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# CHELAN WATERSHED INITIAL ASSESSMENT

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Draft  
May 1995

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With our multitudes of lakes, streams, and rivers, Washington State seems to have an abundance of water. However, the demand for water resources has steadily increased each year, while the water supply has stayed the same, or in some cases, declined. This increased demand for limited water resources has made approving new water uses complex and controversial.

The purpose of this assessment is to evaluate existing data on water to make decisions about pending water right applications. It does not affect existing water rights.

To expedite decisions about pending water right applications, it is vital that we accurately assess the quality and quantity of surface and ground water. The Washington State Department of Ecology recognizes that water right decisions must be based on accurate scientific information. Ecology is working with consultants to conduct special studies called Initial Watershed Assessments throughout the state.

The assessments describe existing data on water rights, streamflow, precipitation, geology, hydrology, water quality, fisheries resources, and land use patterns. Some assessments provide straightforward results, allowing immediate water management decisions. In watersheds with little existing information, further studies will be necessary to acquire new data. In watersheds where major public policy conflicts exist, or where significant land use impacts are expected, water management decisions will be coordinated with local and regional planning processes.

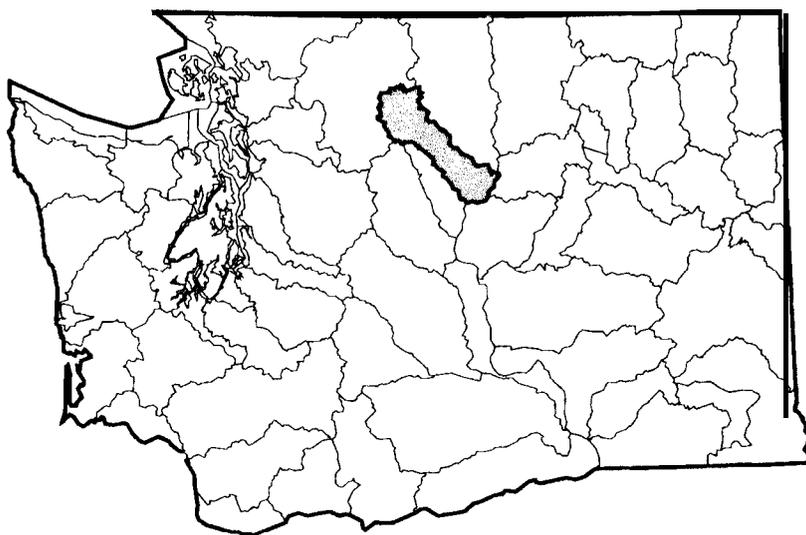
This report summarizes information presented in the detailed Ecology Open File Technical Report No. 95-13. It also presents some actions that could be taken in response to the results of this assessment.

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**Montgomery Water Group  
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and associated firms**

Prepared in cooperation with the  
**Washington Department of Ecology**

## Chelan Watershed Location Map



### What are the water allocation issues?

- Ecology needs to make decisions on 77 pending water rights applications.
- Aquifers present within the watershed flow toward surface water bodies, such as streams, lakes, and rivers. Aquifers in areas undergoing development but which are too far from Lake Chelan to be supplied by surface water, such as areas north and east of **Manson** and Chelan, appear to be capable of providing only limited water supplies.

## What is a watershed?

A watershed is an area of land where topographic features such as hills and valleys cause water to flow toward a single major river or other body of water. The Chelan watershed encompasses 1,047 square miles, including 924 square miles that are tributary to Lake Chelan and 123 square miles that drain directly to the Columbia River.

## Where does the water come from?

Ultimately, all of the streams, lakes, springs, and other surface waters and ground water in the watershed comes from rain or snowmelt. Some of this water evaporates or is used by plants, some flows into the streams and rivers, and the rest infiltrates into the soil to become ground water. Some segments of streams and rivers gain water from ground water that seeps into the channel. Other segments lose water that leaks through the streambed into the ground. See figure, below.

Average annual precipitation in the Chelan watershed ranges from 150 inches per year at the crest of the Cascade Mountains to 11 inches per year in the city of Chelan. Most of the annual precipitation falls in winter as snow, with

accumulations of 25 feet or more in the mountainous areas. As the snowpack melts in spring and early summer, it supplies most of the streamflow. In addition, some melting snow infiltrates into the soil to become ground water, which then slowly discharges to rivers and tributary streams, providing a relatively low but constant flow the rest of the year.

## What are the major surface water sources?

The main surface water feature of the Chelan watershed is Lake Chelan, the largest and deepest lake in the state at 50 miles long and nearly 1,500 feet deep. Roughly 75 percent of the inflow to Lake Chelan comes from the Stehekin River and Railroad Creek. Smaller tributaries to the lake include Fish, Prince, and Twenty-Five Mile creeks. The Columbia River is located at the mouth of the Chelan River, from which Lake Chelan drains. See map, right.

## What are the major ground water sources?

Ground water can be found in usable quantities in two types of materials: bedrock and sediments overlying bedrock. Ground water generally flows

toward Lake Chelan and down toward the Columbia River.

The bedrock in the Chelan area is composed primarily of granitic and metamorphic rocks. Although wells that penetrate the bedrock provide enough water for domestic use, yields are generally low and inadequate to support substantial development.

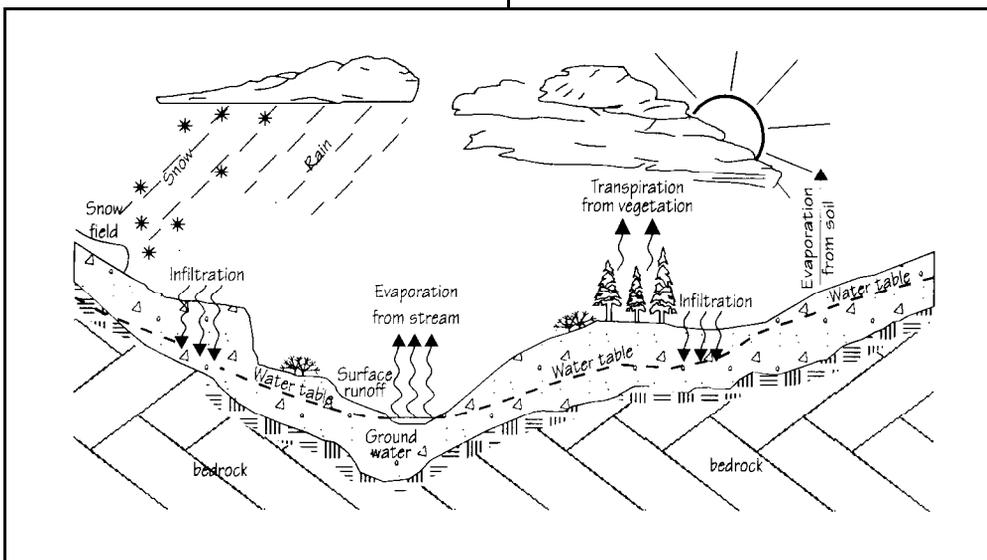
The bedrock is overlain by a variety of deposits of silt, sand, and gravel. The sediments are generally less than 50 feet thick but may be more than 200 feet thick in areas. Well yields range from less than 10 to more than 100 gallons per minute.

Recharge to the aquifer system is primarily in the form of rainfall infiltration, snowmelt, and, on the lower terraces and in the **Manson** area, infiltration of irrigation water. Recharge of the bedrock flow system comes from precipitation, snowmelt, and infiltration from the overlying aquifer.

Some localized aquifers, such as those found in smaller, higher elevation drainages at the south end of Lake Chelan, will likely be more affected by increased ground water usage than larger aquifers lower in the watershed. This is because recharge is limited by the small basin size and low amounts of precipitation occurring in those drainages

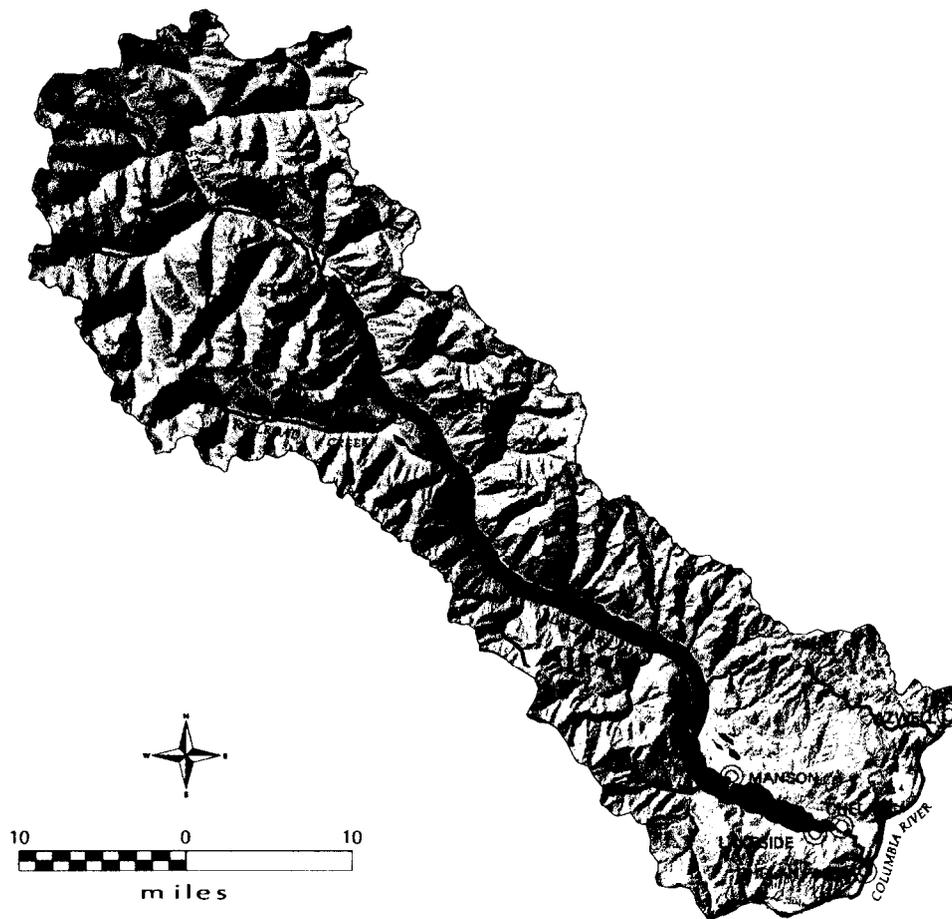
## How is water used?

Irrigation use in the area around Lake Chelan is estimated to account for 2.2 percent of the total annual outflow from the lake, and is the largest use of water in the watershed. Approximately 0.1 percent of the outflow is consumed by municipal and domestic users. Most all of the water discharged from Lake Chelan is routed through turbines to generate hydropower. Another large use of water is for fish propagation at the Wells Dam Hatchery along the Columbia River.



Representative hydrologic cycle (modified from Walters and Nassar).

# Chelan Watershed



## How does land use affect water?

Land use can affect the demand for and use of water. Some land uses, such as irrigated agriculture, require large amounts of water on a seasonal basis. Other land uses, such as residential or livestock production, require less water but need it year-round.

Over three percent of the watershed is in agricultural use, primarily orchards, and less than one percent is developed into roads, houses, and commercial areas. Water use is concentrated in these areas. Approximately six percent of the watershed is comprised of Lake Chelan and other water bodies, and about 90 percent of the watershed is forest land managed by the U.S. Forest Service, the National Park Service, and

private owners.

Although residential, recreation, and tourism uses are predicted to increase in the watershed, a significant impact on water availability is not expected because of their small use relative to the water supply in the watershed.

## What are the water quality issues?

Water supplies must be of high quality for drinking water use and to support fish and wildlife. Lake Chelan has problems with pH (acidity) and pesticide contamination, although levels appear to be relatively stable. Recent studies indicate that because nutrient levels remain low, the lake's water clarity and aesthetic quality have been preserved.

Other potential water quality problems in the lake include wastewater inputs from the growing near-lake population malfunctioning septic systems, and boat sewage disposal and storage. These issues are especially of concern in the southern end of the lake near Chelan, where bacterial concentrations have exceeded drinking water standards.

Activities associated with new development, construction, timber harvesting, and grazing could adversely affect water quality by increasing levels of sediments and chemical contaminants. Drainage from the abandoned Holden Mine is a concern because heavy metals are being introduced to the lake. Cleanup efforts are underway to control that source.

Ecology's 1989 Water Quality Assessment for Lake Chelan found that 10 to 25 percent of phosphorus and nitrogen found in the lake resulted from human activities. This percentage is relatively high considering that only four percent of the 924 square-mile watershed is developed.

**Are fish resources stable?**

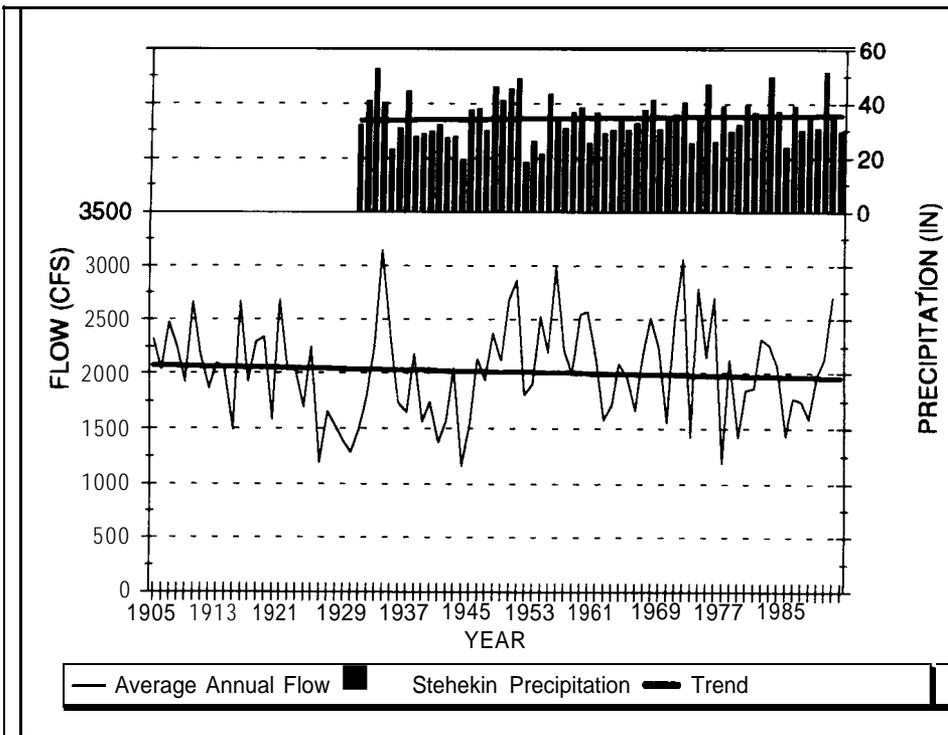
There have been a number of recent studies on the health of fish stocks in Washington State. Technical data from a wide variety of sources, including information from two prominent fishery resource studies, were used to evaluate fishery issues in the Chelan River watershed. The two studies are referred to as the "AFS study" (published as "Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington") and the "SASSI" study (the Salmon and Steelhead Stock Inventory), which was prepared by the Washington State Departments of Fisheries and Wildlife, with assistance from 23 Indian Tribes and tribal organizations.

Fall chinook salmon, kokanee, and rainbow trout are found in the Chelan watershed. Although these species are present, fish production is generally considered low due to low nutrient levels, which limit food availability.

According to the SASSI report, the fall chinook population is "healthy." The AFS study does not rate the species' status.

**How have streamflows changed?**

The US. Geological Survey operates stream gage stations to measure the amount of water that flows through the Stehekin (measured from 1926-present) and Chelan (measured from 1903-present) rivers and Railroad Creek (measured from 1927-1957). These volumes are expressed in cubic feet per second (cfs), which is a measurement of the volume of water flowing through a



Average annual flows in the Chelan River are shown in the graph above. Total streamflow in the system averages about 1.5 million acre-feet per year.

stream. Flows in these streams do not appear to have changed significantly over the period of record. On an annual basis, an average of 2,200 cfs flows into Lake Chelan. Of that inflow, the average annual flow for the Stehekin River is 1,401 cfs and Railroad Creek is 202 cfs. The average annual outflow from Lake Chelan (measured at the Chelan River gage) is 2,042 cfs. See graph, above. The difference between the inflow and the outflow, 158 cfs, is consumed by irrigation and domestic uses and by evaporation from the lake surface.

Streamflows peak in early June and are at their lowest in late winter. Because of the deep and high elevation snowpack in the North Cascade Mountains, snowmelt continues from April through July. Flow rates decrease by 13 to 15-fold on average between peak and low flows on the Stehekin River and Railroad Creek. See graph, page 5, top.

Nearly all of the outflow from Lake Chelan is diverted for power generation. Discharge from the power plant is

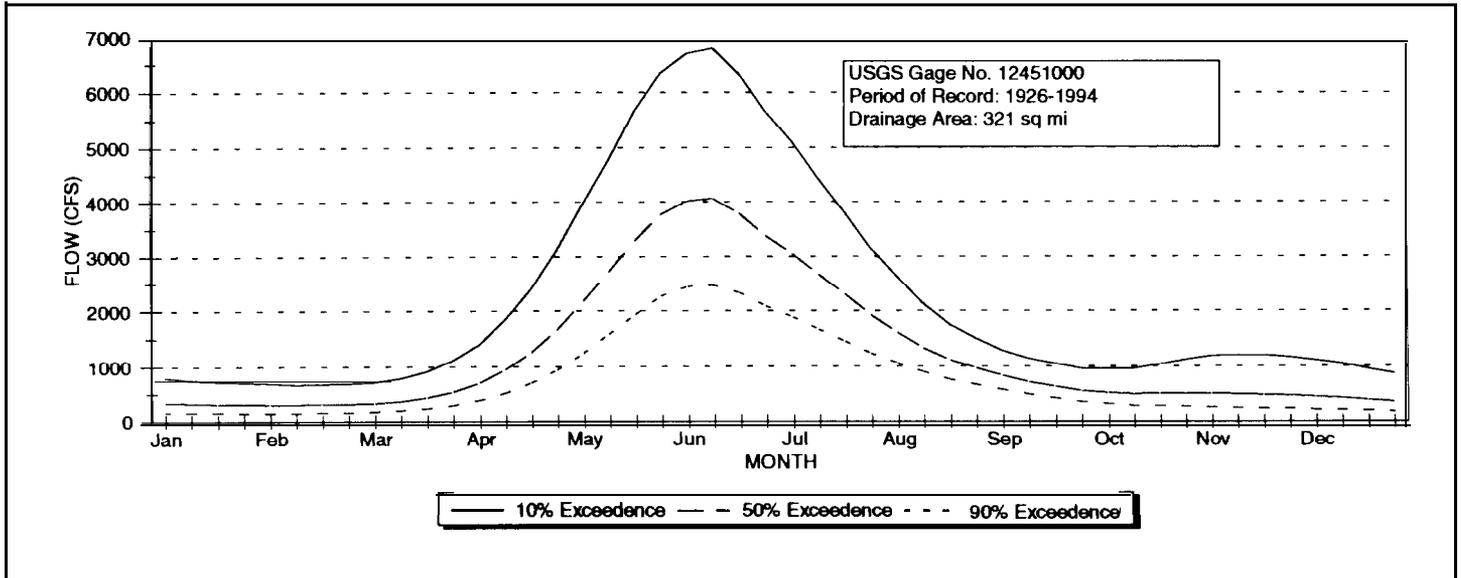
controlled to keep the lake full during the peak recreational season (June through September). The water level may drop by up to 21 feet during the winter before spring runoff begins.

Discharge from the lake is generally held at a constant 2,000 cfs. During spring runoff the average lake outflow rises to approximately 4,000 cfs and in dry years the flow can drop to below 200 cfs during winter.

**What are water rights?**

A water right is a legal authorization to use a certain amount of public water for specific beneficial purposes.

State law requires every user of streams, lakes, springs, and other surface waters to obtain a water right permit before using these waters. People who use ground water also need a water right permit unless they use 5,000 gallons or less each day for one or more of the following purposes: watering stock, watering a lawn or garden less than one half acre in



Because of the deep and high elevation snowpack in the North Cascade Mountains, snowmelt continues from April through July. Flow rates decrease by 13 to 15-fold on average between peak and low flows on the Stehekin River.

size, or for a single or group domestic or industrial water supply.

**What are water right claims?**

A water right claim is just that, a claim for a right to use water. A water right claim on file with Ecology may or may not represent a valid water right. The validity of a claim can only be established through a superior court determination of water rights. Within the watershed, a total of 679 water right claims have been filed, for a total flow equivalent to about 81 cfs. Of these

water right claims, there are currently 150 ground water claims totaling 10 cfs and 529 surface water claims for 71 cfs.

**Why are water rights important?**

The basis for water rights is "first in time, first in right." This means people with older, or senior, rights get to use the water first when there is not enough for everyone. The water rights program ensures that Washington's water resources are appropriately allocated and managed. By effectively

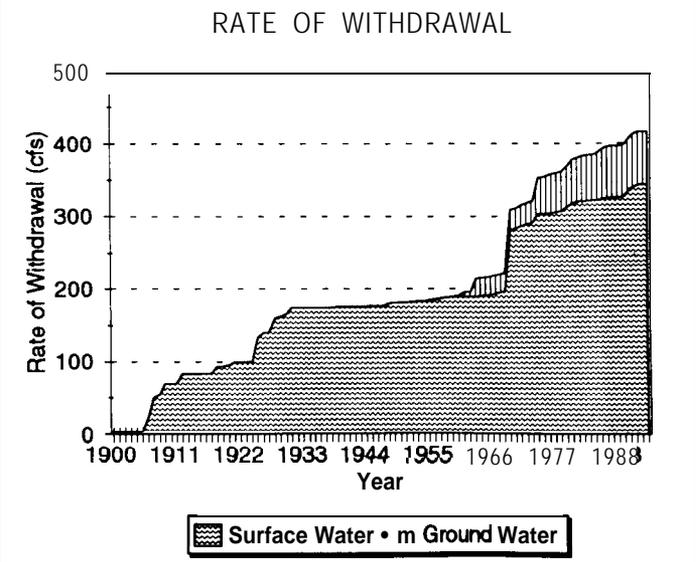
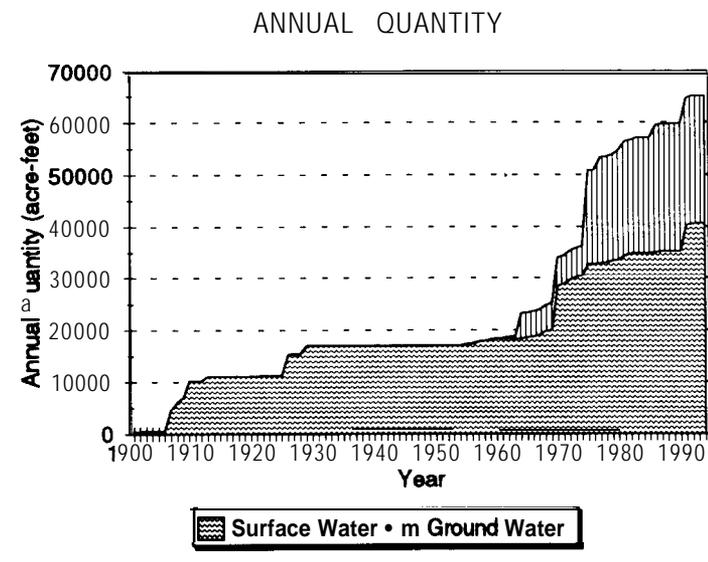
managing allocation of new water rights, Ecology can protect senior water rights and benefit the overall public good.

**How is water currently allocated and what new uses are proposed?**

Ecology has issued water rights for withdrawals of 72 cfs of ground water and 343 cfs of surface water. The total annual volume of issued ground water rights equals 24,556 acre-feet, and issued surface water rights equal 40,537 acre-feet. One acre-foot equals the amount of water contained in a one-acre area with a water depth of one foot.

**HISTORICAL GROWTH OF WATER RIGHTS A**

**PROPRIATIONS IN CHELAN WATERSHED**



Irrigation is the largest type of use, with about 59 percent of the total volume of surface and ground water permits and certificates. Fish propagation is the second largest use, with 25 percent. Municipal, domestic, commercial, and industrial uses comprise about 16 percent of the total. See figures, pages 5, bottom, and 7.

Chelan County PUD No. 1 holds a water right certificate to appropriate 4,000 cfs for the Chelan Falls Hydroelectric Project. The certificate was issued in 1925 subject to reservation of water for irrigation and domestic use on lands bordering and near Lake Chelan. A dispute between the PUD and Ecology regarding the amount of water reserved and available for future allocation from Lake Chelan was settled in 1992. An agreement was signed which

allows Ecology to allocate up to 65,000 acre-feet/year of surface water from Lake Chelan.

Of the surface water permits and certificates, 35,515 acre-feet/year is allocated for use from Lake Chelan and its tributaries, and 5,021 acre-feet/year is for use from the Columbia River and its tributaries lying south and east of Lake Chelan. See figure, below right.

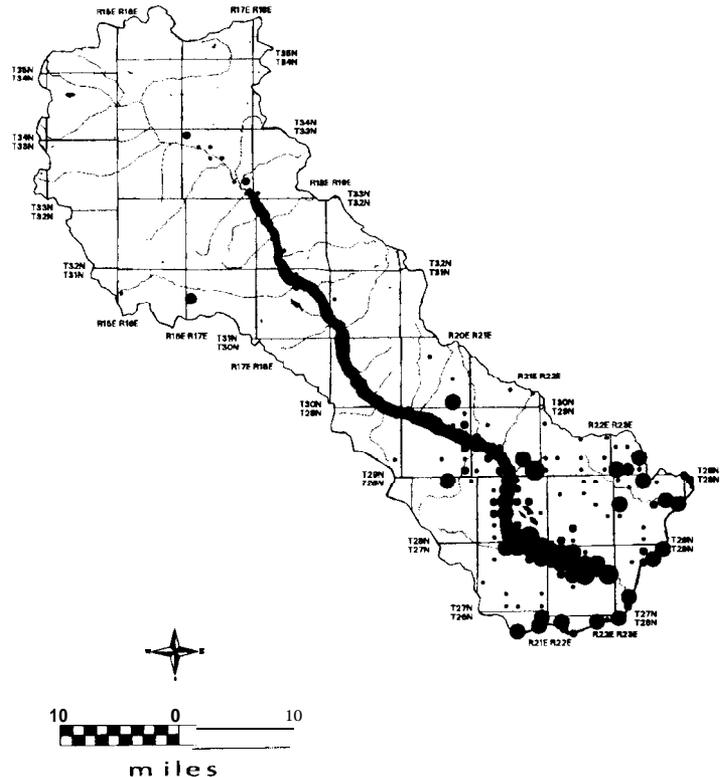
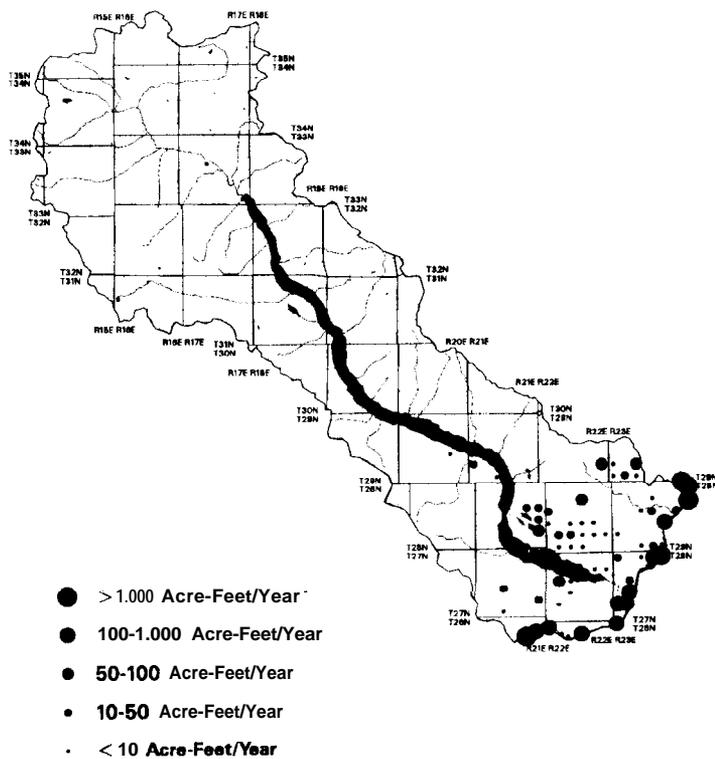
Of the ground water permits and certificates, only 385 acre-feet/year is for use in areas tributary to Lake Chelan and the remainder is for use along the Columbia River and its tributaries lying south and east of Lake Chelan. See figure, below left. The majority of both surface and ground water permits and certificates were

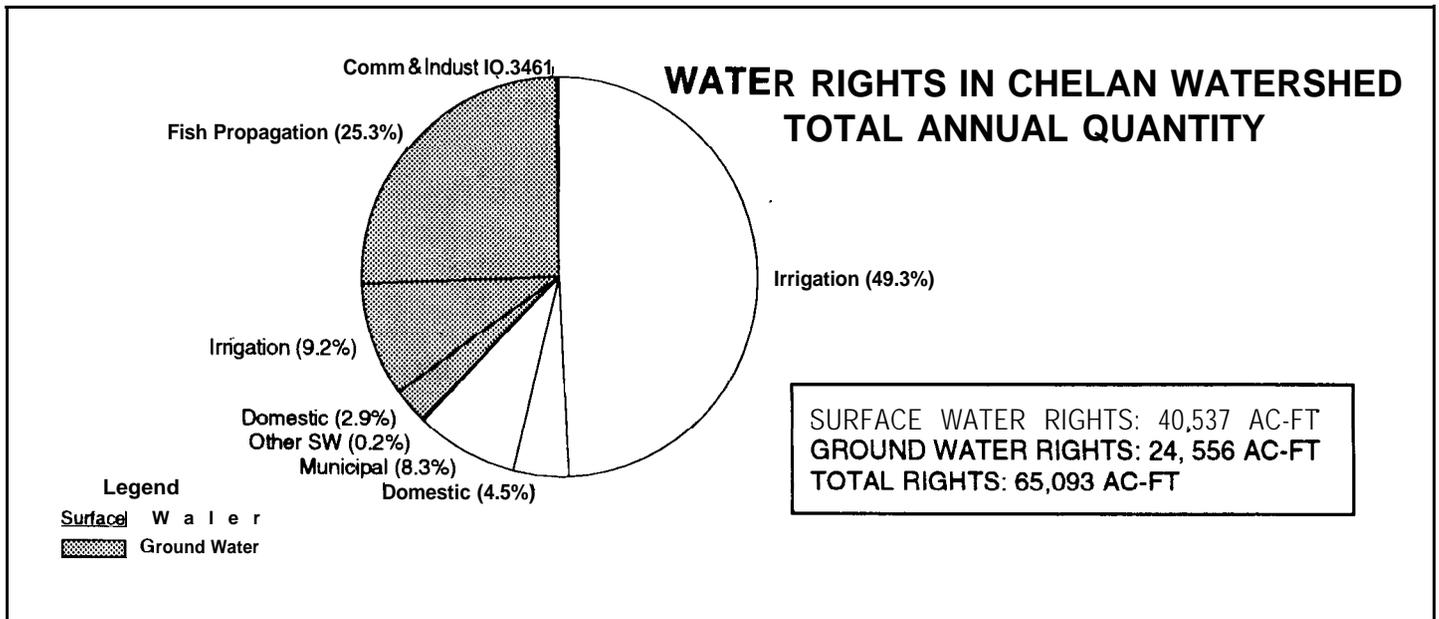
issued for uses in the southern part of the watershed in the developed areas adjacent to Lake Chelan.

There are 77 applications for water right permits pending, 42 for surface water and 35 for ground water, requesting a total of 138 cfs. Single and multiple domestic use applications comprise 58 percent of the total water requested, use for frost protection comprises 29 percent, use for fish propagation comprises 11 percent, and use for irrigation two percent. As with the permits and certificates Ecology has already issued, most of the applications are from areas in the south end of the watershed adjacent to Lake Chelan. Before issuing future water rights, Ecology must consider potential effects on other water users.

**Existing ground water rights in the Chelan Watershed by section.**

**Existing surface water rights in the Chelan Watershed by section.**





### What are the conflicts?

This is an area of the state where there are few conflicts between demand for additional water rights and the availability of water.

Conflicts may occur in smaller basins tributary to Lake Chelan where additional ground water pumping may affect existing users. The reasons for this are the limited recharge areas of the aquifers and the small amounts of precipitation that the basins receive.

Another conflict that may occur is the desire to maintain the current water quality in Lake Chelan and secondary effects of utilizing additional water, such as increased nutrient or pollutant loading to Lake Chelan. These effects can be mitigated with proper water management practices.

Another conflict is with applications for withdrawals from the Columbia River.

A total of 667 surface water right permits and certificates for 289 cfs and 35,515 acre-feet/year have been issued in the Chelan watershed for withdrawals from Lake Chelan and its tributaries. A total of 455 surface water claims are registered,

for an estimated 60 cfs and 11, 224 acre-feet/year for withdrawals from Lake Chelan and its tributaries. The total volume of surface water permits, certificates, and claims is about 46,700 acre-feet/year. However, some of these permits, certificates, and claims are for withdrawals from tributary streams and not Lake Chelan.

The agreement between Ecology and Chelan County PUD No. 1 allows a total annual allocation from Lake Chelan of 65,000 acre-feet. The total volume of the surface water rights, permits, and certificates listed above is well below that allocation, and additional surface water is available from Lake Chelan.

### Where do we go from here?

While Ecology is mandated by law to protect **instream** water use and existing water rights, Ecology also is responsible for making decisions on applications for new water rights. The public's opinion is important to Ecology in making its program decisions related to water use. Ecology invites public input on what steps should be taken next. We will also work with people who have applied for new water rights in the area to discuss options for processing their applications.

### What additional information is available?

If you would like more information about water issues in the Chelan watershed, the following studies and technical reports are available:

AFS. 1991. "Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington," March-April 1991. American Fisheries Society.

Beck, R.W., December, 1991. "Lake Chelan Water Quality Plan." Seattle, WA.

Ecology. 1995. "Initial Watershed Assessment, Chelan Watershed. OFTR 95-13." Washington Department of Ecology.

Harper-Owes, 1989. "Lake Chelan Water Quality Assessment." Seattle, WA.

WDF & WDW. 1993. "1992 Washington State Salmon and Steelhead Stock Inventory." Washington Departments of Fisheries and Wildlife.

## What do we know about the Chelan watershed?

This assessment found that ground water supplies are limited in some areas because of geology, limited recharge area, and low precipitation, but there is still water available for new uses from Lake Chelan. Water quality in Lake Chelan is a concern for both aquatic habitat and drinking water. Good water quality depends on maintaining adequate waste treatment facilities, on controlling boat sewage disposal, and reducing runoff of water containing pesticides and fertilizer. Because of these findings, the Chelan watershed is classified as "low risk" by Ecology.

## What actions can be taken?

Based on the risk, Ecology could take a number of actions. Usually, a combination of actions needs to be taken to effectively manage water resources. The list below describes some actions that could address issues raised in this report. This list is not comprehensive. Ecology wants to hear your opinions on the actions listed here, and any other ideas you have about water management in the Chelan watershed.

- Continue to issue water right permits for direct diversions from Lake Chelan until the limit agreed upon by Ecology and Chelan County PUD No.1 has been reached.

Pro: May meet much of the new water use demand with little impact on Lake Chelan and no adverse impact on senior rights, provided adequate sewage treatment is provided and runoff containing pollutants is prevented.

Con: May only apply to those landowners with access to pump water directly from Lake Chelan.

- Drill wells into the bedrock when ground water pumped from aquifers located in surface sediments would adversely impair senior water rights.

Pro: May provide a small source of water for new residential uses.

Con: Wells drilled and cased into bedrock are more expensive than shallower wells and the quantity of water produced is generally too low to support substantial development.

- Encourage water conservation, changes or transfers of water rights, and pipeline connections to water-short areas to allow efficient water use.

Pro: May meet new water use demand where water is not available without adversely impairing senior water rights.

Con: May only be applicable to large water purveyors or users.

## For more information ...

Contact Darlene Frye at (509) 5752800 (voice), (509) 454-7673 (TDD), or write to: Washington Department of Ecology, Water Resources Section, 15 W. Yakima Avenue, Suite 200, Yakima, Washington 98902-3401. Ecology does not discriminate in its services. If you have special communications needs, contact Lisa Newman at (360) 407-6604 (voice) or (360) 407-6006 (TDD).