2024 NH Envirothon Training Day Activity Questions 11/8/23
Aquatic Ecology Team Judy Tumosa

This activity asks you to compare/contrast the environmental, social, and economic values of two types of aquatic ecosystems; a ponded reservoir created by a dam and a free flowing stream (see enlarged photos). Is one better than the other, do they have the same value, does it depend on the user, etc.?

Question 1 – Environmental values: Answer the following questions based on the wildlife species photo you received (circle one): Common loon, Bald eagle; Brook trout, Largemouth bass; dragonfly, stonefly.

Which aquatic ecosystem would this species prefer; ponded reservoir or free flowing stream or both (circle your choice). Explain why.

Group discussion: Explain any limiting factors that would prevent any of the listed species from living in one of the habitats (consider oxygen levels, ponded vs free running stream flow, presence of plants, levels of pH, types of food available, etc.)

Question 2 – Environmental, social, economic values: Answer the questions based on the human user type you received (circle one): Recreationist, Landowner with waterfront property, Conservation Group with waterfront property

Which aquatic ecosystem would this human user prefer; ponded reservoir or free flowing stream or both (circle your choice). Explain why.

Explain what environmental, economic, or social reasons would make one ecosystem preferable OR are they both preferable for a given human use? (consider wildlife diversity, cost of living there, what opportunities for outdoor activities might be preferable, safety, etc.)

Question 3 (homework): In general, how would any of the wildlife species and human users listed above respond if a dam that had been in place for a number of years was removed and a free flowing stream was re-established? Would that change be good or bad? Explain your answer.

Recreationist

Landowner with waterfront property

Conservation Group with waterfront property

About Hydropower

America's Largest Renewable Resource
About 20% of the world's electricity is generated by using hydropower. In the United States, this resource accounts for 12% of the nation's supply of electricity. This 12% can be thought of in the following ways:

- Hydropower produces more than 90,000 megawatts of electricity annually, which is enough to meet the needs of 28.3 million consumers.
- Hydropower accounts for over 90% of all electricity that comes from renewable resources (e.g.—solar, geothermal, wind, biomass).
- Hydropower is generated at only 3% of the nation's 80,000 dams.

In the Northwest, hydropower is an even bigger part of each person's daily life. Up to 80% of the electricity in the Northwest is produced by hydropower each year. That's enough electricity to meet the needs of 13.6 million homes. And because hydropower is one of the lowest cost forms of energy, most Northwest residents have a significantly lower electric bill than residents in other parts of the country.

How Hydropower Works
The process starts with the annual hydrologic, or water cycle, providing seasonal rain and runoff from snowpack. The runoff from rain and snow collects in lakes, streams and rivers and flows to dams downstream. The water funnels through a dam, into a powerhouse and turns a large wheel called a turbine. The turbine turns a shaft that rotates a series of magnets past copper coils in a generator to create electricity. The water then returns to the river. From the powerhouse, transmission lines carry electricity to communities.

Rivers, Our Quality of Life and Hydropower
Rivers, lakes and streams are nature's way of collecting water from the hydrologic cycle and carrying it back to the ocean for the cycle to begin again. Plants and animals depend on both this cycle and the rivers for survival. As human interaction with rivers increases, maintaining a balance with the plants and wildlife that also depend on the river system becomes more complex and diverse.

Throughout history, people have hunted and fished along rivers. For centuries, rivers have been used to irrigate land for crops. And for generations, paddle wheels used hydropower to harness the force of falling water. With the advent of hydropower, man could operate mills for such things as grinding grain and cutting timber. In harmony with the current, rivers also serve as arteries for passage of fish beneath the surface and all manner of boats above the surface. All of these interactions and shifting balances began before the advent of hydroelectric power production.

Hydropower came of age at the turn of the century when many technological advances were being put in place to further tap the ability of the hydrologic cycle and rivers to help meet the needs of society. Technology became available to build larger dams that could better control flooding and irrigate more land. For instance the Grand Coulee Dam, which has the capacity to generate more electricity than any other dam in North America, was built with the primary purpose of turning the Northwest into another bread basket for the nation. Along with other irrigation projects, six percent of the Columbia River Basin's yearly runoff is now diverted to irrigate about 7.6 million acres of land annually. And with the development of locks and other technologies, larger and larger cargo vessels were able to navigate rivers. In the Northwest, the result is that each year about 17 million tons of cargo are carried along the Columbia and Snake rivers from the Pacific Ocean.

Using hydropower to generate electricity is part of this technological leap. The best known hydroelectric projects are associated with the large dams that have large reservoirs which generate thousands of megawatts of electricity on demand. In fact, the six largest dams in Oregon, Washington and Idaho account for 50% of available hydroelectric power in these states.

For the Northwest as a whole, there are about 160 hydroelectric projects. For the projects which use reservoirs, there are also new recreational opportunities that many people have come to enjoy. Many hydroelectric projects, however, do not use a reservoir. These are called "run-of-river" projects because they do not store significant amounts of water. Instead, they rely on the normal river flow.

Previous generations successfully harnessed this renewable resource in a manner that has developed a standard of living in a way few would consider giving up. Using rivers to meet so many needs, however, also results in significant environmental and cultural impacts. Addressing these impacts and maintaining a balance with the plants, fish and wildlife that also depend on the river has never been more difficult. This and future generations are being asked to meet this challenge.

Hydropower and the Environmental Balance

As mentioned, dams that are part a hydroelectric project also help control flooding. And by using this renewable resource, up to 249 tons of carbon dioxide is not released into the earth's atmosphere each year because fossil fuels like oil and coal are not burned to generate electricity. Because the release of carbon dioxide contributes to environmental concerns related to ozone and global warming, hydropower represents an important environmental benefit in this regard.

Hydroelectric projects, like any energy resource, do have environmental impacts. In the Northwest, the most serious concerns often relate to fish passage. The 1992 listing of sockeye salmon and three other stocks of chinook salmon (spring, summer and fall) as endangered species intensified historic and continuing debates over restoring fish runs. Releasing water to speed up downstream fish migration has been one of many measures taken to preserve fish runs. In 1994, for instance, nearly 11 million acre feet of water was made available to help juvenile salmon and steelhead migrate downstream.

Measures such as water releases, however, are being taken within the context of scientific inquiry and research that is the subject of much debate. For these reasons, the hydro industry and others continue to explore and implement several mitigation strategies that address hatchery, habitat, harvesting, and hydro operation practices. Examples of such strategies include fish screens, surface collection and bypass systems, fish ladders, strobe lights, the catching of squawfish that prey on juvenile salmon, and new turbine designs. In fact, since the 1980s over 2 billion dollars has been spent on salmon recovery measures by Northwest ratepayers. As these efforts continue, scientific inquiry and research findings will continue to play a central role in guiding efforts.

The hydroelectric industry, however, cannot address environmental issues—e.g., fish migration or preserving wildlife habitats, in isolation from other industries and individuals that use the rivers. Every action and every user of a river is part of the overall balance. As a result, any search for balance that considers the Northwest's interests as a whole also needs to calculate and mitigate the effects of multiple impacts. Examples include irrigation, timber, mining and the building of homes and industries near the river system. In the case of salmon, for instance, ocean fishing that captures salmon returning to the river system is part of the overall balance.

Voices In The Development or Maintenance of Hydropower

Most hydroelectric projects across the United States are licensed by the Federal Energy Regulatory Commission (FERC). Many of these licenses, which are required to operate a hydroelectric project, are coming up for renewal during the next ten years. A central piece of receiving a new license is to examine environmental impacts and include the public in both reviewing and considering mitigation and enhancement strategies regarding these impacts. For anyone interested in the river system, becoming informed and heard in these debates is vitally important.

The process for being heard, however, extends well beyond engaging with those who generate hydropower and FERC. Numerous federal and state agencies can become involved in the process. Examples include the National Marine Fisheries Service, U.S. Fish and Wildlife Service, National Parks Service, the Environmental Protection Agency, state fish and wildlife agencies, state water resource agencies and the state agency with Clean Water Act authority. Beyond this crisscrossing of government authority are many tribal governments and non-profit groups with significant interests and concerns. Examples of non-profit groups include American Rivers, the Sierra Club, Trout Unlimited, fishing and hunting associations, and boating groups.

With so many interests participating, and because the issues being addressed are often quite complex, the relicensing process often takes between five to ten years to complete. Regardless of length, becoming an early and informed participant is of benefit to all.

The Nature of Water Power curriculum enables students to begin the process of becoming participants in these very important water and energy issues.

118 active hydro dams in NH

Hydro plants currently provide 14.5% of NH’s electricity.

Generating electricity using clean, free, renewable energy might sound like a scientific marvel somewhere in the distant future. But in reality, it's been around for more than 100 years. Hydroelectric power plants generate electricity by capturing the energy from water as it flows downhill in rivers toward the sea.

It's pollution-free because nothing is burned. And once the hydroelectric plant is built, the power is free (except for maintenance and operating costs) because gravity and water are provided courtesy of Mother Nature. Best of all, since rains replenish the river water, energy used in hydroelectric power generation is 100 percent renewable.

A few of the larger hydro electric dam is in NH

TOWN	NAME	RIVER
BERLIN	SMITH DAM	ANDROSCOGGIN RIVER
BOW	GARVINS FALLS DAM	MERRIMACK RIVER
BRISTOL	AYERS ISLAND DAM	PEMIGEWASSET RIVER
FRANKLIN	EASTMAN FALLS DAM	PEMIGEWASSET RIVER
GORHAM	ANDROSCOGGIN RIVER DAM	ANDROSCOGGIN RIVER
HILLSBOROUGH	JACKMAN RESERVOIR DAM	NORTH BRANCH CONTOOCOOK RIVER
HOOKSETT	HOOKSETT HYDRO DAM	MERRIMACK RIVER
MANCHESTER	AMOSKEAG DAM	MERRIMACK RIVER
STEWARTSTOWN	CANAAN HYDRO DAM	CONNECTICUT RIVER

Amoskeag Dam in Manchester

<u>Small-scale micro hydro power</u> is both an efficient and reliable form of energy, most of the time. However, there are certain disadvantages that should be considered before constructing a small hydro power system.

Micro Hydro Advantages

Efficient energy source

It only takes a small amount of flow (as little as two gallons per minute) or a drop as low as two feet to generate electricity with micro hydro. Electricity can be delivered as far as a mile away.

Reliable electricity source

Hydro produces a continuous supply of electrical energy in comparison to other small-scale renewable technologies. The peak energy season is during the winter months when large quantities of electricity are required.

No reservoir required

Micro hydro is considered to function as a 'run-of-river' system, meaning that the water passing through the generator is directed back into the stream with relatively little impact on the surrounding ecology.

Cost effective energy solution

Building a small-scale hydro-power system can cost from $1,000 – $20,000, depending on site electricity requirements and location. Maintenance fees are relatively small in comparison to other technologies.

Integrate with the local power grid

If your site produces a large amount of excess energy, some power companies will buy back your electricity overflow. You also have the ability to supplement your level of micro power with intake from the power grid.

Micro Hydro Disadvantages

Suitable site characteristics required

In order to take full advantage of the electrical potential of small streams, a suitable site is needed.

Energy expansion not possible

The size and flow of small streams may restrict future site expansion as the power demand increases.

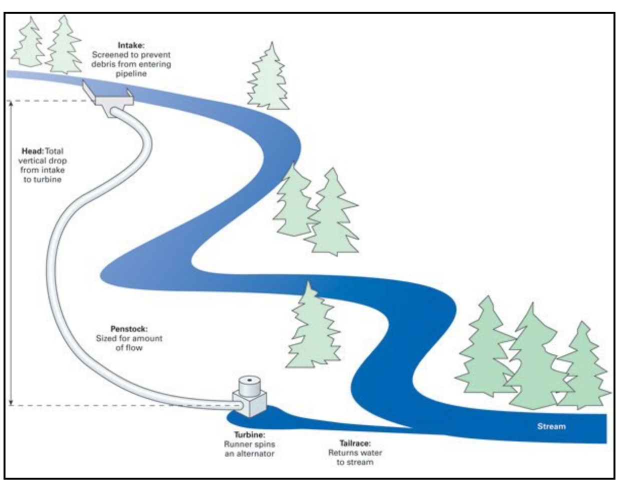
Low-power in the summer months

In many locations stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output. Advanced planning and research will be needed to ensure adequate energy requirements are met.

Environmental impact

The ecological impact of small-scale hydro is minimal; however the low-level environmental effects must be taken into consideration before construction begins. Stream water will be diverted away from a portion of the stream, and proper caution must be exercised to ensure there will be no damaging impact on the local ecology or civil infrastructure.

Micro hydro Sample Schematic



Marden Brook Hydro in Lancaster

NHDES Dam Bureau

Quick Facts as of 05/22/2023

We have record of 5,247 dams - **2,602 are active**

1,068 are exempt, 1,577 dams are ruins, removed, not built, combined or breached.

Hazard Classification		Inspection Interval
High	176	2 yr
Significant	174	4 yr
Low	470	6 yr
Non-Menace	1782	6 yr w/criteria

Ownership	
Private	1937
Local Government	378
State (not including 21 exempt)	254
Federal	33

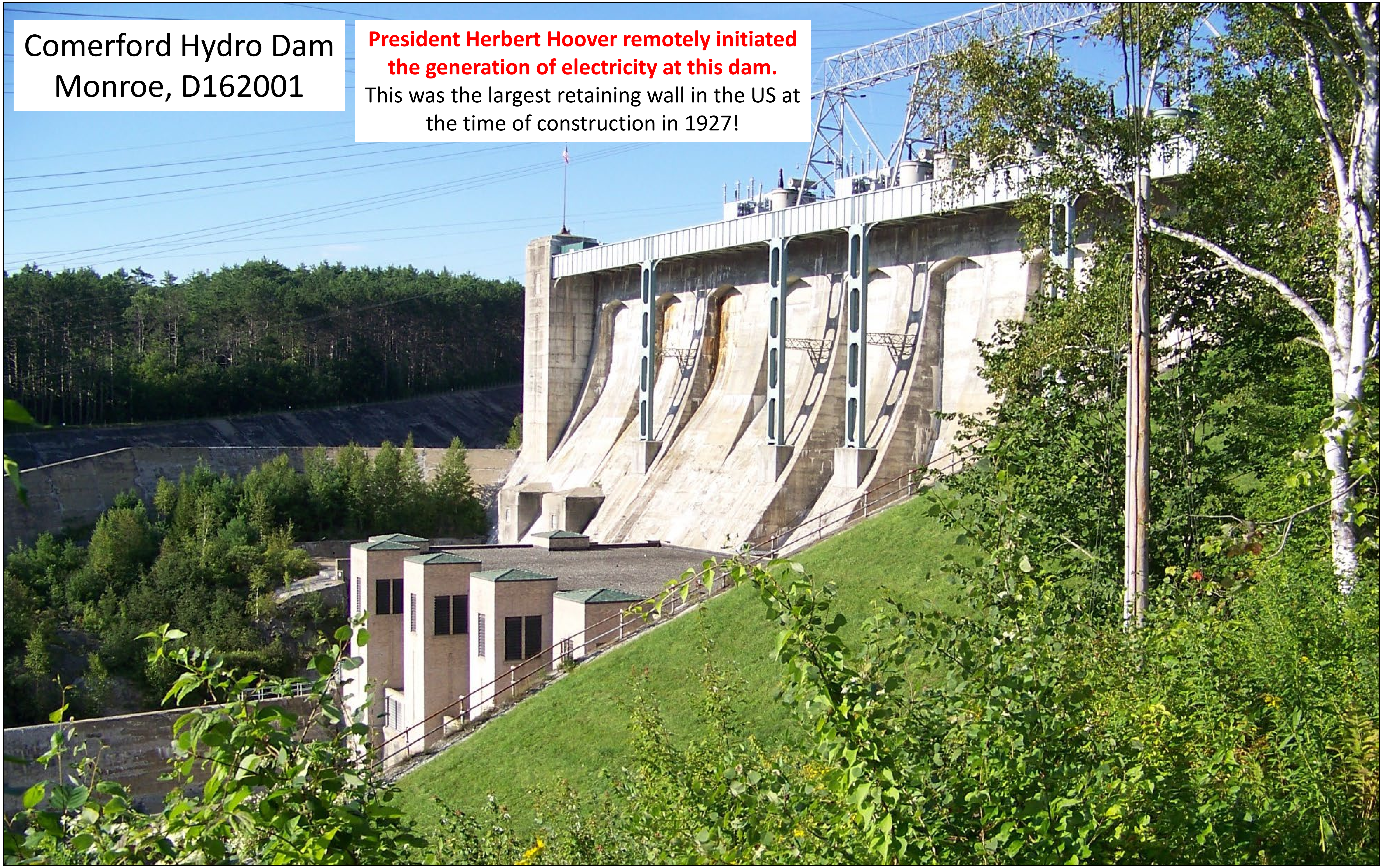
County	
Belknap	203
Carroll	121
Cheshire	244
Coos	176
Grafton	333
Hillsborough	417
Merrimack	320
Rockingham	296
Strafford	207
Sullivan	285

Primary Use	
Conservation	693
Detention	262
Flood Control	49
Hydro	118
Lagoon	67
Mill	15
Protection fire	194
Recreation	1146
Water Supply	58

Height	
> 25 feet	138
> 50 feet	33
> 75 feet	13
> 100 feet	7

If you have any questions please cal 603-271-3406 or email Nancy.l.Baillargeon@des.nh.gov

https://www.des.nh.gov/water/dam-maintenance-and-management


Comerford Hydro Dam
Monroe, D162001
President Herbert Hoover remotely initiated the generation of electricity at this dam.
This was the largest retaining wall in the US at the time of construction in 1927!

Sewalls Falls Dam
Concord, D051001
1932 photo

This dam was the worlds longest timber crib dam when built. It is also said to be the **oldest hydro electric dam in the country!**

Bearcamp River Dam Removal
Bearcamp River in Tamworth
Dam#233.02

Removed in September 2003
Reconnected 28+ miles of river

Removal Cost Estimate:
$ 120,000 (w/ studies)

Actual Cost:
$ 75,000 (w/ studies)

2 weeks after project completion

McGoldrick Dam Removal
Ashuelot River in Hinsdale
Dam# 117.03

Removed in July 2001
Built in 1828, the dam and canal serviced eight manufacturing facilities until 1950.

Removal Cost : $53,000
Funded by several federal and state agencies, and foundation support.

West Henniker Dam Removal
Contoocook River in Henniker
Dam# 114.02

Removed in Summer 2004
Restored 15+ miles of river to a free flowing condition.

Removal Cost Estimate:
$ 160,000

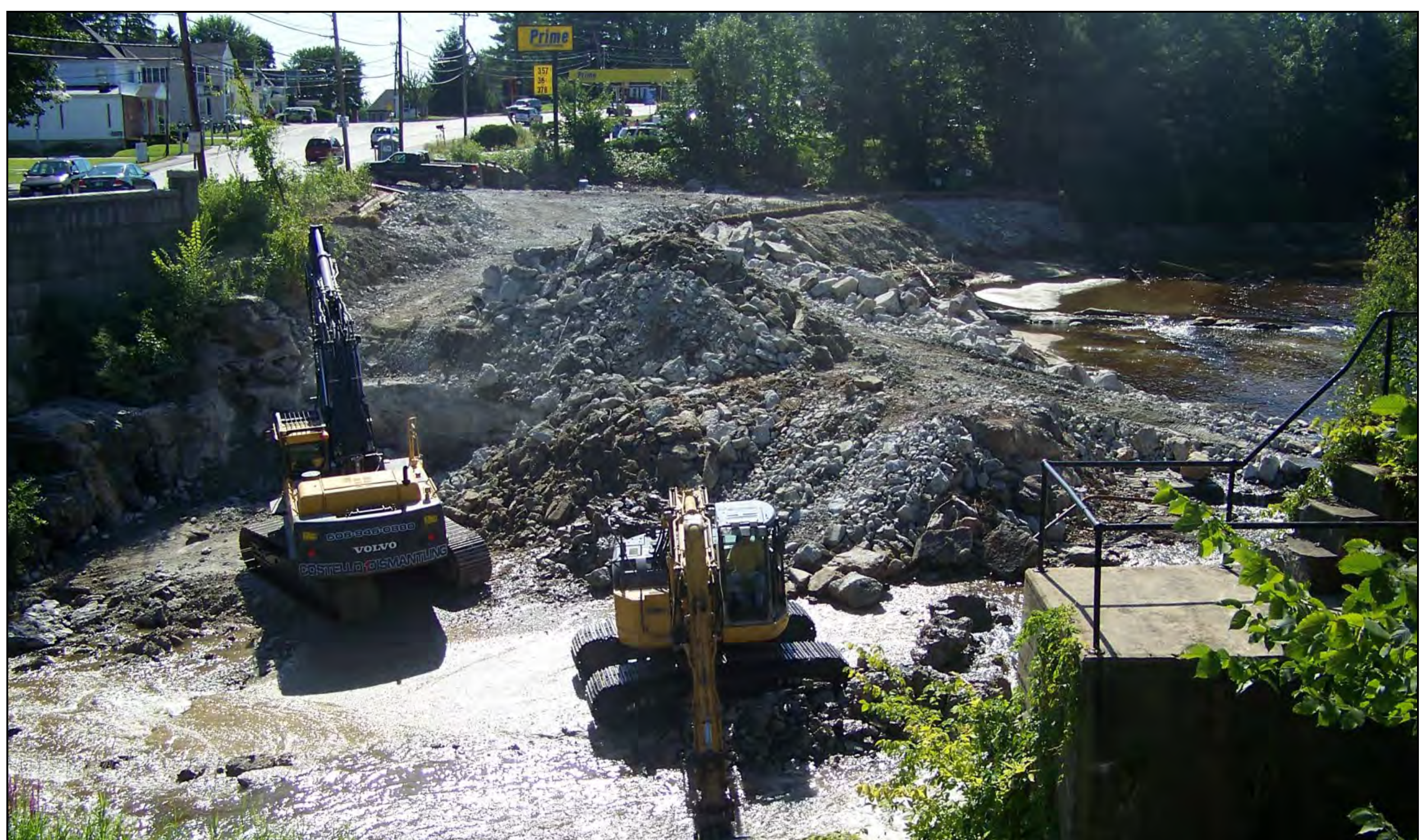
Actual Cost:
$


October 13, 2004

Merrimack Village Dam
D156001
Merrimack

Removed 2008

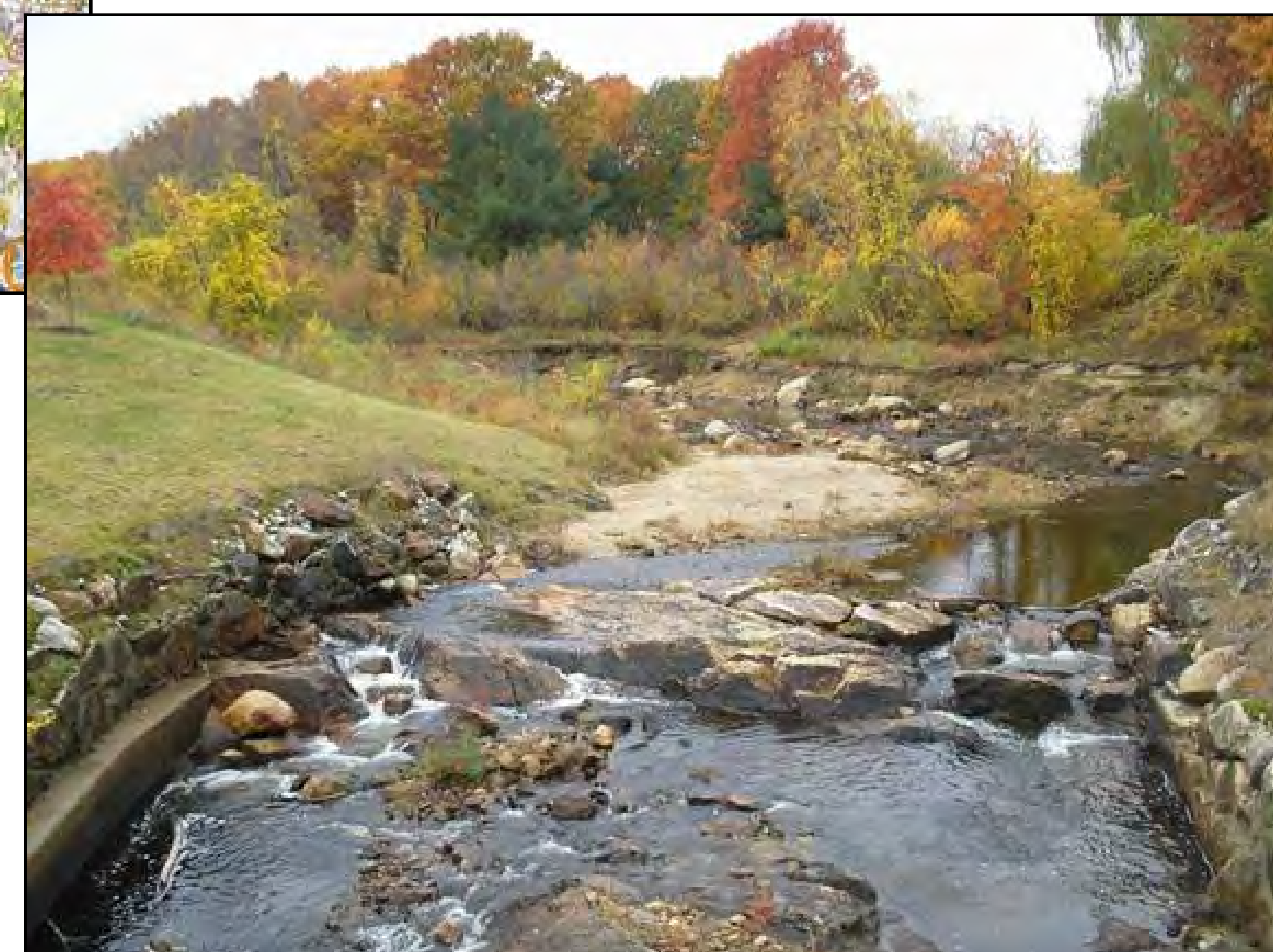
Reconnected 14 miles of river



Maxwell Pond Dam
Dam#150.07
Manchester

Removed 2009

Reconnected 7 miles of river



The following links are to news stories and opinion pieces regarding hydropower. These were covered at the Fall Training to provide insight into the issue of Environmental inequity, a topic often overlooked in the development of many projects, including those specifically dealing with "Clean Energy". Large scale hydropower, and its associated electric transmission lines, can impact a broad range of environments, habitats, and may disrupt the social goals and values of some communities and populations. These projects require careful planning and review to assure that the benefits aren't outweighed by the negatives.

- https://vtdigger.org/2021/06/28/ben-gordesky-the-true-costs-of-renewable-energy-from-hydro-quebec/ (June 2021)
- https://www.cbc.ca/news/canada/north/legault-election-cree-dams-indigenous-innu-consultation-1.6581815 (news article concerning new hydropower/indigenous peoples-September 2022)
- https://montrealgazette.com/news/local-news/power-hungry-quebec-will-soon-need-more-hydro-dams-legault-says (news article highlighting the political/societal conversation about hydropower-January 2023)
- https://adirondackexplorer.org/stories/transmission-line-power-park (news article about the possible impacts of hydropower electricity transport-May 2022)