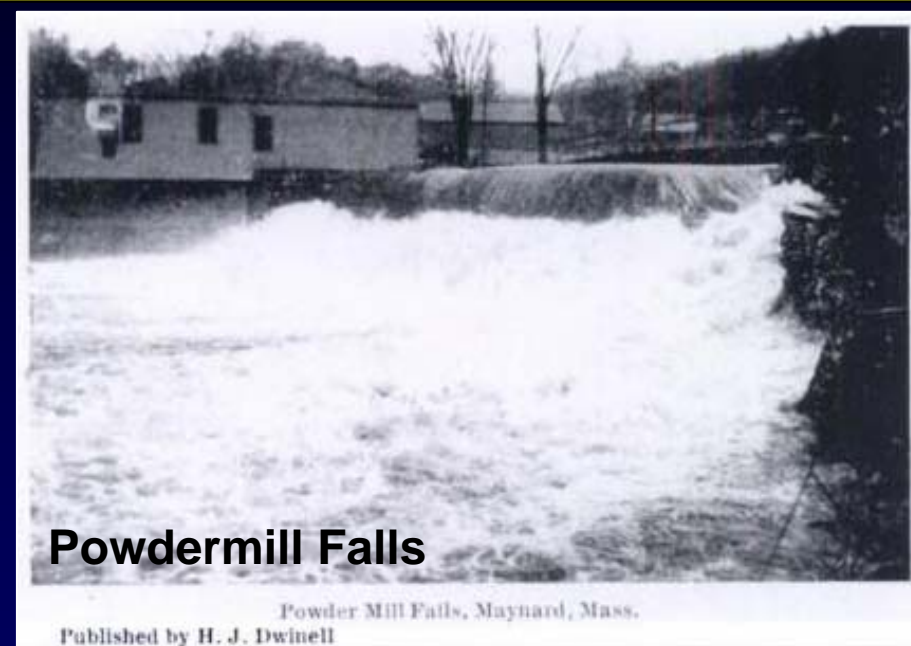
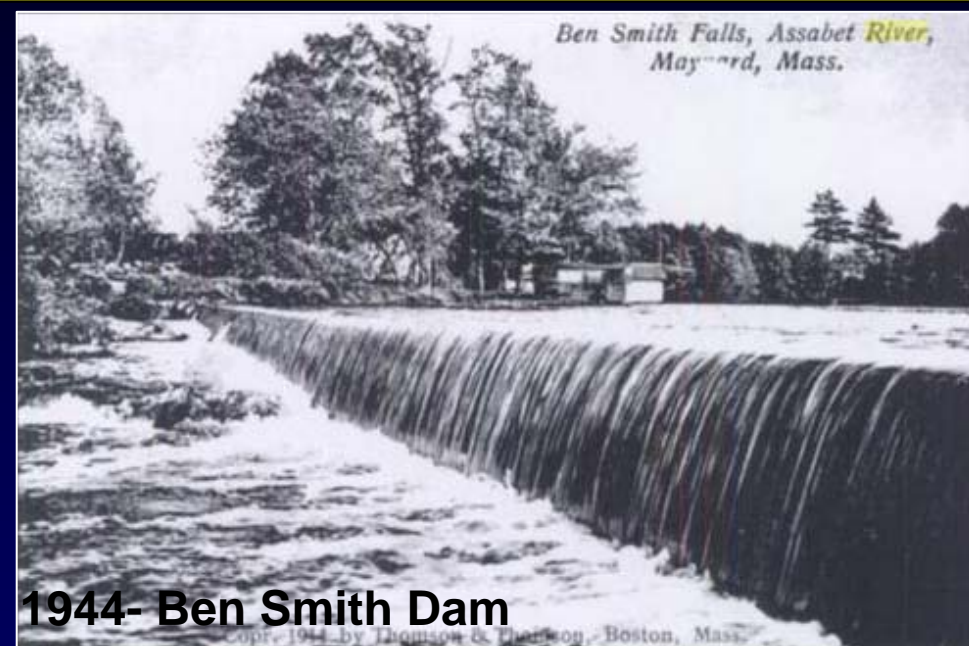


# Hydropower Feasibility at Existing Dams



Mark Wamser, PE  
Gomez and Sullivan Engineers  
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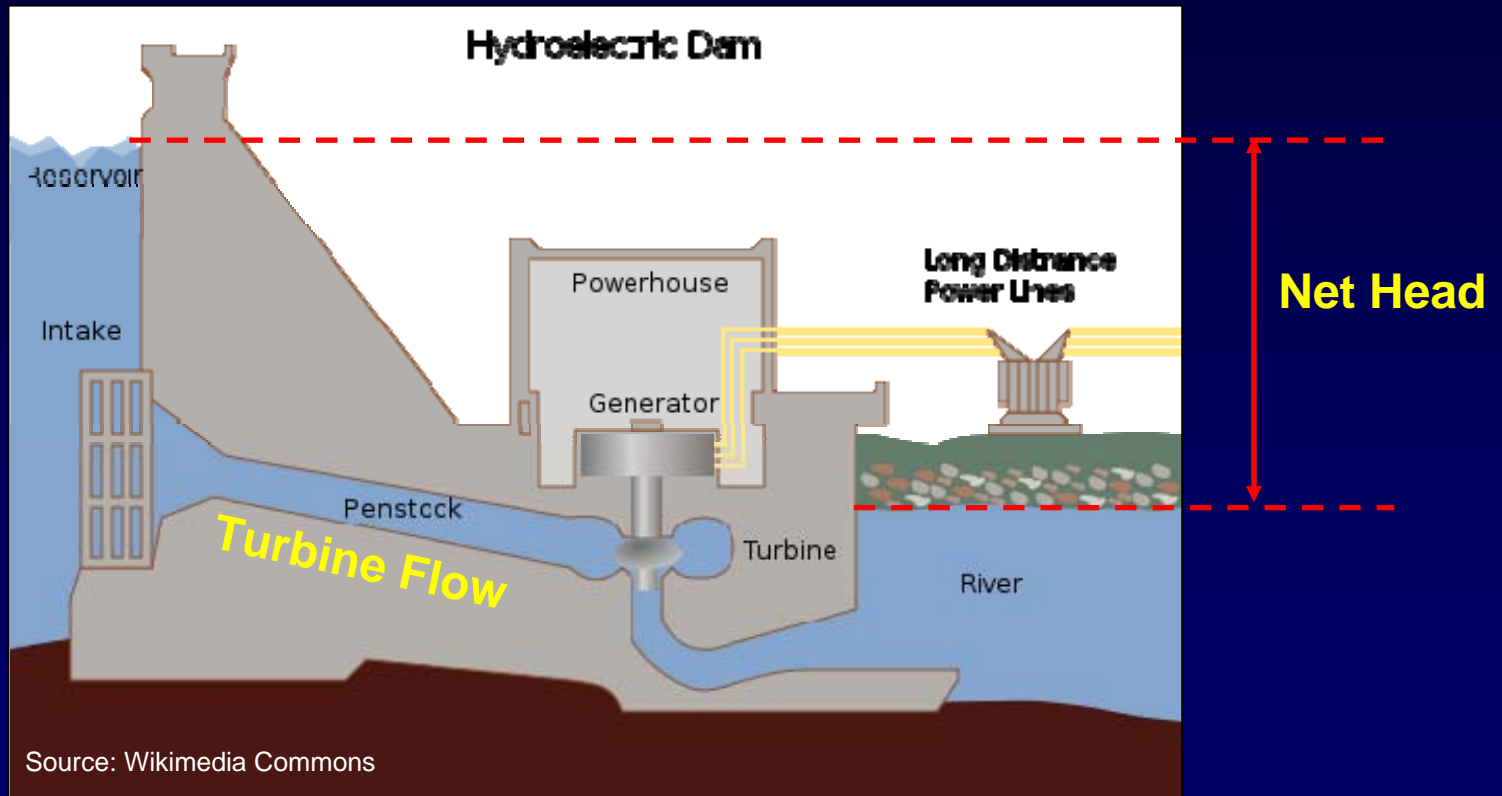
March 28, 2009

# Hydropower 101- What makes power?

Power (kW) =

Turbine Flow (cfs) x Net Head (ft) x T/G Efficiency (%)

11.8



T/G- Turbine/Generator

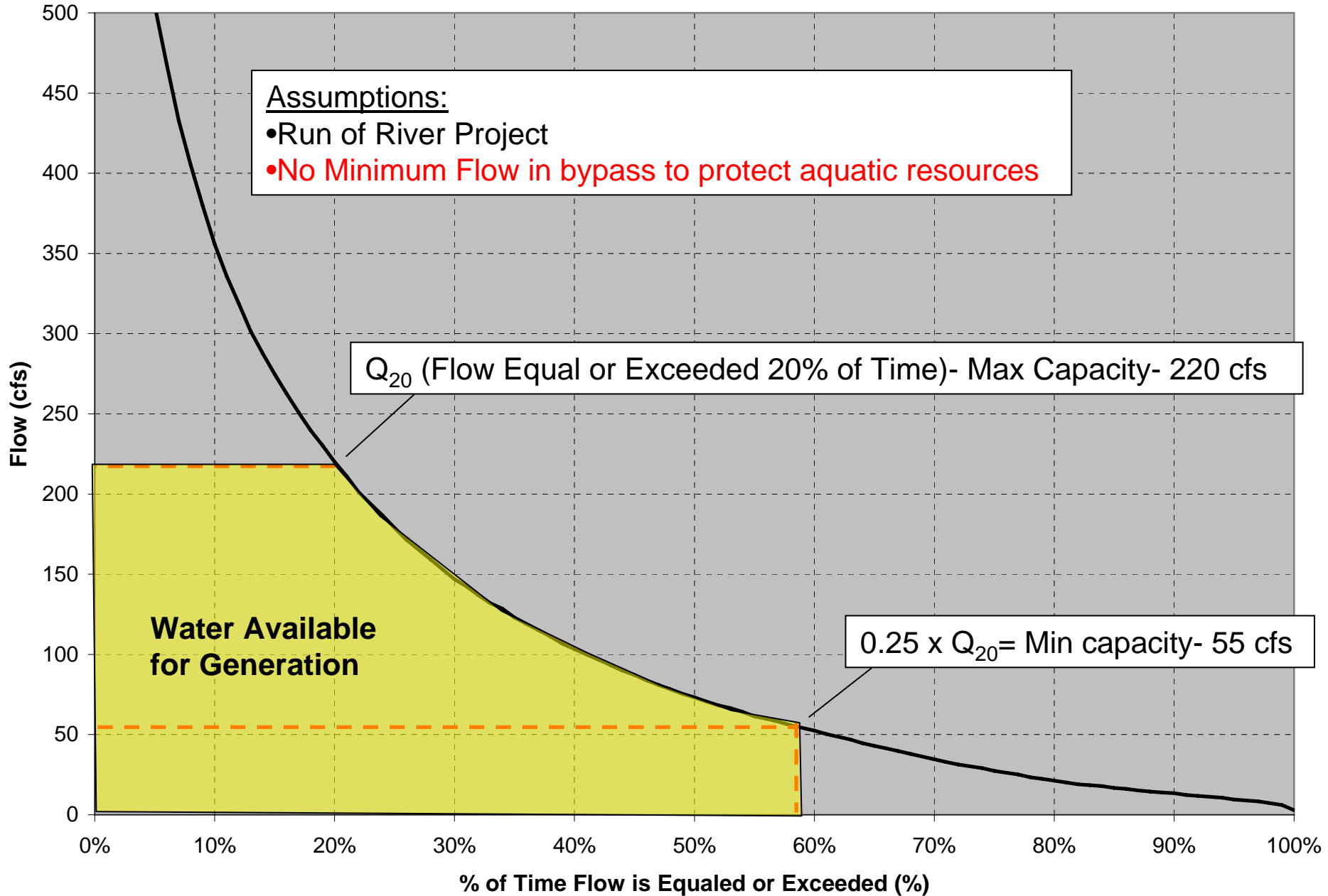
# Pre-Feasibility Study Steps for Hydropower Assessment

- Quantify flow available for generation (USGS gage)
- Estimate flow needs for aquatic resource protection- unavailable for generation
- Identify site constraints
- Estimate energy & revenue
- Estimate development costs
- Conduct preliminary economic analysis

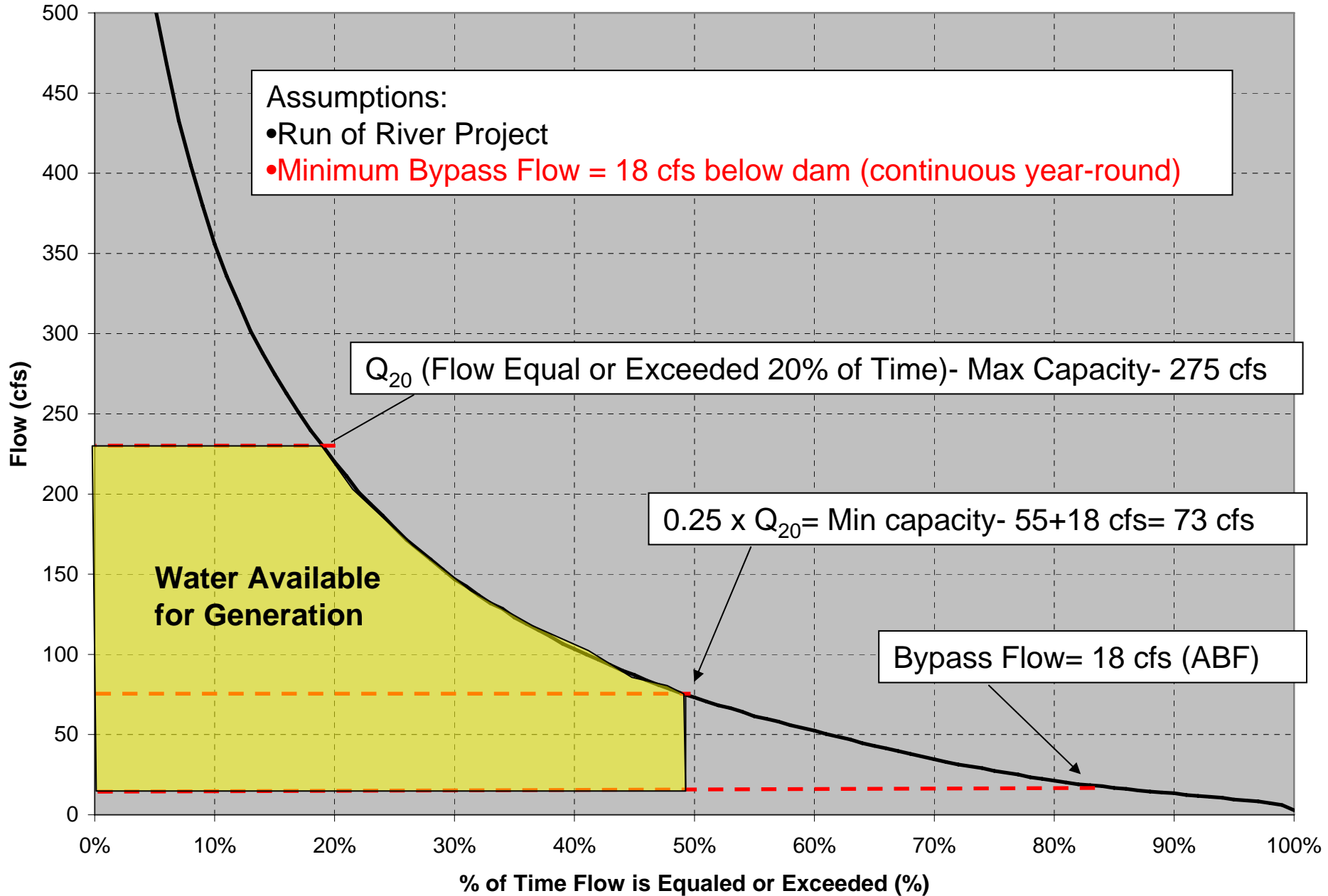
# Coopers Mills Dam, Sheepscot River, ME



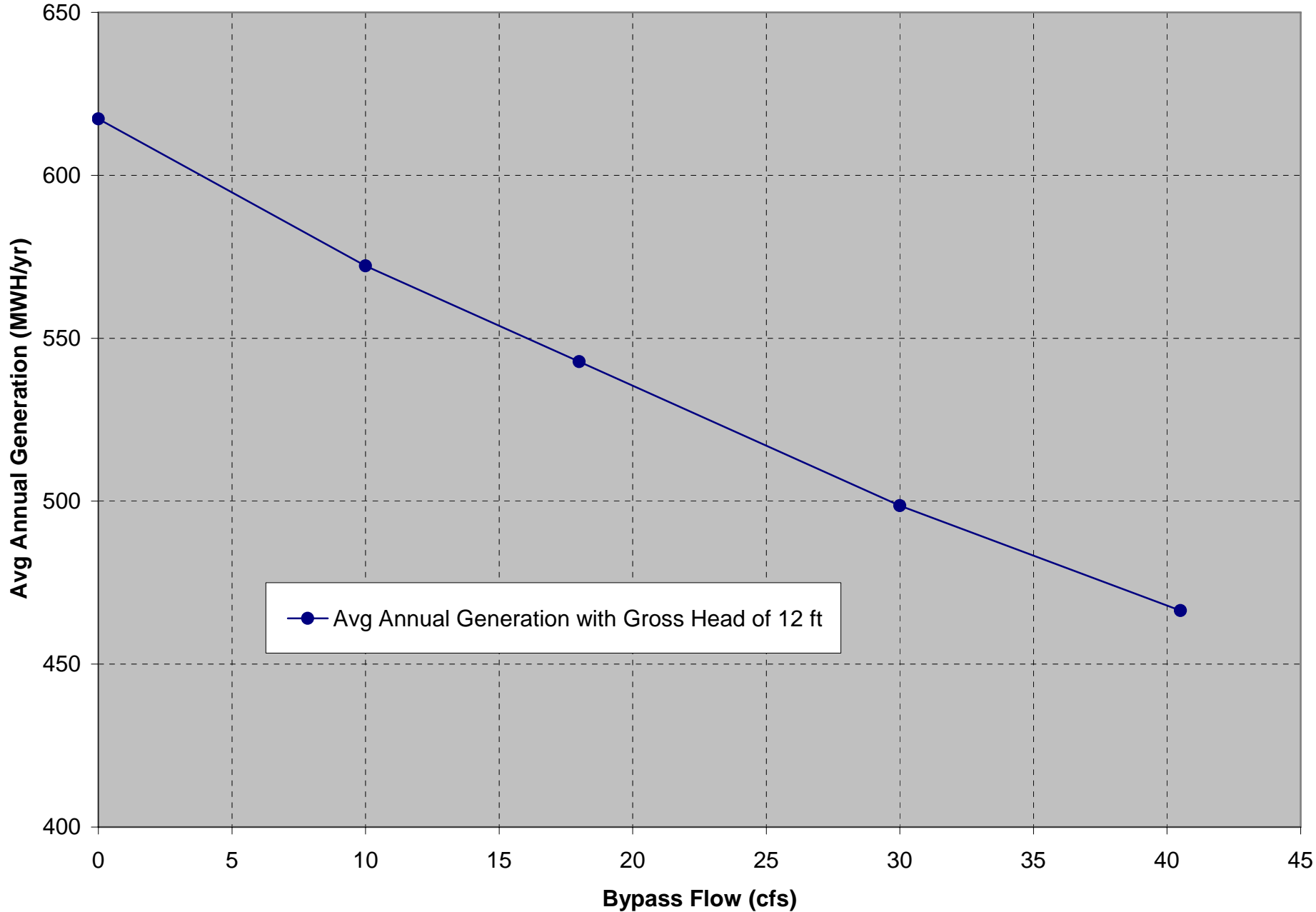
**Sheepsfoot River at Coopers Mills Dam, Average Annual Flow Duration Curve**  
**Drainage Area= 81 square miles (prorated from USGS Gage No. 01038000, 1938-2004)**



**Sheepsfoot River at Coopers Mills Dam, Average Annual Flow Duration Curve**  
Drainage Area= 81 square miles (prorated from USGS Gage No. 01038000, 1938-2004)

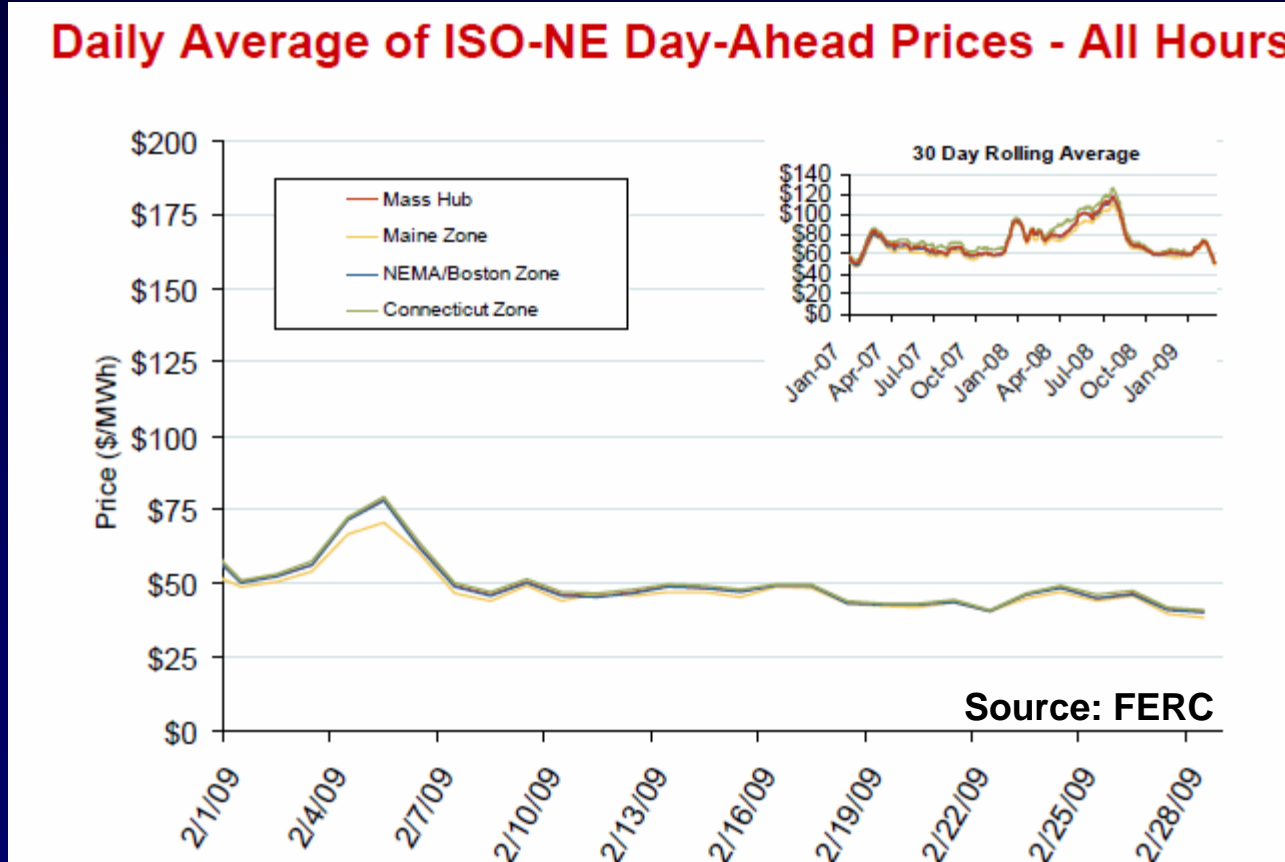


**Average Annual Generation (MWH/yr) Potential under various Bypass Flows at Coopers Mills Dam, Sheepscot River**



# Estimate Revenue Sources

- Power generation sales (\$)
- Capacity (\$)
- Renewable Energy Portfolio- “green” power (\$)





# Estimate Development Costs, Conduct Economic Analysis

- Turbine, Generator, Other Equipment/Components
- Civil Works
- Regulatory (Licensing) and Legal
- Engineering and Administrative Costs
- Include Contingency Allowance
- Compare Revenue vs Development Costs
- Determine Payback Period (years)
- If project appears feasible, conduct full blown feasibility study



# Feasibility Study

- More detailed studies to firm-up potential site configurations, development costs and energy prediction.
- Geotechnical/borings
- Hydraulic assessment
- Survey and bathymetry
- Preliminary design plans
- Re-assess economics
- Make go or no-go decision

# Order of Magnitude Cost Estimates for Development

Project	Available Head (ft)	Capacity (kW)	Ballpark Cost (\$)
ME	15	362	\$3,000,000
NY	9	500	\$3,900,000
VT	21	400	\$2,960,000

Estimates are based on existing dams with no hydropower  
Estimates do not include dam repair costs

# Other Costly Considerations- Licensing the Hydropower Facility

- Minimum flows to protect aquatic resources in bypass (generation loss). Study needed to determine habitat needs- takes away from generation.
- Upstream/downstream fish passage. If diadromous fish are present, passage may be required. Costly.
- Entrainment and/or impingement of fish. Concern with sucking in or impinging fish against trashracks.
- Impact of project operations or construction impacts on rare, threatened and endangered species. Requires study.

# Other Costly Considerations- Licensing the Hydropower Facility

- Impact of project operations or construction impacts on wetlands and wildlife- typically wetland and vegetation mapping required.
- Impact of project operations on water quality- typically dissolved oxygen and temperature studies required.
- Impact of project operations or construction impacts on archeological/cultural resource impacts. Phase IA study required.
- Evaluate potential for hazardous waste issues in project development location.
- Licensing Costs \$150,000 to \$500,000 (small dams, run-of river projects, not as controversial)

# Take Home Messages

- Consider the full cost of hydropower development- licensing, permitting, equipment, civil, mechanical and electrical works, legal, etc.
- Most low-head dams with little drainage area (flow) have not been feasible. Payback period simply too long.
- Federal: Energy Policy Act of 2005- tax incentives for hydropower development.
- MA State: Green Communities Act includes financial incentives for the development of hydro. Massachusetts Renewable Energy Trust also awards grants for hydro development.
- Most recent development has occurred at existing hydropower dams- \$ into upgrades or adding turbines (expansion)