DEEP WATER: BUILDING THE CATSKILL WATER SYSTEM

A Teacher's Guide *(Revised)*

This guide accompanies the film *Deep Water* about the building of the Ashokan Reservoir in Ulster County, NY at the turn of the 20th century. The original 45-minute film is available for purchase on DVD. A condensed 20 minute version can be viewed at www.ashokancenter.org.

Deep *Water: Building The Catskill Water System* documents the building of the Catskill Water System (including the Ashokan and Schoharie Reservoirs, the Catskill Aqueduct and the Shandaken Tunnel, 1905-1926) to supply billions of gallons of water to New York City and several communities north of the City. Using vintage photographs, rare film footage and interviews with historians *Deep Water* is a tale of brilliant engineering, immigrant workers and a power struggle between New York City and Upstate communities. It is the story of a city desperate for water and the rural area that was forced to provide it.

Deep Water is based on two books -- Bob Steuding's *The Last of the Handmade Dams* and Diane Galusha's *Liquid Assets, The Story of New York City's Water System* -- as well as interviews with residents, newspaper accounts and historic records.

Two songbooks created by reservoir workers and engineers were uncovered by the video's producers. Three songs are performed on the film by folk singer John Herald. Other music was contributed by Catskill Mountain musicians and performers, including Abby Newton, Robbie Dupree, Artie Traum, Al Petteway, Amy White and several others.

Deep Water was researched, produced and edited by Tobe Carey, Robbie Dupree and the late Artie Traum, independent documentary producers from Ulster County. It was sponsored in part by grants from the Catskill Watershed Corporation and individual contributors.

Deep Water, Building The Catskill Water System can be used as a springboard for lessons in history, technology, math, biology, geography, political science and government. It also offers opportunities for students to express themselves about contemporary issues of water and property rights, the environment and public health.

This guide includes

For additional resources to help conduct these activites visit:
The Catskill-NYC Watershed Educators Network: www.WatershEducators.org

Discussion Points

Life in the Catskill Mountains

For generations before the damming of the Esopus and Schoharie Creeks, people lived in small villages and on outlying farms in these valleys. They gleaned a living from the forests, rivers, and fields; built communities that included small business, churches and schools, and often spent their entire lives within a few miles of where they were born.

- Describe life in the Catskill Mountains at the turn of the century. How did people make a living? What did they use for transportation? Compare the life of a country boy or girl to that of a young person in New York City.

Averting A Water Crisis

New York City was in desperate need of a reliable source of fresh water in 1900. Immigrants had been pouring into the city for years, arriving by the boatload from Europe. Many people were without, clean, reliable water for cooking, drinking and basic sanitation.

- What problems did New York City face regarding water in the 18th and 19th centuries? What impact did the arrival of hundreds of thousands of European immigrants have on the city? Where did their water come from before the reservoirs were built? Explain the concept of "healing waters."

Tapping The Catskills

Although the Croton Water System had been built in Westchester and Putnam Counties, it was clear the City had to find a much larger and reliable source of water. It was decided to create a system of reservoirs West of the Hudson River in the Catskill Mountains where rainfall and stream flow were dependable and copious.

First, the Esopus Creek was dammed to form the Ashokan Reservoir. The Catskill Aqueduct carried the water underground, beneath the Hudson River to the Kensico Reservoir, and then to the City's distribution system. Construction of the Reservoir and Aqueduct went on from 1907 to 1917. Chief Engineer J. Waldo Smith oversaw the design of the huge dam, tunnel, aerators, dikes and other buildings. The project was often compared to the Panama Canal in its scope and size. Winston and Company from Virginia was the principal contractor for the job.

- Why is the Ashokan called "the last of the handmade dams?" What would it be like to be a worker on the reservoir project? Describe life in a reservoir labor camp. What kinds of jobs did workers have? What were some of the dangers? Where did the workers come from? How much were they paid?

After completing the Ashokan Reservoir, contractors moved on to the Schoharie Creek, where they built a dam at Gilboa. Water from this new Schoharie Reservoir was sent through the Shandaken Tunnel to join the Esopus Creek and thence to the Ashokan. The discovery of the famous Gilboa Fossils, 300-milion-year-old fossilized tree ferns – put Gilboa in the history books.

- How was the Shandaken Tunnel built? Show on a map how the Schoharie Creek flows north, and how its water is diverted southward as part of the Catskill Water System. Explain what a fossil is, and why the Gilboa Fossils are so important.

Eminent Domain

The city used the power of "eminent domain," also known as "condemnation" to claim land, for the benefit of millions of water consumers in NYC and its suburbs. Farms, homes, businesses, entire towns were removed or relocated to create the Catskill Water System and hundreds of people were forced to move. Even graves were dug up and bodies reburied on higher ground. Although compensation was provided, a lingering resentment of the city's power remains to this day.

- Explain "eminent domain." Debate the concept of "greater public good." Explain the difference between public rights and the private rights of an individual. What legal

processes do citizens have to protest or petition the government if it wants to take your house, land, or business for a public purpose?

Beyond the Catskill System

The Ashokan and Schoharie projects of the Catskill System were followed by four more reservoirs which together make up the Delaware Water System. Every day, more than 1 billion gallons of water is consumed by people living, working and visiting in New York City and its suburbs. Approximately 40 percent of the water comes from the Catskill System, 50 percent from the Delaware System and 10 percent from the older Croton System.

- What does it mean when we say the water gets to the City by gravity alone? Name the reservoirs in the Delaware System. Locate them on a map.

The Future

The 1997 New York City Watershed Memorandum of Agreement (MOA) is an attempt to keep water sources clean without building an expensive filtration plant. This is a closely watched experiment in partnership in which New York City, Watershed communities, State agencies, the federal government and environmental interests all have a seat at the table. The goal is to maintain water quality while protecting residents and businesses in the watershed from undue regulation and expense.

- What are some causes of water pollution? How can it be prevented? What is the MOA and who are its partners? How does the MOA benefit the City? How does it help Watershed residents?

Classroom Lessons and Activities

Social Studies

Meets NYS Learning Standards 1,3 & 4 for Social Studies

Mapping: Map Catskill watersheds, rivers, and major cities. Map old villages that are now underwater; assign groups of students to research these old towns, what life was like in them and how they looked. Perhaps the end product could be a picture book with simple descriptions, or a mural depicting the present area of the chosen reservoir and where the towns were.

Oral history: Invite an engineer, equipment operator, "sand hog," or Watershed resident into the classroom to describe his or her memories of working on a water supply project, or being displaced by one. Have students do such interviews outside the classroom. Produce a booklet or compose songs telling these individual stories.

Research: Have students research living conditions for turn-of-the-century immigrants to New York City. Relate findings to public health problems, and the need for clean water. Make posters comparing the life-style and occupations of those living in NYC in the early 1900s to today. What do old photographs tell us about how people lived, worked, played and got around?

Timeline: Develop a timeline showing construction of NYC reservoirs in the context of other national and world events. Compare water system developments with NYC expansion. (See time line at http://cwconline.org/linked/watershedtimeline.pdf)

Science/Technology

Meets NYS Learning Standards 1, 4 & 5 for Math, Science and Technology

Research: Investigate technology available to dam- and tunnel-builders at the turn of the century, and show how those methods/machines have changed. Find out how City Tunnel #3 is being constructed today. Request a classroom visit from a NYC DEP presenter.
http://www.nyc.gov/html/dep/html/environmental_education/index.shtml

Compare: Compare the NYC Water System to other major urban water systems. How much water is used? Where does it come from? How is it treated? When were other systems built?
http://www.nyc.gov/html/dep/html/drinking_water/history.shtml

Stream study: Study a nearby stream or river. Examine the invertebrates found in the stream and determine what they tell about water quality. Conduct other water tests, such as pH, dissolved oxygen, turbidity, and temperature, possibly phosphate and nitrate testing for older groups.

Do an erosion experiment in conjunction with the stream study. Fill a pan with soil, tilt the pan, and rapidly pour water onto the top of the pan, watching the water wash away the soil as it runs down; relate this to stream erosion and its effects on water quality and sedimentation.

Math

Meets NYS Learning Standards 1&3 for Math, Science and Technology

How many yardsticks placed on top of each other would it take to equal the height of the Ashokan Dam, 252 feet high?

Find out how much water the average household uses each day. Then have each student calculate how much water their family uses, and how much could be saved by employing various conservation methods.

Political Science/Government

Meets Learning Standards 1&3 for English Language Arts and Standard 5 for Social Studies

Research: Who were the NYC mayors during the development of the Catskill System and what major issues were they facing? How did they pay for the new water projects? Was there any controversy over how to supply more water to city residents?

Investigate the US Supreme Court battle which led to the 1931 ruling allowing New York City to build reservoirs on the Delaware River. What were the arguments, pro and con? How was it resolved? What was the impact on the Catskills? On downstream interests? On New York City?

Debates: Students could portray residents of NYC and residents of the affected villages on the topic of building the dam and flooding the villages; they might take opposing sides to argue for or against the imposition of more stringent regulations on Watershed residents (c. 1990); or debate the issue of NYC land acquisition in the watershed today.

Discuss the benefits of partnership, conflict resolution and negotiation to Upstate and Downstate parties to the MOA. Relate this process to issues that divide communities, schools and individuals.

Vocabulary words from the film

Aerator: A machine that can mix water with air to help filtrate water and keep it clean

Aqueduct: A large pipe for moving water long distances

Bluestone: A type of bluish-gray sandstone quarried in the Catskill/Hudson River region

Capacity: The potential/maximum amount that a container, reservoir, tunnel, etc. can hold or carry

Conservation: management of land and water in ways that prevent it from being damaged or destroyed

Controversial: a topic or subject that people will disagree on and will argue or debate over

Corruption: Improper or illegal behavior or action

Dam: A wall built across a river to stop the water from flowing, in order to create a lake or reservoir

Dike: A bank, usually constructed of earth, to confine or control water

Eminent Domain / condemnation: The right of government to take private property for public use; the owner must be paid for the property that was taken

Exhume: To dig up; to remove a grave from the ground

Filtration: The process of passing a liquid, such as water, through a porous material, such as sand, to remove solid matter floating in it and/or anything contaminating it

Fossil: an impression or trace of an animal or plant of past that has been preserved in the earth's crust

Ingenuity: Cleverness or skill in planning or inventing

Immigrant: A person who enters a country or region from a different country or region

Pollution: Contamination of the environment with man-made waste

Portland cement: A type of cement, used in making mortar and concrete, made by burning limestone and clay in a kiln

Protest: To object; a public demonstration of disapproval to express displeasure or unhappiness about a decision or course of action

Quarry: A place where stone is dug, cut or blasted out for use in building

Reservoir: A place where water is collected and stored to distribute for drinking and everyday use

Scrip: Temporary paper money or a token used in place of government-printed bills; used to pay workers or to purchase goods

Segregation: The separation of people of different races and ethnicity in housing, schools, public facilities, etc.

Stewardship: when people take care of something and protect it

Tourism: Travelling for pleasure

Trestle: A braced structure of timbers, piles or steel beams used for carrying a road or railroad across a gap in the earth

Unfiltered: water that is not passed through a filtration system

Watershed: The land that catches rain or snow and drains or seeps into a common marsh, stream, lake, groundwater or reservoir

Water system: The network of reservoirs, dams, treatment plants, tunnels and pipes that collect, purify and distribute water to homes, businesses, institutions, farms and other consumers

Weir: A dam in a stream to raise the water level or divert its flow

A Sampling of Reservoir Songs

Wait Till The Dam Is Finished (air: Wait Till the Sun Shines Nellie)

On an autumn day, Carleton went away.
With his map-case by his side
Through each mountain lane, he trampled for fame
"We must do the job," he cried,
"At the Tongore site, there's a snag or two.
And at the Olive Bridge, a few."
So a plan he made, and at it he stayed
And we heard him softly say:

Wait till the Dam is finished
And the water's rising high
We will be happy, Waldo don't you sigh
Down the Aqueduct we'll wander, Robert, you and I
Wait till the Dam is finished, bye and bye

Shall We Gather At Ashokan (air: Shall We Gather At The River)

Shall we gather at Ashokan
Where the Catskill flood is stored,
With its crystal waters shining
To the glory of the board

Chorus:
Yes, we'll gather at Ashokan
The wonderful, the mighty Ashokan
Drink with the Chief at Ashokan
To the health of the Water Board

Soon the water of Esopus
Capped white with the silvery spray
We shall hold in that great basin
In the mountains far away

Underneath the silent Hudson
Through the tube of massive stone,
We will take the Catskill water
Far, far from its mountain home.

"Deep Water" and related lessons support the following NYS Learning Standards:

English Language Arts

Standard 1: Students will read, write, listen, and speak for **information and understanding**
Standard 2: Students will read, write, listen, and speak for **literary response and expression**
Standard 3: Students will read, write, listen, and speak for **critical analysis and evaluation**
Standard 4: Students will read, write, listen, and speak **for social interaction**

Mathematics, Science, and Technology Education

Standard 1: Analysis, Inquiry, and Design - Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
Standard 2: Information Systems - Students will access, generate, process, and transfer information using appropriate technologies.
Standard 4: Science - Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.
Standard 5: Technology - Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs.
Standard 6: Interconnectedness: Common Themes - Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.
Standard 7: Interdisciplinary Problem Solving - Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

Social Studies

Standard 1: History of the United States and New York - Students will use a variety of intellectual skills to demonstrate their understanding of major ideas, eras, themes, developments, and turning points in the history of the United States and New York.
Standard 3: Geography - Students will use a variety of intellectual skills to demonstrate their understanding of the geography of the interdependent world in which we live—local, national, and global—including the distribution of people, places, and environments over the Earth's surface.
Standard 4: Economics - Students will use a variety of intellectual skills to demonstrate their understanding of how the United States and other societies develop economic systems and associated institutions to allocate scarce resources, how major decision-making units function in the United States and other national economies, and how an economy solves the scarcity

problem through market and nonmarket mechanisms.