

Lesson 6

Why Dams?

Overview

In Lessons 4 and 5 students experienced three investigations identifying the different human and non-human stakeholders of the Columbia River Watershed. As they discussed the life cycle of the salmon and viewed the DVD *Journey of the King*, they were made aware of how the dams on the Columbia River and its tributaries have had a dramatic effect on the salmon and steelhead runs of the Pacific Northwest. The impact that the dams have had on the once bountiful fish runs and as a result, on the Native American tribes whose culture, and livelihood depend on the salmon might lead students to ask the question, “Why do we need dams?” Lesson 6 addresses this question by examining the reasons that the 400+ dams have been constructed on the Columbia River and its tributaries. Through reading selections, examination of maps and classroom discussion students examine the tremendous benefits that the dams bring to the desert region of Eastern Washington, Oregon, and Western Idaho.

Their understanding of the Columbia River and the stakeholders who depend on the river is deepened through the initial reading selection in the student book *Voyage to the Pacific*.

- Students use the *What We Know About Dams* brainstorming chart from Lesson 1 to review and discuss their current understanding of dams.
- Students label a map of the state of Washington identifying the major rivers, mountains, lakes, towns, and dams of the Columbia River Basin.
- Students read to learn about the dams of the Columbia River and their importance to the stakeholders of the Columbia River watershed.

Student Learning Targets

Using a map of Washington State, I can identify and label the major rivers, lakes, cities, and dams of the Columbia River Basin.

I will learn more about the dams of the Columbia River through class discussions, and reading selections.

Disciplinary Core Ideas

Science

4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth’s features.

4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and uses affect environment.

4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Social Studies

Economics 2.2.1 Understands the basic elements of Washington State’s economic system, including businesses, industry, natural resources, and labor.

- Examines how irrigating the semi-desert climate of Eastern Washington has impacted the economies of Indian tribes and other residents of Washington State.

Economics 2.4.1 Understands how geography, natural resources, climate, and available labor contribute to the sustainability of the economy of regions of Washington State.

- Explains how dams impact the economic well-being of regions of Washington State

Scientific & Engineering Practices

Obtaining, evaluating, and communicating information

Crosscutting Concepts

Patterns



Academic Vocabulary

Irrigation: The watering of land by artificial means to foster plant growth.

Industry: A distinct group of productive or profit-making enterprises.

Recreation: Something people do to relax or have fun; activities done for enjoyment.

Hydroelectric Power: Electricity that is generated by falling water in a dam. Flowing water pushes a turbine, which turns a shaft and magnets inside a generator to produce electricity.

Columbia River: The largest river in Washington and the 4th largest river in the United States. It is 1243 miles long.

Dam: A barrier built across a waterway such as a river to control the level, flow of water.

Flood Control: The act of controlling river flow with dams, dikes, artificial channels, etc., to minimize the occurrence of floods.

Run off: Water from rain or snow that flows over the surface of the ground into streams.

I can communicate the affect dams can have on the lives of those living in the Columbia River Basin.

Teacher Background Information

See the Teacher Background Information from Lesson 1 entitled *The Columbia River* by [Bill Lang](http://www.ccrh.org/), Professor of History Portland State University, Director, Center for Columbia River History, <http://www.ccrh.org/>

The sections entitled “Description,” and “Uses of the Columbia” provide detailed information related to the topics discussed in Lessons 4, 5, and 10.

Information taken from the document - *What Makes The Columbia River Basin Unique And How We Benefit*

By the Foundation for Water and Energy Education (FWEE)

In short, the Columbia River Basin is an essential reason for the Northwest being a dynamic and highly prosperous region within the nation and the world. Hydropower, flood control, irrigation, navigation and recreation are specific benefits that the uniqueness of the Basin and its river system provide.

Hydropower

Up to 80% of the electricity in the Northwest is produced by hydropower. Historically, hydropower has been one of the most inexpensive and most efficient sources of electricity in the region. In the Northwest, for example, electricity from hydropower typically costs \$10 per megawatt hour to produce. This compares to \$60, \$45 and \$25 per megawatt hour to produce electricity, respectively, at nuclear, coal and natural gas plants. To determine these price comparisons, planners calculate what it costs to build, maintain and operate these differing generation facilities.

This source of inexpensive electricity was a major attraction for energy intensive industries such as aluminum, food processing, and the production of plutonium for national

defense. Other industries, such as aerospace, were attracted to this area because they wanted proximity to a resource, in this case aluminum, being manufactured in the Northwest. In addition, the mining industry was a major beneficiary because inexpensive electricity greatly reduced the costs of extracting various metals.

Individuals benefited as well. For instance, hydropower was the first source of electricity for many rural areas. Further, the cost of owning and maintaining a more comfortable home was less. Specifically, inexpensive electricity meant installing electric heaters, dryers, stoves and other appliances was in easy reach of the many, not the few.

Today, natural resource and manufacturing industries are becoming less vital to the Northwest's economy. Indeed, one forecast shows that the non-manufacturing share of total regional employment could grow to nearly 89 percent by the year 2015. As a result, the Northwest's traditional dependence on inexpensive electricity to fuel the economy has declined somewhat.

On the other hand, the Northwest's population is continuing to boom. From 1980 to 2010, population is expected to increase from eight to almost twelve million people. Each of these individuals is a consumer of electricity. To continue to receive the individual benefits of inexpensive electricity, maintaining hydropower as a resource is as important as ever.

And while the dollar cost of hydropower is highlighted here, the environmental costs and benefits of this renewable resource are very important as well.

Flood Control

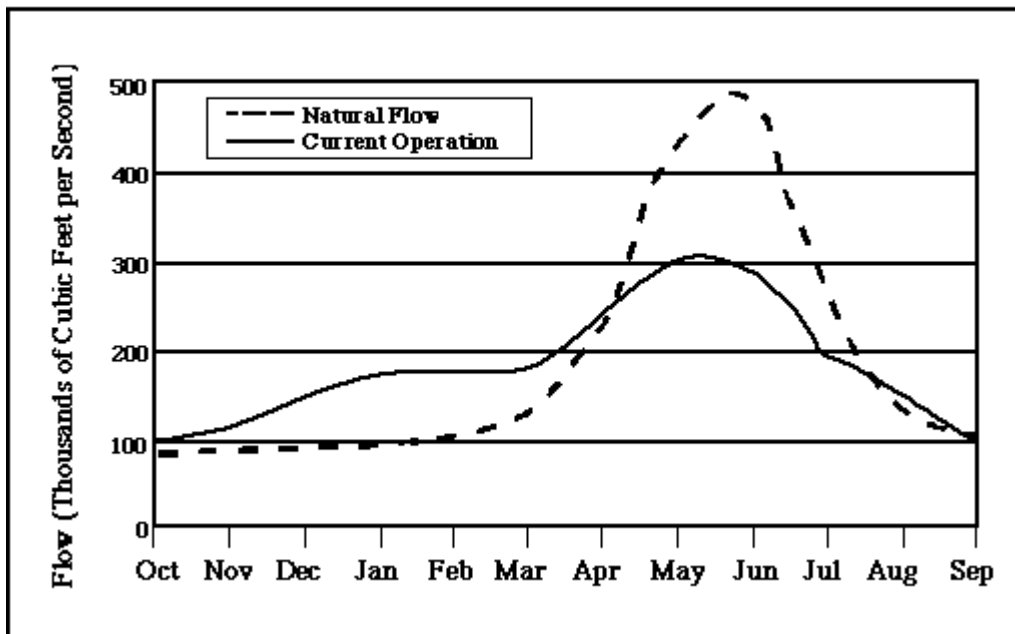
Historically, the two priorities for coordinated management of the Columbia River system have been electric generation and flood control. Other priorities, such as irrigation, navigation and recreation, are largely carried out within the context of meeting these needs. Most recently, impacts on salmon have resulted in the National Marine Fisheries Services stating that anadromous fish recovery should receive priority over all river uses except flood control.

Understanding the importance of flood control is similar to understanding the importance of insurance. Until you lose something, you do not appreciate how important it is. In 1948, the importance of flood control became a priority after Vanport, Oregon was destroyed by a flood. The Army Corps of Engineers responded by developing a multiple-use reservoir storage plan for the Columbia River Basin.

A treaty with Canada and the evolution of sophisticated planning and interagency cooperation have resulted in up to 39.7 million acre-feet of storage space being available for flood control. That is enough water to cover the Northwest four inches deep in water. For the Columbia River Basin, the need for reservoir space to help reduce the risk of flooding is most important during two seasons of the year: in winter, when there are rain-induced floods, and in the spring and early summer, when there are floods from snowmelt and rain.

By manipulating the amount of water in reservoirs throughout the Basin, system operators are able to create a balance between releasing water to produce hydropower when it is most needed, and reducing the potential for flooding. Looking at average river flows at The Dalles Dam over the course of the year is one way to see the difference between unrestricted water flow and the use of reservoirs to make this flow more constant. Further, reservoir storage is also assisted by a system of levees, flood walls, bank protection, and various types of land use regulation.

Average River Flows at The Dalles Dam



Source: Northwest Power Planning Council. Fourth Northwest Power Plan, Portland OR, March 13, 1996, p.4-5

Forty-eight years of developing this coordinated approach came together as never before in February, 1996. Heavy rains and melting snowpack due to mild temperatures created the worst flooding in over 30 years in the Northwest. Government agencies and non-federal hydro operators worked together to reduce flood damage by an estimated 3.2 billion dollars. Because the Northwest had a flood control plan in place, the evening news did not show downtown Portland six feet deep in water. Some of the details of how the [flood of 1996](#) was contained are remarkable. Although nobody expected these types of floods to occur for another several years, floods at the end of 1996 reminded everyone that the importance of flood control is always present.

Navigation

Every year, the Columbia and Snake Rivers carry 17 million tons of cargo to and from the Pacific Ocean along a 465-mile waterway. This is another example of technology and coordinated planning leading to the Columbia Basin being put to multiple use. Specifically, a [series of eight locks](#) facilitates the passage of ships from the ocean to as far inland as Lewiston, Idaho. These locks are part of the same projects and reservoirs that produce hydropower and help control flooding.

From the ocean to Portland, Oregon and Vancouver, Washington dredging assures that a 40-foot-deep open river channel remains open year-long for ocean-going vessels. This 106-mile segment then connects with a 359-mile segment that extends to Lewiston, Idaho. Within this second segment, a 14-foot-deep channel for barges and other craft is kept open. To maintain this channel depth, maximum and minimum reservoir elevations are set. These elevations are determined within the context of meeting needs for electrical generation, flood control, and the release of water to help fish passage.

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Irrigation

Another benefit that stems directly from the unique nature of the Columbia Basin is irrigation. In fact, six percent of the Columbia River Basin's yearly runoff is diverted to irrigate about 7.8 million acres of land. Much of the water that is diverted eventually finds its way back into the river system. Farmers in arid parts of eastern Washington, northeastern Oregon, and southern Idaho depend on irrigation to support crops such as wheat, corn, potatoes, peas, alfalfa, apples, and grapes.

The Columbia Basin Project, for instance, turned the high desert area of central Washington into another bread basket for America. The centerpiece is the Grand Coulee Dam, which was built primarily as an irrigation project by the Bureau of Reclamation. Water stored behind Grand Coulee Dam in Lake Roosevelt is pumped into Banks Lake. This lake was formed by damming both ends of Grand Coulee, which is one of the geological formations that dates back to ice age floods. The water then flows through a system of tunnels and canals to irrigate croplands. The project irrigates over 500,000 acres and has the potential to be expanded to irrigate over 1.1 million acres. The Grand Coulee Dam is also used as a hydroelectric project and has the capacity to generate more electricity than any other hydroelectric project in North America.

The Bureau of Reclamation, local irrigation districts and water companies are examples of authorities that regulate how much water is diverted from the river system to support irrigation. Although scheduled locally, the cumulative effect of utilizing water from the river system to support large and small irrigation projects can be quite significant. As a result, those responsible for coordinated management of the river system estimate the effect of such diversions when determining reservoir levels. through accurate estimates, reservoir levels can be properly maintained to meet flood control, hydroelectric generation and irrigation needs.

One should also note that some areas and stretches of river are much more affected by irrigation than others. The effects on the Snake River are more pronounced than on the main stem of the Columbia. For instance, the Minidoka Project along the Snake uses water from six storage and two diversion dams. Thousands of miles of distribution canals then provide irrigation service to more than 1.1 million acres of farmland.

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For these reasons, the issue of "water rights" has been a source of contention for quite some time. In Idaho, for instance, the state constitution grants "the right to divert and appropriate the unappropriated waters of any natural stream to beneficial uses." In other words, if you got there first you can keep diverting water for the "beneficial" purpose of irrigation. While contentious at a local and state level, the situation is made even more complex by recognizing that the Northwest as a whole is also affected. For example, because irrigation can cause less water to be available for reservoirs, flexibility in releasing water to support fish passage can be lost.

Recreation

Recreation is the last major benefit that will be discussed. This benefit is also somewhat different from the others. When hydroelectric and reservoir storage projects were proposed, more recreation was not the driving force behind their creation. Rather, opportunities for new and additional recreation came with development of a project. Such opportunities were used to meet local and regional needs as well as address impacts caused by construction. Each year, for instance, about 450,000 thousand people pass through the Grand Coulee Dam Visitor Center.

Examples of recreation opportunities that stem from project development include fishing, swimming, waterskiing, picnicking, camping, hiking, rafting, boating and sightseeing. Often, developing these opportunities were part of receiving a license to develop and operate a project. Now that some of these projects are being relicensed, which generally occurs after a project has been in existence for 30 years, maintenance and further development of many recreation sites is being reviewed.

The number and diversity of recreational opportunities associated with hydroelectric projects is indeed remarkable. Each year, hundreds of thousands of individuals take extended vacations, weekend and day trips to access these opportunities. Looking at a [directory of recreational](#) sites associated with non-Federal hydroelectric projects tells the story better than words.

Note – The information in the Teacher Background information is intended to provide information that can be shared during class discussion related to the role that dams play in the Columbia River Basin.

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Materials

For each student

- 1 science notebook
- 1 Washington map with Columbia Basin landmarks

For every two students

- 1 *Voyage to the Pacific* student reader

For the class

The *What We Know about Dams* chart from Lesson 1

Glue sticks to paste the Washington/Columbia Basin map into students' science notebooks

Preparation

1. Post the *What We Know about Dams* chart from Lesson 1 in a visible location.
2. Review the Teacher Background information in preparation to lead a discussion related to the benefits the dams on the Columbia River and its tributaries provide.
3. Copy the Washington map with Columbia Basin landmarks numbered for each student.
4. Prepare to display the Washington/Columbia Basin map using a document camera and projector or computer; or by creating an overhead transparency and using an overhead projector.
5. Prepare a page in a model notebook, copy "Student Map Key," or use it by following the numbering and numbering for students to identify the landmarks on the Washington/Columbia Basin map.

Procedure

1. Review with students that in Lesson 4 the class examined how dams have had a dramatic effect on the native salmon and steelhead runs, as well as to greatly affect the lifeway of the Native American peoples of the Columbia Basin. Tell students that in today's lesson the class will be answering the question, "Why dams?"
2. Introduce the student learning targets for Lesson 1 and check for understanding.
3. Display the *What We Know about Dams* chart from Lesson 1. Give students a chance to read over the information that was recorded on the first day of the River of Power unit. Draw a solid "line of learning" under the last recorded response. Ask students if there is any new information that they would like to add to the chart.
4. Let students know that an important part of the class discussion related to dams will be to identify where they are located. Hand out the Washington/Columbia Basin student maps.

5. Display the Washington/Columbia Basin map for the class to observe. Let students know that they will fill in the name of the river, town, dam, lake, etc. next to the appropriate number in their notebook.
6. As you share the identification of each landmark on the map record the name of the landmark on the sample notebook page prepared in advance. To help students orient themselves with the map it is suggested that you begin by labeling the rivers, followed by the lakes, then the cities, and finally the dams or copy black line master for them to paste into science notebooks. See the key below.

Cities			
A	Wenatchee	H	Chelan
B	East Wenatchee	I	Bridgeport
C	Moses Lake	J	Brewster
D	George	K	Omak
E	Quincy	L	Tonasket
F	Cashmere	M	Oroville
G	Leavenworth	N	Ephrata

Dams			
1	Rocky Reach Dam	4	Grand Coulee Dam
2	Rock Island Dam	6	Chief Joseph Dam
3	Wanapum Dam	7	Wells Dam
4	Priest Rapids Dam		

Rivers			
8	Columbia River	11	Wenatchee River
9	Snake River	12	Yakima River
10	Okanogan River		

Lakes			
13	Lake Chelan	15	Lake Roosevelt
14	Moses Lake	16	Banks Lake

7. Ask students the following observation questions.
 - Where do you see most cities located? (near rivers or bodies of water)
 - Why do you think the cities are located here? (water, recreation opportunities, transportation of goods, roads often follow rivers)
 - What cities are represented by numbers 4 and 5?
 - What is the major industry in this region? (agriculture)
 - What do you think makes it possible for these cities to have an agricultural-based economy? (irrigation water diverted by dams)
 - In the spring of the year when the winter snow melts what happens to the rivers? (flooding)

- What do you think allows the cities to be located near the rivers safely? (dams control flooding)

Note – During the discussion share pertinent information from the Teacher Background information provided.

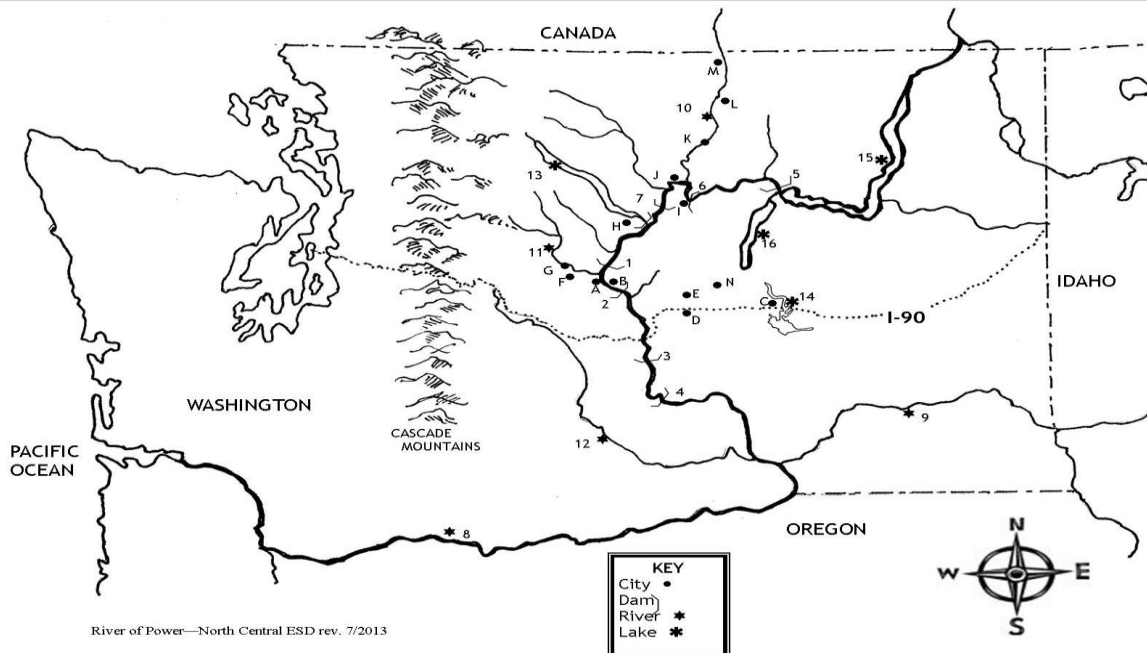
8. Draw students' attention to the chart *What We Know about Dams*, circle the following key benefits that dams provide to the Columbia River Basin while students record them in the science notebook. If they have not been listed on the chart add them from the class discussion.

Dams Provide

- Flood control
- Renewable energy (Electricity)
- Irrigation water
- Transportation of goods
- Recreation opportunities

Final Activities

1. Revisit student learning targets for Lesson 1 and use the formative map assessment to check for student understanding.
2. Read *Voyage to the Pacific* pages 7-11 *A Lake on the Roof of the World, and Back Toward Civilization*.



Lesson 6 “Why Dams” Student Map Key

Name: _____

Date _____

Cities

A		H	
B		I	
C		J	
D		K	
E		L	
F		M	
G		N	

Dams

1		5	
2		6	
3		7	
4			

Rivers

8		11	
9		12	
10			

Lakes

13		15	
14		16	

Lesson 6

Map KEY

Cities

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Dams

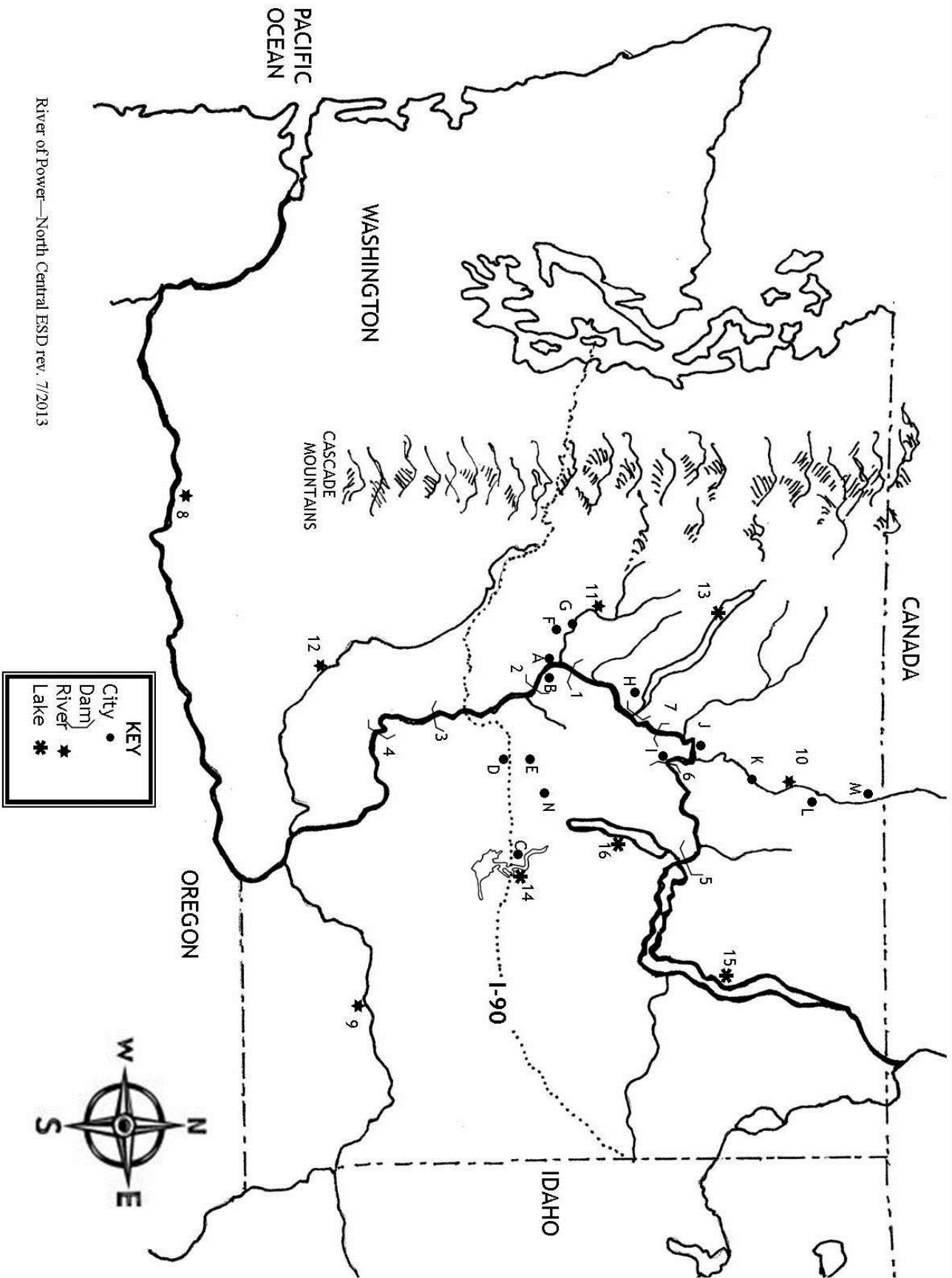
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