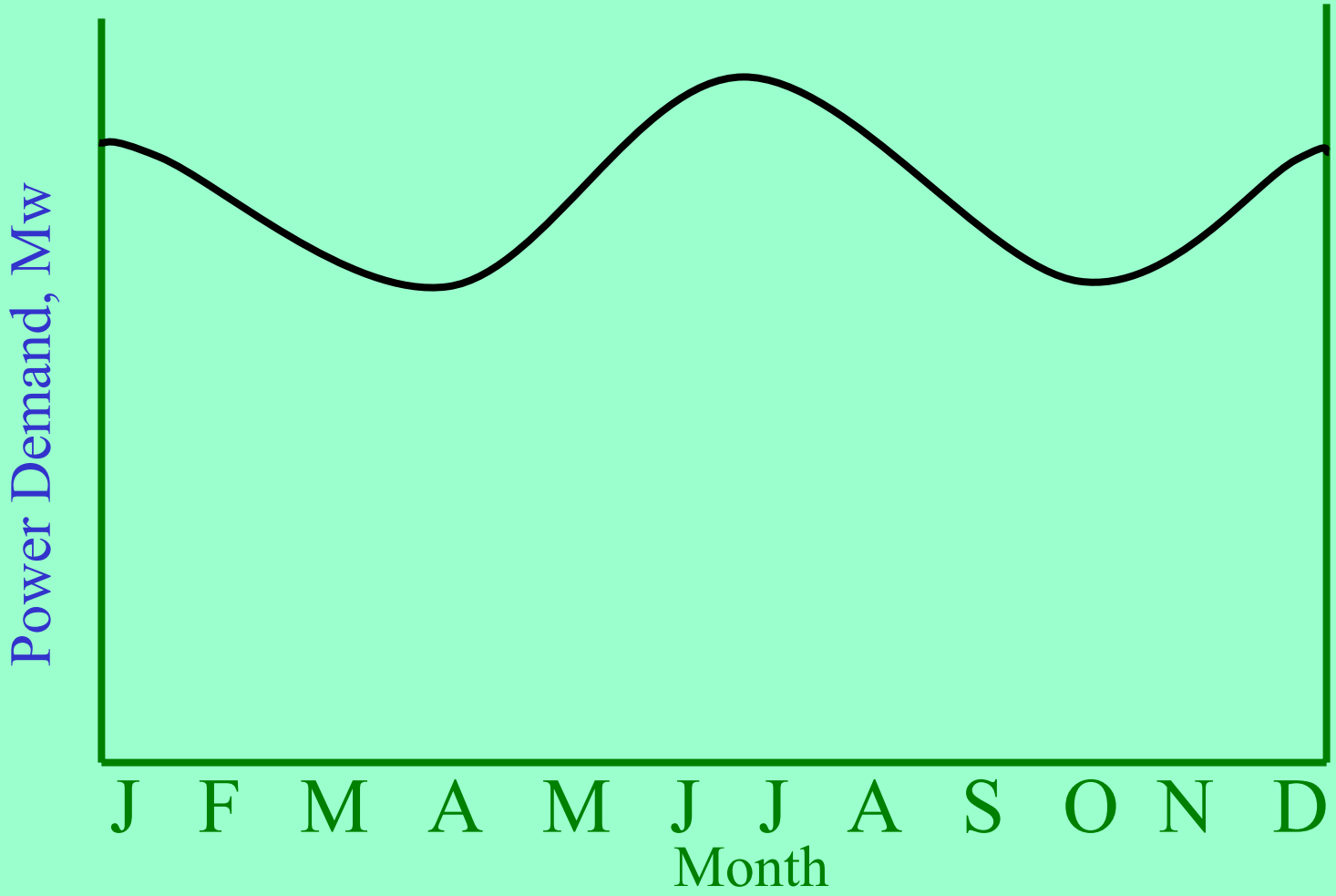
Impact of Reservoir Level on Power Output



Firm Power:

Power intended to have assured availability to the customer to meet all or any agreed upon portion of his load requirements.

Seasonal Variation in Demand for Power



“Producer needs to have enough generating capability to meet firm power demand”

Firm Power:

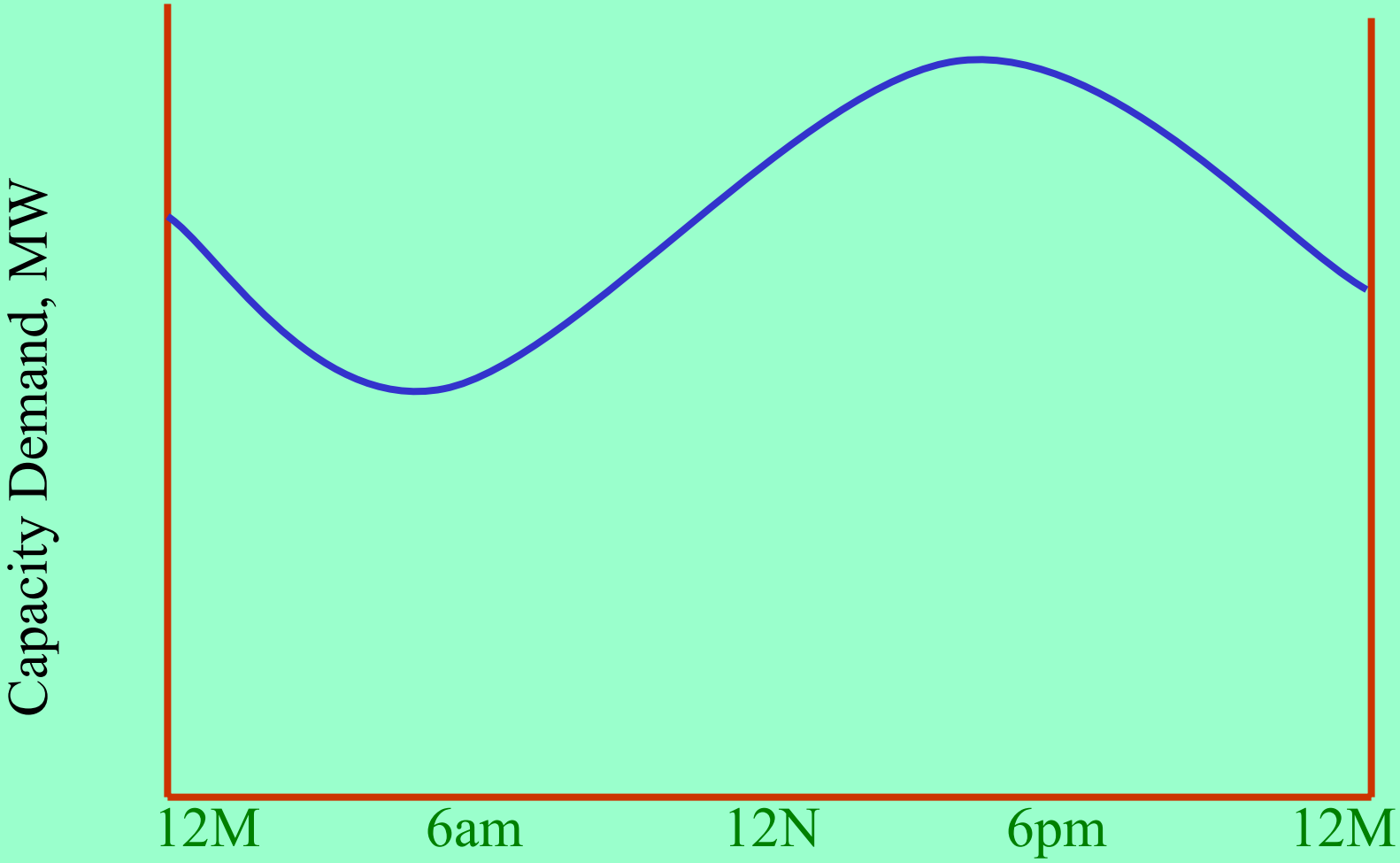
is based on adverse (critical) water conditions.

Firm Power

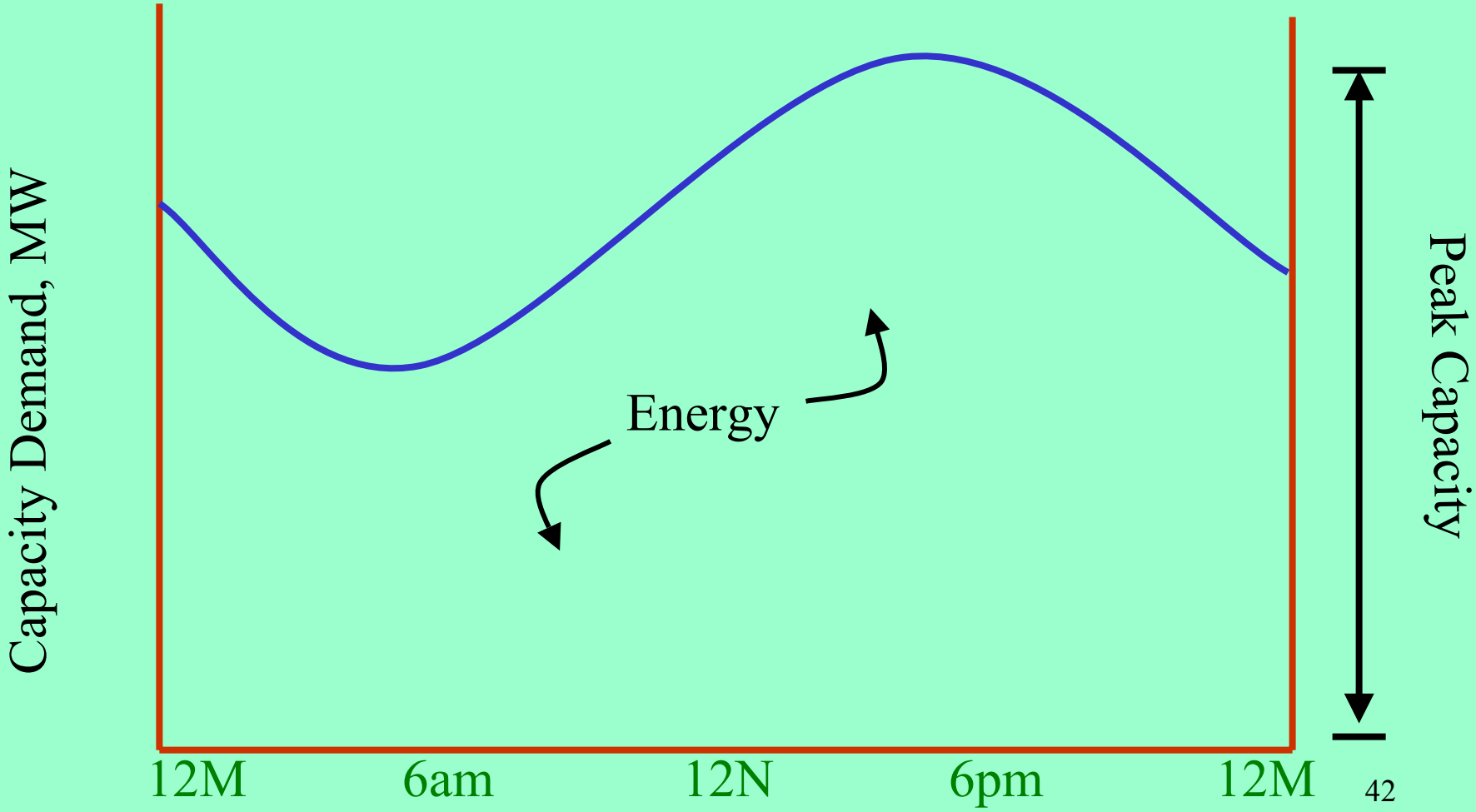
Has two components:

- Energy, MWh
- Capacity, MW

Daily Load Shape



Daily Load Shape



Secondary Power:

Energy produced by a hydroelectric plant in excess of firm power

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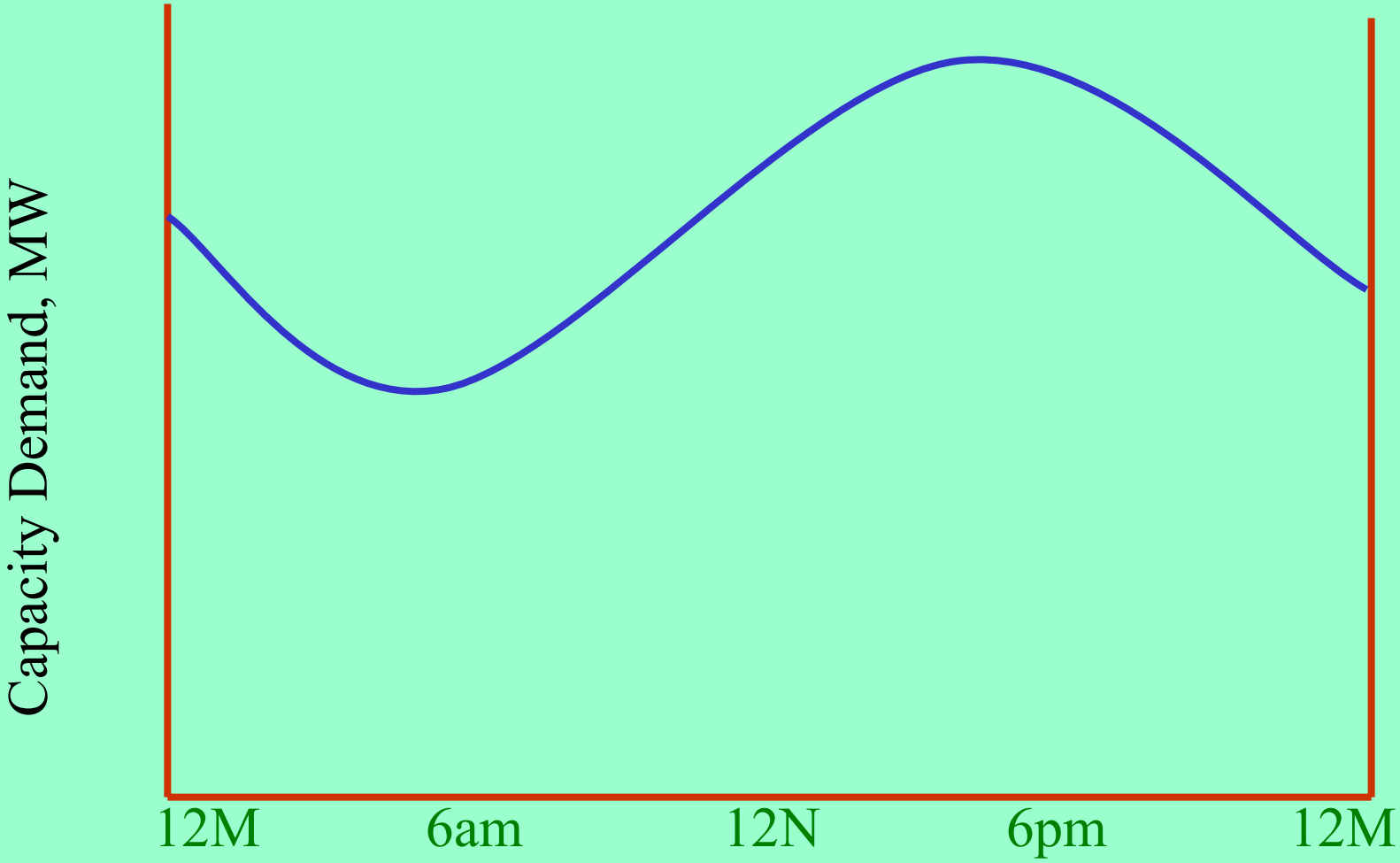
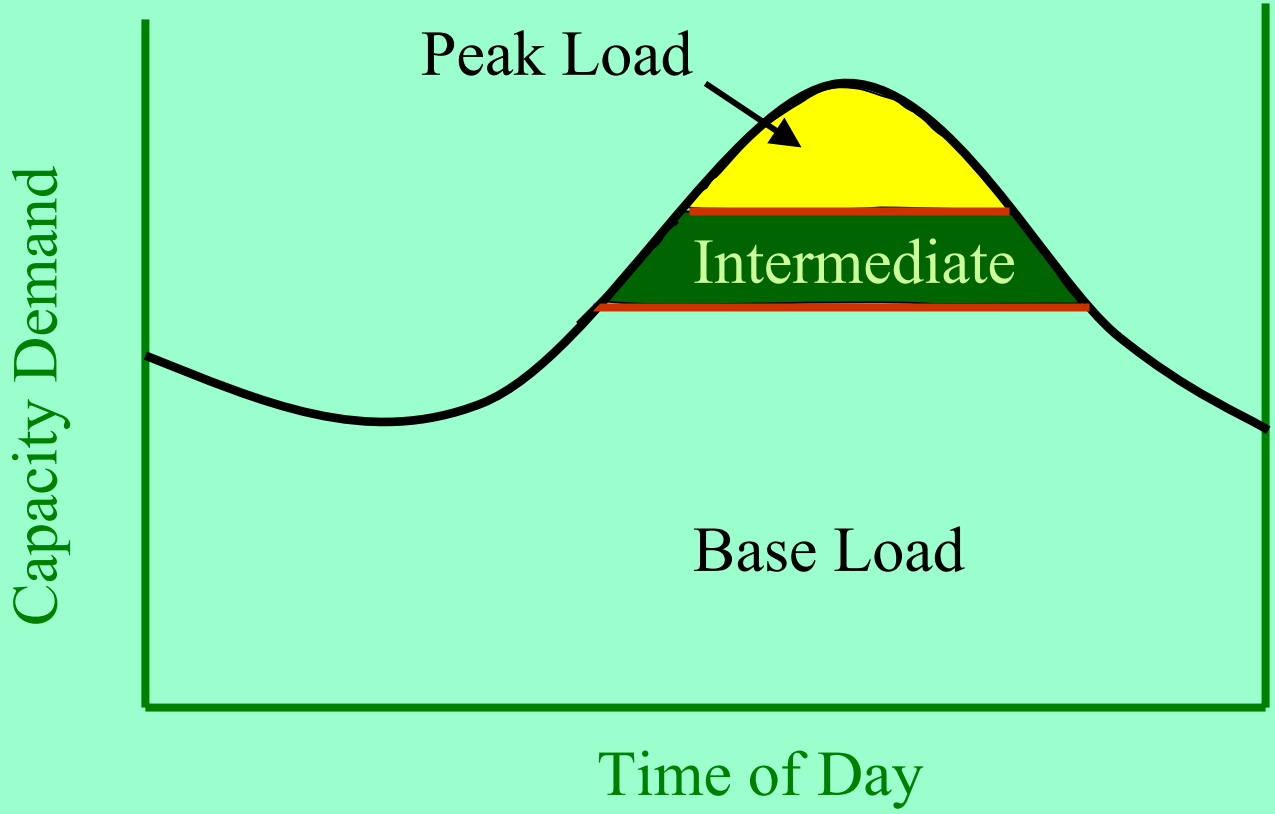
Daily Load Shape



Resources Available to Meet Loads (without hydro)

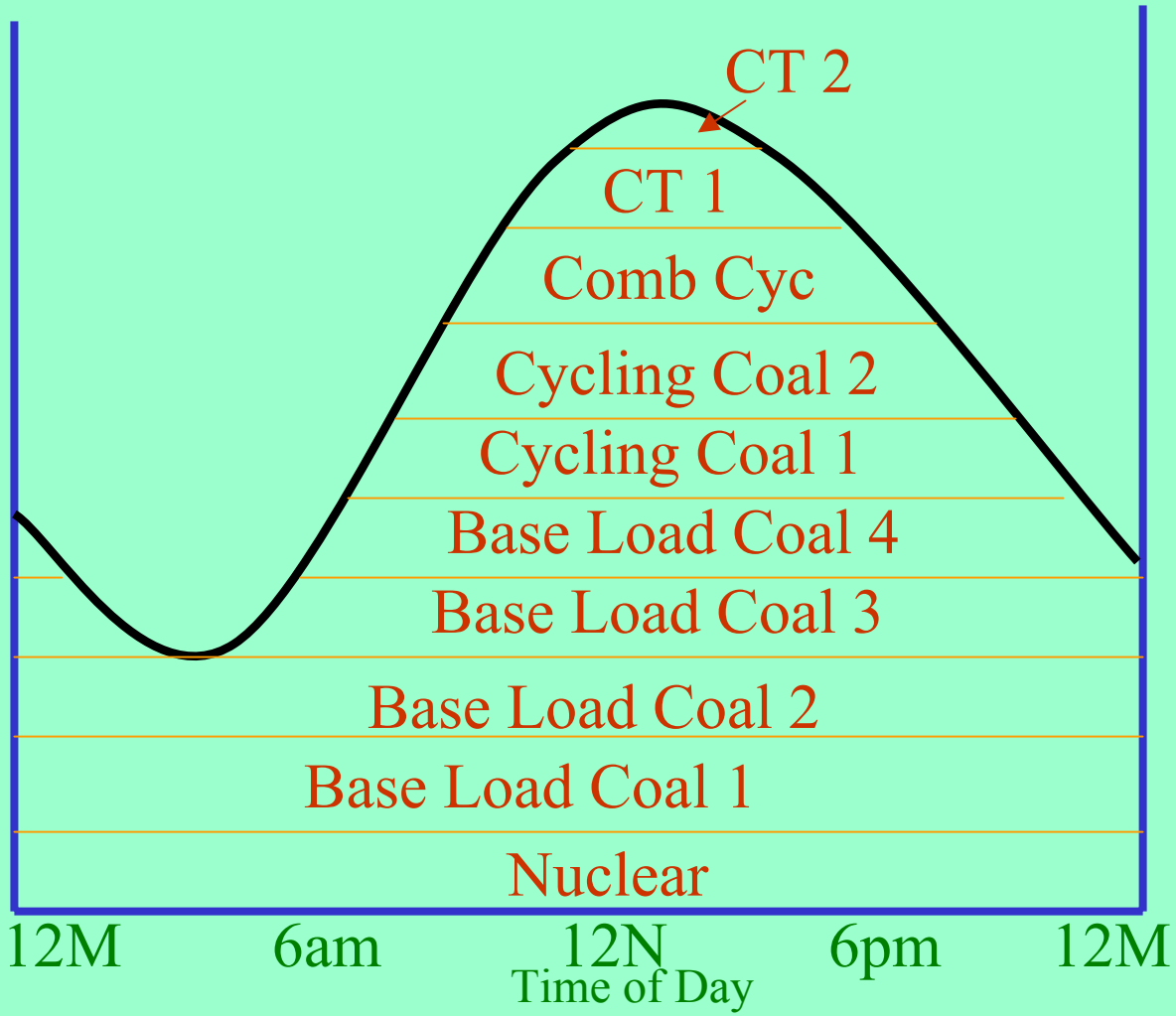
Nuclear	15 $/MWh
Base-Load coal	20-25 $/MWh
Cycling coal	25-30 $/MWh
Combined cycle (gas)	35 $/MWh
Combustion turbine (gas)	50 $/MWh
Combustion turbine (oil)	70 $/MWh
Purchases	50-200 $/MWh

Classes of Load



Dispatch of Resources to Meet Daily Load
(without hydro)

100	P
70	CT
60	CT
50	CT
50	CT
40	CC
35	CY
33	CY
25	BC
23	BC
22	BC
20	BC
15	N



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The output of a hydro plant has two benefits:

* Capacity benefits
* Energy benefits

Capacity Benefit

The fixed costs of constructing and operating the most likely alternative thermal powerplant

- primarily the amortized construction cost

Energy Benefit

The variable cost of producing
the same energy as the hydro plant
by thermal power plants in the power system.

- primarily fuel costs
- this is a system cost

Value of energy produced by hydropower plant varies with type of use

Plant Factor
(Load Factor)

$$\text{P.F. (\%)} = \frac{\text{(energy)}}{\text{(time)(capacity)}}$$

Energy in MWh

time in hours

capacity in megawatts

Example of Daily Plant Factor (Load Factor)

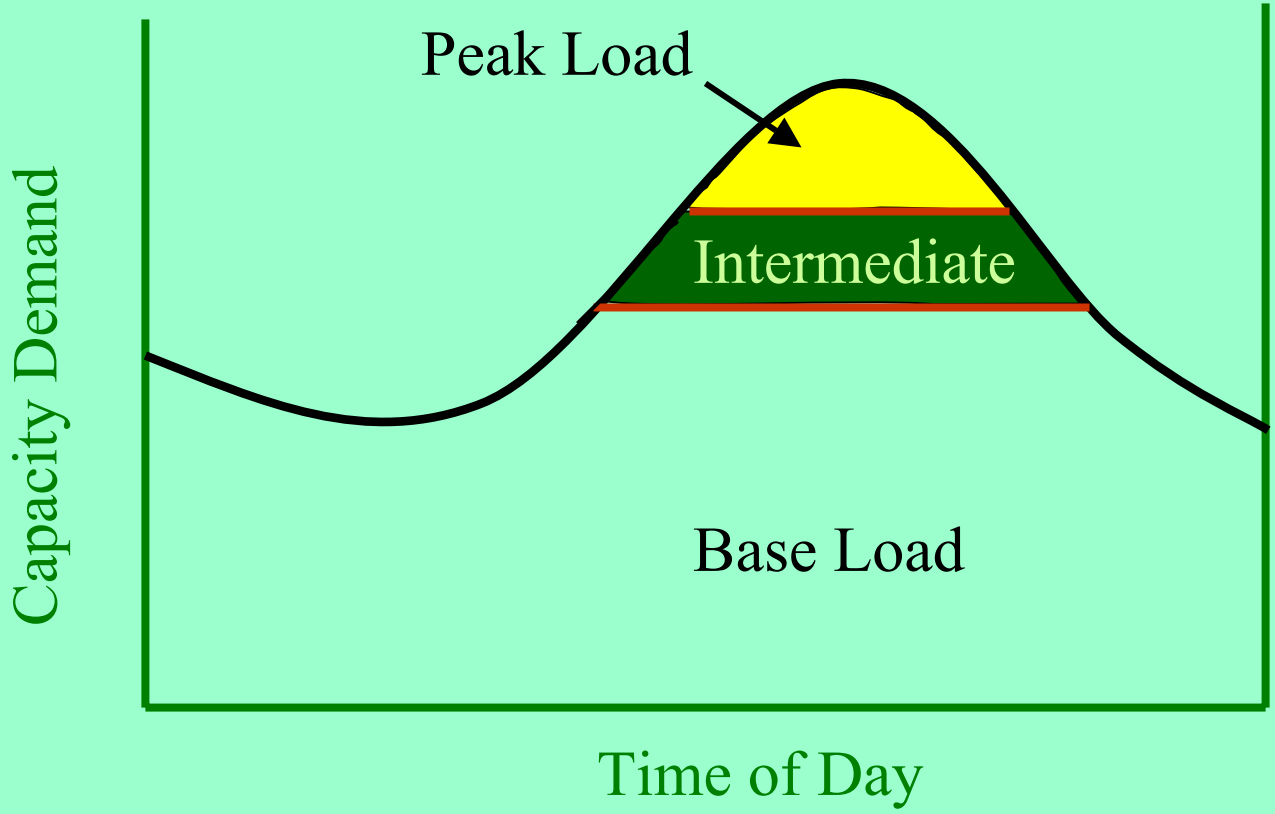
$$\text{Plant Factor} = \frac{(1{,}200\ \text{MWh})}{(24\ \text{hrs})(100\ \text{MW})} = 50\%$$

energy = 1,200 MWh

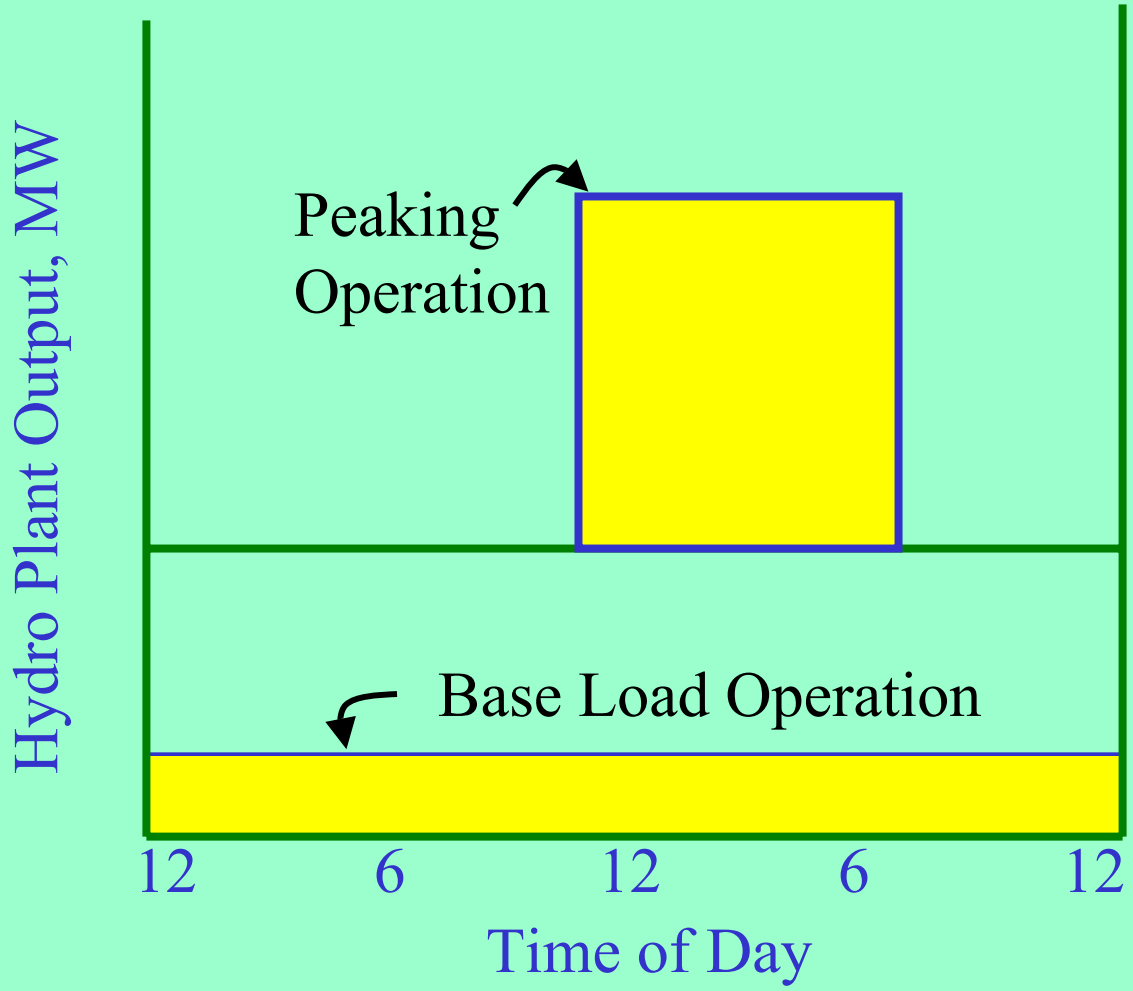
time = 24 hours

capacity = 100 Megawatts

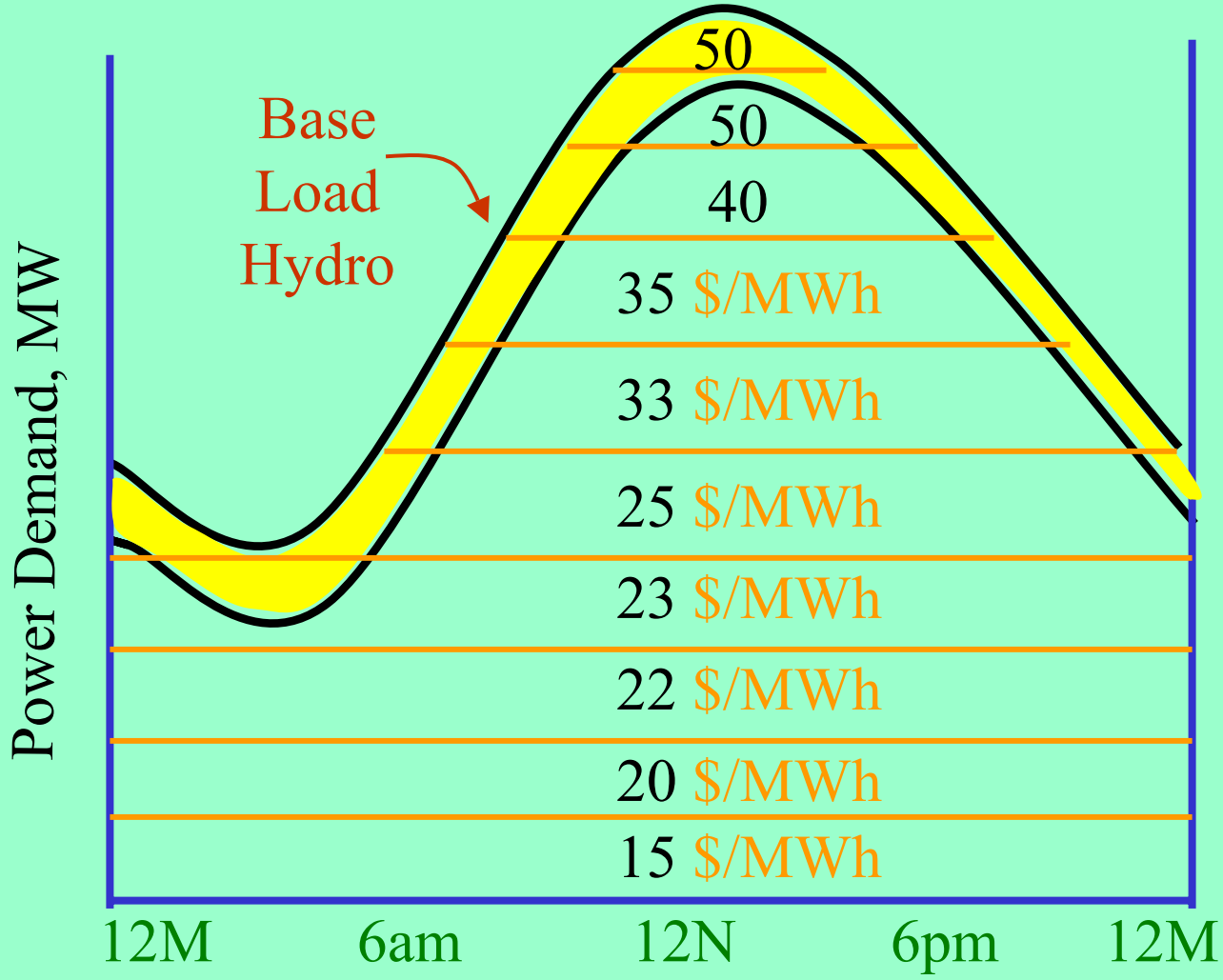
Classes of Load



Hydropower is Energy - Limited

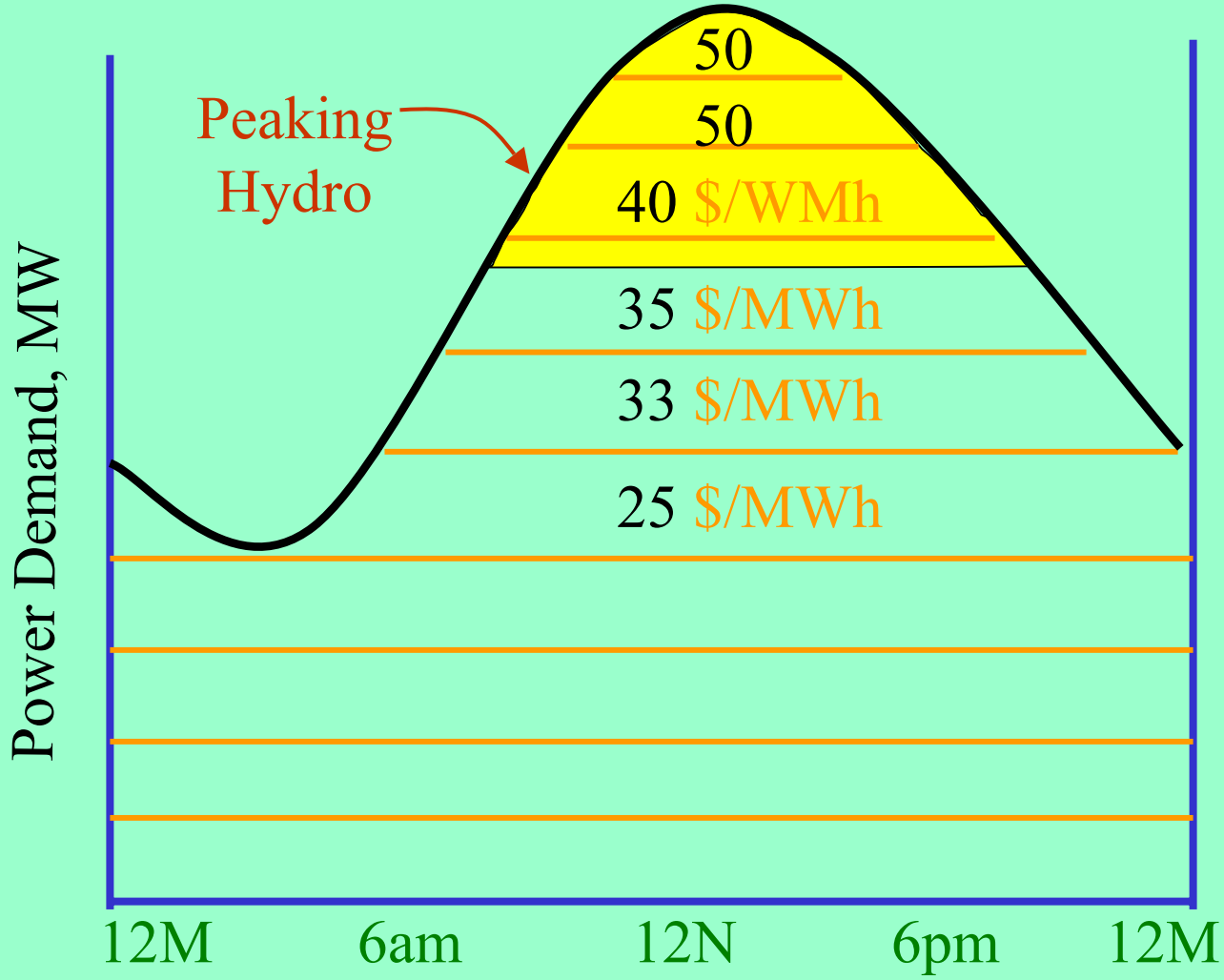


Use of Hydropower for Base Load Generation



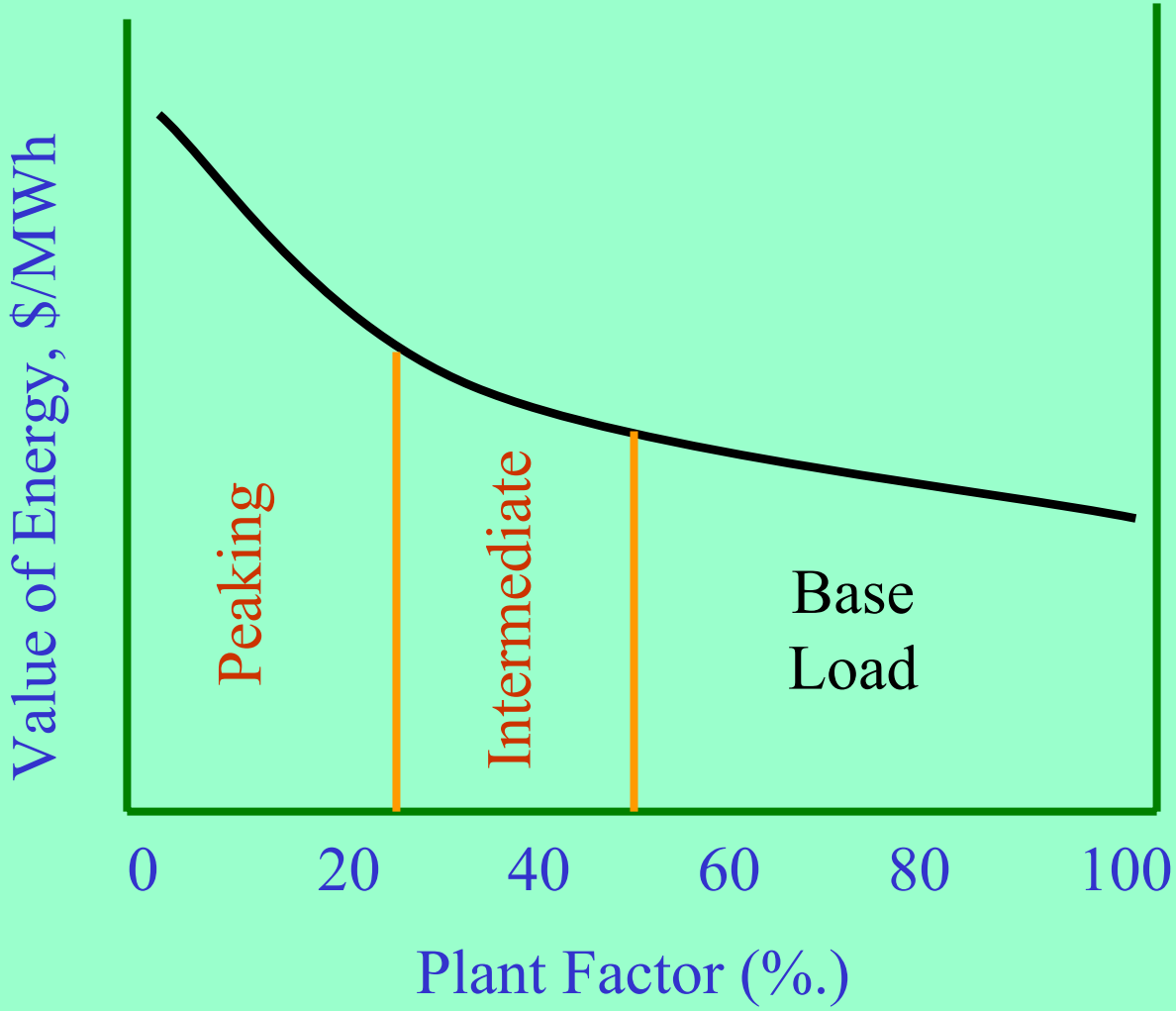
Average Value of Energy Displaced ≈ 32 $/MWh

Use of Hydropower for Peaking Generation



Average Value of Energy Displaced ≈ 44 $/MWh

Variation of Value of Energy with Plant Factor



Hydropower Principles

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Plant Factor
(Load Factor)

$$\text{P.F. (\%)} = \frac{\text{(energy)}}{\text{(time)(capacity)}}$$

Energy in MWh

time in hours

capacity in megawatts

Original Corps Design Criteria

"Unless the project is an unusual one, and unless otherwise directed by the Office, Chief of Engineers, a load factor of 20 to 25 percent should be adopted for the determination of hydro installations."

25 Percent Plant Factor Criteria

The project must be capable of generating six hours a day at full capacity under adverse water conditions.

Capacity

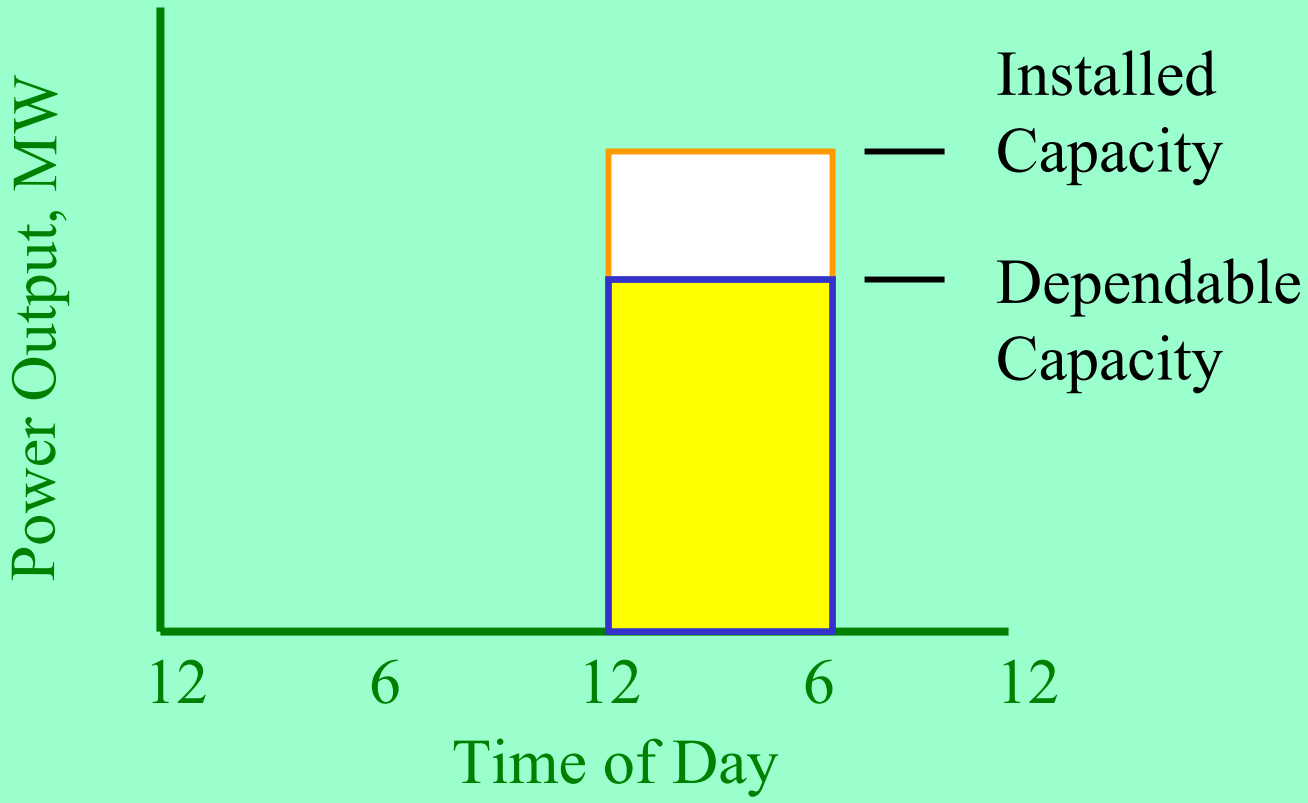
"The maximum load for which
a generator or powerplant is designed to
carry under specified conditions
(such as temperature, head, etc.)"

Dependable Capacity

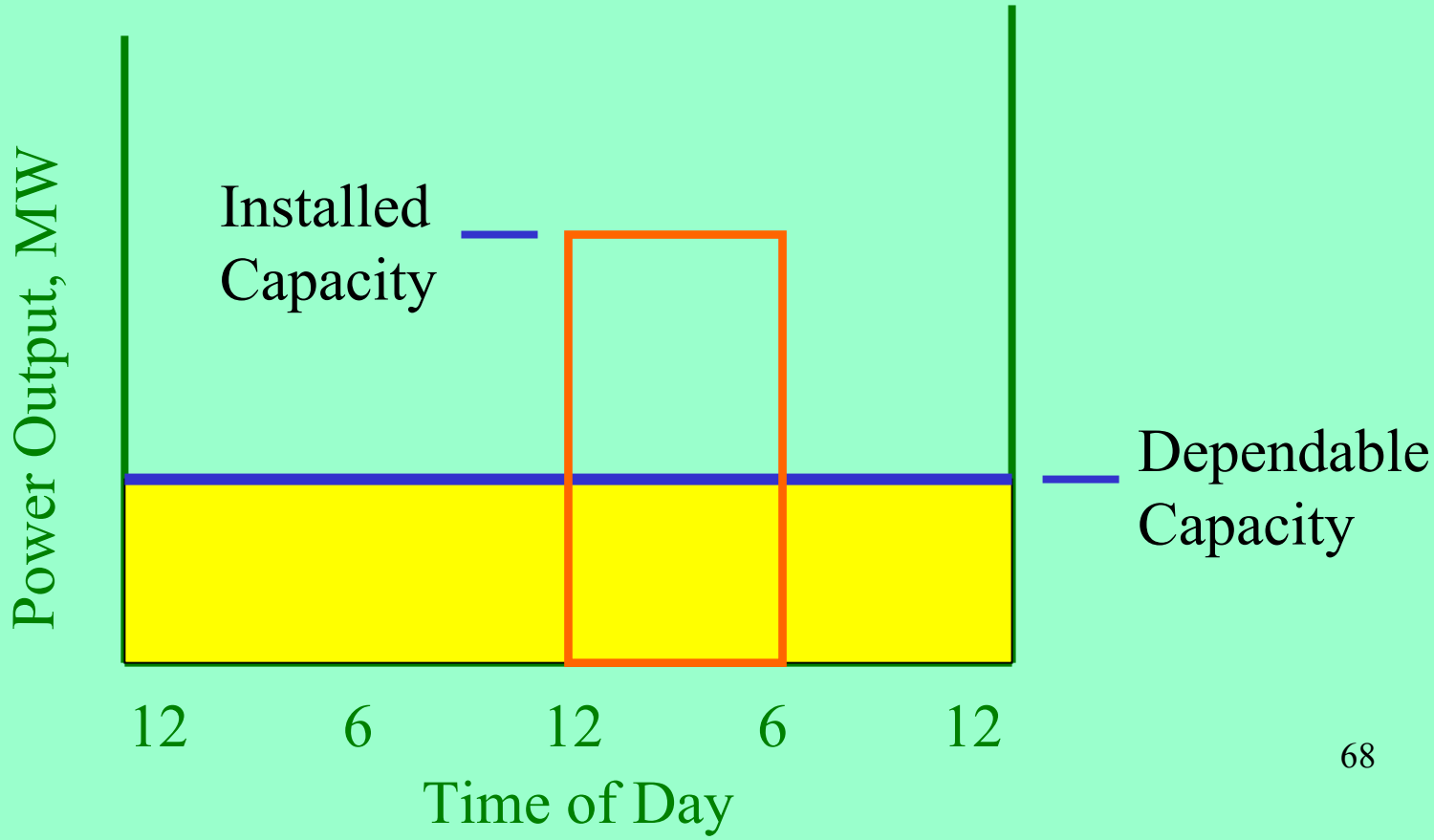
The load-carrying capability of a plant or system

- under adverse conditions
- for the time interval and period specified
- when related to the characteristics of the load

Energy (water) is required to make capacity dependable



Energy (water) must be available when needed for capacity to be dependable.



Capacity Benefit

The fixed costs of constructing and operating the most likely alternative thermal powerplant

- primarily the amortized construction cost
- based on dependable capacity, not installed capacity

1. **Criteria for Dependable capacity**

2. **System Considerations**

Hydropower Principles

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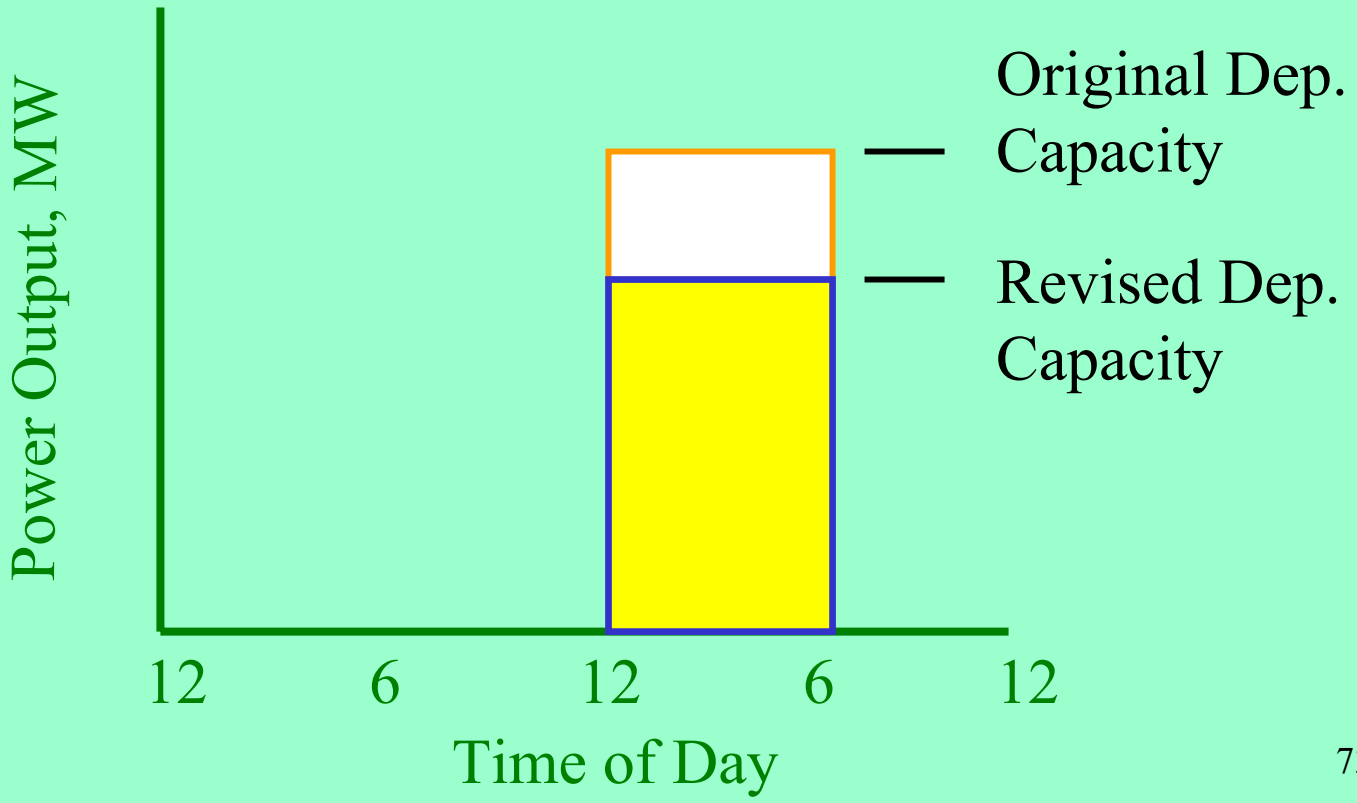
6. Dependable Capacity
7. **Impact of Operational Changes**
8. Cost Allocation

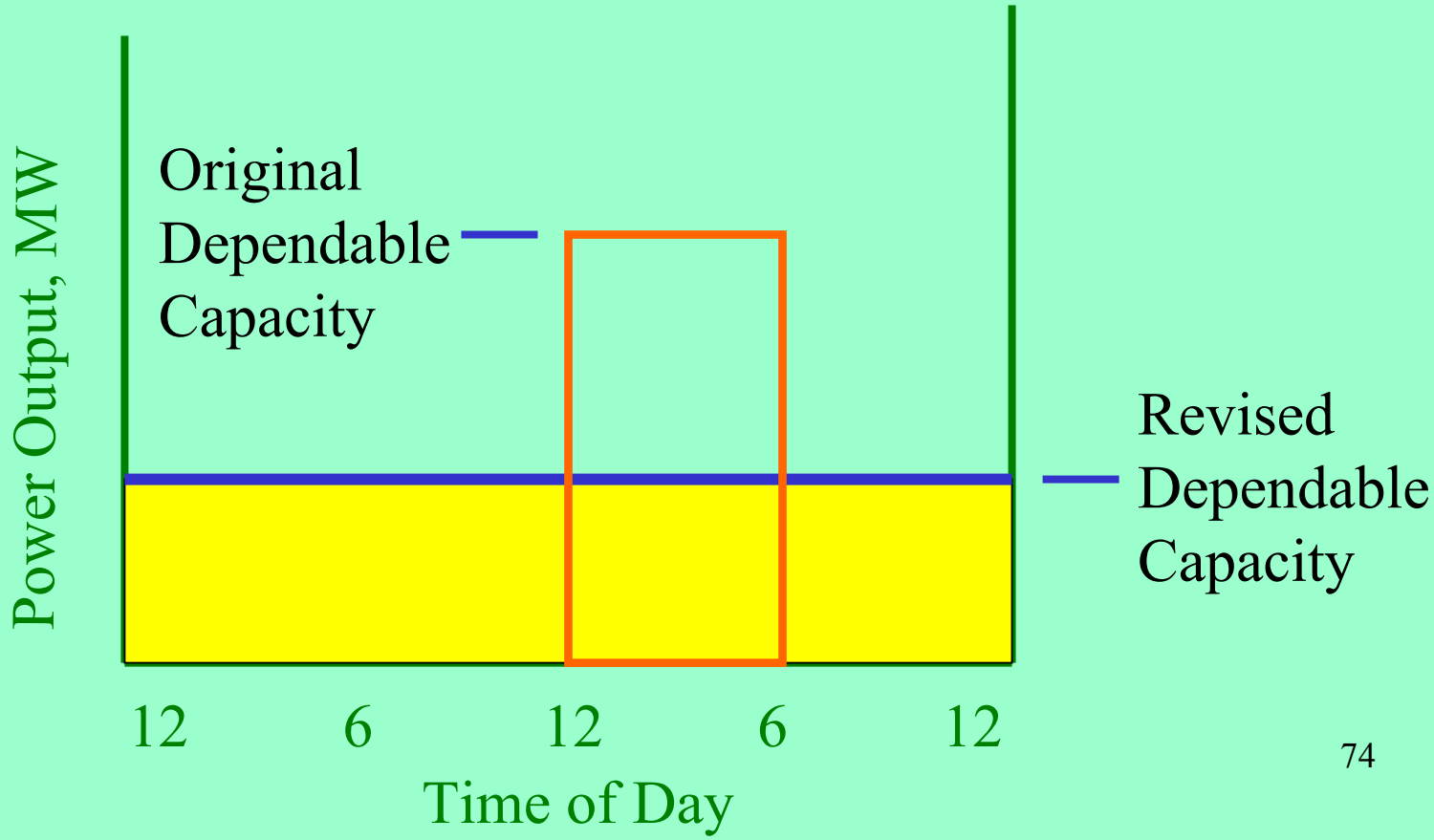
Impact of Operational Changes on Hydropower

1. Water Supply Withdrawals
2. Fixed Flow Requirements
3. Variable Flow Requirements
4. Limits on Use of Storage

Impact of Water Supply Withdrawal on Dependable Capacity



Impact of Fixed Flow Requirements on Dependable Capacity



Impact of Operational Changes on Hydropower

1. Water Supply Withdrawals
2. Fixed Flow Requirements
3. Variable Flow Requirements
4. Limits on Use of Storage

Hydropower Principles

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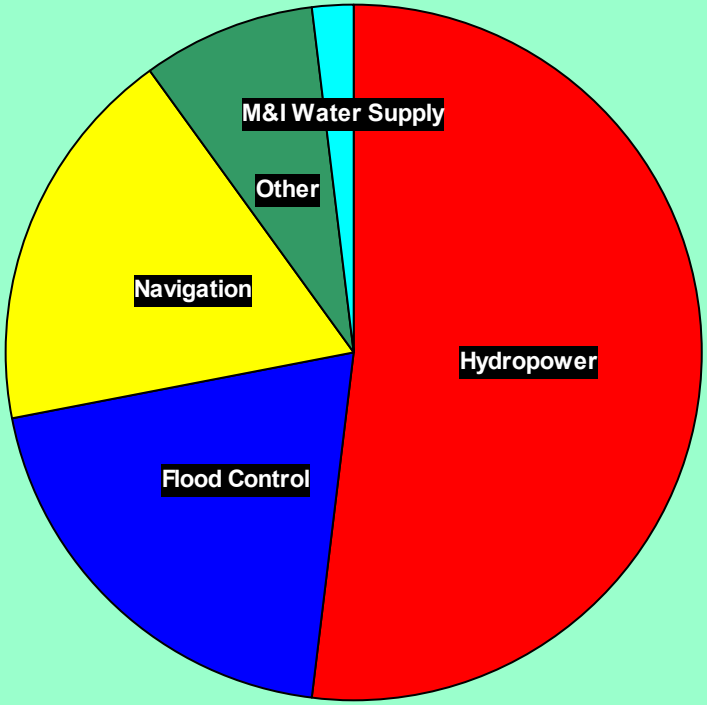
8. **Cost Allocation**

Cost Allocation

Purpose is to determine how the costs of constructing and operating a project are to be covered

(i.e., how much does each beneficiary pay)

Hypothetical Cost Allocation

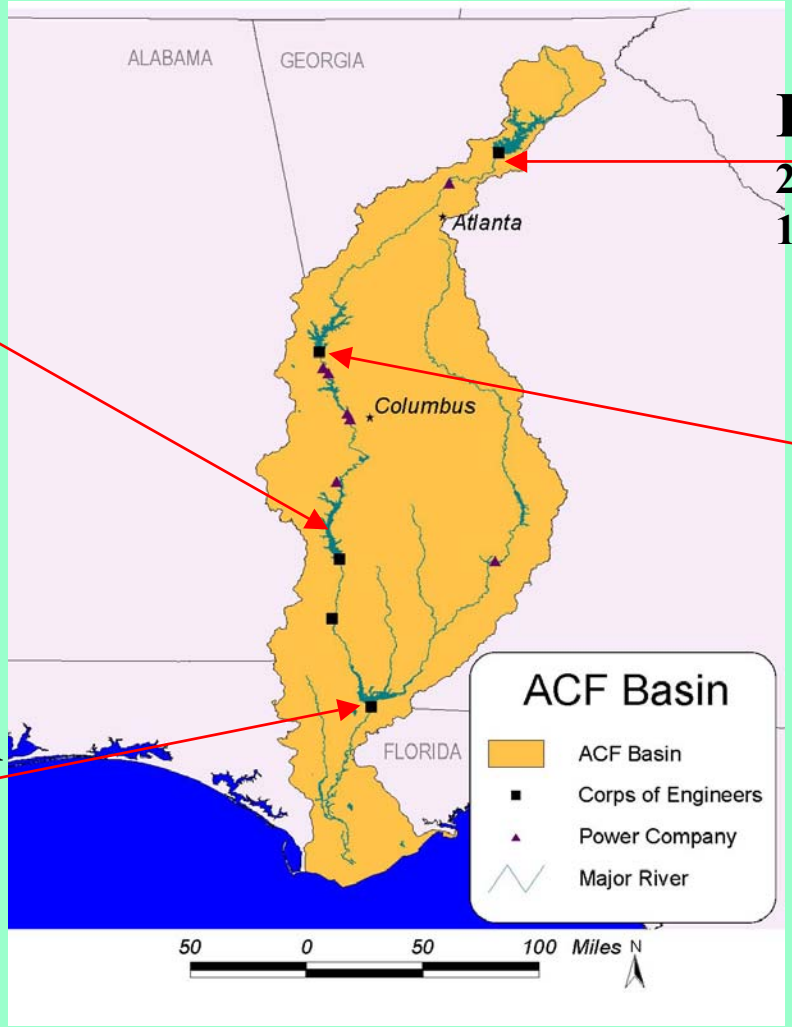


Project Operations for Hydropower

ACF River System
Federal Power Projects

Walter F. George Dam
4 turbines – 32.5 MW each

Jim Woodruff Dam
3 turbines – 14.5 MW each



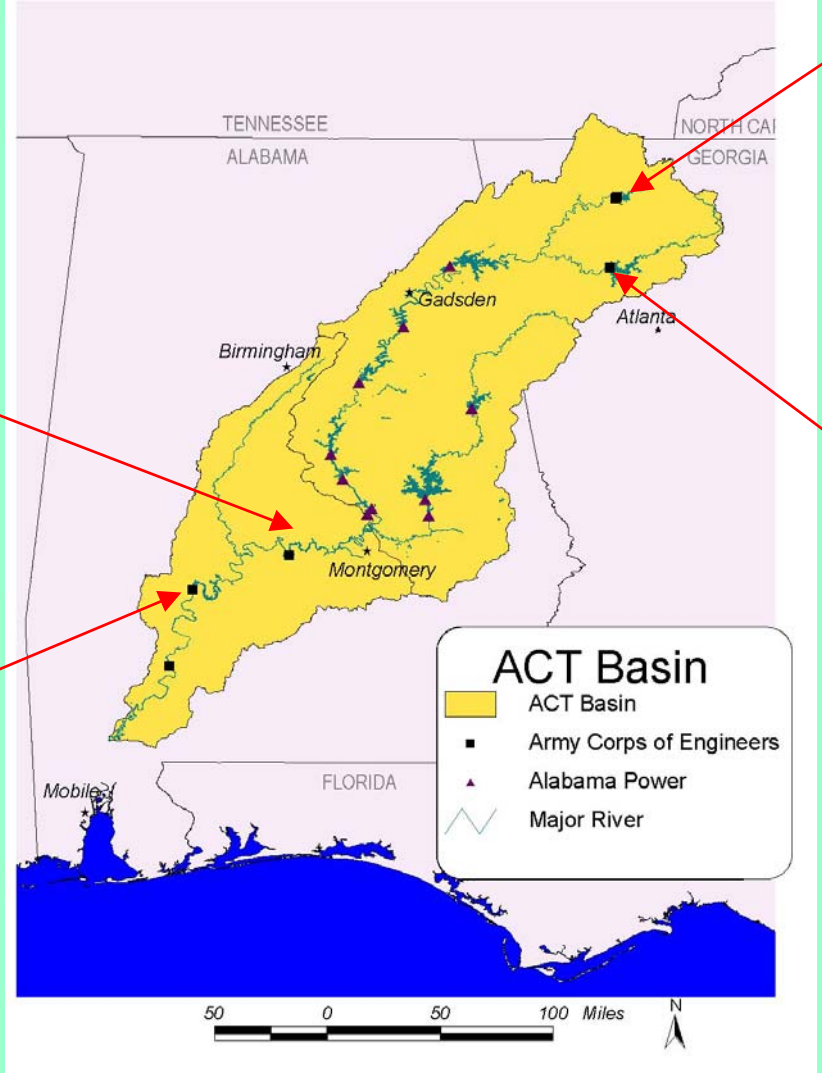
Buford Dam
2 large turbines - 40 MW each
1 small turbine – 5 MW

West Point Dam
2 large turbines - 35 MW each
1 small turbine – 3 MW

ACT River System
Federal Power Projects

Carters Dam
4 turbines – 125 MW each

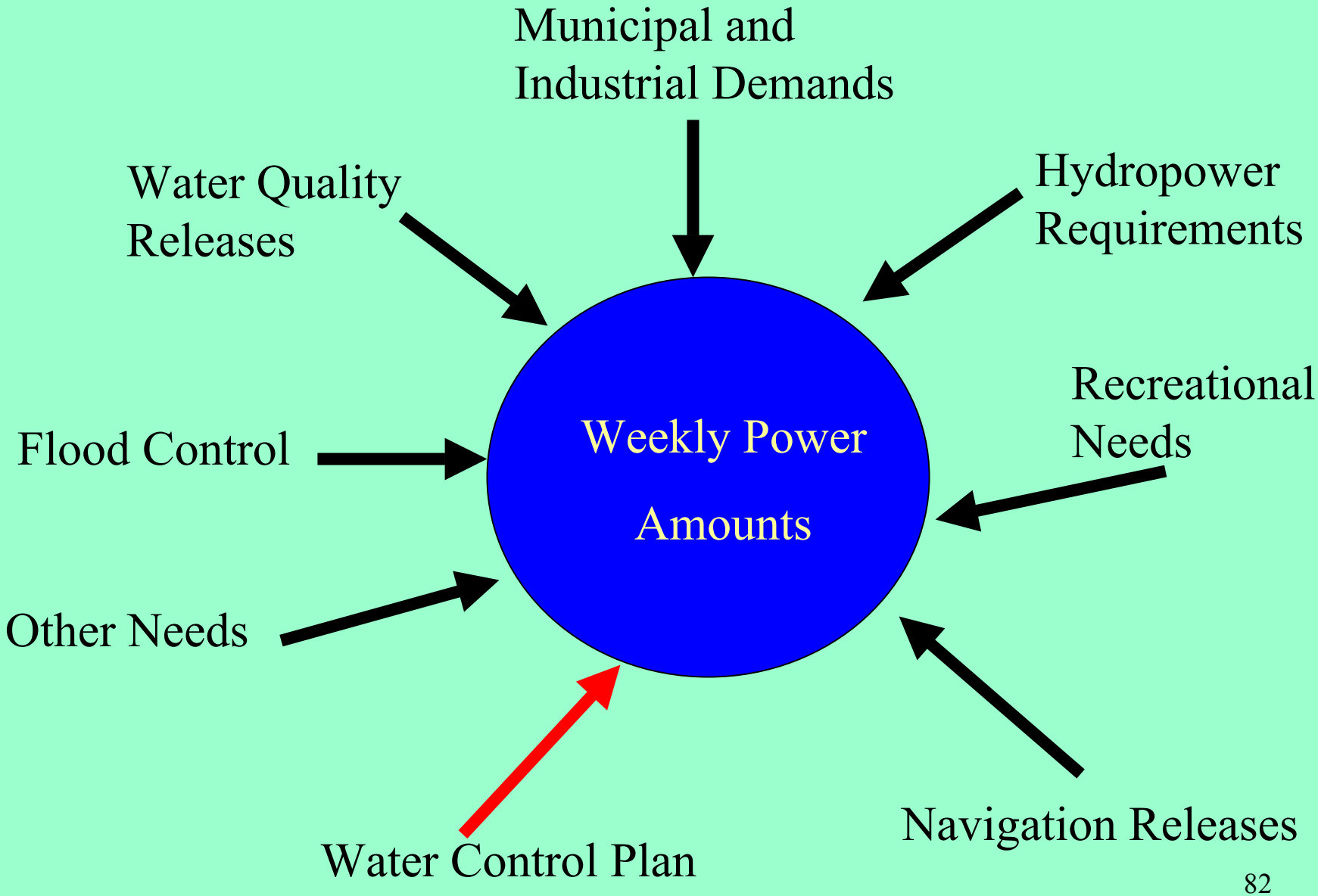
R.F. Henry
4 turbines – 17 MW each



Allatoona Dam
2 large turbines - 40 MW each
1 small turbine – 2 MW

Millers Ferry
3 turbines – 25 MW each

Decision-making for Weekly Power Releases



Water Management Power Declaration Process

- Downstream flow needs from each lake are determined based on various project purposes with consideration made for impact to lake levels in accordance with Water Control Plan Action Zones.
- Weekly discharge amounts are converted into megawatt-hours at each project to determine amount of power generated at specific project.
- Total generation for all projects compared against monthly SEPA contract requirements and more generation may be added to a specific project if available.

Water Management Power Declaration Process

- If a shortfall occurs, meeting contract requirements coordination is done with SEPA, and Savannah and Mobile Districts to help meet the contract amounts.
- Weekly declaration submitted to SEPA on Wednesday afternoon. This provides them with an overview of what the available generation for upcoming week will be.
- Daily review of flow needs made each morning by Water Management. SEPA is provided with the desired amount of generation for each project. A maximum and minimum range to operate within for upcoming day is also specified.
- From this information and information from scheduling customers, SEPA determines the actual hours of generation. SEPA prepares the following day's schedule of generation and sends schedules to projects. Copies also provided to Water Management Section.

SEPA Power Declaration Process

- Customers are provided their allocated portions of the generation made available at the projects on a weekly/daily basis.
- Customers blend their SEPA allocations in with their other generation resources and develop hourly schedules which will meet their anticipated load.
- Customers provide SEPA with hourly generation schedules for their SEPA declared power.

SEPA Power Declaration Process

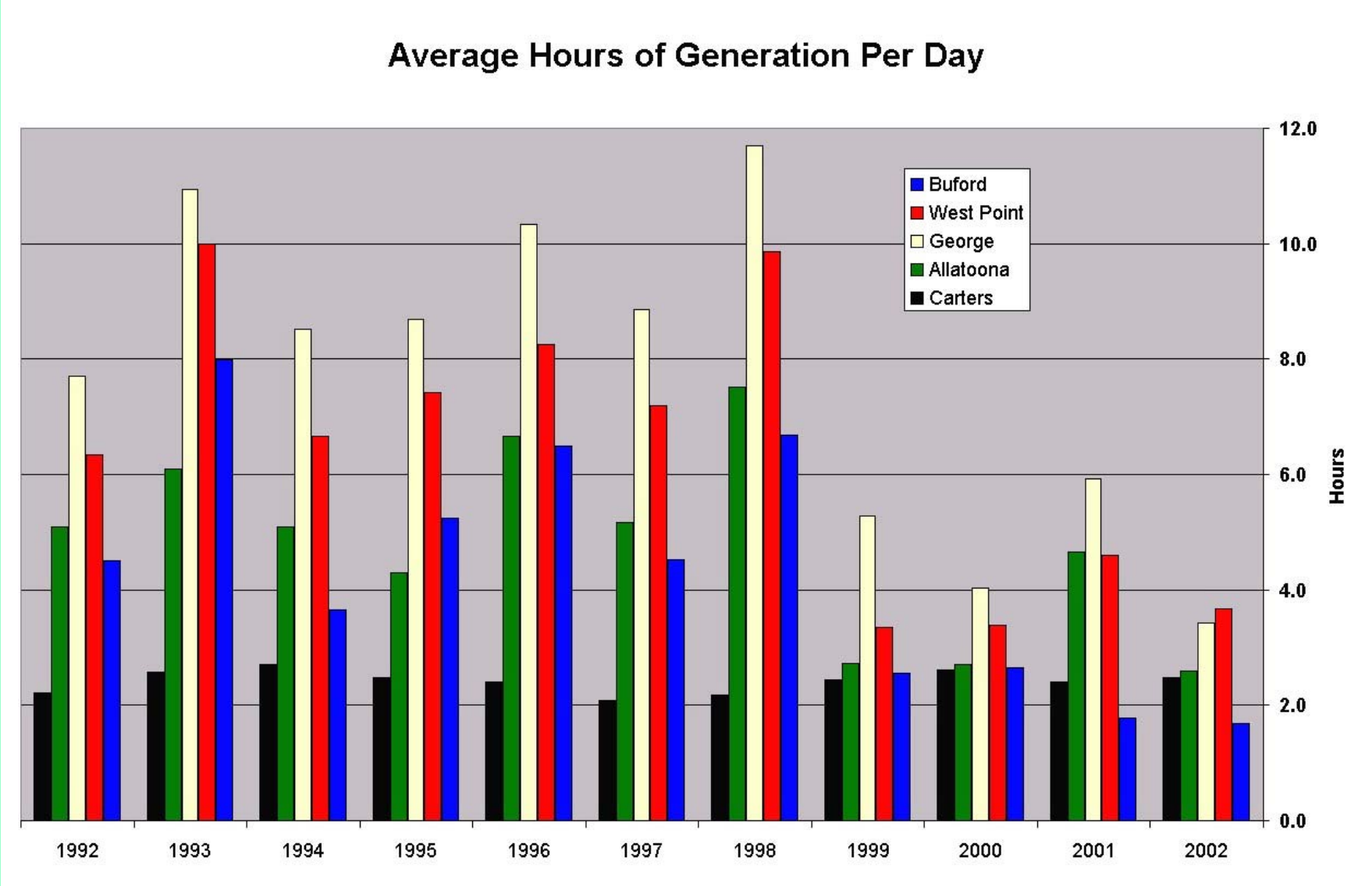
- Customers schedules are blended together by SEPA to develop composite plant schedules which take into account all of the weekly/daily criteria established by COE Water Management.
- Composite schedules are supplied to plant operators who in turn run the units to meet the hourly requirements.
- Customers schedules are modified as required.

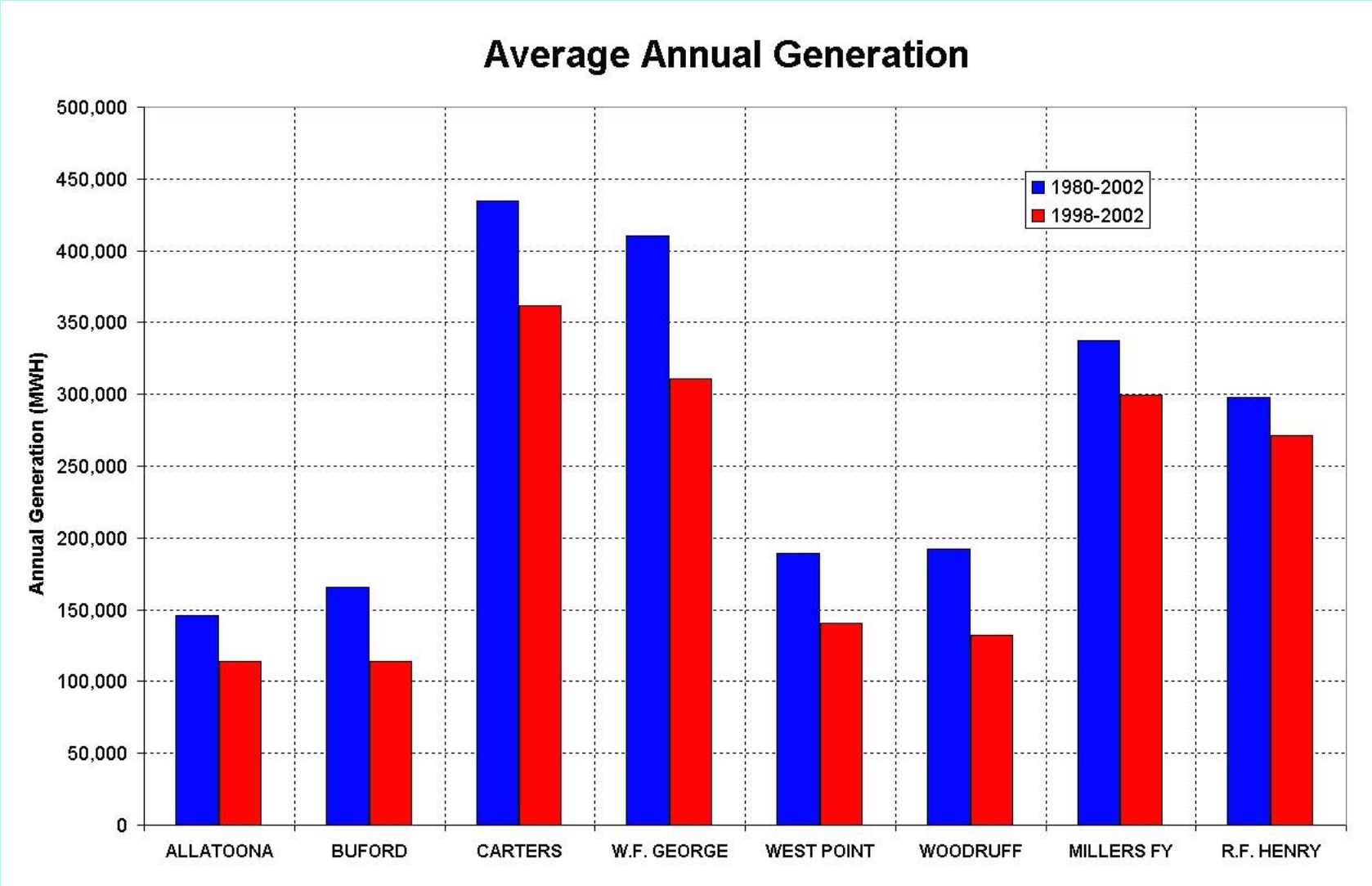
Water Management Power Declaration Process

Special situations such as outages for search and rescue, oil spills, downstream events, and other activities may require adjustments to generation amounts and are coordinated with SEPA.

SEPA System Energy Minimum Contract Requirements

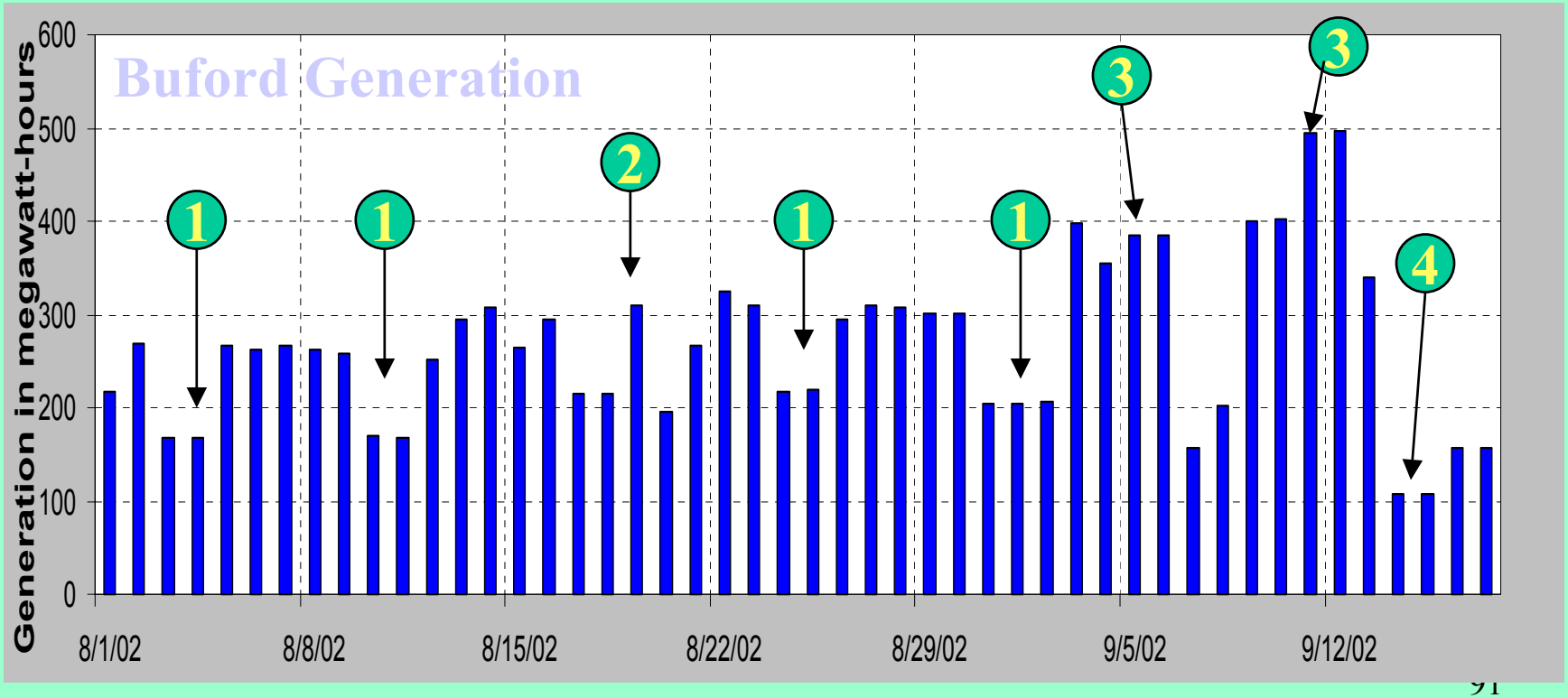
	megawatts-hours
January	40020
February	40070
March	38540
April	38450
May	38350
June	39730
July	46095
August	51785
September	44870
October	39430
November	38900
December	39760


Average Hours of Generation Per Day
Buford
West Point
George
Allatoona
Carters
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Hours
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

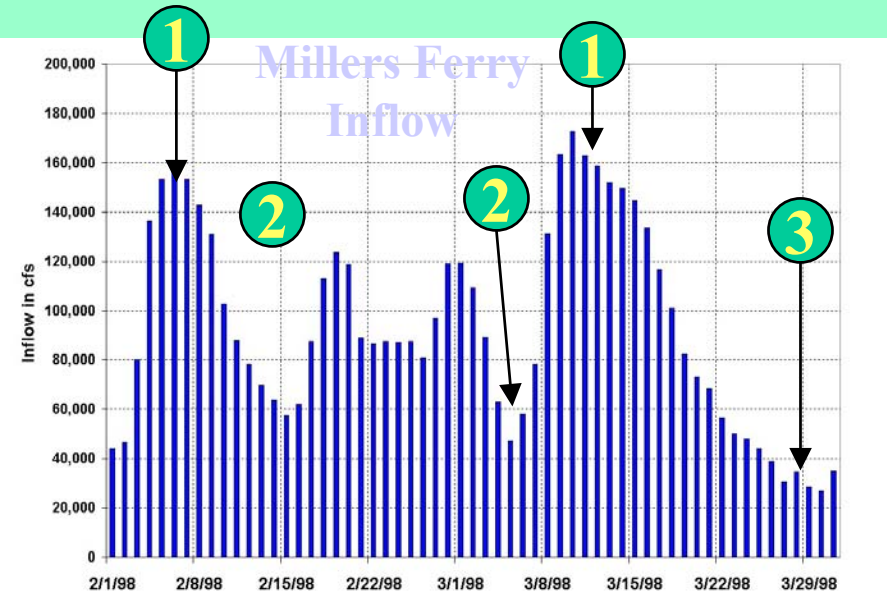

Average Annual Generation
Annual Generation (MWH)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1980-2002
1998-2002
ALLATOONA
BUFORD
CARTERS
W.F. GEORGE
WEST POINT
WOODRUFF
MILLERS FY
R.F. HENRY

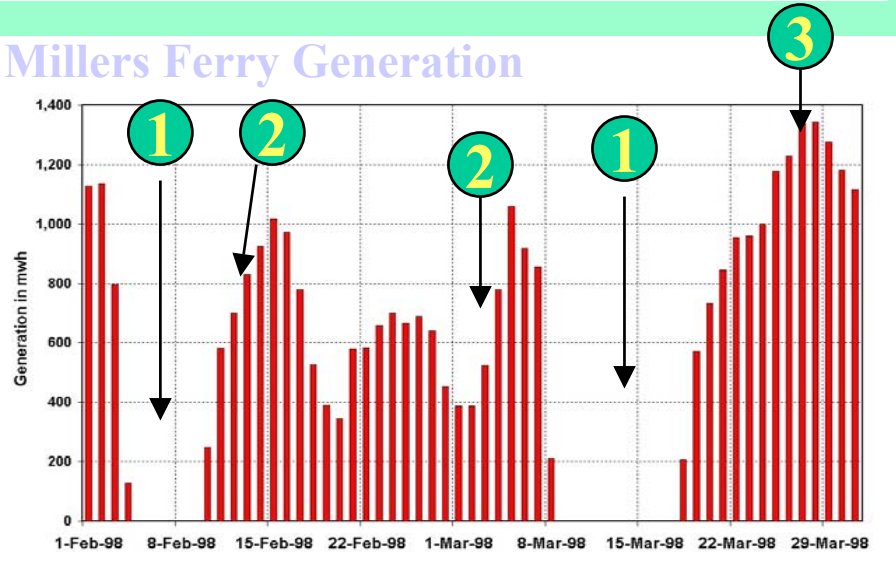
Example Low Water Scenario

1. Weekend generation is usually lower due to lower power demand. Morgan Falls is filled by Friday to meet flow needs over weekend.
2. Increased generation to maintain Morgan Falls level.
3. Generation increased to support declining flows on lower system.
4. Rainfall occurs across entire basin. Most of Atlanta area needs met by rainfall runoff. Lower river system no longer needs support from Buford.



Example High Water Scenario



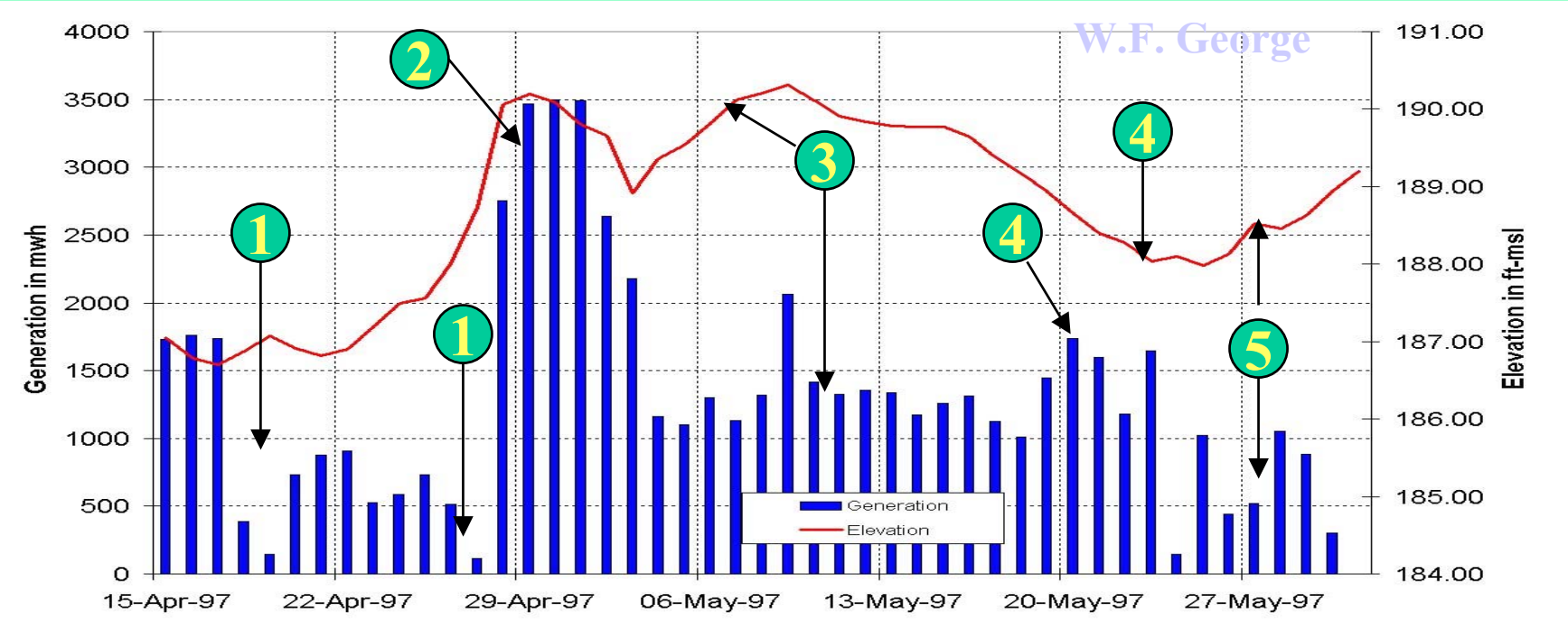


Operations at Run-of-River Project

1. Inflow into project reaches very high levels. Dam loses head and turbines are flooded down, thus unable to generate power.
2. Inflows begin to decline. Some generation becomes possible.
3. Inflows decline to moderate level. Full generation available again.

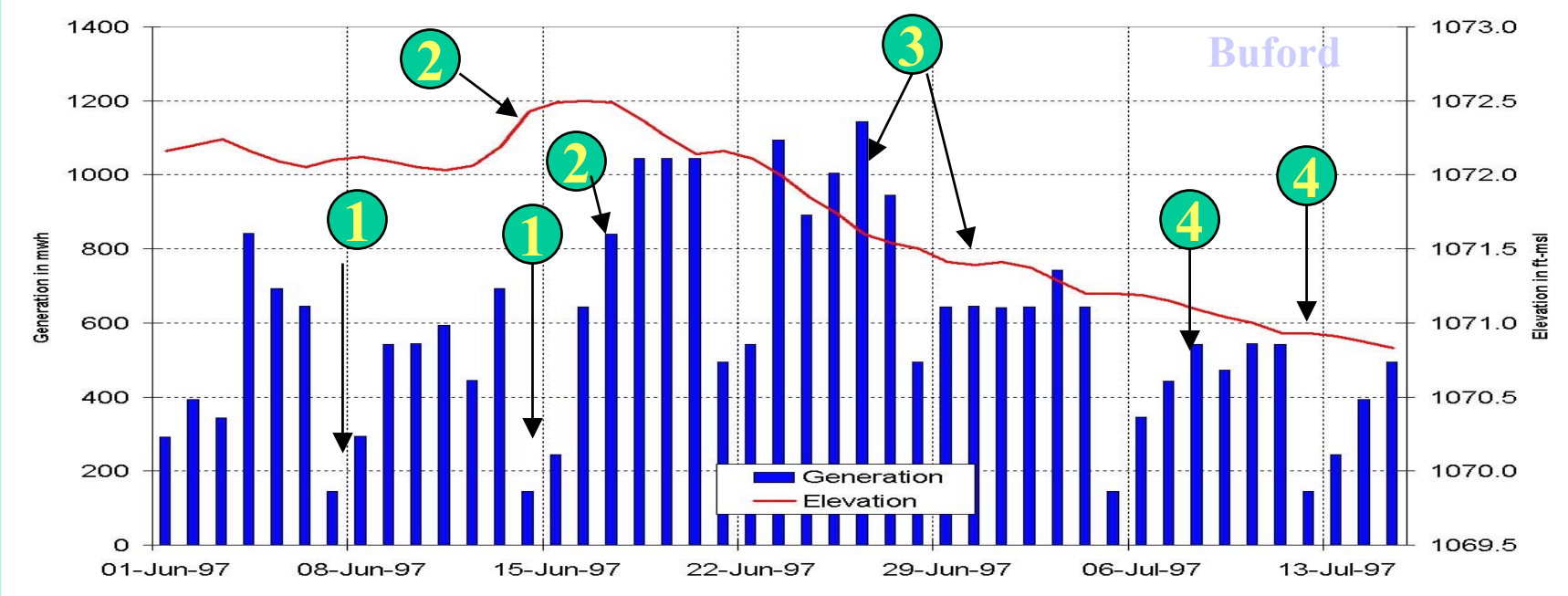
Example Normal Water Scenario 1

1. Weekend generation is usually lower due to lower power demand.
2. Storm event results in heavy generation – 24 hours/day with some releases made through spillway. As storm event subsides, spillway closed and generation is reduced.
3. Lake continues to fill and generation continues at rate to meet peak hours. Heavy weekend generation is necessary.
4. Moderate generation continues as lake is brought back to Winter Pool level.
5. As lake returns to normal range, generation is reduced accordingly.



Example Normal Water Scenario 2

1. Weekend generation is usually lower due to lower power demand.
2. Lake level increases due to rain event. Generation is increased to maintain lake at reasonable level as summer approaches.
3. Peaking energy demand increases as summer heats up. Lake level begins to decline but still above summer top of conservation.
4. Generation reduced as lake level continues to fall. Energy to meet System contract requirements are supported by other projects if Buford cannot support larger share.



Marketing Hydropower

Southeastern Power Administration (SEPA)

Southeastern Power Administration

- SEPA was created in 1950 to carry out the functions assigned to the Secretary of Interior by the Flood Control Act of 1944.
- SEPA markets energy generated at 23 U. S. Army Corps of Engineers hydro electric projects located in the Southeastern United States.
- SEPA's marketing area covers 11 Southeastern states and is comprised of four Systems, the Georgia-Alabama-South Carolina, Cumberland, Kerr-Philpott, and Jim Woodruff.

Southeastern Power Administration

- In accordance with the Flood Control Act, generation is marketed in a manner which encourages the most widespread use at the lowest possible rates.
- Preference in the sale of power is given to public bodies and cooperatives.

Southeastern Power Administration

- Generation from the ACF projects of Buford, West Point, and Walter F. George along with the ACT projects of Allatoona, Carters, R.F. Henry, and Millers Ferry is marketed as part of the Georgia-Alabama-South Carolina System.
- Generation from this system provides benefits to 186 Preference Customers located in Georgia, Alabama, South Carolina, North Carolina, Mississippi, and Florida.

Southeastern Power Administration

- Generation from the Jim Woodruff project is marketed in the Jim Woodruff System.
- Generation from this system provides benefits to 7 Customers located in Florida.

Southeastern Power Administration

- SEPA is responsible for the negotiation, preparation, execution, and administration of contracts as well as the numerous utility responsibilities involved in the scheduling, delivery, and sale of power.
- SEPA is also responsible for the repayment of the Federal investment, which has been allocated to the power purpose, to the United States Treasury, including interest.

Southeastern Power Administration

- Rates are developed which provide for the repayment of capital costs over a fifty year period and operation and maintenance costs on an annual basis. Rates are based on a system operation in which the projects are hydraulically, electrically, and financially integrated.
- Rates are approved on an interim basis by the Secretary of Energy and on a final basis by the Federal Energy Regulatory Commission.
- SEPA repays 100% of the specific power costs as well as a percentage of the joint costs for each project.

Southeastern Power Administration

Current cost allocation by project:

Project	Percent of Costs
Buford	74 %
West Point	41 %
George	57 %
Woodruff	59 %
Allatoona	68 %
Carters	85 %
M. Ferry	59 %
R.F. Henry	63 %

Southeastern Power Administration

- SEPA's current contracts extend through the year 2016.
- SEPA's current contractual obligations are based on the 1981 hydrologic conditions.
- If adverse hydrologic conditions are encountered, similar to the 1981 conditions, SEPA purchases replacement energy on the open market in order to conserve the water resource and preserve the capacity and operating flexibility at the projects.

Southeastern Power Administration

- Since May of 1999 SEPA has purchased approximately 900,000 MWH of replacement energy at a cost in excess of $ 45.5 million for the Georgia-Alabama-South Carolina System.

Allocation Formula Implementation

Approach for Implementation of ACT and ACF Water Allocation Formulas

- ACT and ACF Compacts require implementation of the allocation formulas
  - to maximum extent practicable
  - consistent with existing Federal law

Approach for Implementation of ACT and ACF Water Allocation Formulas (cont'd)

- Prepare revision to Water Control Manuals and Plans upon agreement on an allocation formula
  - Include measures within current Congressional authorization and the discretion of District Engineer
  - Partial implementation of the allocation formulas
- Conduct implementation studies

Approach for Implementation of ACT and ACF Water Allocation Formulas (cont'd)

- Revise water control plans upon approval of implementation study recommendations
- Water supply reallocation studies
  - Official request
  - Budgeting and funding
  - Complete the study, including NEPA compliance
  - Congressional authorization of reallocation of storage

Approach for Implementation of ACT and ACF Water Allocation Formulas (cont'd)

- Prepare and execute storage contracts
  - Storage space purchased
  - Regulation and right to use of water
  - Measurement of withdrawals and releases
  - Payment
  - Permanent rights to storage

Example Reallocation Report

- Municipality requested reallocation of storage to support 2040 needs
- Alternatives considered
  - Use of other Corps lakes
  - Construction of a single purpose water supply reservoir
  - Reallocation of storage from the flood control pool
  - Reallocation of storage from the conservation pool

Example Reallocation Report
(cont'd)

- Cost of Storage (January 1992 price level)
  - Hydropower Benefits Foregone ($3.3M)
  - Hydropower Revenues Foregone ($1.9M)
  - Replacement Cost ($3.3M)
  - Updated Cost of Storage ($9.0M)

Example of Paying for Increments of Reallocated Storage

- Sponsor desired to contract for two increments of storage
- First increment would satisfy 2016 need
- Cost of Storage
  - 1st increment = $4.6 million
  - 2nd increment = $4.6 million subject to appropriate cost indexing and interest rate adjustments
  - Interest 6-1/8%
- O&M
  - 1st increment =1.75% of actual O&M for preceding FY
  - 2nd increment = 1.75% of actual O&M for preceding FY
- Annual Cost = $336,600

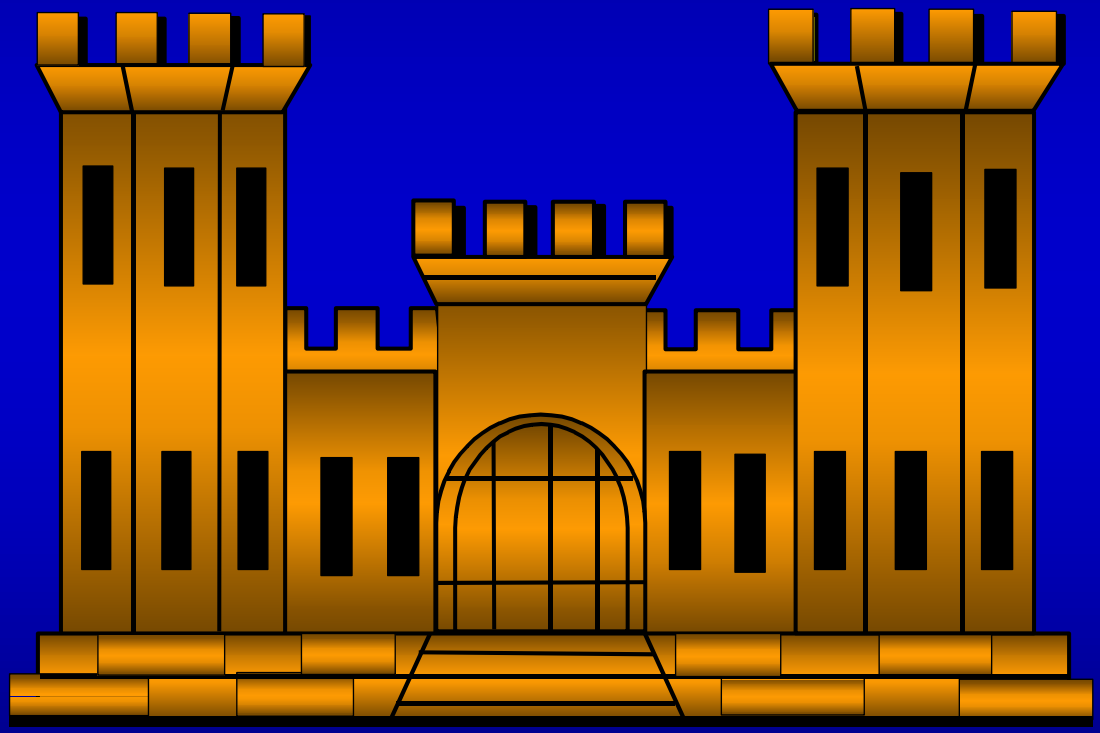
Example of Paying for Increments of Reallocated Storage

- Repayment Provisions – 1st Increment
  - Project Investment Cost plus reconstruction, rehabilitation, and replacement costs plus annual operation and maintenance costs
  - 30-years from the date of the initial payment
  - Equal consecutive annual payments
  - First payment due within 24 months after storage contract is approved or within 30 days of first use of storage
  - Interest Rate determined by Department of Treasury
  - Water Resources Development Act of 1986, Section 932
  - Interest Rate Adjusted every five years

Example of Paying for Increments of Reallocated Storage

- Repayment Provisions – 2nd Increment
  - Project Investment Cost plus reconstruction, rehabilitation, and replacement costs plus annual operation and maintenance costs – subject to indexing
  - 30-years from the date of the initial payment
  - Equal consecutive annual payments
  - First payment due within 30 days of first use of storage or January 1, 2016, whichever comes first
  - Interest Rate determined by Department of Treasury
  - Water Resources Development Act of 1986, Section 932
  - Interest Rate Adjusted every five years

Mobile District



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