

CONSIDERATIONS FOR
SMALL HYDROPOWER
SITING, DESIGN AND LICENSING

MCWRA SMALL HYDRO WORKSHOP
MARCH 22, 2013

Agenda

- Definitions of “Small Hydro”
- Site Selection
 - ▣ Conventional vs. in-line/conduit projects
 - ▣ Power production estimates
 - ▣ Existing dams vs. new construction
- Turbine Alternatives
 - ▣ Traditional vs. Emerging Turbine Technologies
 - ▣ Turbine Performance Comparisons
- Licensing and Exemptions
 - ▣ Comparison of Exempt vs. Non-Exempt Regulatory Process
 - ▣ Overview of FERC License Exemption Criteria
- Development Trends in California

Definitions of “Small Hydro”



Definitions of “Small Hydro”

- Electrical capacity and physical size do not correlate well in hydropower
- Sometimes based on regulatory language and/or perceived environmental impacts
- Generally-accepted (US) terms based on capacity
 - ▣ Small Hydro – all projects <30 MW
 - ▣ Mini Hydro – 100 kW to 1 MW
 - ▣ Micro Hydro – all projects <100 kW

Site Selection

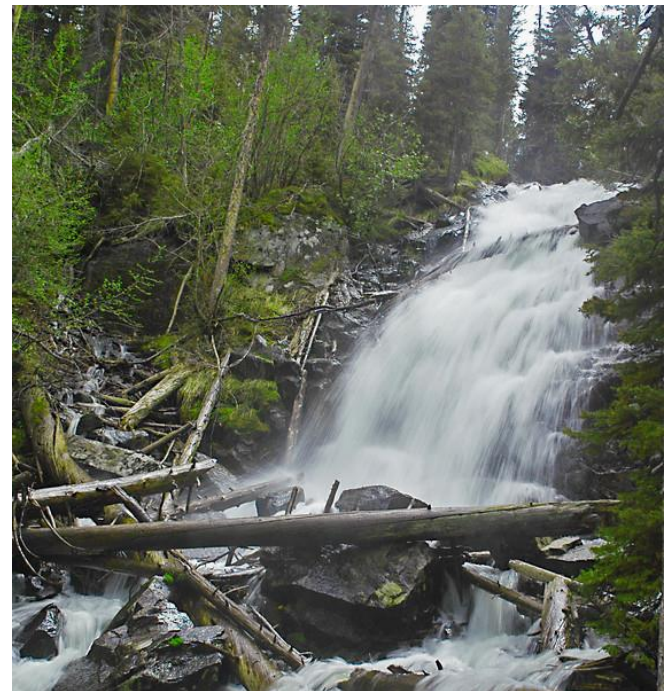


Site Selection

- Conventional small hydro
 - ▣ Powering existing dams/diversions
 - ▣ “Minimum flow” units resulting from FERC relicensing process on existing projects
 - ▣ New diversion projects
- In-line/conduit small hydro
 - ▣ Includes drop structures in existing canal/flume systems
 - ▣ Generally more scalable than conventional hydro
 - ▣ Often co-located with other necessary infrastructure
- Transmission access considerations

Site Selection (cont'd)

- Power Production Estimates
 - ▣ Head and flow exceedance curves
 - ▣ Available hydrology
 - Influence of snowpack/snowmelt
 - Consider minimum instream flows for new diversions
 - Ungaged watersheds – surrogate data methods

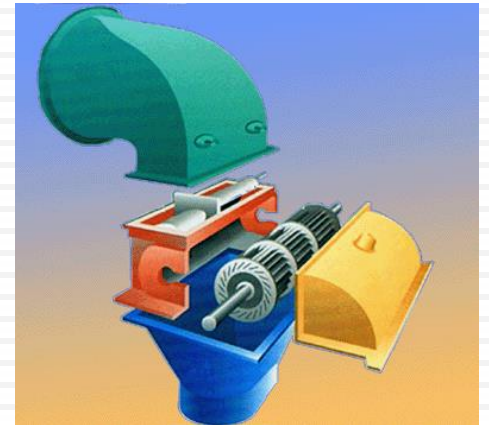
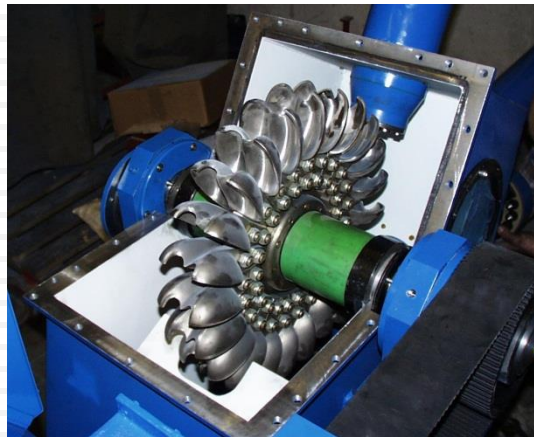


Site Selection (cont'd)

- ❑ Modifications at Existing Dams
 - ❑ Don't forget about water rights!
- ❑ New Construction

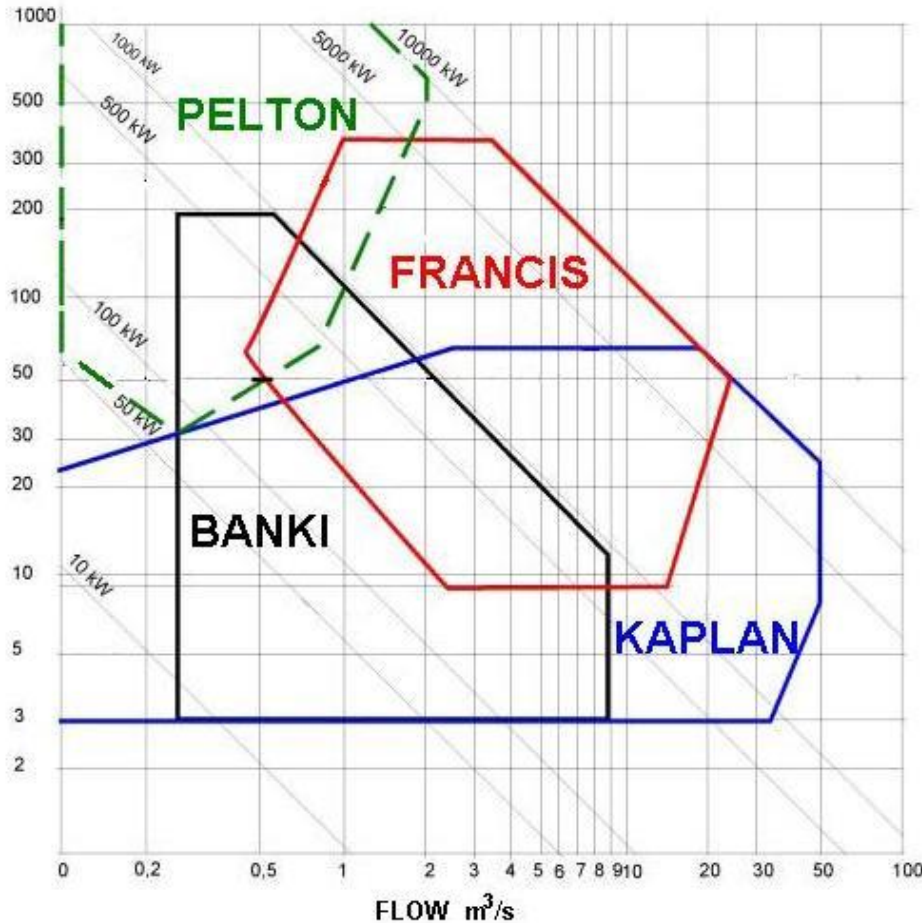


Turbine Alternatives



Turbine Alternatives

NET HEAD (m)



Traditional Turbine Technologies

Reaction

- Kaplan/Propeller
- Francis

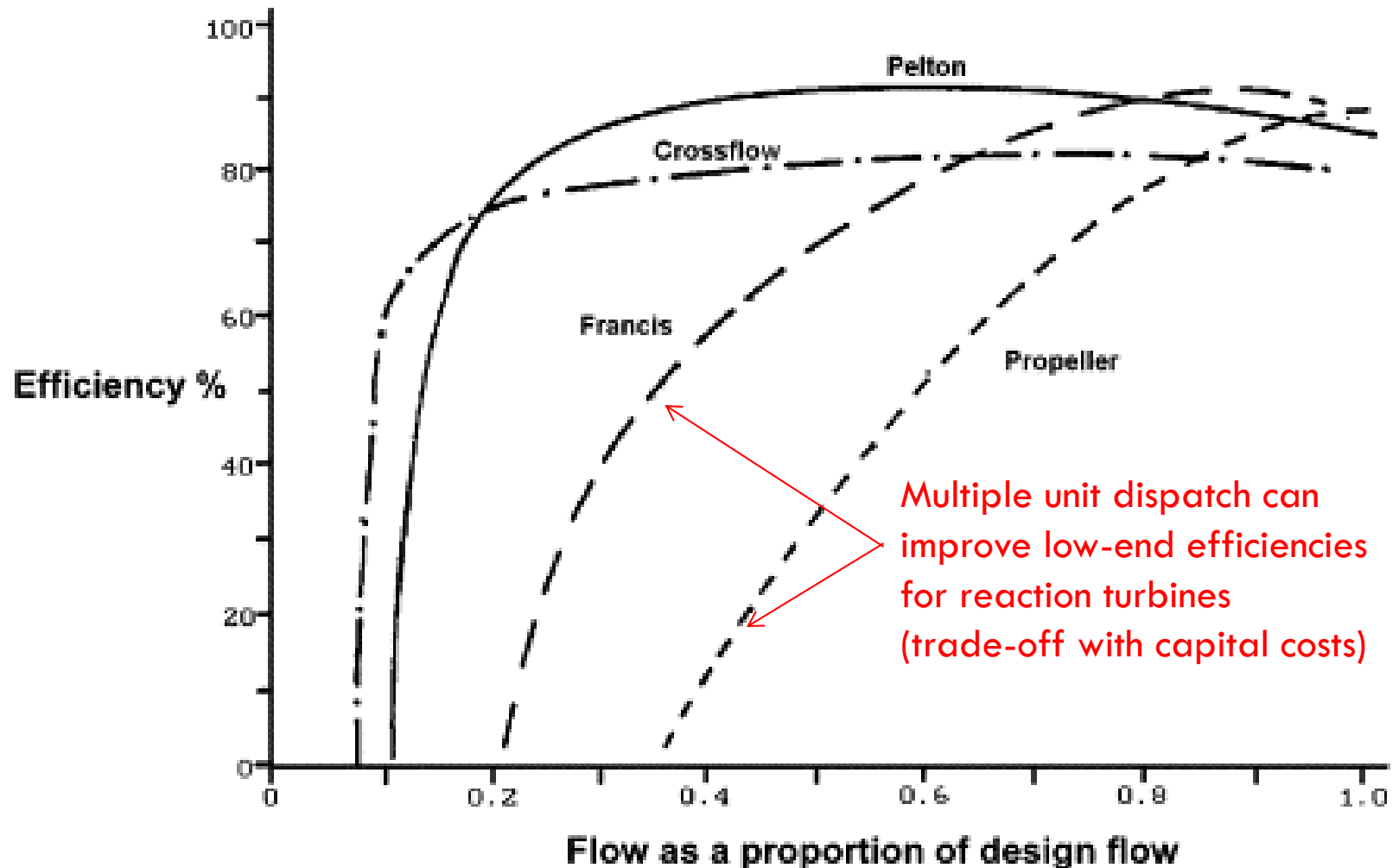
Impulse

- Pelton
- Turgo/Banki/Crossflow

Emerging Turbine Technologies

- Natel hydroEngine
- Reverse Archimedes Screw

Turbine Alternatives (cont'd)

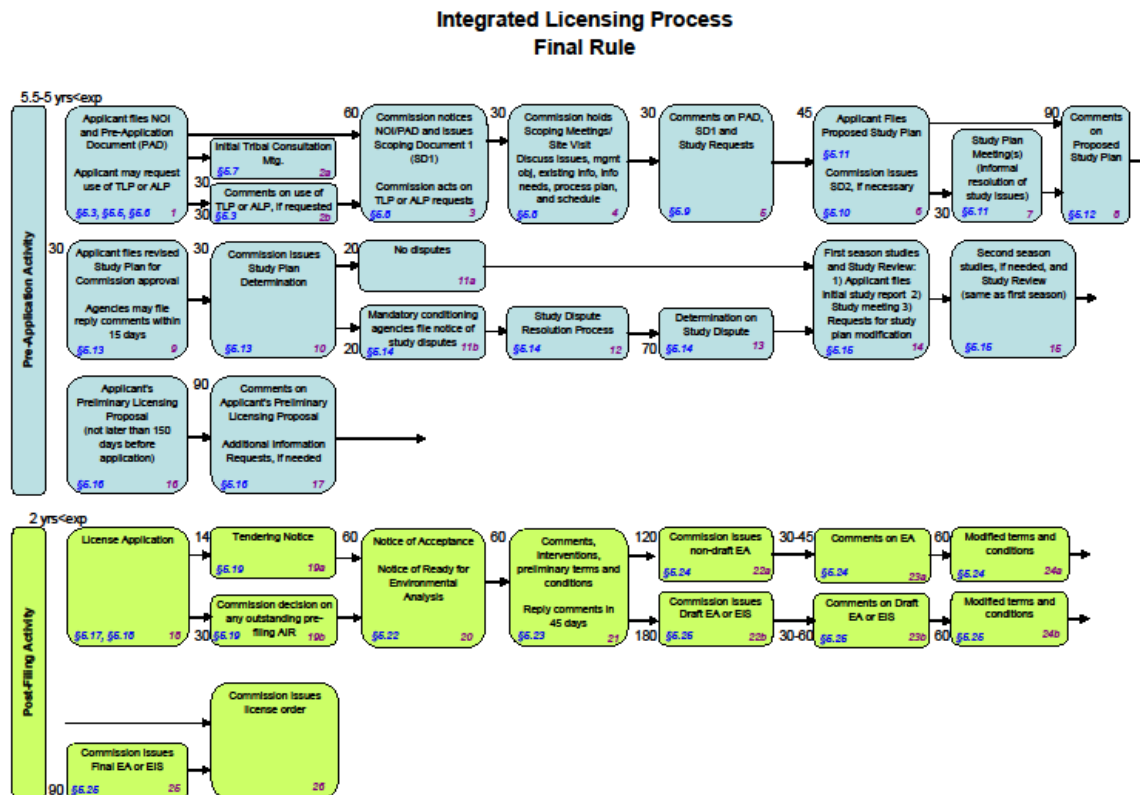


Licensing and Exemptions

Licensing and Exemptions

- Licensing for “Major” Projects (>5 MW)
 - ▣ Integrated Licensing Process (ILP) vs. older processes
 - ▣ State and Federal fish and wildlife, cultural and water resource agencies have jurisdiction over license conditions
 - ▣ Typically 7-8 year process, notwithstanding 401 water quality certification
 - ▣ 30 to 50 year license term

Licensing and Exemptions (cont'd)



Licensing and Exemptions (cont'd)

- Exemptions for Small (<5 MW) and Conduit Hydro
 - ▣ Based on Traditional Licensing Process
 - ▣ 4-6 month typical turn-around for exemptions (sometimes faster)
 - ▣ Less resource agency scrutiny, particularly for conduit projects (Section 30(c) conditions)
 - ▣ Issued in perpetuity
 - ▣ Small Hydro: Powerhouse must be <500' from existing dam, and >36% of head must be provided by the dam

Licensing and Exemptions (cont'd)

□ Key Differences between 5 MW and Conduit Exemptions

Category	5 MW Exemptions	Conduit Exemptions
Location	Existing dam or natural water feature	Any manmade water conveyance <u>not</u> primarily used for hydro
Max Capacity	5 MW	15 MW (private) 40 MW (muni)
Land Ownership	Not Required	Required
NEPA Eligibility	Yes	Categorically Exempt

Licensing and Exemptions (cont'd)

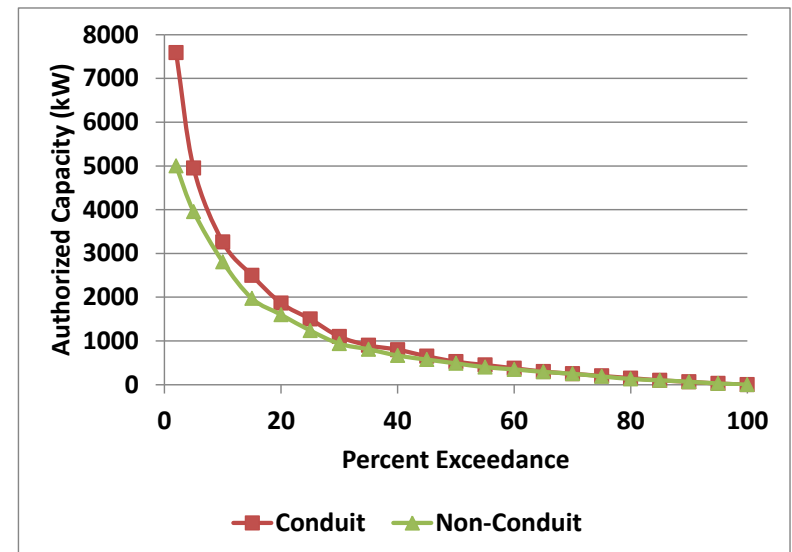
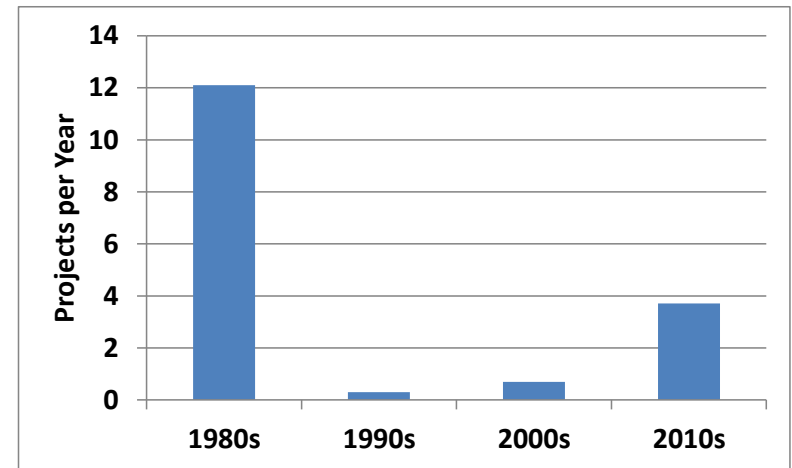
- Ways to Expedite Exemption Applications
 - ▣ Unlikely to affect T&E species or need fish passage
 - ▣ Little change to range and timing of flows
 - ▣ Develop stakeholder consensus early in process
 - ▣ Applicant owns all lands needed for construction and O&M
 - ▣ Application is complete



Development Trends in California

Development Trends in California

- 1980s small hydro boom (PURPA), 1990s-2000s market limitations, 2010s growth led by conduit projects and new renewables legislation
- Size distribution of projects by type are remarkably similar, and conduit projects are (surprisingly) larger



Development Trends in California

(cont'd)

- Renewable Portfolio Standards eligibility
 - ▣ Small Hydro >30 MW nameplate capacity
 - ▣ Cannot have adverse impact on instream beneficial uses or cause change in volume/timing of flows (limits eligibility to run-of-river)
- Benefits of RPS certification and RECs
 - ▣ Renewable Energy Credits (RECs) – current values range from \$10-50/MWh
 - ▣ RECs can be sold “bundled” or “unbundled”
 - ▣ Public awareness



End of Presentation