Moosehead Hydroelectric Project
Pre-Feasibility Study for Hydropower Redevelopment

for the Town of Dover-Foxcroft

Background/History

- **11/1981**- Town has Lease Agreement with Moosehead Manufacturing Company (MMC).
- **01/1982**- MMC applies with FERC for a hydropower exemption. Proposed Project is 300-kilowatt (kW) facility.
- **06/1982**- MMC receives an exemption from FERC.
- **2008**- Project ceases to produce power.
- **05/2008**- Town assumes operating responsibility from previous lease holder.
- **12/30/2022**- Town notifies FERC it partnered with ASF and TNC to evaluate hydro and non-hydro concepts to meet community and environmental needs.
- **02/2023**- FERC approves plan, but notes Town must file an application to surrender or application requesting an amendment to the exemption by **12/31/2023**.

Exempt vs Non-Exempt Hydroelectric Projects

Exempt Hydroelectric Projects

- Exempt projects are exempt from Part I of the Federal Power Act. Exempt projects are subject to the mandatory terms and conditions set by federal and state fish and wildlife agencies and FERC.
- Exemptions issued in the 1980's had few-if-any studies conducted to inform Protection, Enhancement and Mitigation (PME) measures.
- Exemption application filed on 1/19/1982 and approved by FERC on 6/2/1981. Would not occur in today's environment.
- Exemptions are issued in perpetuity; Licensees are not subject to having to "relicense" the project. However, if the Licensee proposes to increase the size of the project (greater than 15% of its maximum hydraulic capacity or greater than the authorized capacity), it may be required to file a capacity amendment.
- A non-capacity amendment, such as that filed with FERC in November 2020 calling for repairing the dam/fish ladder and rehabilitating the hydropower facility, resulted in FERC seeking agency input. FERC likely required agency consultation due to the site being located in critical habitat for endangered Atlantic Salmon.

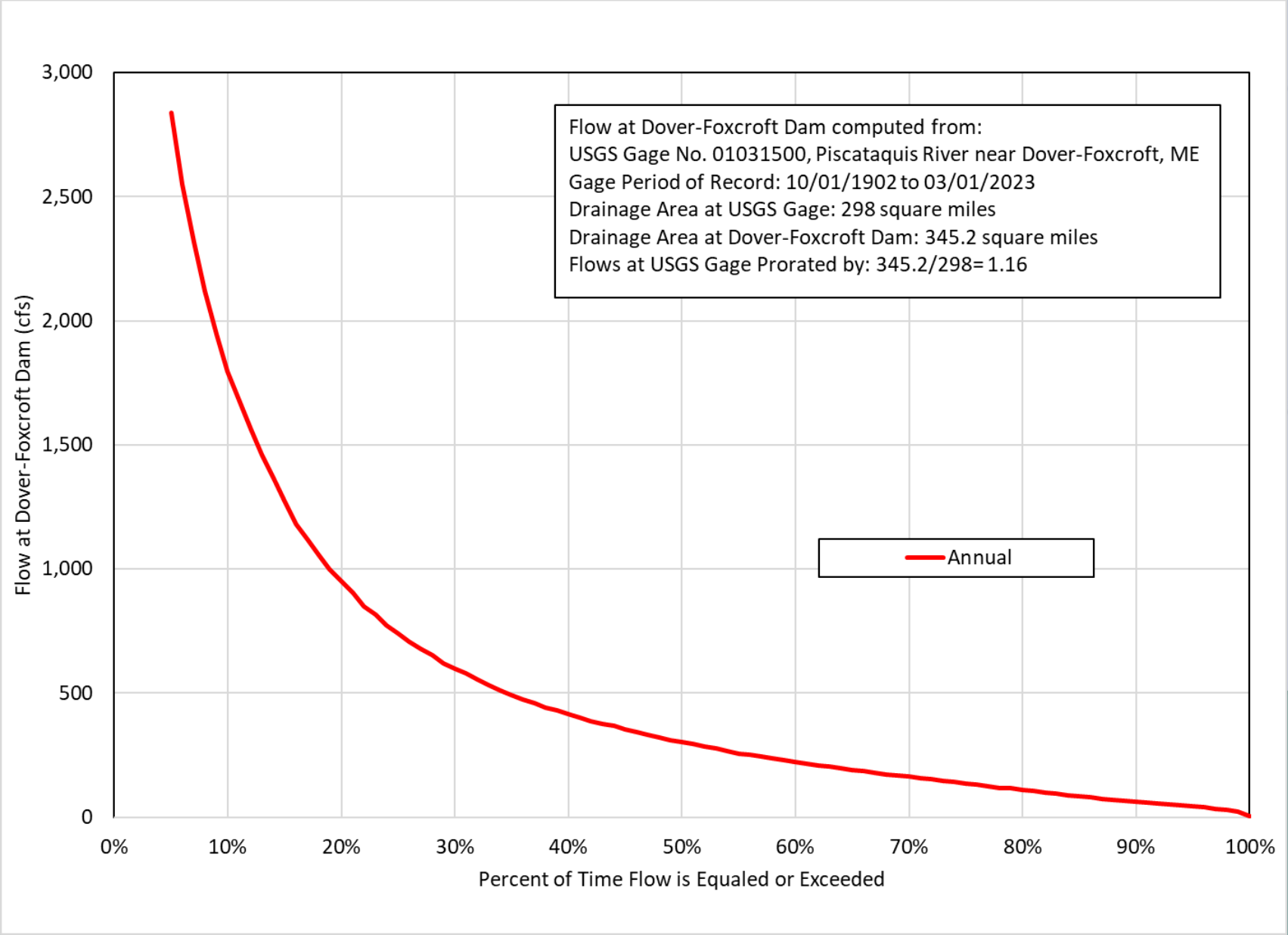
Exempt vs Non-Exempt Hydroelectric Projects

Non-Exempt Hydroelectric Projects

- Non-Exempt projects are subject to Part I of the Federal Power Act; Licensee must undergo the FERC licensing process.
- Licenses are issued for 40-50 years, upon expiration, Licensee must undergo licensing again.
- Licensing lasts ~4-5 years (or more) depending on the project complexity. Requires high level of consultation and numerous studies (more studies for projects with migratory fish).
- Licensee must also obtain from MDEP a 401 Water Quality Certificate certifying the Project meets State Water Quality Standards). FERC must accept the MDEP conditions.
- FERC is required to balance power and non-power resources. MDEP is required to ensure the project meets State Water Quality Standards.
- After MDEP issues the 401 Water Quality Certificate, FERC can then issue the license.
- Licensing is a lengthy and expensive process. If Town opts to repower the site, it is recommended to limit it to the authorized capacity of 300-kW.

Hydrologic Analysis

- Flow data needed to conduct the energy analysis.
- Used USGS gage flow data recorded on the Piscataquis River just upstream of the Project Dam.
- Flows were increased, by a ratio of drainage areas at the gage and at the dam, to the Project Dam.
- Flow data period: 1902-current.



Energy Analysis- Alternatives Evaluated

Alternative 1- Base Case (capacity 300-kW)

- Min Capacity- 60 cfs
- Max Capacity- 300 cfs
- Constant Net Head- 12 ft
- Constant T/G Efficiency- 83%
- Station Downtime- 5%
- Average Annual Generation: 1,426 MWh/year

Alternatives 1a – 1d (capacity 300-kW)

- Same as Alternative 1, but evaluated sensitivity to constant net head, constant T/G efficiency and station downtime.

Energy Analysis- Model Inputs

P = ($\underline{Q \times H_{net} \times T/G \text{ efficiency}}$)/11.8, where

Q= flow (cfs)
H_{net}= headwater elevation-tailwater elevation-headlosses (ft)
T/G= composite turbine/generator efficiency (%)

- Energy model developed for period January 1, 1903, to December 31, 2022.
- Model computes daily generation, summed annual, and then computes the average annual generation.

<u>Model inputs:</u>

- Inflow (from USGS gage, adjusted by drainage area)
- Flow unavailable for generation (in this case flows needed for upstream/downstream fish passage)
- Minimum and Maximum Turbine Capacity
  - If inflow < min hydraulic capacity, then spill
  - If inflow > max hydraulic capacity, then spill flow exceeding the max hydraulic capacity
- Constant net head over the range of flows
- Constant T/G efficiency over the range of flows
- Scheduled/Unscheduled Outages

Energy Analysis- Energy Results

Alternative	No. of Turbines	Hydraulic Capacity of Turbine(s) (cfs)	Maximum Hydraulic Capacity (cfs)	Minimum Hydraulic Capacity (cfs)	Flows Unavailable for Generation (Upstream and Downstream Passage Flows), cfs	Constant Net Head (ft)	Constant Turbine / Generator Efficiency (%)	Downtime Factor (%)	Average Annual Generation based on period 1903-2022 (MWh/year)
1	2	150 150	300	60	01/01-03/31: 0 cfs 04/01-04/30: 25 cfs 05/01-05/31: 65 cfs 06/01-10/31: 40 cfs 11/01-11/30: 65 cfs 12/01-12/31: 25 cfs	12	83%	5%	1,426
1a	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	13	same as Alt 1	same as Alt 1	1,545
1b	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	80%	Alt 1	1,375
1c	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	10%	1,351
1d	1	300	same as Alt 1	100	same as Alt 1	same as Alt 1	same as Alt 1	same as Alt 1	1,389
2	same as Alt 1	300 300	600	100	01/01-03/31: 0 cfs 04/01-04/30: 30 cfs 05/01-05/31: 80 cfs 06/01-10/31: 50 cfs 11/01-11/30: 80 cfs 12/01-12/31: 30 cfs	same as Alt 1	same as Alt 1	same as Alt 1	2,157

	Represents the same conditions as Alternative 1
	Represents different conditions from Alternative 1

Economics

Opinion of Probable Construction Cost Ranges for Addressing Dam Deficiencies, Powerhouse Building Deficiencies, and Stabilizing Dam

Feature	Low OPCC Estimate	High OPCC Estimate
Resolve Dam Deficiencies	$977,000	$1,193,000
Resolve Powerhouse Building Deficiencies	$99,000	$118,000
Stabilize Dam	$950,000	$1,155,000

Economics

Cost to Rehabilitate Hydroelectric Project- Natel Energy Estimate

- In 2020, Natel Energy estimated the cost to: rehab the powerhouse, add new hydro (300 kW) and repair divot on the downstream face of the dam.
- Budgetary Estimate (2020$) = $2,000,000.
- Adjusted by Engineering News Record Construction Cost Indices (2023$)= **$2,300,000**.

Cost for Hydropower Development- Maine Hydropower Study (2015)

- Study estimated cost to develop hydropower at existing dam at $6,000/kW < 200 kW and $5,000/kW for 200-700 kW.
- Applied $6,000/kW x 300 kW (2015$)= $1,800,000.
- Adjusted by Cost Indices (2023$)= $2,400,000.

Feature	Low OPCC Estimate	High OPCC Estimate
Resolve Dam Deficiencies	$977,000	$1,193,000
Stabilize Dam	$950,000	$1,155,000
Rehabilitate Hydroelectric Project	$2,300,000	$2,300,000
Total	**$4,227,000**	**$4,648,000**

Economics

Value of Hydroelectric Power

- Hydropower producers typically sell electricity at wholesale prices.
- Information on wholesale pricing is available at ISO-New England.
- The average annual wholesale prices in Maine for 2018, 2019, 2020, 2021, and 2022 were $55.27, $42.76, $33.41, $52.92 and $95.11/MWh. $95.11/MWh is an anomaly.
- Based on $33/MWh to $56/MWh and our estimated average annual generation of 1,426 MWh/year, the value ranges from **$47,000 to $80,000/year**.

Simple Payback- Assumes Dam Repaired, Dam Stabilized and Hydro Rehabbed

Description	Budget Estimate	Estimated Avg Annual Revenue	No. of Yrs to Payback Investment
Low Budget Cost, Low Revenue Estimate	$4,227,000	$47,000	90 years
Low Budget Cost, High Revenue Estimate	$4,227,,000	$80,000	53 years
High Budget Cost, Low Revenue Estimate	$4,648,000	$47,000	99 years
High Budget Cost, Low Revenue Estimate	$4,648,000	$80,000	58 years

- Hydroelectric developers would seek a much faster return on investment than the estimates above.
- Economic assessment does not account for costs associated with a part time operator, annual O&M, periodic capital expenditures, taxes, insurance, and administrative costs.