The Spokane Valley – Rathdrum Prairie Aquifer Atlas

2015 Edition

CONTENTS

Welcome!

Welcome to the 2015 edition of the Spokane Valley – Rathdrum Prairie (SVRP) Aquifer Atlas. The original SVRP Aquifer Atlas was published in 2000 and updates were issued in 2004 and 2009.

As in past versions of this atlas, the purpose is to present a comprehensive summary of the region's most precious groundwater resource. The intent is to provide a basic reference of the geographic, geologic, and hydrologic characteristics of this aquifer. It is intended for regional use in education, in planning, and as a source for general technical information.

The SVRP aquifer spans two states, Washington and Idaho. Natural resources that cross political boundaries are often subject to different and sometimes conflicting standards, protections, and uses. All SVRP Aquifer Atlas editions are a joint effort by agencies in both states to create a holistic representation of the SVRP aquifer as both a geologic feature and a natural resource used daily by more than half a million people.

Political boundaries and objects made by people are absent from the front cover map to show the aquifer as a natural feature. The SVRP aquifer area is not blue to differentiate the aquifer area from surface water bodies.

The authors' goal in this SVRP Aquifer Atlas edition is to include issues that are currently facing our region. Our hope is to educate the public, and through greater understanding of this precious resource, to become good stewards who will protect and preserve this finite aquifer.

SVRP Aquifer Extent

The boundary of the SVRP aquifer has been defined differently by various investigators over time. The 2000 and 2004 aquifer atlases used the aquifer boundary adopted by the Environmental Protection Agency (EPA) in 1978. The boundary used in this document is the aquifer extent described by the US Geologic Survey (USGS) in 2005 (Scientific investigations Report 2005-5227) that expanded portions of the aquifer boundary based on hydrogeologic information and also to facilitate computer modeling.

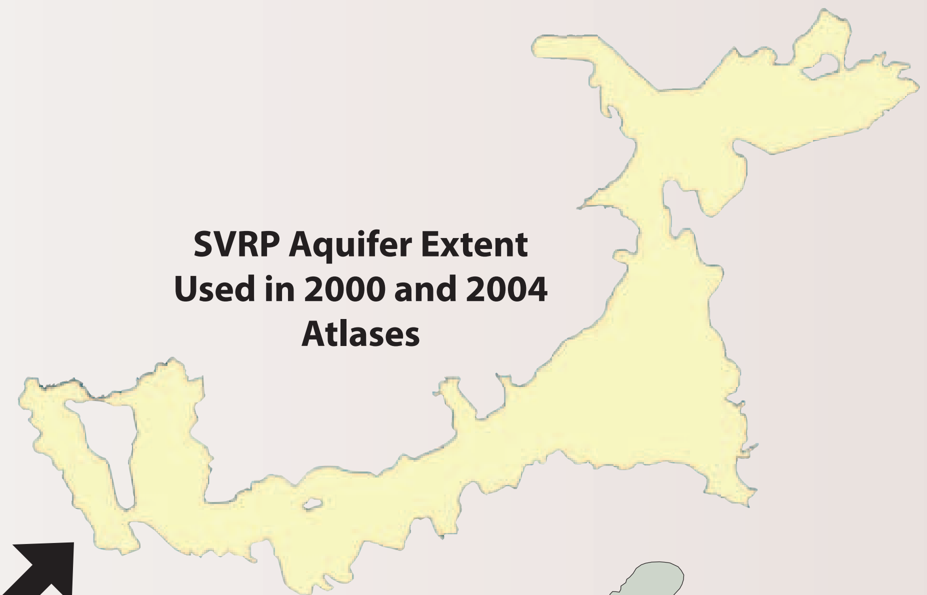
The aquifer extent defined by the USGS in 1978 or for the 2005 to 2007 studies does not represent the EPA's Sole Source Aquifer boundary defined for the SVRP aquifer. The boundaries presented in this atlas should be considered general in nature and are appropriate for the use and information available at the time of publication.

What's New In The 2015 Edition

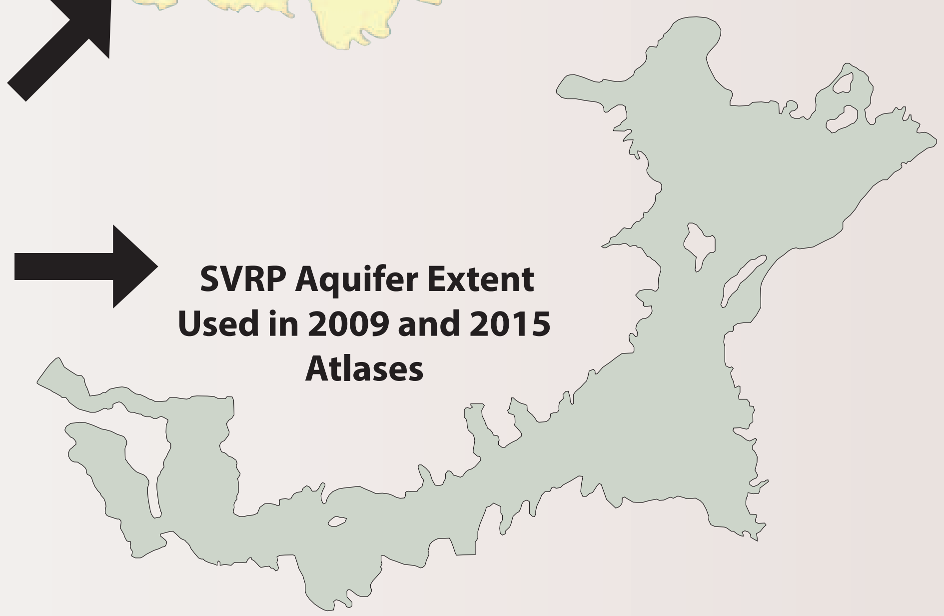
This atlas starts with new colors for the cover map. Many of these colors are used through the entire atlas. The last page of the atlas has a link to a website with additional information on many of the topics covered in this atlas. The website also has a resource guide for educators and parents with many activities that use this SVRP Aquifer Atlas.

Many new issues face our region since the 2009 edition of the SVRP Aquifer Atlas. These issues have been the subject of media reports and the source of much public discussion. These issues include the amount of interaction between the Spokane River and the SVRP aquifer, stormwater and wastewater discharge to the river and minimum flow rates of the Spokane River in late summer and fall. These interactions have the ability to impact the water quantity and quality of the SVRP aquifer and the Spokane River. These issues have also raised public concerns related to the health of the fisheries and general aquaculture of the Spokane River.

It is not the authors' intent to describe or suggest potential solutions regarding the issues of the region in this publication but to provide a tool to educate the public allowing constructive and productive dialogue for future solutions.



SVRP Aquifer Extent Used in 2000 and 2004 Atlases



SVRP Aquifer Extent Used in 2009 and 2015 Atlases

Navigating The Atlas

The pages are organized into six theme categories with a unique color for each.

October 17, 1898
Spokane Daily Chronicle

THAT CITY WATER

Had the Right Thing

[E. V. Van Osdel, the city chemist:]

"It was said that when the workmen were digging the channel above the water works [in 1895] at a point 50 feet above the power house they encountered the water in larger quantities than it could be pumped out. If that is so, why didn't they stop there, and we would have had good filtered water"

May 6, 1909
Spokesman-Review

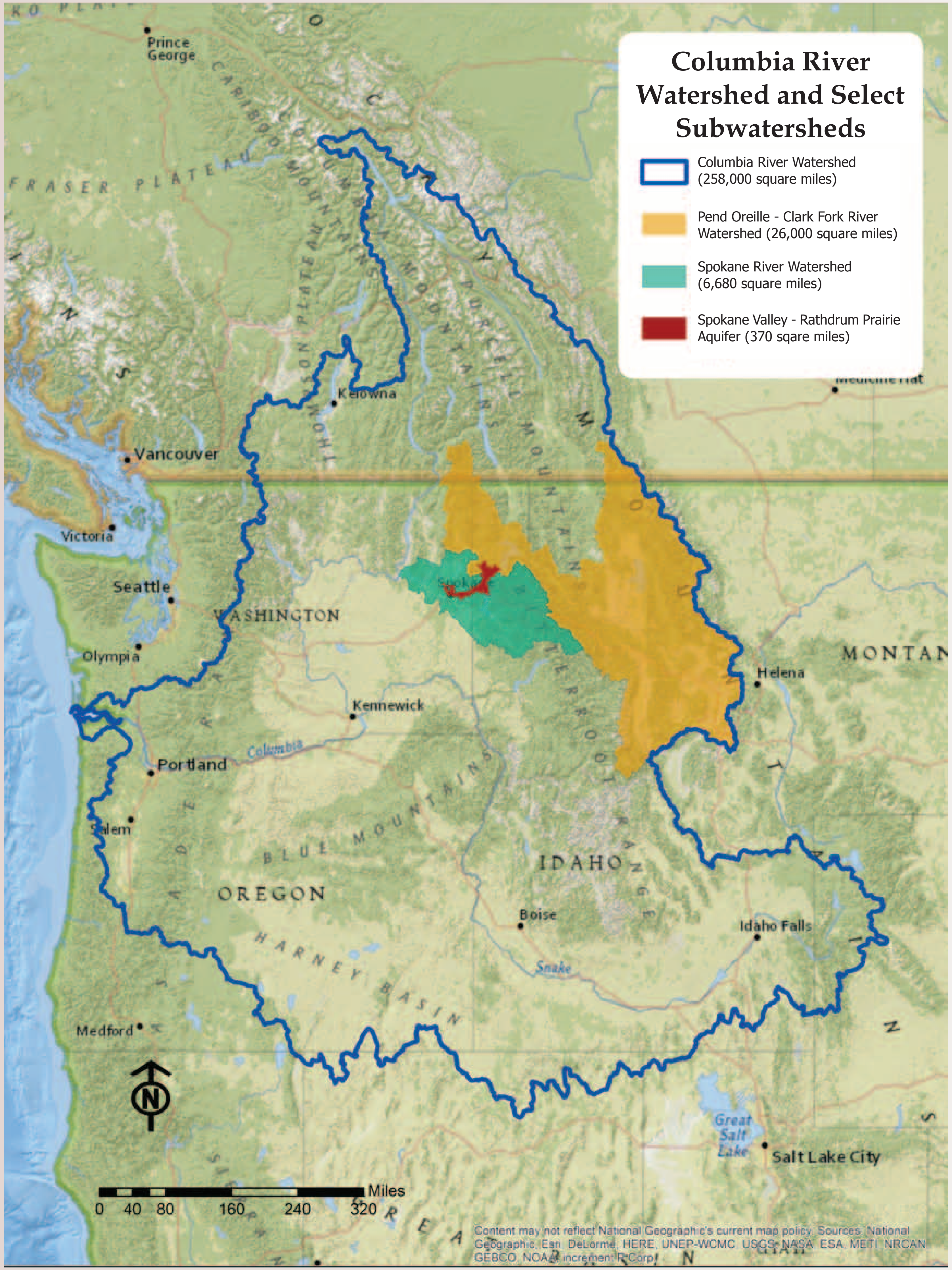
SPOKANE'S WATER PUREST IN WORLD

City Bacteriologist Frank Rose Reports Results No Colon Bacilli Found

Showing the Spokane water supply purer than the average of American cities, Frank Rose, city bacteriologist, has made a report of tests from the city well made monthly since last October. The tests are simply counts of the number of bacteria found in a cubic centimeter of water.

The average count shows only seven or eight germs in that amount of water. The test was made from water taken from the drinking fountain at Howard street and Riverside avenue or from water from a faucet in the Rookery building. Speaking of his tests, Dr. Rose said:

"It can be said that there is no city in the world that has a better water supply than Spokane. Water which shows 100 germs in a cubic centimeter is considered comparatively pure and drinkable. I made from four to eight counts monthly since last October, and the counts in any one month was 17 bacteria, while the tests last month showed 15 bacteria in eight tests, less than two each.



The Water Beneath Us

The sole source of water for most people in Spokane County, Washington, and Kootenai County, Idaho, is a large deposit of gravel, cobbles, and boulders containing high-quality water called the Spokane Valley – Rathdrum Prairie (SVRP) aquifer, also commonly known as the "Rathdrum-Spokane aquifer." Discovered in 1895, this aquifer has become one of the most important resources in the region, supplying drinking water to more than 500,000 people. The SVRP aquifer has been studied in considerable detail since 1977, and the results of these investigations have produced programs and regulations designed to ensure this aquifer will remain a valued and protected resource for future generations.

The geology and hydrogeology of the Spokane Valley and Rathdrum Prairie have, over millions of years, been formed by various geologic events and shaped by water flowing from the western slopes of the Rocky Mountains to the Pacific Ocean. During the last Glacial Age (18,000 to 12,000 years ago), and possibly in multiple previous Ice Ages, cataclysmic floods inundated northern Idaho and Washington as a result of the rapid draining of Glacial Lake Missoula when ice dams broke (see pages 5 and 6). These floods deposited thick layers of gravels, cobbles, and boulders that form the aquifer of today. Water from adjacent lakes, mountain streams, the Spokane River, and precipitation flows through these flood deposits supplying the SVRP aquifer.

In the 1970s area residents recognized that their unconfined aquifer could easily become contaminated. The highly permeable flood deposits, together with very thin topsoil layers in many locations, make the SVRP aquifer highly susceptible to pollution. Area residents took the first important step to protect the SVRP aquifer by petitioning the US Environmental Protection Agency (EPA) to designate the SVRP aquifer as a "sole source aquifer". The EPA agreed and granted this designation in 1978. It was the second aquifer in the nation to receive this special designation. The sole source designation increased public awareness for SVRP aquifer and supported the development of special management practices (such as eliminating septic systems and pretreating stormwater over the SVRP aquifer) by local agencies. Presently, SVRP aquifer protection efforts are managed cooperatively by Spokane County, local cities, the Department of Ecology and utilities in Washington, and by the Department of Environmental Quality, Panhandle Health District, and local cities and counties in Idaho.

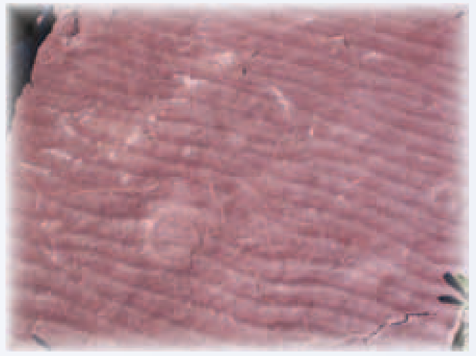
GEOLOGY

The geology of the Spokane Valley – Rathdrum Prairie area is the result of multiple geologic events that have occurred over hundreds of millions of years creating both our landscape and the aquifer of today. Understanding the geologic events of the past helps us better understand our environment and current issues. The geology of the area is complex and it has taken decades to piece the history together. Five significant geologic units compose most of the rock types found in the Spokane Valley – Rathdrum Prairie area . Brief descriptions of these units follow on the next pages. The color surrounding the description and abbreviation **match the color of the geologic units shown on the accompanying geologic map.**

1. Belt Supergroup (Bsg) - 1.1 to 1.4 billion years ago

What Are They?

Belt Supergroup rocks are composed of a thick sequence of sediments that were deposited in an ancient sea basin. The term "Supergroup" refers to an extremely thick sequence of rocks of the same kind, and Belt refers to the name of the basin that the sediments were deposited within. The basin was formed by geologic forces pulling the rock apart and creating a large, deep rift. The sediment was deposited deep under water forming thick accumulations. As the rift filled with sediment, it was also slowly sinking; a process geologists call "subsidence". The subsidence allowed even more sediment to accumulate in the rift. Eventually the rift started to fill and younger sediments were deposited in shallower water. The sediment consisted mostly of clay and silts, along with sands and calcium carbonate. The basin's great depth allowed sediment that is tens of thousands of feet thick to accumulate. The weight of all the overlying sediment eventually caused the sediment to metamorphose or turn into a type of rock called an argillite.



Fossil ripple marks

Window To An Ancient World

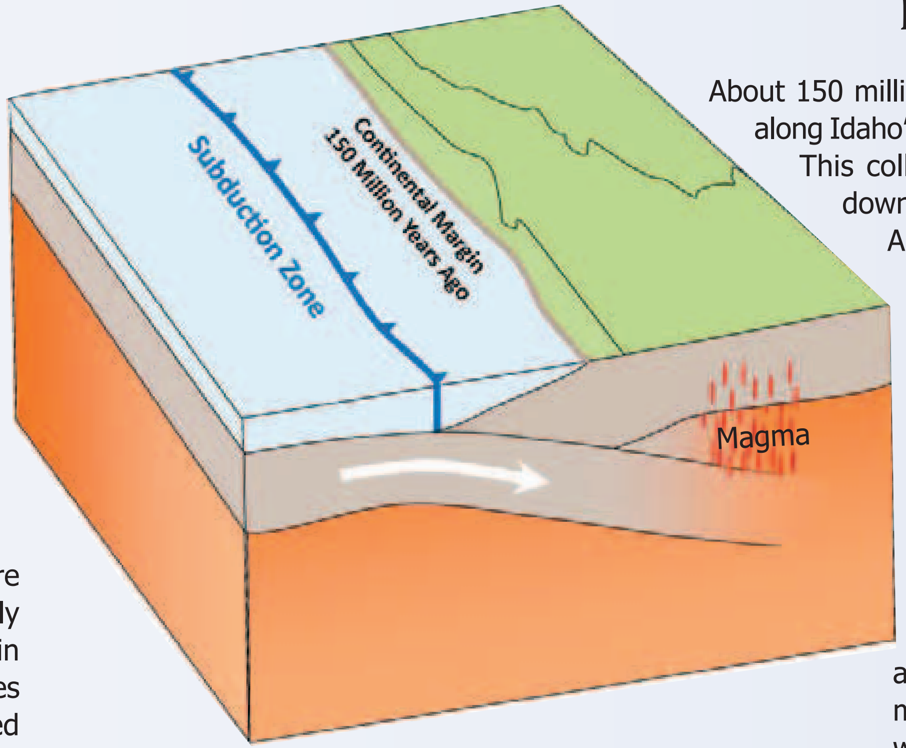
The Belt rocks were probably deposited much like what we see today with silts and sands from nearby land washing out into a shallow basin of water. Some of the sediments have ripple marks from wave action, indicating the sediments were deposited near the shoreline.

Fossils in the metamorphosed sediments of a type of blue-green algae are called stromatolites. Stromatolites are the oldest known fossils and formed layers or mats often shaped like domes. These fossilized domes are seen in some of the Belt Supergroup rocks. Stromatolites thrived in areas of warm shallow water and, like plants of today, needed sunlight and carbon dioxide to live. Stromatolites lived in large colonies, similar to current day coral reefs. Stromatolites currently exist in a few places in the world. They are found in small, isolated fresh-water lakes and shallow marine lagoons.

Living stromatolites in Australia

Fossil stromatolites

2. Kaniksu Batholith (Kbth) - 50 to 100 millions years ago



Batholith Formation

About 150 million years ago, the continental margin was located along Idaho's western border, where two tectonic plates collided. This collision resulted in the western plate being forced down (subducted) and overridden by the eastern plate. As the western plate was subducted, the rock began to heat up as it reached greater depths, melting portions of the upper plate. The drawing shows what happened.

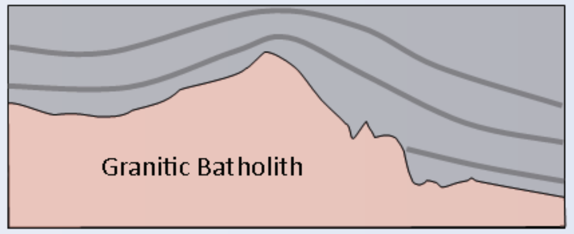
The melted material (magma) was lighter than the surrounding rock and rose up from deep within the earth. Instead of forming a volcano, it solidified near the earth's surface. The solidified body of rock is called a batholith.

The Kaniksu Batholith is located in northern Idaho and northeastern Washington, and is the northern-most formation of Idaho's many batholiths, which were formed about 70 to 80 million years ago.

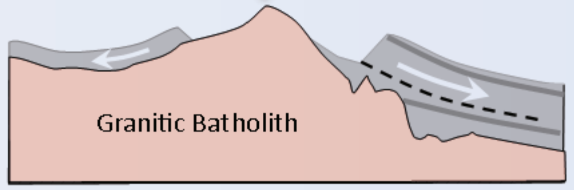
Batholith Exposure

When the Kaniksu Batholith intruded upward, it forced the overlying Belt Supergroup rocks to the east and west. The Kaniksu Batholith split the Belt Supergroup rocks along the Purcell fault. In geology, a fault is where two rock bodies move past each other. Over time erosion of the overlying rock exposed the Kaniksu Batholith. The movement of the Belt Supergroup rocks to the east also formed a large trench between the two rock groups that eventually filled with gravels and sand forming the Rathdrum Prairie.

Deposition of Belt Supergroup



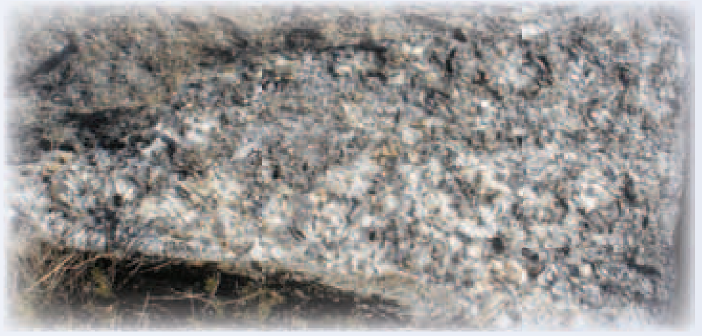
Intrusion of granitic batholith



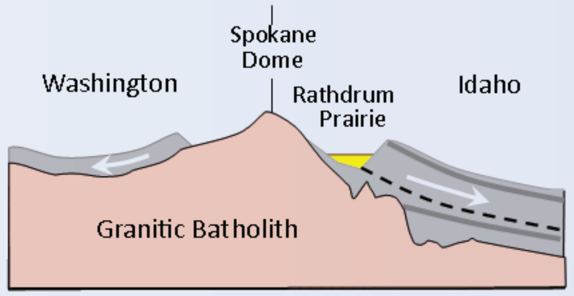
Batholith emplacement displaces Belt Super-group rocks to east and west

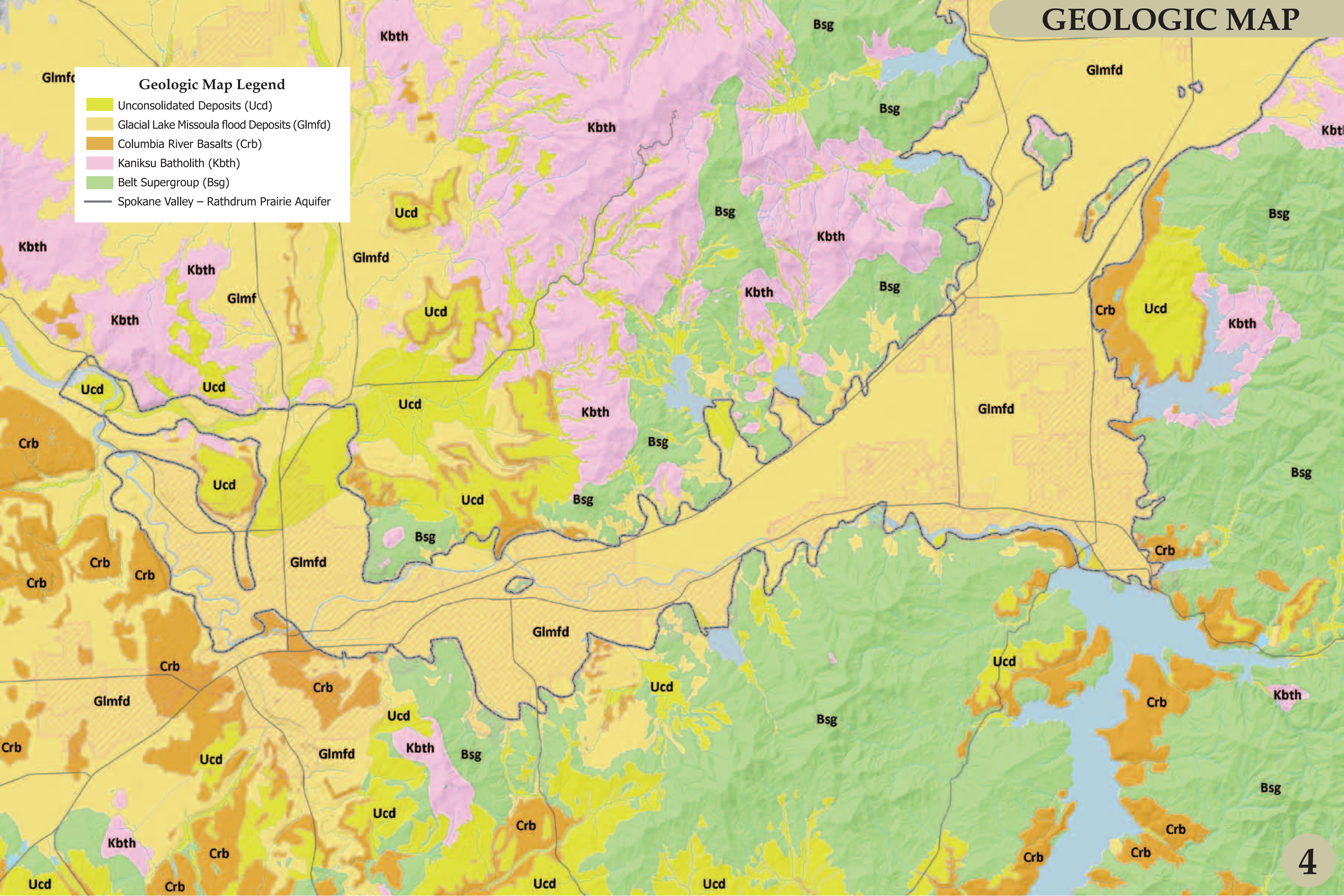
Kaniksu Batholith Rocks

The upper crustal material is made up of many different types of minerals (rocks are made from one or more minerals) with different melting temperatures. Minerals with low melting temperatures melt first and separate from the larger rock mass. The minerals that melt first make up granitic-type rocks. Because it took millions of years for the magma to solidify back into rocks, it had time to form many different minerals as crystals that we can see when we look at the rocks.



Kaniksu rock on Mount Spokane



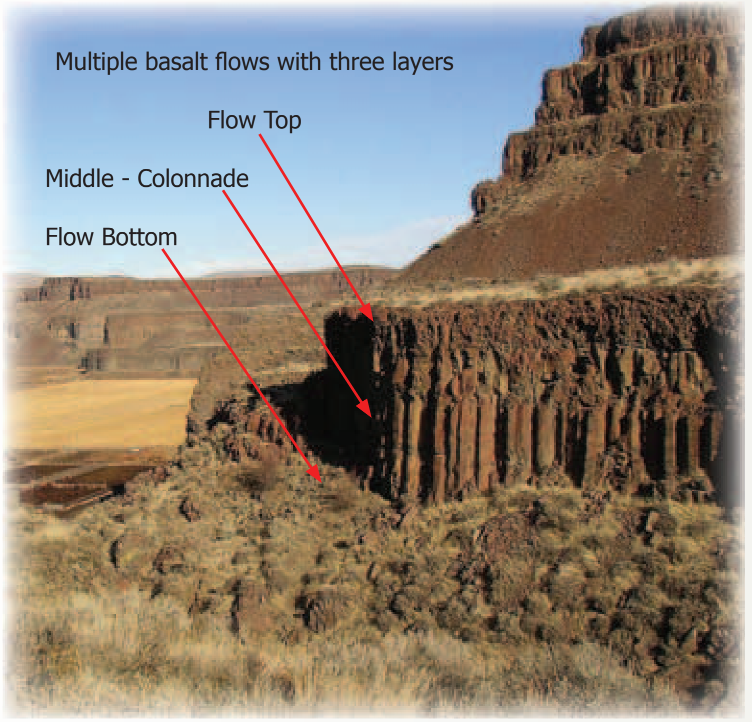

Geologic Map Legend
Unconsolidated Deposits (Ucd)
Glacial Lake Missoula flood Deposits (Glmfd)
Columbia River Basalts (Crb)
Kaniksu Batholith (Kbth)
Belt Supergroup (Bsg)
Spokane Valley – Rathdrum Prairie Aquifer
Kbth
Bsg
Glmfd
Ucd
Crb

3. Columbia River Flood Basalts (Crb) - 10 to 17 million years ago

Lava Flows

About 10 to 17 million years ago, as many as 270 lava flows erupted from basalt fissures located near the Idaho, Oregon, and Washington borders. The eruptions did not form volcanos because the lava was very fluid and acted like floods. It is estimated that almost 42,000 cubic miles of lava flowed out over an area of 63,200 square miles. The individual lava flows were estimated to be about 150 feet high and moved at approximately 3 miles per hour. Sometimes there were hundreds of thousands of years between the lava flows.

In the central area of Washington near the Tri-Cities the cooled and hardened lava, called basalt, is up to 10,000 feet thick. The Spokane Valley – Rathdrum Prairie (SVRP) aquifer is at the edge of the Columbia River Flood Basalts and many of the mountains around the SVRP aquifer stick out above the basalts.



Three Basalt Forms From Each Lava Flow

The basalt has three appearances depending on where it was in the flow when it hardened: flow top, middle section, and flow bottom.

- The upper part of the basalt flow (flow top) cooled and hardened quickly in contact with the atmosphere so it developed many small air bubbles. Basalt with many small air bubbles is called vesicular basalt.
- The middle section of a basalt flow took a long time to cool and solidify. As the basalt cooled, it shrank and developed cracks. The cracks started near the top where it cooled first and then spread downward making long columns. Each individual basalt column is called a colonnade.
- The flow bottom was in contact with the top of the previous older basalt flow. Generally the top of the previous flow was exposed to the elements and weathered into soil and smaller bits of basalt. When the new lava flowed over the top of the older basalt, it picked up and incorporated large amounts of the rock debris. Basalt with bits of rock is called a breccia.

Each basalt flow covered the previous one and developed similar appearances. You can see all three basalt forms when the full height of the flow is exposed.

Latah Formation

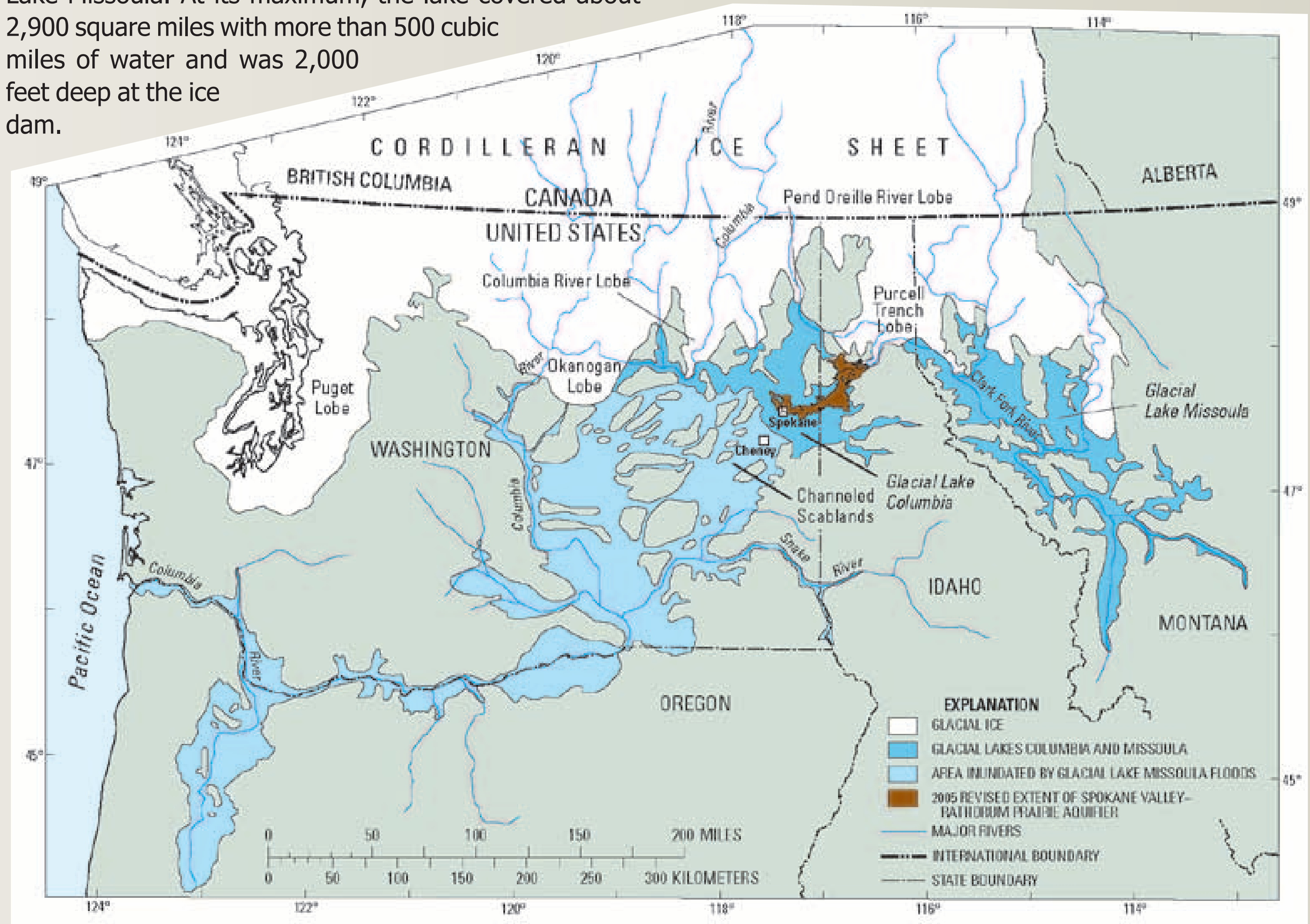
In northern Idaho and eastern Washington, the flood basalts filled the valleys, blocking streams and rivers creating ponds and lakes. These ponds and lakes filled with silt and fine-grained sediments that later formed siltstone and are called the Latah Formation. Many types of fossils including plants, mollusks, and fish can be found in these sediments.

Latah rocks with leaf fossils

4. Glacial Lake Missoula Flood Deposits (Glmfd) - 15 to 100 thousand years ago

The cooling climate during the Pleistocene Epoch, or Ice Age, caused sheets of ice to advance south several times from current day Canada. The uneven leading edges of the Cordilleran ice sheet are called lobes. There were two main lobes in the area. The Purcell Trench Lobe flowed far enough south to sometimes block the Clark Fork River and the Okanogan Lobe flowed far enough south to block the Columbia River.

The Purcell Trench lobe of ice reached south to completely cover the area of present day Lake Pend Oreille during the last glacial advance, 13,000 to 18,000 years ago. This glacier blocked the Clark Fork drainage forming Glacial Lake Missoula. At its maximum, the lake covered about 2,900 square miles with more than 500 cubic miles of water and was 2,000 feet deep at the ice dam.



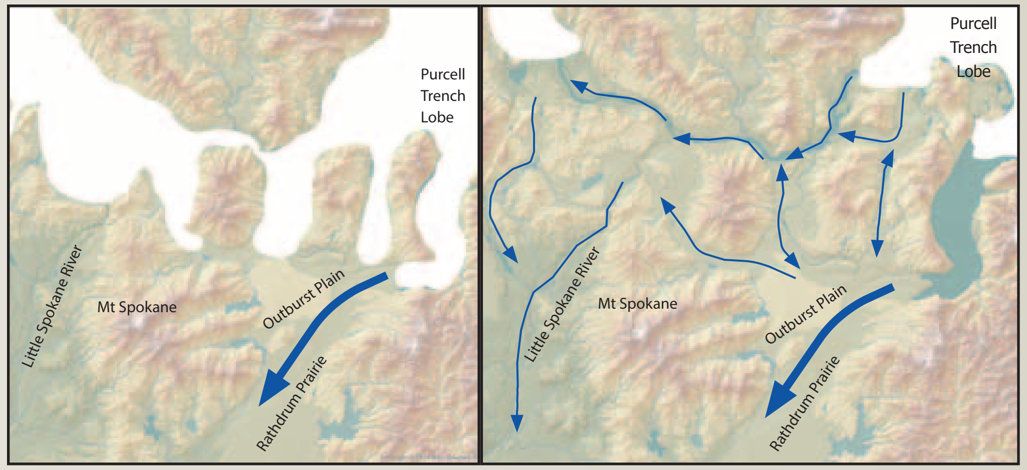
Exploding Ice

The water behind the ice dam exerted great force on the ice dam and forced its way into the ice. Eventually the ice dam failed and released a great volume of water all at once, creating enormous floods. Ice dams reformed and exploded at least 40 times. These types of glacial floods are called jokulhalups, an Icelandic term meaning "glacial run".

Different Paths

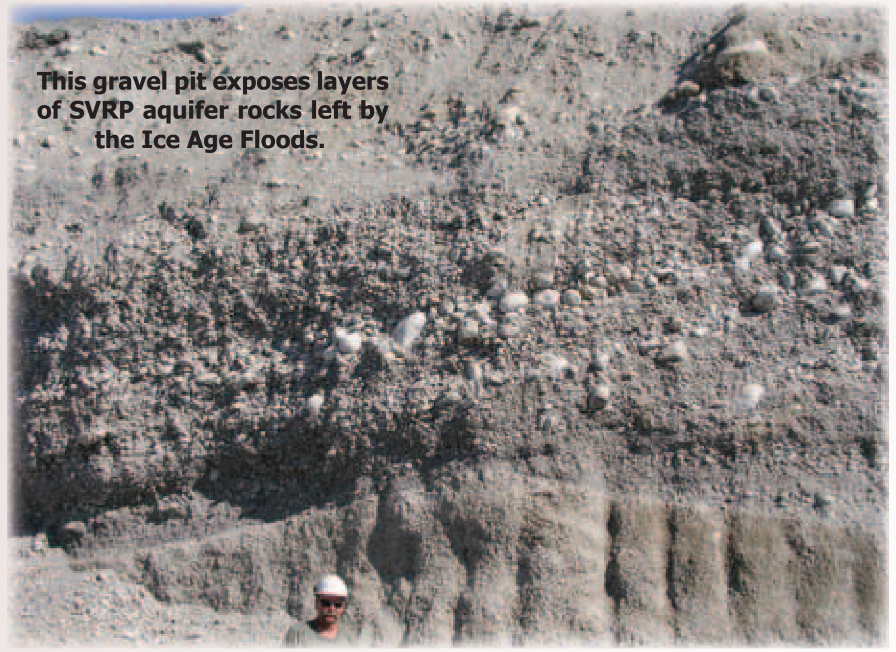
Sometimes the Purcell Trench Lobe extended to the southern end of Lake Pend Oreille. When the ice dam broke, the only path available to the floods was south over the Rathdrum Prairie. See the map at right.

When the Purcell Trench Lobe did not extend as far, the floods had several possible paths besides the Rathdrum Prairie. Some of the water flowed through routes that led to the Little Spokane River valley. See the map at far right.



Full ice advance

Partial ice advance



This gravel pit exposes layers of SVRP aquifer rocks left by the Ice Age Floods.

How The Ice Age Floods Created The Spokane Valley – Rathdrum Prairie Aquifer

The water in the Spokane Valley – Rathdrum Prairie (SVRP) area during the floods reached depths of about 450 feet and flowed with peak velocities of 60 miles per hour. The flow rates may have reached one billion cubic feet per second—more than the flow of all the rivers in the world. Large amounts of ice, cobbles, sand, and gravel were carried along with the water. The larger gravel, cobbles, and boulders were deposited and the smaller silt and sand were carried away. These rocks are now part of the SVRP aquifer.

Glacial Lake Columbia covered the Rathdrum Prairie and Spokane Valley almost to the front of the ice dam during some of the floods. When the lake was present, it slowed down the water so some silt and sand were deposited along with the gravel, cobbles, and boulders.

Wave-cut strandlines near Perma, Montana record former high-water lines, or shorelines of Glacial Lake Missoula.

Repeated Ice Age Floods

After a flood event ended, the ice lobe slowly moved southward, blocking the Clark Fork River once again. Eventually, this dam would also fail, resulting in another flood. This repeated flooding deposited large amounts of mainly gravel and cobbles in the Spokane Valley – Rathdrum Prairie area and eventually blocked the tributary valleys, forming Lakes Coeur d'Alene, Hayden, Pend Oreille, Spirit, Twin, Hauser, Liberty and Newman.

Did you know ?

- The ice dam was over 2,000 feet tall.
- Glacial Lake Missoula was as big as Lake Erie and Lake Ontario combined.
- The floodwaters speed may have peaked at about 60 mph.

Ice Age Floods Beyond The SVRP Aquifer

The catastrophic floods from Lake Missoula rapidly flowed into Glacial Lake Columbia displacing enormous amounts of water forming geologic features called "coulees." Coulees are generally long with steep sides caused by the rapid erosion and down cutting from the large amounts of water flowing through them. The water that spilled out into the coulees to the west and over low points to the south flowed in enormous sheets across central Washington. The large amounts of water deformed the landscape giving the area the name "scablands."

Large pieces of ice with boulders floated many miles in the flood. The boulders were deposited as the ice melted leaving behind unusual rocks called "erratics".

The flood water finally spilled into the present day Columbia River Gorge and on to the Pacific Ocean.

An ice rafted erratic in a coulee.

The West Bar with ripple marks and the basalt cliffs along the Columbia River near Trinidad, Washington are evidence of the Ice Age floods.

Evidence For The Ice Age Floods

The evidence for Glacial Lake Missoula comes from shoreline features called wave-cut strandlines on many hillsides in Montana.

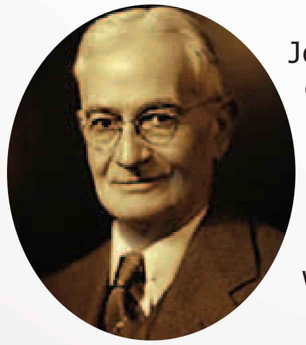
Giant ripples marks on Camas Prairie in Montana and on the West Bar in Washington as well as large coulees are evidence of large amounts of water flowing rapidly.

Sediment layers with large rocks on the bottom and clay on the top, called rhythmites, found in many places along the flood's path are the evidence for repeated Ice Age floods. Some rhythmites are found along the lower part of Hangman Creek. The exposed rhythmites near Touchet, Washington, have at least 40 layers.

Rhythmites and volcanic ash layers exposed near Touchet, WA, provided evidence of at least 40 large Ice Age floods to geologists in the early 80s. Note height of the cliffs compared to the person at the lower right.

GEOLOGISTS UNRAVEL THE MYSTERY OF THE ICE AGE FLOODS AND GLACIAL LAKE MISSOULA

J Harlen Bretz (1881-1981) was a University of Chicago professor who studied the channelled scablands of eastern Washington. His 1923 theory proposed the scablands resulted from a catastrophic ice age glacial flood, an idea that was not accepted until the 1950s because he did not know the source of the flood.



Joseph T. Pardee (1871-1960) was a US Geological Survey geologist who theorized the wave-cut strandlines above Missoula and other features in western Montana came from a large lake that emptied rapidly. In 1940 he reported the lake emptied to the west and was the source of Bretz's catastrophic flood.

5. Unconsolidated Deposits (Ucd) - Present to 1.6 million years ago

These deposits represent all unconsolidated deposits that have been accumulated through wind, water, or as a result of landslides. These include the Palouse wind blown-sediments that extend from the Central Washington to the Pullman-Moscow area north to some of the upland areas surrounding Spokane. About a million years ago a warm dry climate existed and significant winds from the southwest carried silt from the central Washington area. The source of the fine silt was the fine material that flowed with older catastrophic floods and settled in what is now the channeled scablands. These wind blown silts are also called "loess" deposits, derived from the German word for loose.

SVRP AQUIFER TIMELINE

Spokane River, 1885

Overview of Fort Sherman, ID, 1890

Irrigation System, Post Falls, ID, 1900

Post Falls Lumber Co. sawmill, pre-1902

Modern Irrigation & Land Co, 3,000 gpm, 1908

Vera looking northeast, 1933

Ancient story of the lakes and aquifer of the Coeur d'Alene Tribe
Boy Travels Underground - as told by Felix Aripa, Coeur d'Alene Tribe

There was a boy who lived towards Hayden Lake area. The boy loved fishing. The boy loved to walk around. He went to the forests; he went to the mountains. There he saw his friends. There were a lot of animals that lived there. There were animals that fly; there was duck, bald eagle, owl, bee, magpie. Also there were the ones that live in the forest: elk, deer, bear, squirrel. There were the fierce animals: cougar, bear. And the ones that live in the river: frog, trout. A lot live on the prairie: rabbit, spider, prairie chicken, coyote.

One day the boy went fishing. He had a canoe. And he paddled across the water at Hayden Lake. And the weather changed. It began to get windy. The sky became gray.

And the boy approached an eddy. He started spinning, and he went down. He dove in. He arrived at a cave. He was all wet. And the boy was really tired. He laid down. He went to sleep.

[He woke up.] He walked a long ways kind of in a confusion (of where he was at). And the boy walked for three days.

And he heard something loud. There was a waterfall! And then the boy looked through it. He saw animals; there were his friends. They were happy. There was duck, bald eagle, owl, bee, cougar, bear, frog, rabbit, spider, chicken, squirrel, coyote, trout, ...

And the boy ran. He leaped through the waterfall. There was a splash! He dove in the river! And he swam. He crossed the water. He got really tired. He laid down on the shore. And he slept.

And he awoke. He was at q'emlin (Post Falls). That is the end of the road.

1830 1840 1850 1860 1870 1880 1890 1900 1910 1920 1930 1940

Since time immemorial, ancestors of the Coeur d'Alene and Spokane Tribes have lived in the lands surrounding the aquifer. The watershed provided them with bounteous fish, game, and plants that were, and are, an integral part of the tribal communities for millennia.

1860 James Madison Alden paints "Plante's Crossing" while official artist of the Northwestern Boundary Survey.

1894 Aquifer accidently discovered by City of Spokane contractor during Upriver Dam construction.

1899 Spokane Valley Irrigation District formed and Corbin ditch canal irrigation started.

1905 Modern Irrigation and Land Company, the first of many, formed to provide SVRP aquifer water to Spokane Valley farmers.

1908 The SVRP aquifer replaces the Spokane River as the City of Spokane's primary source of drinking water.

1923 J. Harlan Bretz presented his theory on the formation of the channeled scablands by a catastrophic flood.

1931 Washington Water Power Company (Avista) prepares the first comprehensive study of groundwater in the Spokane Valley and Rathdrum Prairie.

1938 A survey of all major Washington rivers and waterways found the Spokane River the foulest water body in the state.

1940 Joseph T. Pardee, a USGS geologist, proposes that an Ice Age glacial lake (Lake Missoula) drained rapidly creating Bretz's catastrophic floods.

Background picture is a watercolor by James Madison Alden of the Spokane Valley in 1860.

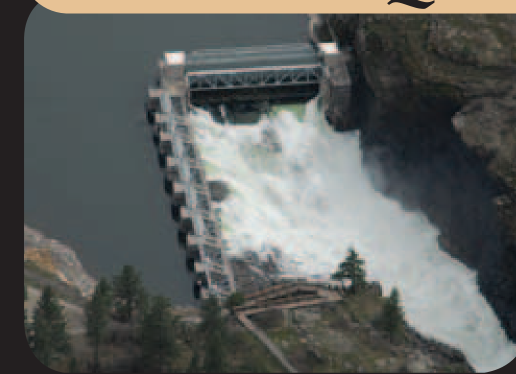
SVRP AQUIFER TIMELINE

Rathdrum Prairie, ca 1952

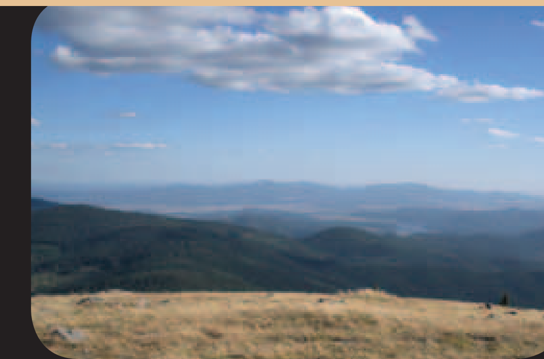
Expo '74, Spokane, 1974

Stateline, 2005

Rathdrum Prairie, 2008



Post Falls north channel dam, 2008



Rathdrum Prairie from Mt Spokane, 2014

1951 USGS publishes an inventory of SVRP aquifer wells in Bonner and Kootenai Counties.

1952 USGS publishes an updated inventory of SVRP aquifer wells in the Spokane Valley.

1972 Federal Clean Water Act provides authority and funding for SVRP aquifer protection planning efforts.

1973 Liberty Lake Sewer and Water District created to protect the lake and aquifer.

1974 EXPO '74 opens in Spokane with the theme: "Celebrating Tomorrow's Fresh New Environment."

1976 Local citizens and environmental groups petition the EPA to designate the aquifer as a "sole source aquifer".

1976 Army Corp. of Engineers publishes the 14 volume Spokane Region Water Resources Study.

1977 Local "208" studies are completed, and the sources of aquifer pollution are identified.

1977 Panhandle Health District implements the rule that limits domestic septic systems to one per 5 acres.

1978 EPA designates the SVRP aquifer as a "sole source aquifer" under Section 1424(e) of the Safe Drinking Water Act.

1980 Spokane County and Panhandle Health District initiate a groundwater monitoring program for the SVRP aquifer.

1980 DEQ designates the SVRP aquifer as a "special resource water" in Idaho, the highest level of state protection.

1981 Spokane County adopts a wastewater manangement plan to eliminate septic systems over the SVRP aquifer.

1985 Spokane County authorizes the aquifer protection area for 20 years in a public vote.

1988 USGS publishes Molenaar's Aquifer Report, the first modern SVRP aquifer study.

1988 U.S. Congress provides aquifer protection funding through the EPA.

1990 Panhandle Health District begins requiring secondary containment of critical materials.

1995 DEQ adopts guidelines for land-applying wastewater over the SVRP aquifer in Idaho.

1997 DEQ designates Aquifer as a "sensitive resource aquifer" in the Idaho state Ground Water Quality Rule.

1998 The City of Spokane and the Spokane Aquifer Joint Board publish a wellhead protection plan.

The plan is updated in 2007.

2004 Spokane County reauthorizes the aquifer protection area.

2007 The results of a 4 year USGS bi-state aquifer study and monitoring program are presented to the public.

2007 Kootenai County residents vote to form and fund an Aquifer Protection District to fund SVRP aquifer protection programs.

2008 Idaho begins water rights adjudication of the Rathdrum Prairie aquifer.

2009 Avista's Post Falls and other Spokane River dams relicensed.

2013 Idaho Washington Aquifer Collaborative forms to maintain and/or enhance the aquifer quality and quantity.

2015 Washington Department of Ecology issues an instream flow rule for the Spokane River.

Background picture is the 2004 view from Arbor Crest with the same view as the watercolor on the previous page.

HISTORY OF WATER USE

Apples Trees, 1908

Family picking cucumbers, 1908

Spokane Valley Fruit Growers Warehouse, 1914

Water melons, Spokane Valley

Squash, Spokane Valley

Rathdrum Prairie, ca 1952

How The Valley Turned from Rocks To Green

Low rainfall and rocky soil made agriculture difficult above the Spokane Valley – Rathdrum Prairie (SVRP) aquifer. In 1895, irrigation canals bringing water from Newman and Liberty Lakes allowed agriculture to surge. The Modern Electric Water Company was formed in 1905 to provide irrigation water by using electricity to pump water from the newly discovered SVRP aquifer. The company set up a test plot, planted with every likely crop—and a few unlikely ones such as cotton and peanuts—and soon settled on the crop deemed most profitable: apples. The newly irrigated fields of Spokane Valley were planted with acre after acre of apple trees. New railroads provided a way to get the apples to many markets so the demand was high. By 1922, there were more than 1.6 million apple trees in the Spokane Valley. The main road from Spokane to Coeur d'Alene was named the Apple Way (or Appleway) because it was lined with apple trees for mile after mile.

The early 1920s proved to be the peak apple-growing years. Apples were a risky venture, far from the surefire cash crop predicted by that test plot. By about 1925, farmers were beginning to yank out their orchards because of a combination of problems: disease, insect infestations, low prices, untimely freezes, and competition from the Wenatchee and Yakima valleys, where the climate and nearby rivers for irrigation were perfectly suited for apple growing. In 1926, about 200,000 apple trees were pulled out, and by 1945, only about 50,000 apple trees remained.

Truck farms growing melons, berries, and vegetables replaced apple orchards. The Heart of Gold cantaloupe became a valley specialty. Today, the major crops above the SVRP aquifer are grain, hay, pasture, and mint. Most of the large-scale agriculture occurs on the Rathdrum Prairie. Many smaller farms are operated part-time to produce food for families and their animals, or are rural home sites.

What The Water Grew:

- Apples (8 different varieties)
- Cantaloupes (Heart of Gold variety)
- Watermelon
- Cherries
- Berries
  - ◇ Strawberries
  - ◇ Raspberries
- Truck Farming
  - ◇ Tomatoes
  - ◇ Beans
  - ◇ Peas
  - ◇ Asparagus
  - ◇ Squash
  - ◇ Cucumbers
  - ◇ Corn

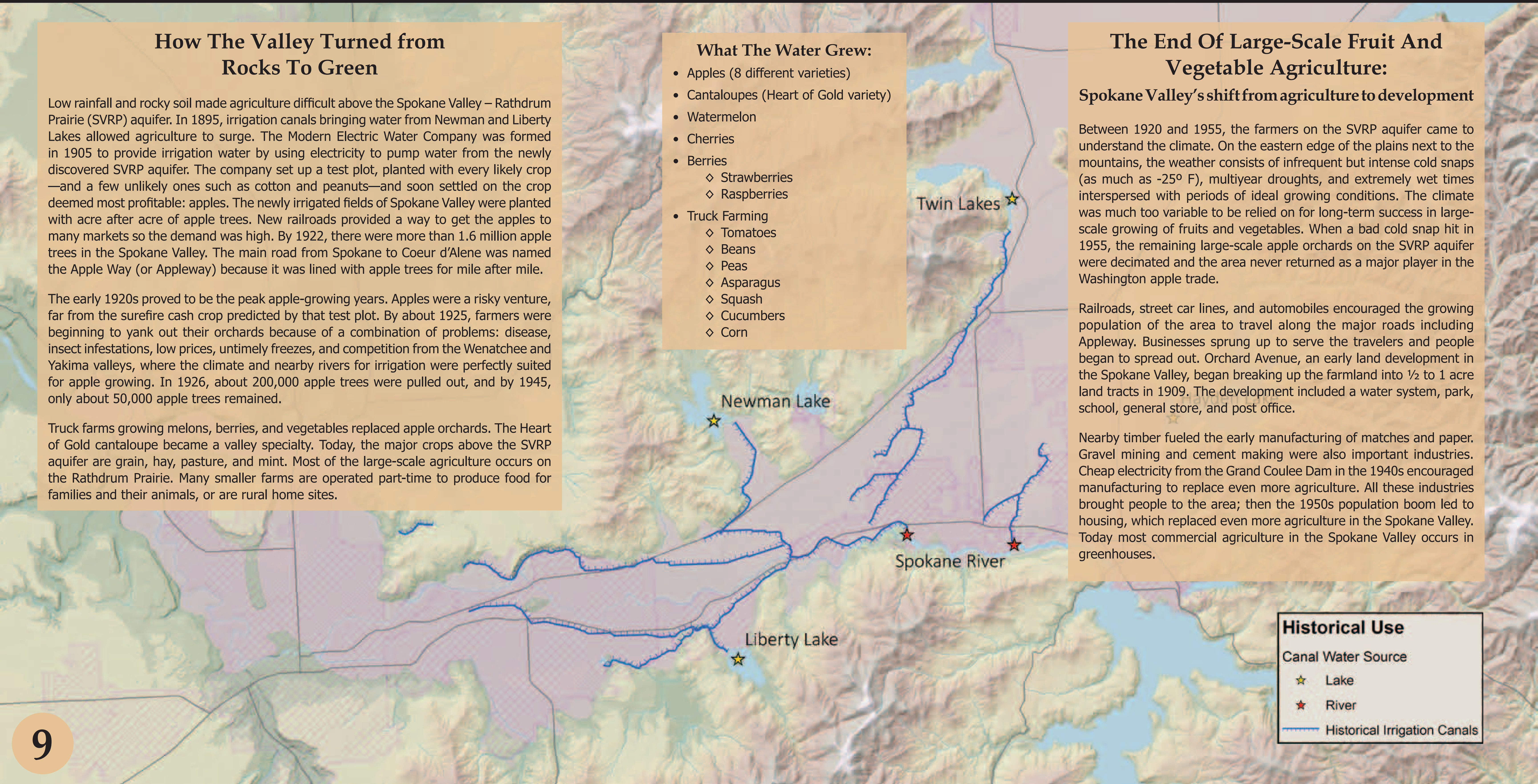
The End Of Large-Scale Fruit And Vegetable Agriculture:

Spokane Valley's shift from agriculture to development

Between 1920 and 1955, the farmers on the SVRP aquifer came to understand the climate. On the eastern edge of the plains next to the mountains, the weather consists of infrequent but intense cold snaps (as much as -25º F), multiyear droughts, and extremely wet times interspersed with periods of ideal growing conditions. The climate was much too variable to be relied on for long-term success in large-scale growing of fruits and vegetables. When a bad cold snap hit in 1955, the remaining large-scale apple orchards on the SVRP aquifer were decimated and the area never returned as a major player in the Washington apple trade.

Railroads, street car lines, and automobiles encouraged the growing population of the area to travel along the major roads including Appleway. Businesses sprung up to serve the travelers and people began to spread out. Orchard Avenue, an early land development in the Spokane Valley, began breaking up the farmland into ½ to 1 acre land tracts in 1909. The development included a water system, park, school, general store, and post office.

Nearby timber fueled the early manufacturing of matches and paper. Gravel mining and cement making were also important industries. Cheap electricity from the Grand Coulee Dam in the 1940s encouraged manufacturing to replace even more agriculture. All these industries brought people to the area; then the 1950s population boom led to housing, which replaced even more agriculture in the Spokane Valley. Today most commercial agriculture in the Spokane Valley occurs in greenhouses.



HISTORY OF WATER USE

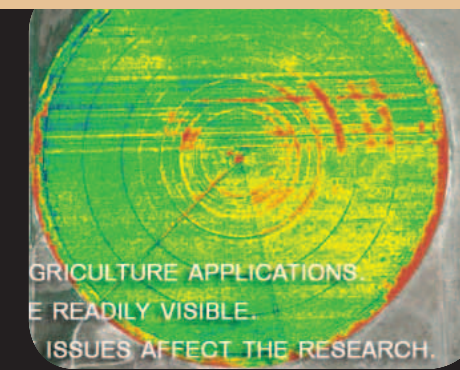
Corbin Ditch, ca 1900

Irrigation ditches, 1908

Field with wooden flume

Laying irrigation pipes,1908

Upriver well construction, 1926



Crop circle satellite image, 2012

1900s — 2015

Before wells with pumps were drilled into the Spokane Valley – Rathdrum Prairie (SVRP) aquifer, people used lakes, rivers, and springs for all of their water needs. Gravity was the only force that moved the water to its destination. This greatly limited the distance people could live from a water body.

Canals and flumes carried water from lakes, rivers, or hand-dug wells to the first irrigated crops over the SVRP aquifer. Canals needed the correct slope to get water to the fields, so they were difficult and costly to build. Large quantities of water leaked out of the bottom of the canals, so much of it was lost on the way to the fields. Water flow was manually controlled by "ditch walkers" who opened and closed gates.

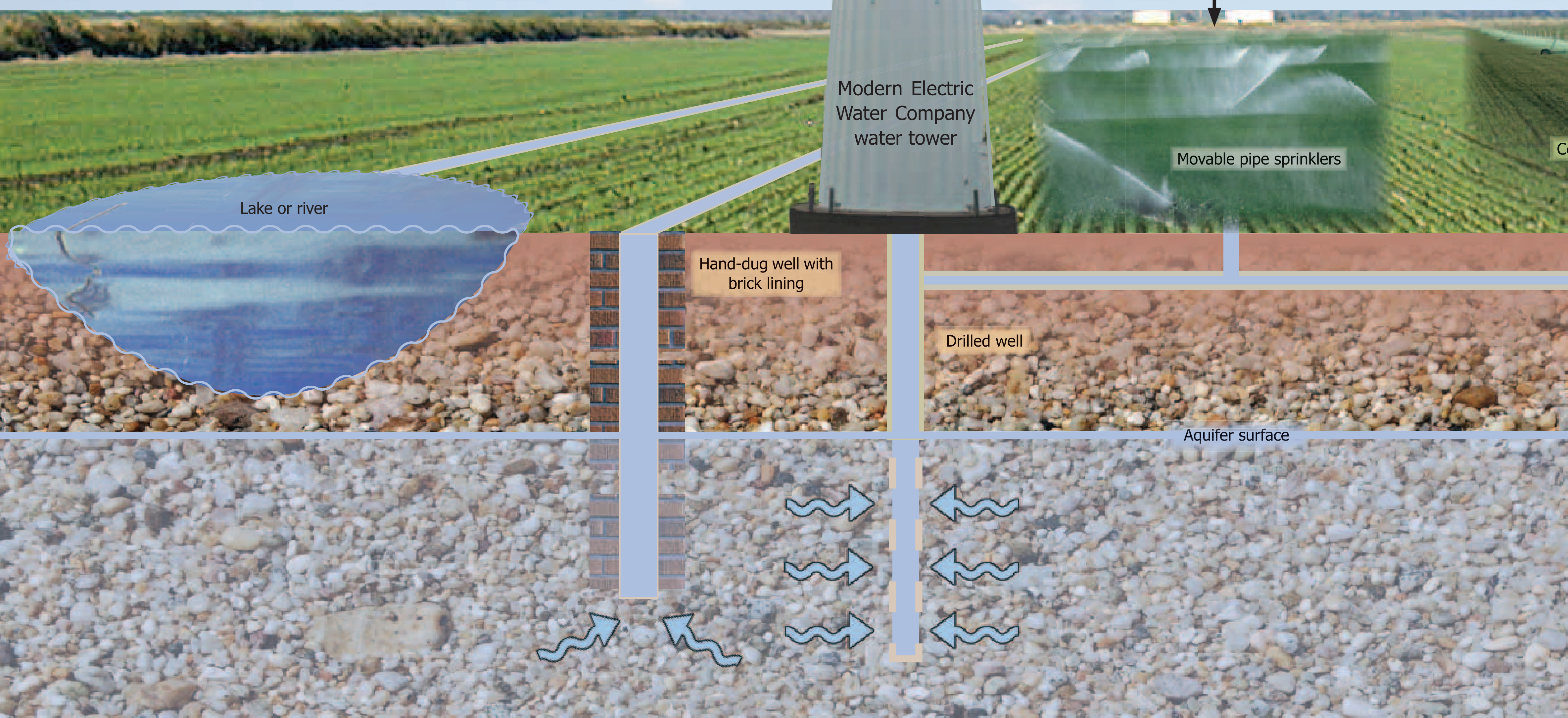
In 1967, the last big irrigation canal shut down and SVRP aquifer water from drilled wells pumped into water towers finally supplied all the water used for agriculture and most other uses throughout the system. Underground pipes did not lose as much water as canals. The pipes did not leak much and water was not exposed to the air and lost to evaporation. Water flow in pipes was, and still is, controlled by valves in the pipe.

The first agricultural sprinklers used aboveground pipes to get water to crops. The pipes could be moved easily, and the slope was not as important. The sprinklers shot water up into the air before falling on the crop.

More recently, large agricultural sprinklers were changed to spray water down to reduce the evaporative losses before reaching the ground/crop.

Today, new technology can help us use our water more efficiently. Indoors we can use WaterSense applicances and fixtures. Outdoors, many new computer-based innovations help put water on our landscape and crops evenly and at the right time.

One new technology uses visible and infrared images, captured from satellites and aircraft to help farmers identify where fields are stressed, need more water, or are receiving too much water. With this information, farmers (and other land managers) can adjust their irrigation practices to maximize the crop yield obtained from a field while reducing water waste.



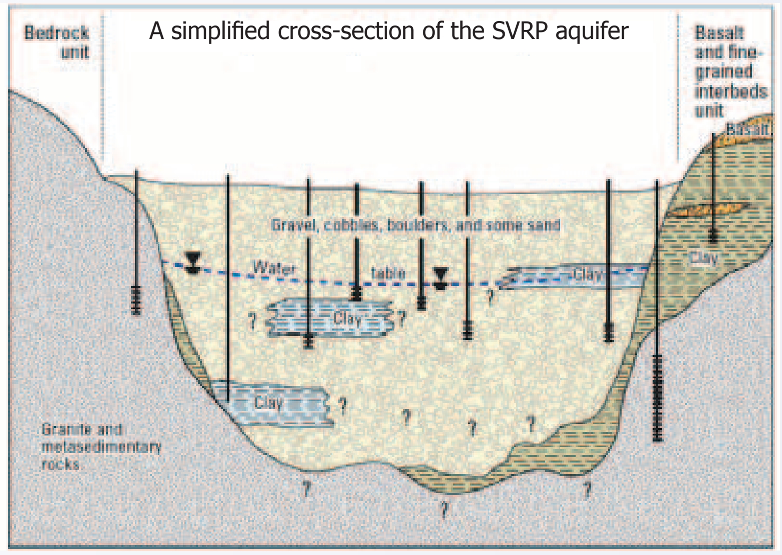
Another new technology is AGRIMET, a large network of automated weather stations placed near agricultural fields, that allows for field-specific irrigation scheduling. This makes it possible to use just the right amount of water needed for a crop, as local soil conditions can vary greatly over small distances. These weather stations are now becoming useful in helping homeowners more efficiently irrigate their yards by transmitting evapotranspiration (ET) data wirelessly to controllers. The data inform the controller whether it has rained recently and changes the scheduled watering period up or down, depending on how much water is present in the soil. The result is healthier grass, less water waste, and cheaper utility bills!

The Spokane Valley – Rathdrum Prairie (SVRP) Aquifer

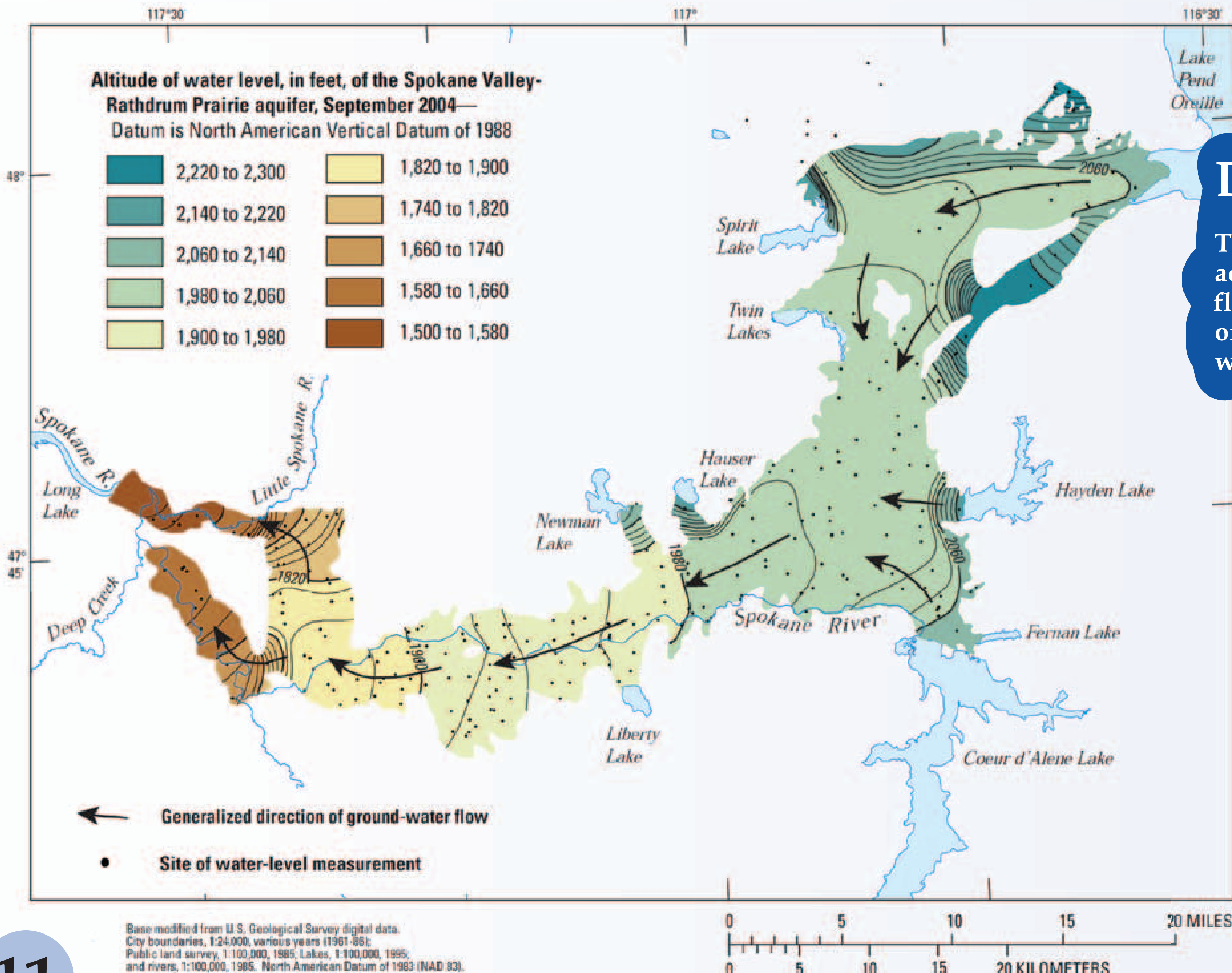
The SVRP aquifer covers about 370 square miles in northern Idaho and eastern Washington. It is composed of Ice Age flood deposited gravels, cobbles, and boulders and is filled with water. No continuous clay or silt layers exist across the SVRP aquifer to keep contaminants from the surface moving down into the SVRP aquifer.

The valley walls are composed of massive rocks and clay that continue below the ground surface to form the impervious basin that holds the SVRP aquifer gravels. Relatively flat basalt plateaus such as Five Mile Prairie and the Columbia Plateau rise hundreds of feet above the valley.

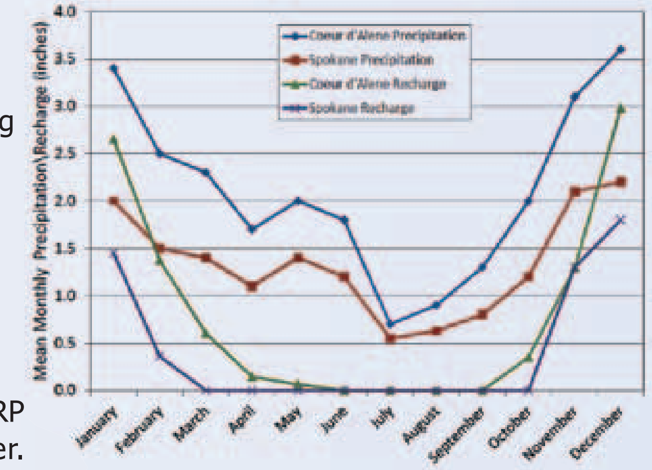
The Bitterroot Mountains east of Rathdrum Prairie and the Selkirk Mountains along the Washington – Idaho border also form the aquifer edges (or "basin"). These mountains are more than 2,000 feet higher than the basalt plateau to the southwest.



Not to scale



SVRP Aquifer Recharge



Water enters the SVRP aquifer from several sources including
1) Precipitation
2) Inflow from upland bedrock watersheds
3) Seepage from lakes
4) Seepage from the Spokane River
5) Water from irrigation
6) Effluent from septic systems

Precipitation that falls onto the land surface above the SVRP aquifer eventually infiltrates and recharges the aquifer. Precipitation that falls onto the bedrock upland areas infiltrates very little because the bedrock is not very permeable. The water moves more laterally eventually combining with other water in the watershed and forming small streams. These streams flow downhill and discharge onto the permeable soils above the aquifer and quickly infiltrate downward to the water table. Some of the watersheds have lakes at the bottom that collect all the water. The lakes contribute water to the aquifer either through seepage from the bottom or overflow to streams that discharge onto the land surface above the aquifer. The Water Budget on page 14 shows the average amount of water that enters the SVRP aquifer from each of these sources in a year.

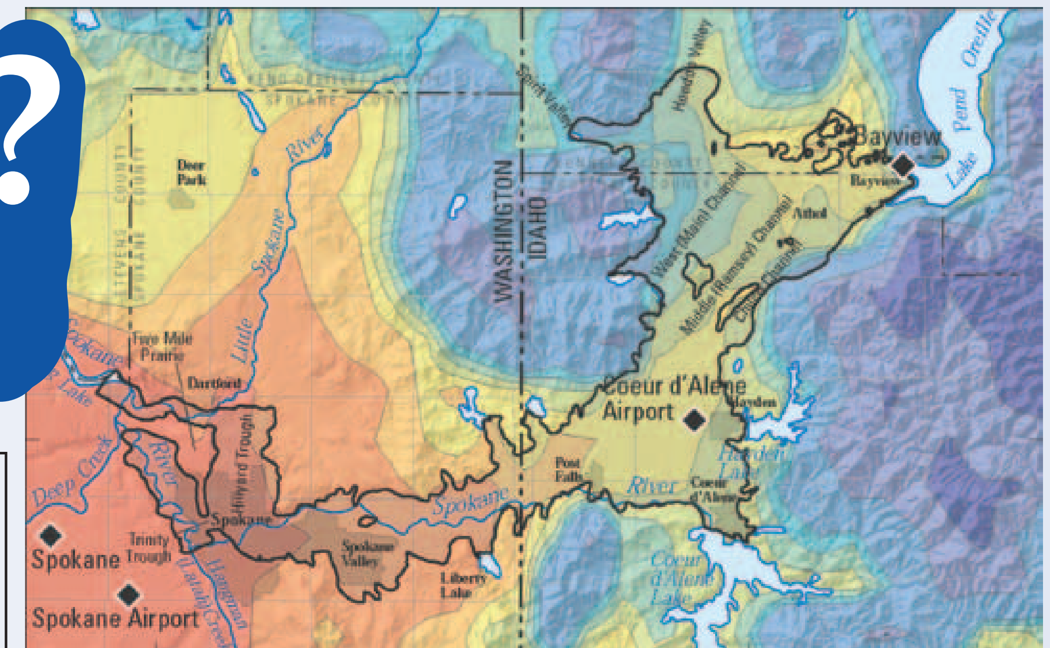
The amount of water that recharges the SVRP aquifer is lowest in the summer and highest in the spring when the snow melts.

Did you know?

The surface of the SVRP aquifer is so porous creeks flow only a short distance on top of it before all the water soaks into the ground.

Average Annual Precipitation in inches

16.0 - 18.0	26.1 - 28.0
18.1 - 20.0	28.1 - 30.0
20.1 - 22.0	30.1 - 40.0
22.1 - 24.0	40.1 - 50.0
24.1 - 26.0	50.1 - 67.0



Groundwater Flow

The elevation of groundwater in the northern Rathdrum Prairie is about 2,110 feet while the elevation is about 1,550 feet near Lake Spokane. Groundwater in the SVRP aquifer flows from the northern Rathdrum Prairie area southward to Coeur d'Alene–Post Falls, then toward the west into Washington. The water flows through Spokane–Spokane Valley areas and separates to flow around the Five Mile Prairie. All the water eventually empties into the Spokane and Little Spokane Rivers that flow into Lake Spokane. Because of the very permeable nature of the aquifer, groundwater flow velocities can reach approximately 50 feet per day.

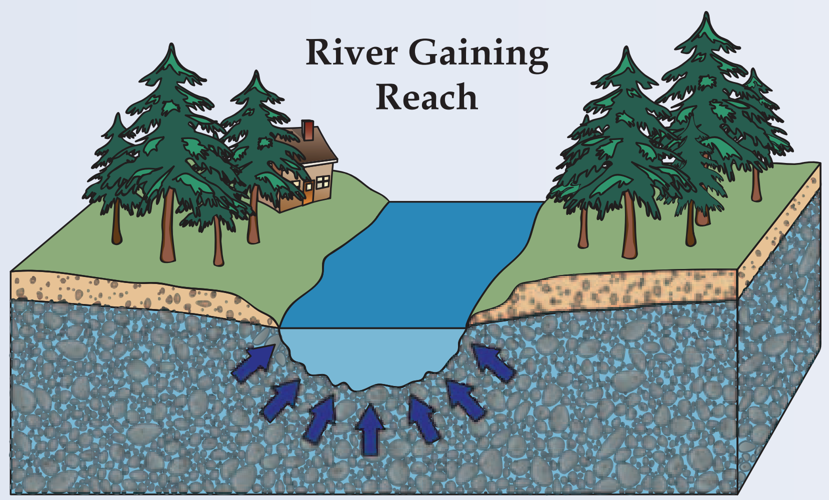
In some places, water seeps out of the bottom of the Spokane River and supplies a lot of recharge to the SVRP aquifer. Water is pumped from the SVRP aquifer for people to use. Some of this water is returned to the SVRP aquifer through irrigation or septic discharge. Generally people use more water than is returned to the SVRP aquifer, so there is a net loss.

Spokane Valley – Rathdrum Prairie (SVRP) Aquifer - Spokane River Interconnection

The large spaces between the rocks in the SVRP aquifer allow relatively large interchanges of water with the river. The losing reaches of the Spokane River are the largest recharge source to the SVRP aquifer. The gaining reaches of the river get a significant amount of water from the SVRP aquifer.

Did you know ?

The Spokane River is the largest source of water to the SVRP aquifer and most water leaving the SVRP aquifer goes to the Spokane River.



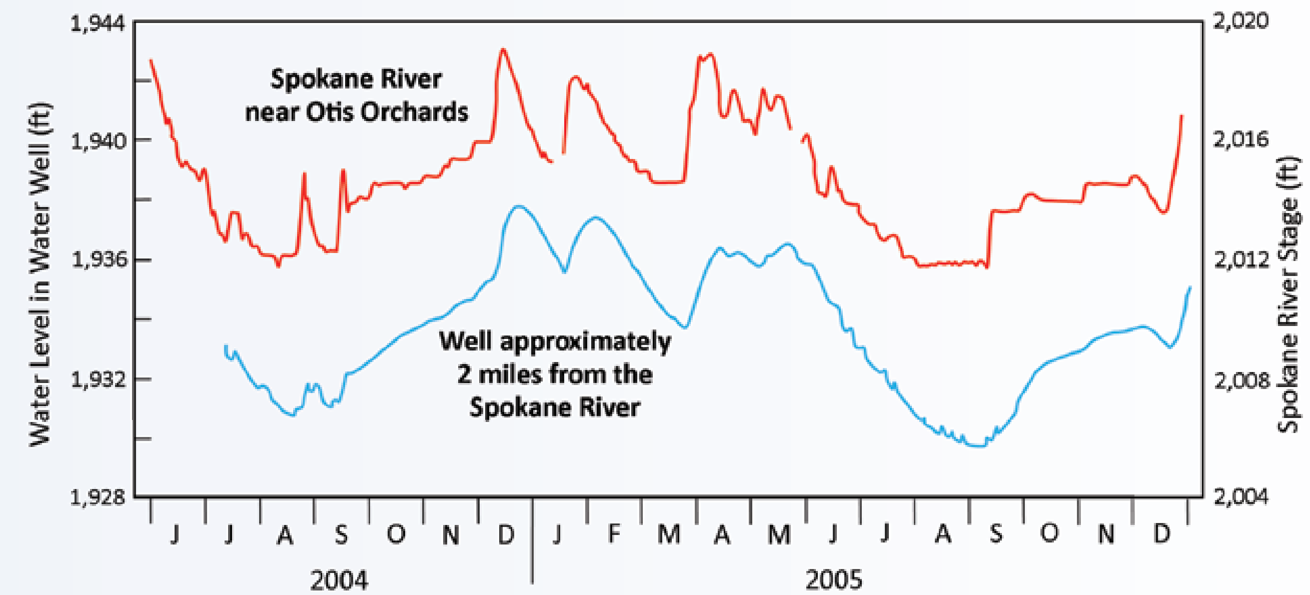
The surface elevation of the SVRP aquifer is a little higher than the bottom of the river in parts of Washington. Water flows into the river through the bottom or through springs on the banks of the river. These are called "gaining reaches".

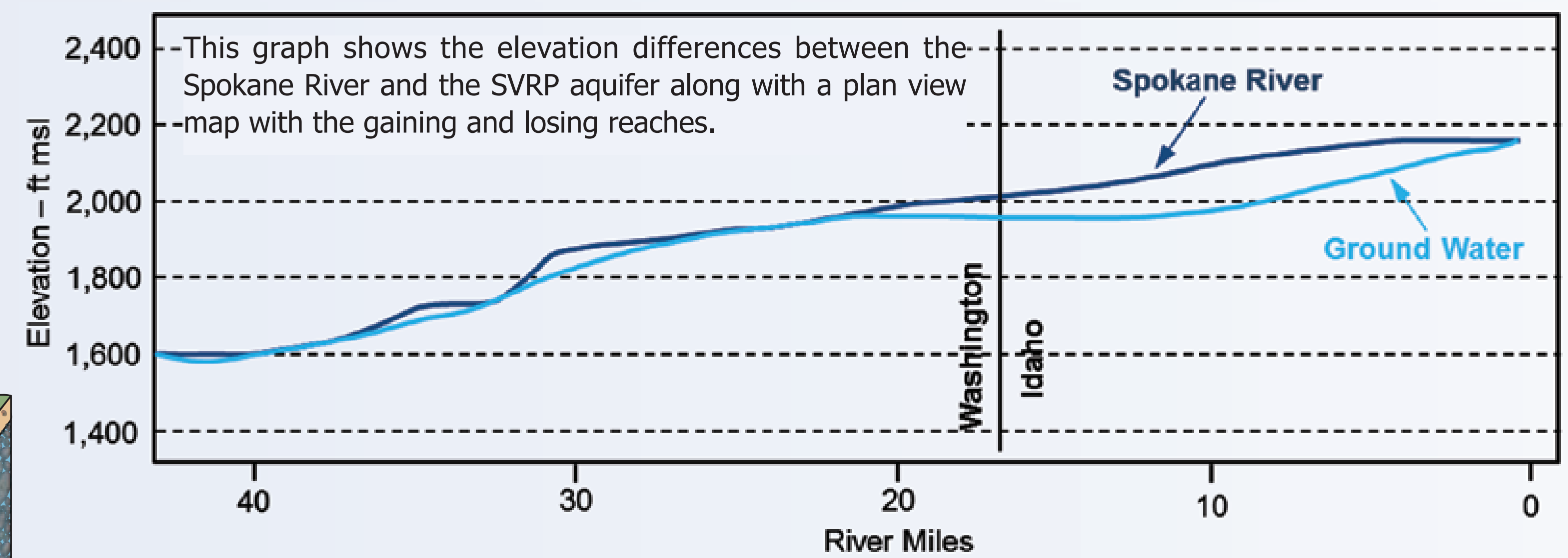
This is a gaining reach of the Spokane River near Sullivan Road. The ripples on the water at the bottom left corner of the picture shows water flowing out of the SVRP aquifer and into the river on August 20, 2003

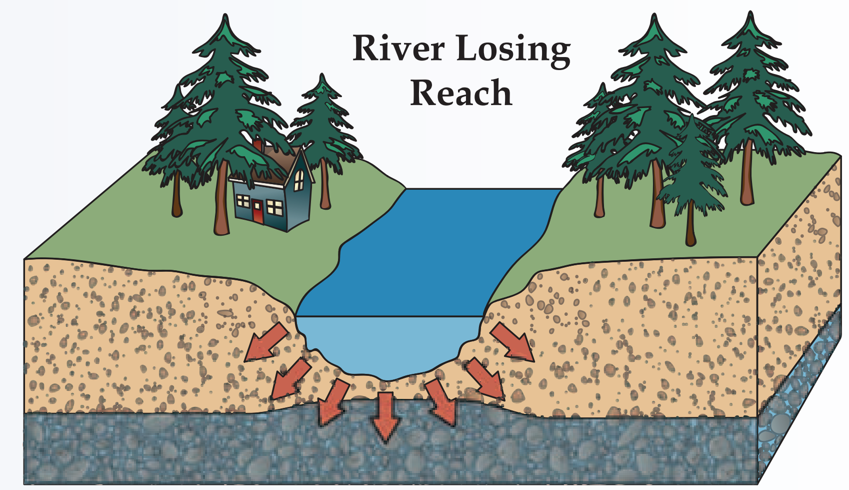
SVRP Aquifer And Spokane River Water Levels

The aquifer surface levels in the SVRP aquifer downstream of Post Falls depend on the flow in the Spokane River. The Spokane Valley well on the graph is located 2 miles from the Spokane River. The many peaks and valleys of the aquifer surface levels seen in the Spokane Valley well correspond to peaks and valleys of Spokane River water levels, which show their interconnection.

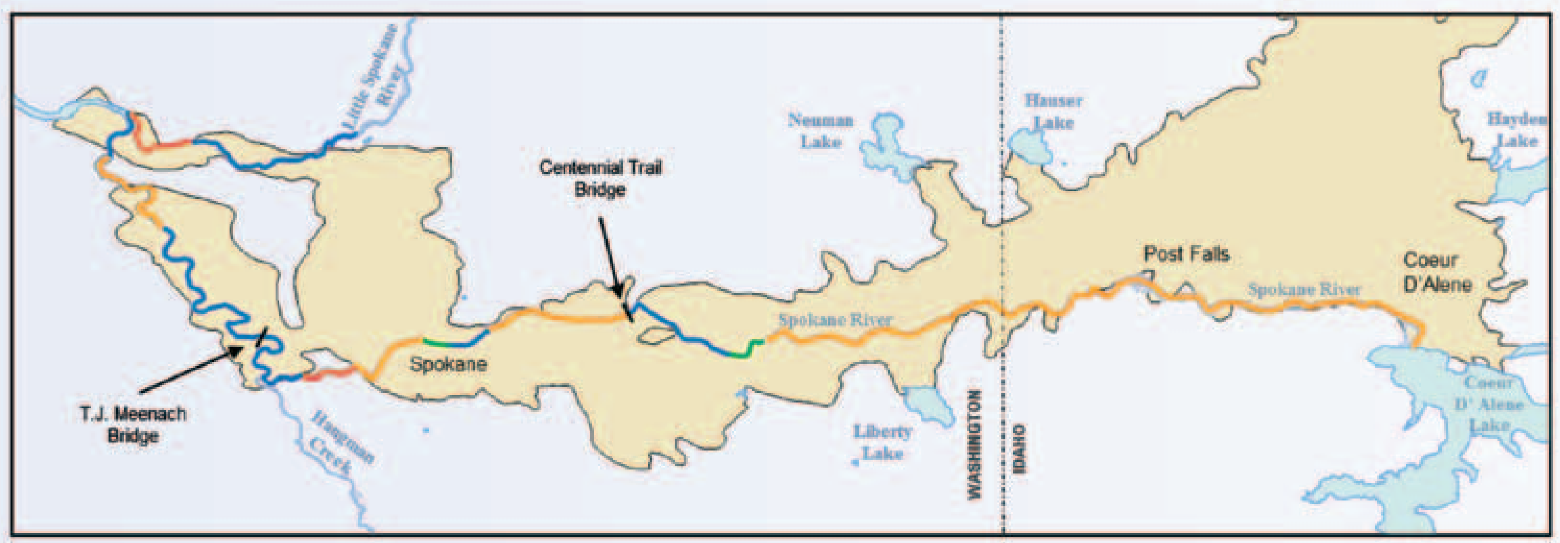
Pumping from the SVRP aquifer can lower the amount of groundwater that seeps into the Spokane River in the gaining reaches, which reduces the river flow. The closer a well is located to the gaining reach, or the greater the pumping rate, the larger the reduction will be. Keeping enough water in the Spokane River is important to maintain a healthy environment for fish and other aquatic life. It also supports recreation and scenic beauty.







The Spokane River flows from Coeur d'Alene Lake in Idaho westward into Washington and into Lake Spokane. The river bottom is higher than the SVRP aquifer in Idaho and parts of Washington. In these areas the water seeps out of the bottom of the river and recharges the Spokane Valley - Rathdrum Prairie (SVRP) aquifer. These are called "losing reaches" of the river.



Losing Reach: the river loses water to the aquifer

Gaining Reach: the river gains water from the aquifer

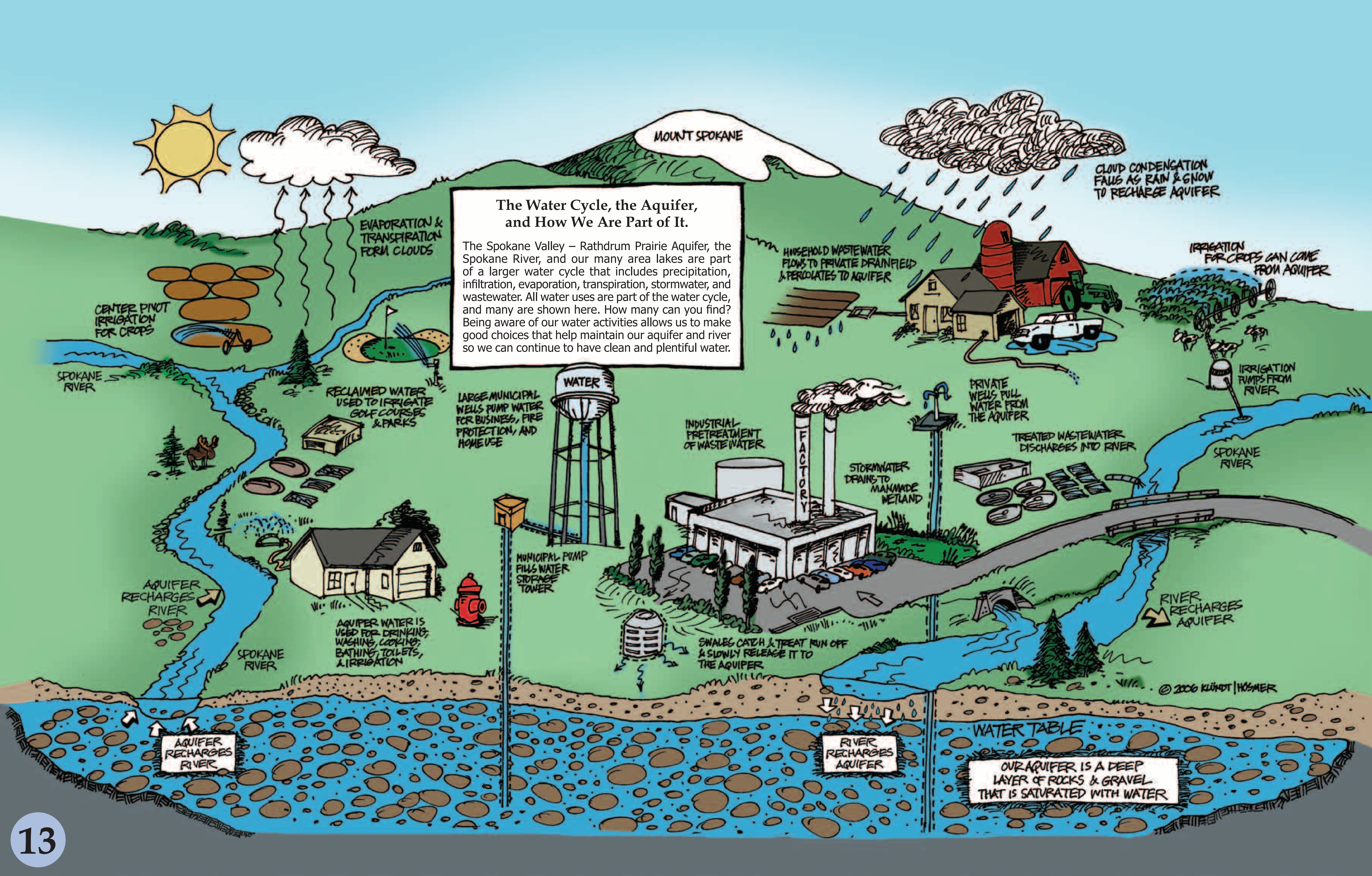
Transitional Reach: changing condition between gain/lose

Minimal Interaction: the river neither gains nor loses

This losing reach of the Spokane River near Greenacres had very little flow on August 1, 2003.

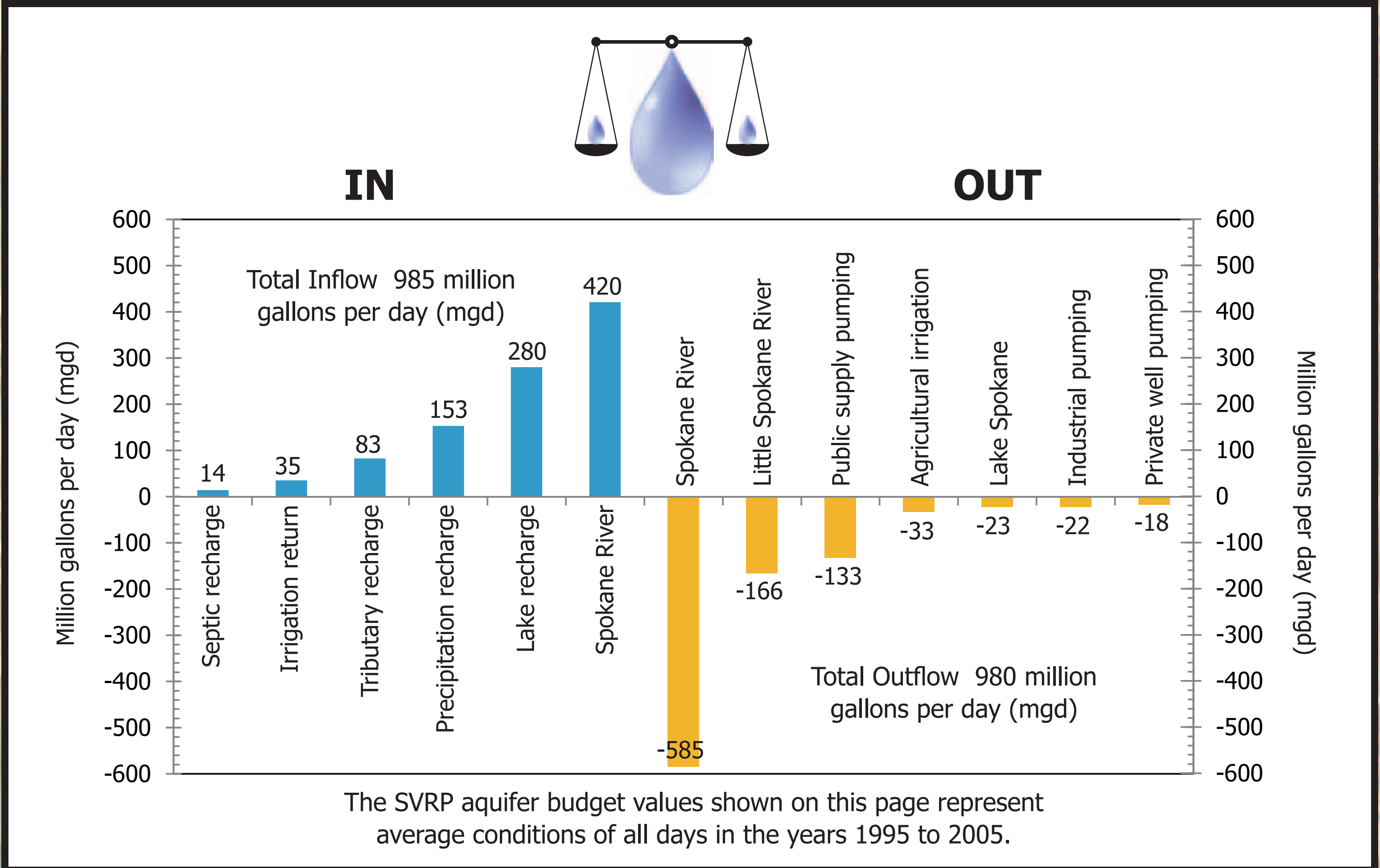
The Water Cycle, the Aquifer, and How We Are Part of It.

The Spokane Valley – Rathdrum Prairie Aquifer, the Spokane River, and our many area lakes are part of a larger water cycle that includes precipitation, infiltration, evaporation, transpiration, stormwater, and wastewater. All water uses are part of the water cycle, and many are shown here. How many can you find? Being aware of our water activities allows us to make good choices that help maintain our aquifer and river so we can continue to have clean and plentiful water.

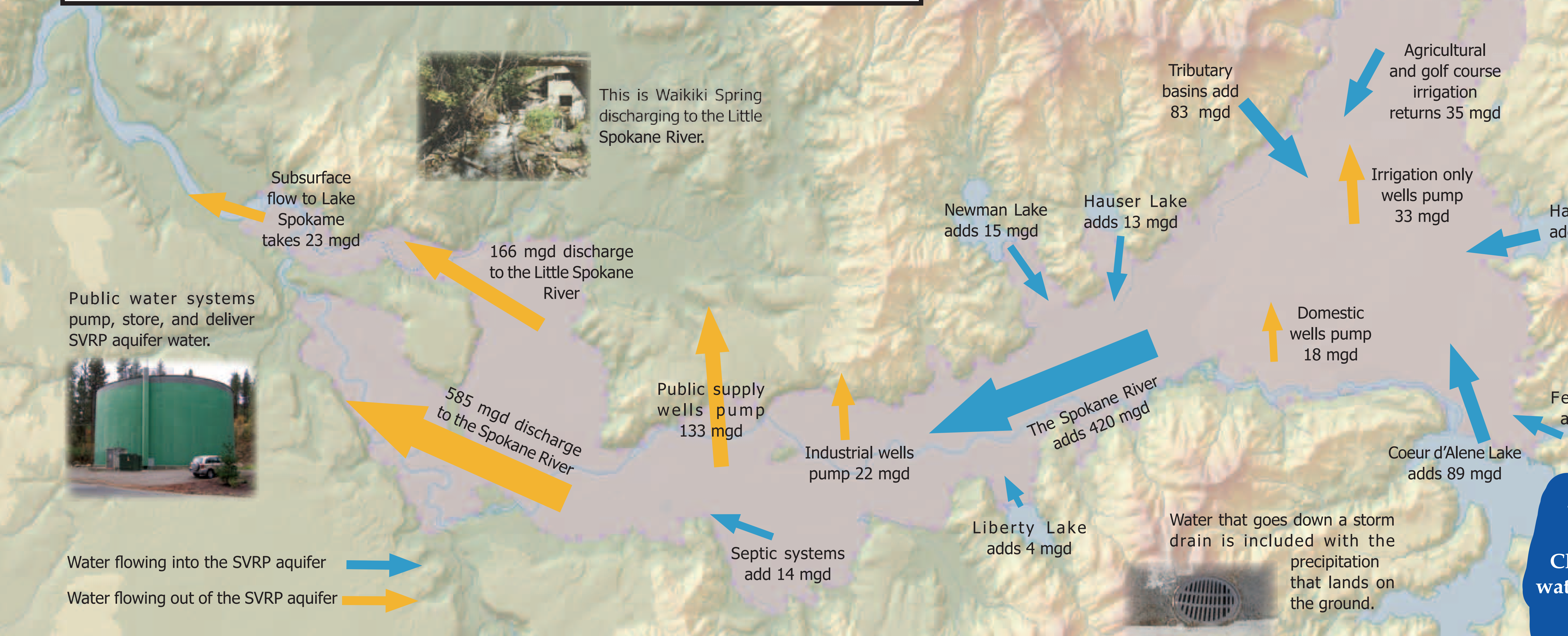


WATER BUDGET

The Spokane Valley – Rathdrum Prairie (SVRP) aquifer is dynamic with water flowing into and out of the system. Like a household budget, a water budget is an accounting of the amount and source of water recharging the SVRP aquifer, and the amount and destination of water discharging from the SVRP aquifer. This water budget is organized into two categories: inflow (water that recharges or flows IN to the SVRP aquifer) and outflow (water that discharges or flows OUT of the SVRP aquifer). In any successful budget, the IN and OUT numbers should match. More information could narrow the small gap in this budget.



The SVRP aquifer budget values shown on this page represent average conditions of all days in the years 1995 to 2005.



This is Waikiki Spring discharging to the Little Spokane River.

Public water systems pump, store, and deliver SVRP aquifer water.

Hayden Lake recharge

The Spokane River plays a key role in the aquifer water budget: the river provides about 43% of the SVRP aquifer inflow, and it receives almost 60% of the SVRP aquifer outflow. The lakes near the SVRP aquifer contribute about 28% of the inflow.

Human uses are only about 21% of the SVRP aquifer outflow. Look on page 15 to find out how much SVRP aquifer water people in Idaho and Washington use.

Did you know?

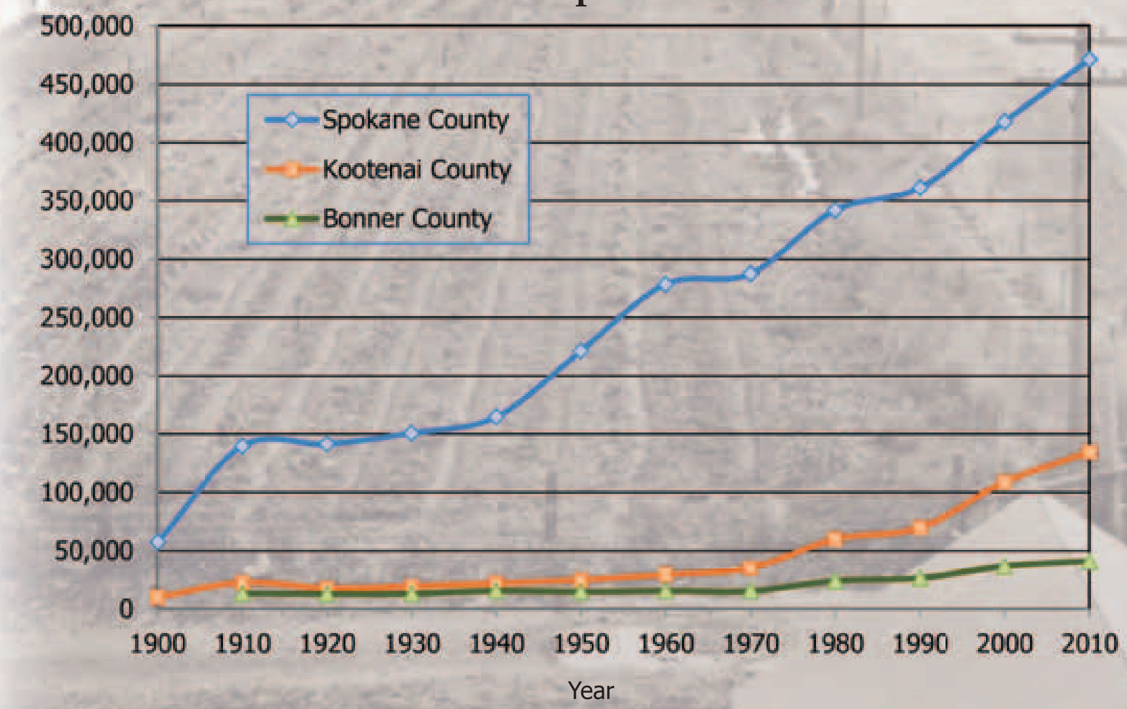
Close to 1 billion gallons of water flows into and out of the SVRP aquifer each day.

The information on this page are adapted from USGS Scientific Investigations Report 2007-5044.

WATER USE

Everyone who lives in the Spokane Valley – Rathdrum Prairie (SVRP) area uses the aquifer as their water supply. We use water from the SVRP aquifer to drink, flush our toilets, water our yards, and irrigate crops. Being good stewards of our aquifer means knowing how much water we use and how much is available.

US Census Population 1900 to 2010



Population and Land Use

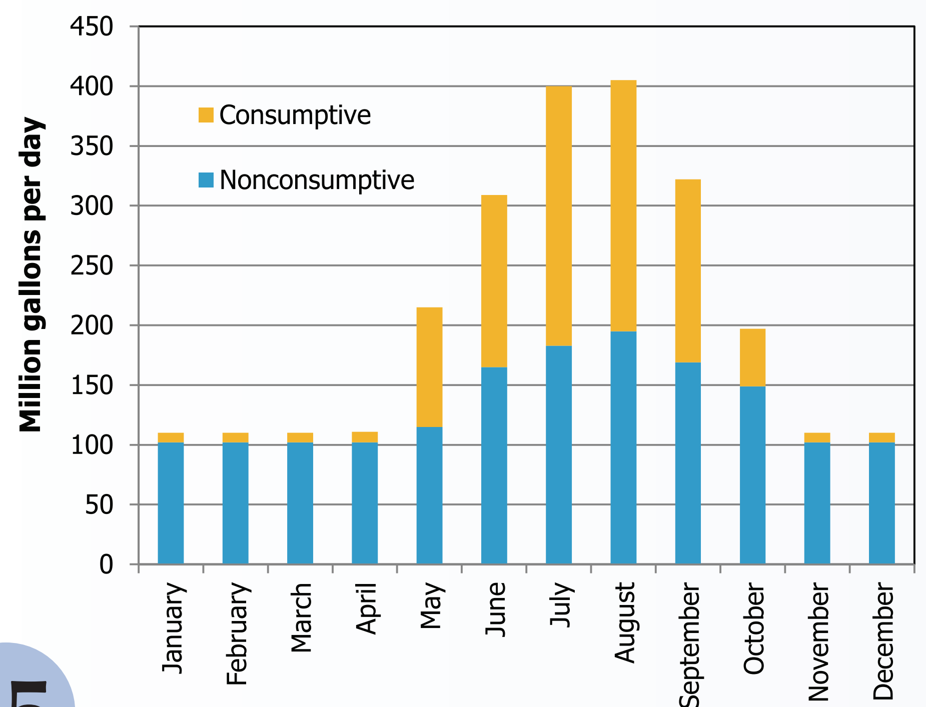
The population over the SVRP aquifer has been increasing since 1900. Most of the population growth occurred in the municipal areas. Most of the population of Spokane and Kootenai Counties use SVRP aquifer water. while very few Bonner County residents live over and use the aquifer. Water use increases as the population grows.

Land use in our area has changed over the years from a few houses and a lot of agriculture with canal irrigation to many houses with lawns and some agriculture using sprinkler irrigation. Water use changes as land use changes.

Background picture: Looking south from the Modern Electric Water Company water tower on Pines towards Broadway in 1908.

Did you know?

Some of the water we pump and use out of the SVRP aquifer returns to the aquifer or Spokane River.



Monthly Water Use

We use more water in the summer because we irrigate our lawns and fields. The amount of irrigation water we use depends mostly on precipitation and the amount of evaporation. The annual precipitation varies across the SVRP aquifer, increasing from west to east. The average annual precipitation in Spokane is about 16 inches, while it is over 25 inches in Coeur d'Alene.

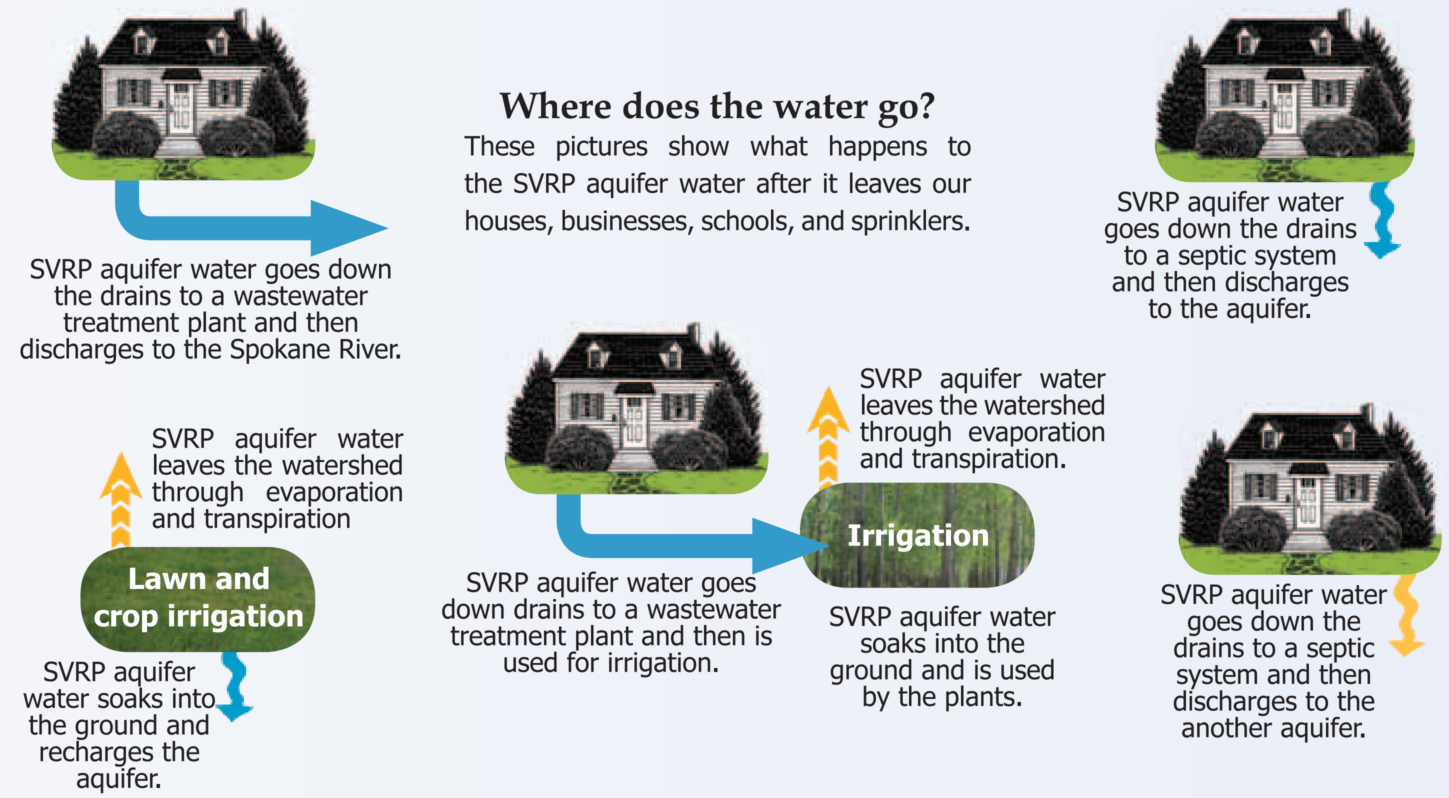
This graph shows how much more water we use in the summer. It also shows the amount of consumptive water use in each month.

Consumptive and Nonconsumptive Water Use

All the water we pump from the SVRP aquifer either returns to the watershed (the aquifer or the Spokane River) or it leaves the watershed. When it returns to the watershed it is nonconsumptive water use. Consumptive water use usually happens when the water evaporates or transpires. Transpiration happens when water moves through plants then is released through small pores in the leaves. Consumptive water use can also happen when the water is exported to another watershed, aquifer or river.

Where does the water go?

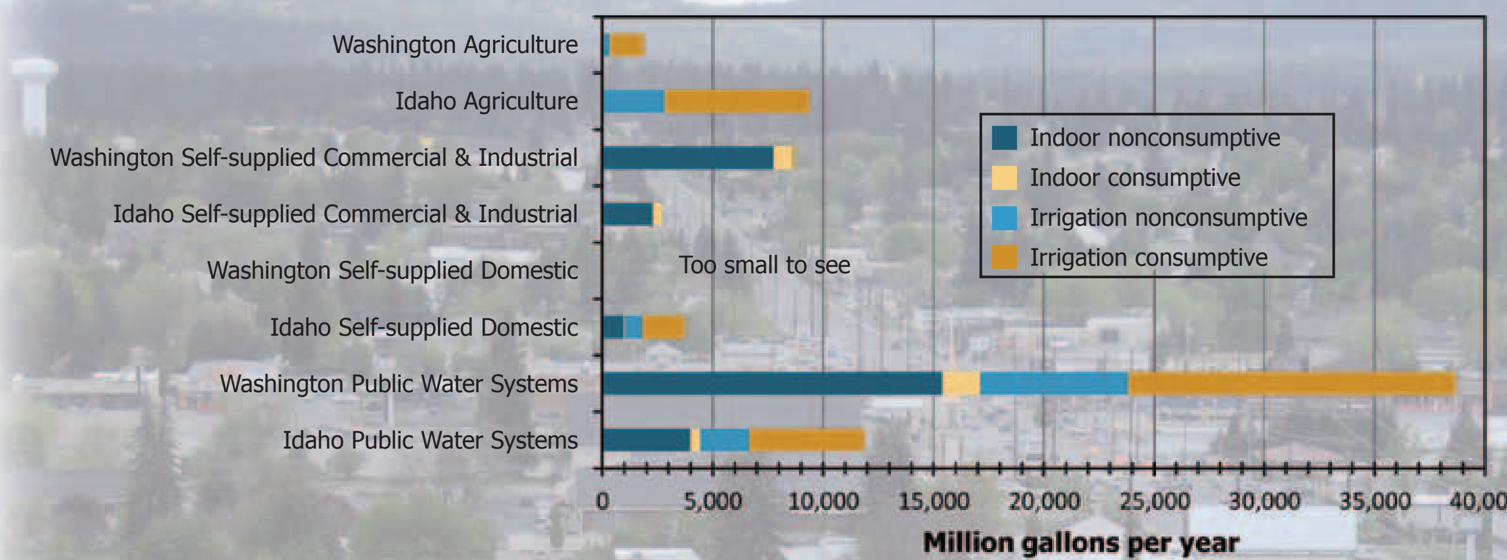
These pictures show what happens to the SVRP aquifer water after it leaves our houses, businesses, schools, and sprinklers.



SVRP Aquifer Water Use

Today, the water is used for different purposes depending on where you are on the SVRP aquifer. Public water systems supply residents, businesses, manufacturers, and irrigation for schools and parks. Private wells also supply water for residences and businesses, but significant quantities are used for agricultural irrigation.

The Idaho Comprehensive Aquifer Planning and Management Program (CAMP) process calculated average annual water uses for 2009 to 2013, and the Spokane County Water Demand Forecast process calculated water uses for 2010.



Background picture: Looking south from the Modern Electric Water Company water tower on Pines towards Broadway in 2008.

FORECAST OF SPOKANE VALLEY – RATHDRUM PRAIRIE (SVRP) AQUIFER WATER USE IN SPOKANE COUNTY

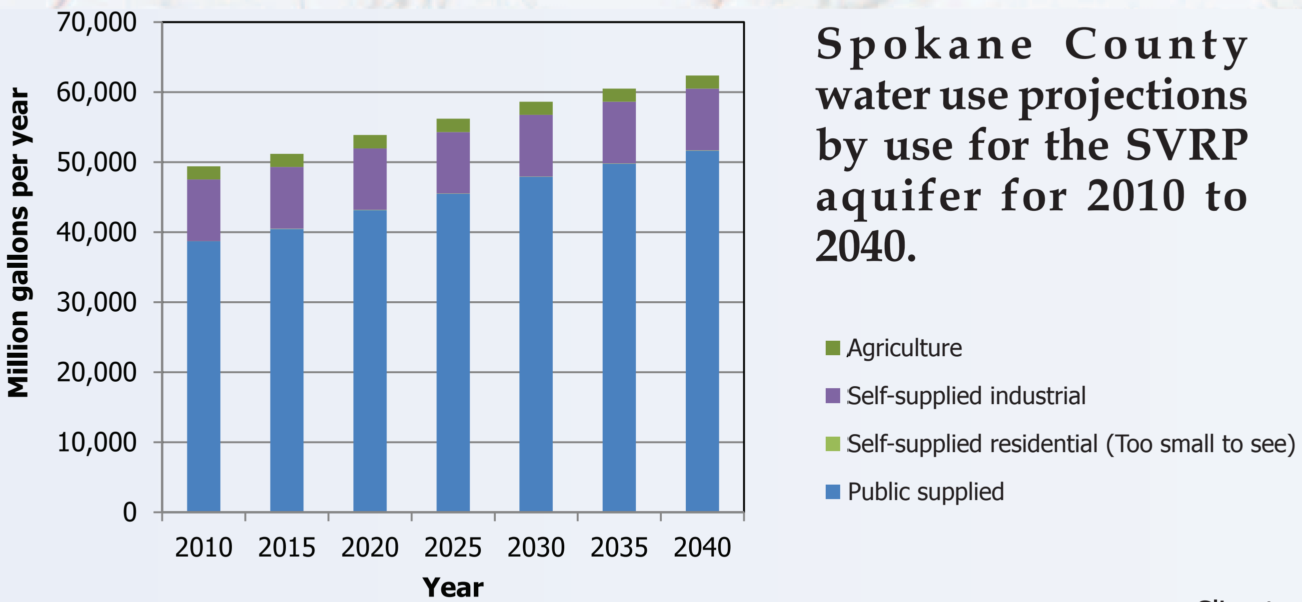
The goals for the Spokane County Water Demand study included developing a model to forecast future water use for consumptive uses in Spokane County so local groups can generate their own forecasts.

The Forecast Model is a spreadsheet model based on water use data, population and economic data, agricultural and industrial data, and 20-year average temperatures and precipitation. It can be modified to use different inputs as new information becomes available.

SVRP aquifer water use for Spokane County is forecasted to increase 26% by 2040. The increase is approximately 13 billion gallons a year, which is significant given that the most recent USGS study shows increases in withdrawal from the SVRP aquifer decreases flow in the Spokane River.

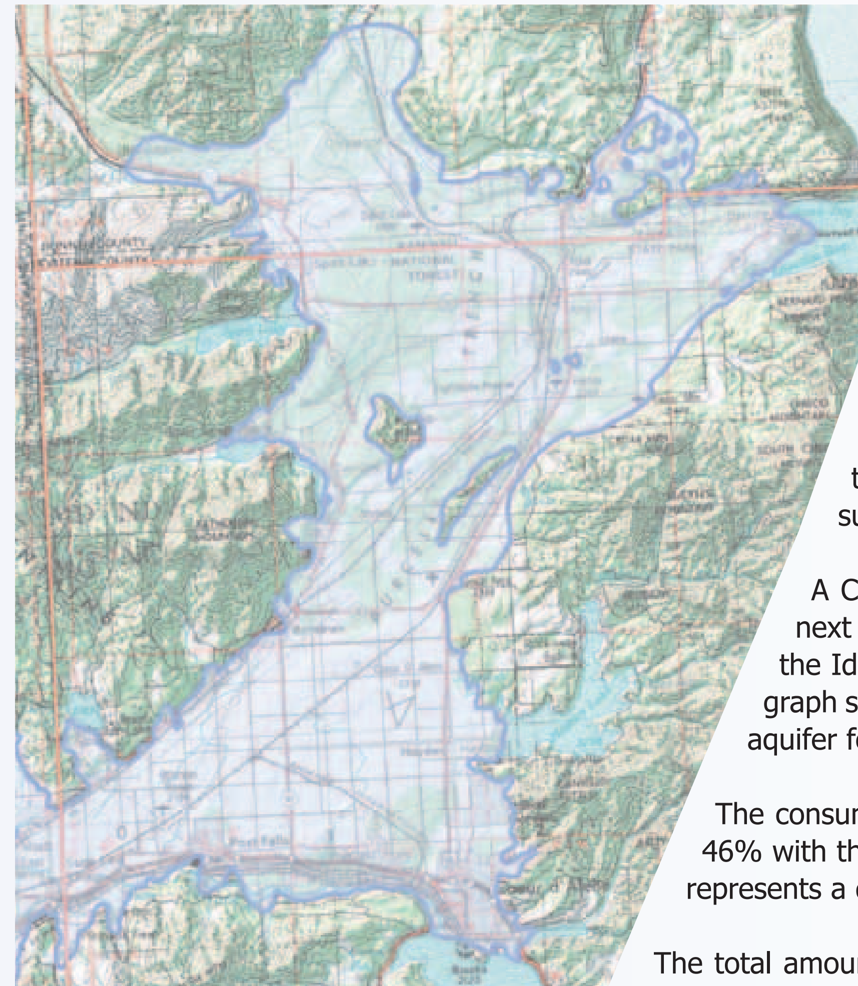
The SVRP aquifer provides 73% of the water used in Spokane County and provides a significant amount of water to the Spokane River during low flow times of the year. Analyses of consumptive and nonconsumptive water use and return flows give a better understanding of the interaction of water use and the river-aquifer system.

The water use projections are based on the 20-year average temperatures and precipitation. Using the cooler and wetter weather of 2005 decreased the modeled water use by 5%. Using the hotter and drier weather from 2006 increased the modeled water use by 5%. Conservation lowers water demand, but warmer drier weather can counteract the savings.



Spokane County water use projections by use for the SVRP aquifer for 2010 to 2040.

Spokane County Water Demand Forecast Model was developed throughout 2010 and 2011 then updated in 2013 by Spokane County Water Resources, technical consultants Tetra Tech and CDM, and an advisory committee comprised of area utility providers, local and state government, academics, and citizens. Funding for the project was provided by the Washington Department of Ecology. Spokane County collected data on water use. The main source of demographic data used in the demand model was the Spokane Regional Transportation Council 2040 Growth Forecasts for Employment, Housing, and Transportation.



Rathdrum Prairie Aquifer Area

FORECAST OF SVRP AQUIFER WATER USE IN KOOTENAI AND BONNER COUNTIES

The Idaho Comprehensive Aquifer Planning and Management Program (CAMP) was created to provide information for managing ground and surface water resources into the future. The purpose of CAMP is to avoid future conflicts over water resources, prioritize state investments in water resources, and find ways to decrease the difference between future water needs and available supply.

A CAMP report forecasts Rathdrum Prairie water use over the next 50 years for three levels of population growth based on the the Idaho Economic Forecasting Model. The water use projection graph shows the amount of water that could be withdrawn from the aquifer for low, baseline, and high population growth possibilities.

The consumptive portion of the projected water use in 2060 is about 46% with the rest returning to the SVRP aquifer or Spokane River. This represents a decrease from 53% consumptive use in 2010.

The total amount of projected water use could be reduced through water conservation. Water conservation means using less water for the same activity. Conservation could include more efficient dishwashers, low flow shower heads, better irrigation methods, and landscaping with native plants that need less water. Aggressive water conservation could reduce the projected water use up to 40%.

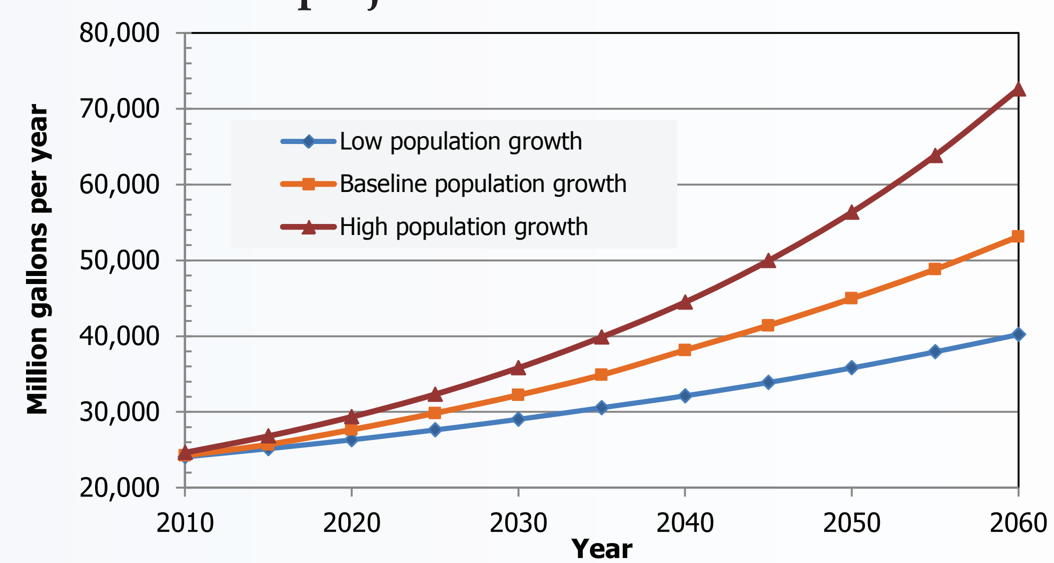
Did you know ?

The USGS SVRP aquifer model indicates that water pumped from the SVRP aquifer reduces flow in the Spokane and Little Spokane Rivers.

Climate Change

Climate change will affect future water use. The Climate Impacts Group (CIG) at the University of Washington studied the potential change in climate for the Pacific Northwest. The CIG studies indicate that the SVRP aquifer area could experience higher temperatures along with wetter fall and winter months and drier spring and summer months. These changes mean increased irrigation with additional withdrawals from the SVRP aquifer. The additional withdrawals would increase the amount of consumptive use and decrease summer flows in the Spokane River.

Idaho CAMP water use projections for 2010 to 2060



The Idaho water-demand study was conducted for (and funded by) the Idaho Water Resource Board (IWRB) as part of the Rathdrum Prairie CAMP process. The study was conducted by SPF Water Engineering, LLC, AMEC Earth and Environmental, Idaho Economics (John Church), and Taunton Consulting, with guidance from the IWRB, Idaho Department of Water Resources, and the Rathdrum Prairie CAMP Advisory Committee. The study was done between 2008 and 2010 then updated in 2014.

SVRP AQUIFER MONITORING

The Spokane Valley – Rathdrum Prairie (SVRP) aquifer is the primary source of water for drinking and irrigation for over 500,000 people living in the area. The SVRP aquifer has been designated as a sole source aquifer by the US Environmental Protection Agency and as a sensitive resource aquifer by the Idaho Department of Environmental Quality. The large number of people that use the SVRP aquifer and the lack of any natural barriers to prevent pollutants from reaching the aquifer mean it is important to monitor the water quality and water quantity.

All public water systems are required to regularly monitor water quality in their wells. The water quality information is reported in their annual Consummer Confidence Report which, you can get from the public water system's website or by calling their office.

Spokane County has been monitoring water quality conditions in the aquifer since 1977. Monitoring the aquifer shows the effects of human activities and replacing septic systems with sewers. Currently, water resources staff collect samples quarterly from up to 29 monitoring wells and 16 public supply wells. The samples are tested for nitrate, phosphorus, lead, arsenic, chloride, and other chemicals.

Washington Department of Ecology's water programs work closely with Washington communities to clean up and protect water quality in Washington. They also work to ensure the state has clean, adequate water supplies that meet current and future drinking water needs, commercial and agricultural uses, and can sustain fish and the natural environment.

The Panhandle Health District (PHD) has been monitoring the aquifer on the Rathdrum Prairie since 1975. The sampling began because of concerns about the increasing number of septic systems and the potential to impact water quality. The sampling program has changed over time. Today PHD monitors approximately 28 wells three times a year for chemicals such as nitrate, arsenic, and chloride.

Did you know?

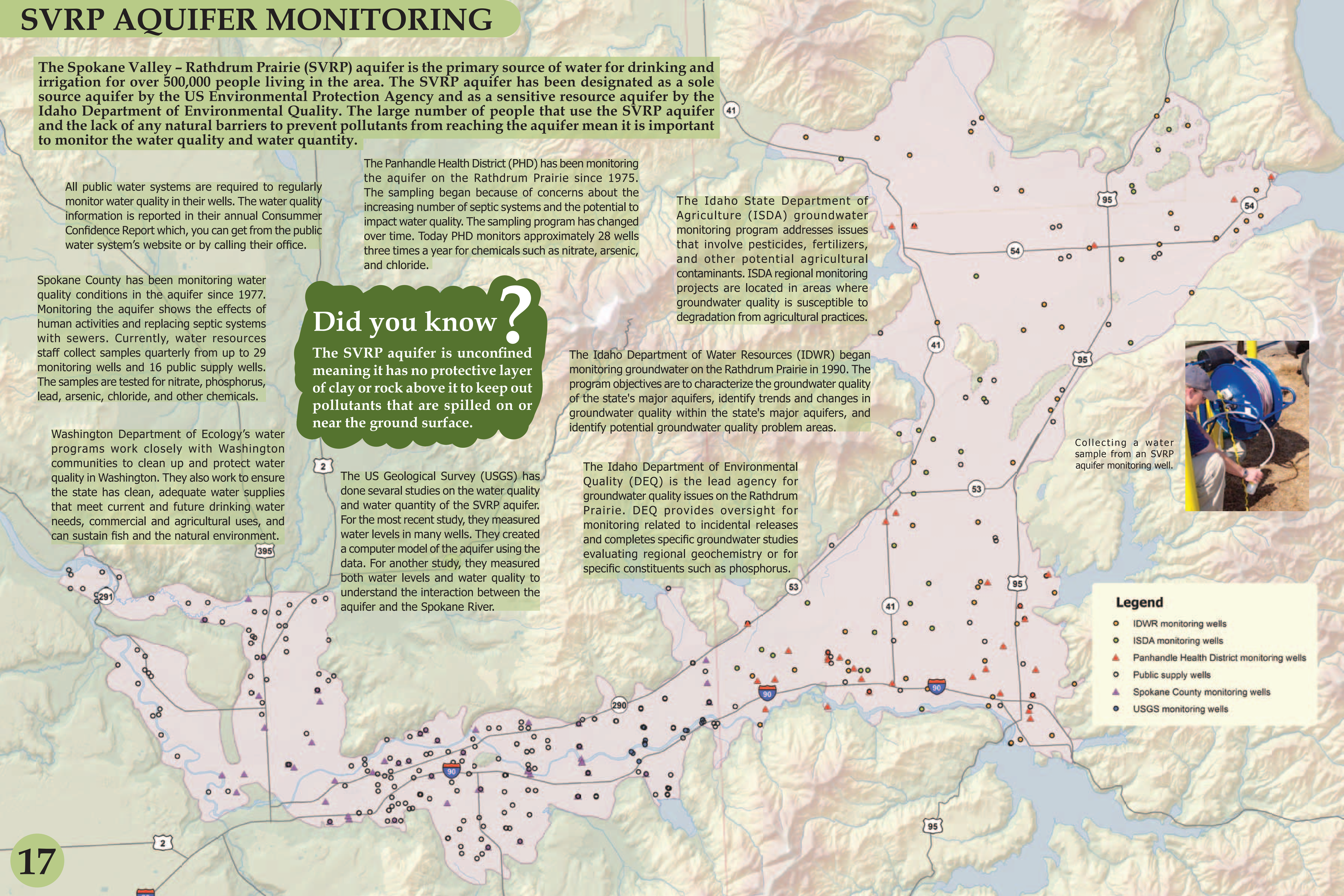
The SVRP aquifer is unconfined meaning it has no protective layer of clay or rock above it to keep out pollutants that are spilled on or near the ground surface.

The US Geological Survey (USGS) has done sevaral studies on the water quality and water quantity of the SVRP aquifer. For the most recent study, they measured water levels in many wells. They created a computer model of the aquifer using the data. For another study, they measured both water levels and water quality to understand the interaction between the aquifer and the Spokane River.

The Idaho State Department of Agriculture (ISDA) groundwater monitoring program addresses issues that involve pesticides, fertilizers, and other potential agricultural contaminants. ISDA regional monitoring projects are located in areas where groundwater quality is susceptible to degradation from agricultural practices.

The Idaho Department of Water Resources (IDWR) began monitoring groundwater on the Rathdrum Prairie in 1990. The program objectives are to characterize the groundwater quality of the state's major aquifers, identify trends and changes in groundwater quality within the state's major aquifers, and identify potential groundwater quality problem areas.

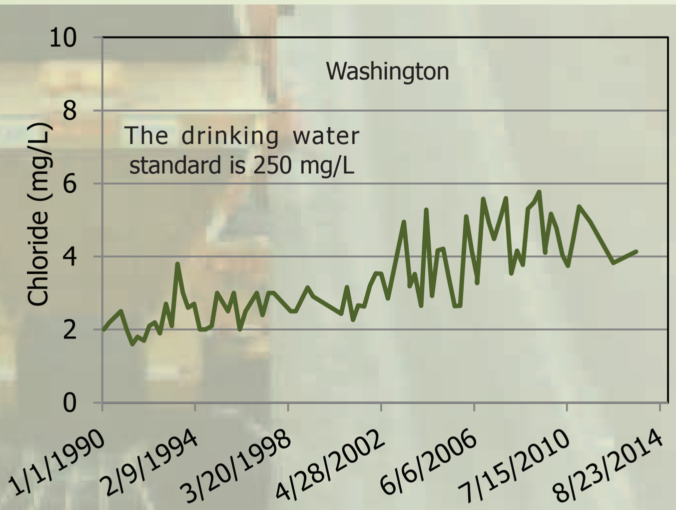
The Idaho Department of Environmental Quality (DEQ) is the lead agency for groundwater quality issues on the Rathdrum Prairie. DEQ provides oversight for monitoring related to incidental releases and completes specific groundwater studies evaluating regional geochemistry or for specific constituents such as phosphorus.



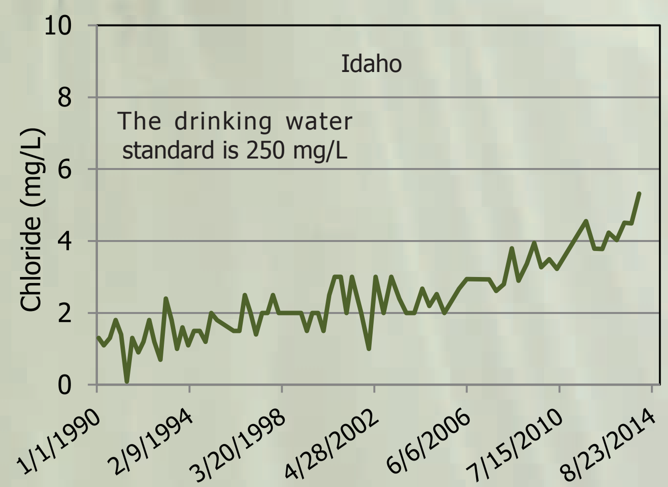
Collecting a water sample from an SVRP aquifer monitoring well.

Chloride Trends

Chloride, not to be confused with chlorine added to drinking water and swimming pools, gets into groundwater naturally when it dissolves from rocks and soil. Chloride is also added to groundwater from human sources such as wastewater, leaking landfills, industrial waste, fertilizer, and deicing salt. Chloride, dissolved in water, can move very easily through sand and gravel from the ground to the water table and through the aquifer. This means that chloride is a good indicator of human activities that may be impacting aquifer quality.



The lowest chloride concentrations in the Spokane Valley – Rathdrum Prairie (SVRP) aquifer are less than 1 milligram per liter (mg/L). Since the mid-1990s, the chloride concentrations have been increasing slightly, some getting near 30 mg/L. Fortunately, the chloride concentrations are still significantly below the drinking water standard of 250 mg/L.



One large source of chloride is the salt used for deicing roads, parking lots, and sidewalks. During the winter season hundreds of pounds of salt can be used for every mile of road to make them safer for driving. Discharge from septic systems can have chloride concentrations around 50 mg/L. Thousands of septic drainfields over the SVRP aquifer can contribute to the elevated chloride concentrations.

The increasing chloride concentrations tend to be in areas with higher populations. The graphs show the chloride concentrations in the water from two wells in the SVRP aquifer with increasing chloride trends.

Phosphorus

Phosphorus is an important nutrient required for plant growth. Too much phosphorus in a lake or river can lead to excessive algae and aquatic plant growth. Excessive plant growth in lakes and rivers can make the water unsafe for swimming or reduce dissolved oxygen for fish.

Local efforts to reduce phosphorus pollution since the 1970s have led to reductions of phosphorus in household products such as laundry detergent, dishwasher detergent, and turf fertilizer. Keeping phosphorus out of these products helps protect groundwater, surface water, and the environment.

Spokane County collects groundwater phosphorus samples from the SVRP aquifer to better understand how phosphorus concentrations vary by location. The phosphorus concentrations in SVRP aquifer water flowing into the Spokane and Little Spokane Rivers are very low.

Did you know ?

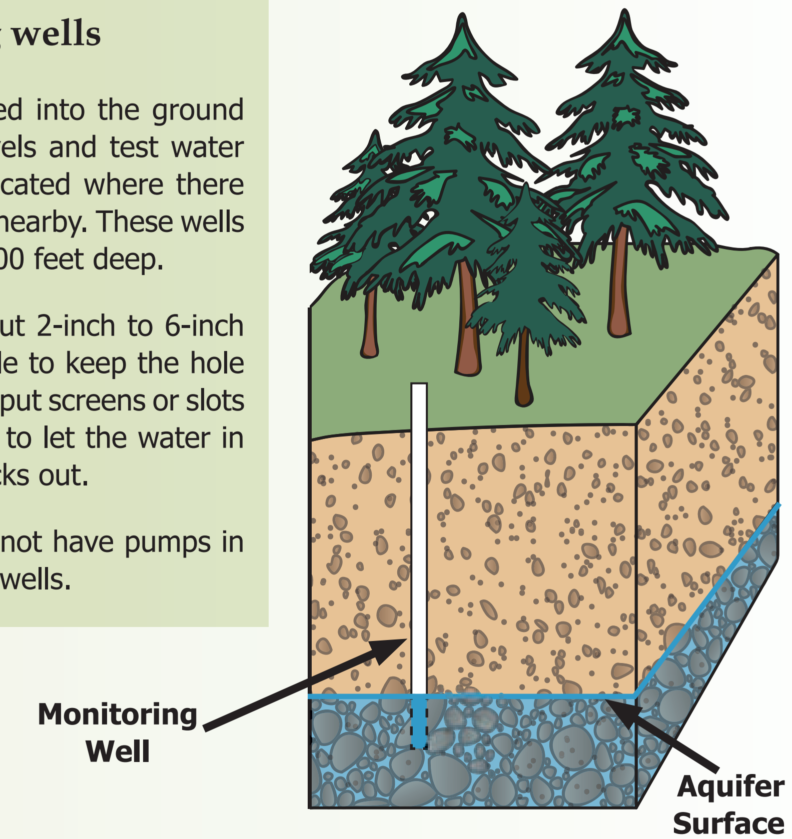
Monitoring of water quality and water levels shows how the SVRP aquifer is changing over time.

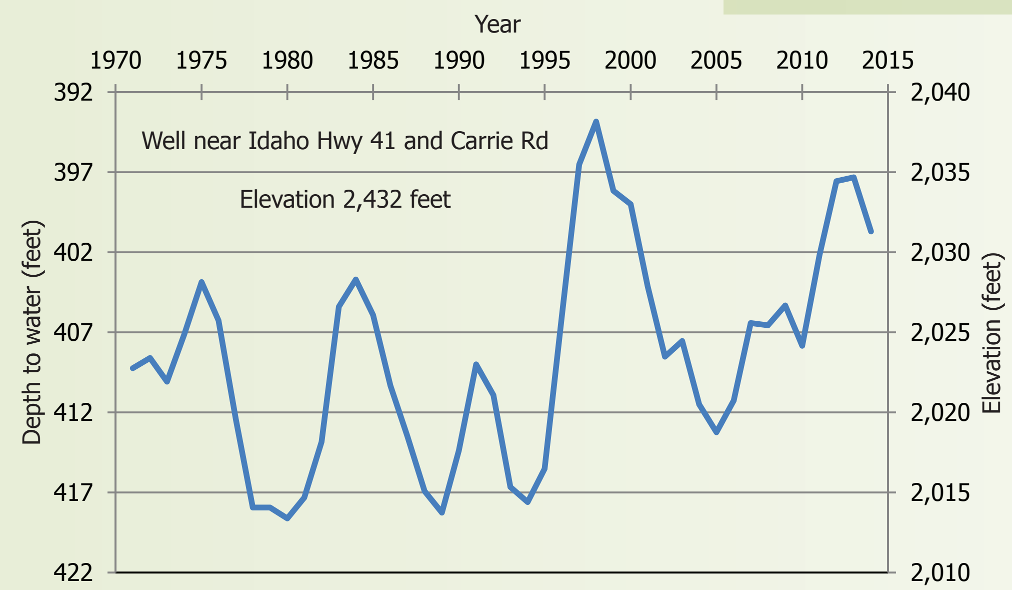
Monitoring wells

Monitoring wells are drilled into the ground to measure the water levels and test water quality. They are often located where there are no public supply wells nearby. These wells may be from 30 to over 400 feet deep.

The well drillers usually put 2-inch to 6-inch diameter pipe into the hole to keep the hole from collapsing. They also put screens or slots at the bottom of the pipe to let the water in but keep the sand and rocks out.

Most monitoring wells do not have pumps in them unlike public supply wells.

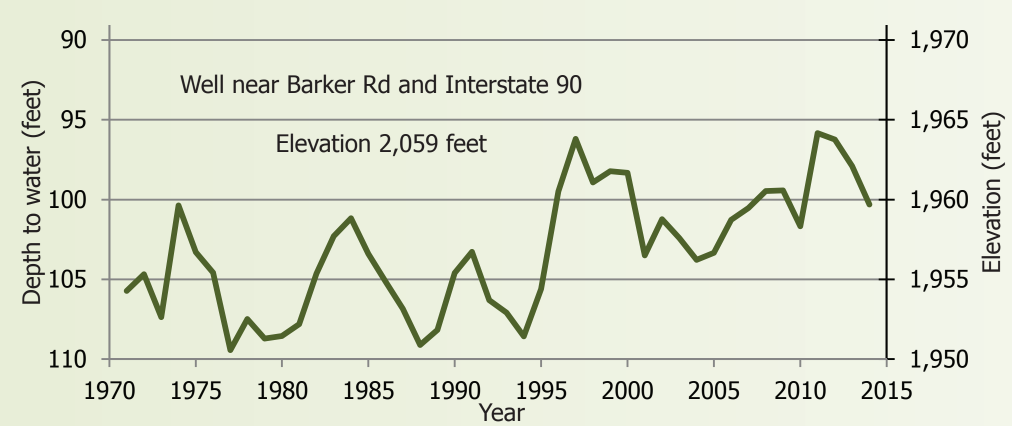




Annual average aquifer surface elevations

These wells are both measured by the USGS — one in Idaho and the other in Washington. The data on these graphs represent the average of all the measurements taken in each year.

The SVRP aquifer surface elevation in the well in Idaho is much higher than in the well in Washington, and the averages vary by more than 25 feet in the Idaho well and less than 15 feet in the Washington well. The SVRP aquifer surface levels in the Washington well are influenced by the flow in the Spokane River while the levels in the Idaho well are influenced mainly by snow melt and precipitation.

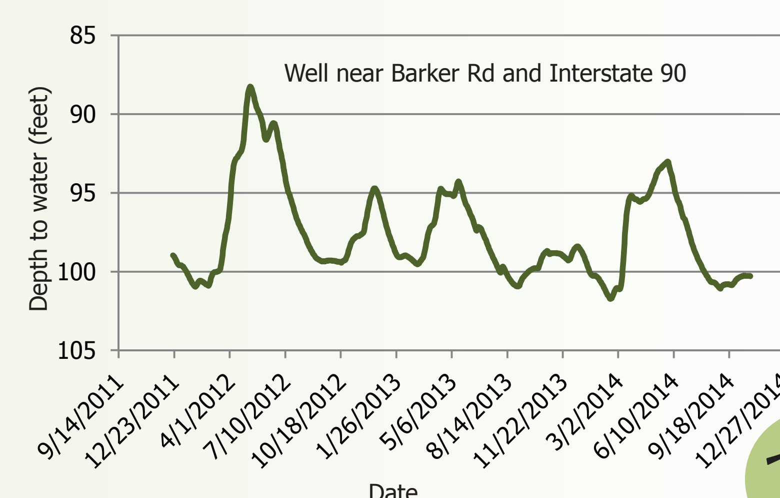


SVRP Aquifer Surface Elevations Monitoring

The USGS and others measure the depth of the SVRP aquifer surface below the ground surface. SVRP aquifer surface elevations are calculated from these data. Changes in SVRP aquifer surface elevations are caused by precipitation, water pumping, and river flow.

Daily depth to aquifer surface measurements

The water levels in this well have been measured daily by an electronic device since September 2011. The peak level was in May 2012 when the Spokane River had high flows from snow melt in Idaho mountains. The lowest levels are in the summer when we have the least precipitation and lowest flows in the Spokane River.



STORM DRAINS & THE AQUIFER

WHAT IS STORMWATER?

Rain and snowmelt are important for healthy wildlife habitat, recreation, and replenishing groundwater supplies in the Spokane Valley - Rathdrum Prairie (SVRP) aquifer.

However, when we replace the natural landscape with rooftops, parking lots, and streets, the water no longer soaks naturally into the ground. Instead, it flows across these hard surfaces as stormwater runoff.

It's important for local governments and businesses to manage runoff as quickly as possible to prevent flooding, erosion, and water pollution. In our region, storm drains are the most commonly used method to handle stormwater runoff, as they can easily be placed in the curb and gutter during road and parking lot construction.

Storm drains can pipe runoff to a variety of places. Check out the photos below to learn about the many different places storm drains lead, including to the SVRP aquifer!

Dear Storm Drain Dan,

The other day I saw my neighbor changing the oil in his car on his driveway. Then, I saw him walk over to a storm drain and pour the oil right into it! I ran over to tell him he probably shouldn't do that but couldn't explain why.

Signed,
To Dump, or Not To Dump?

Dear Not To Dump,

We can't tell where the water from a storm drain goes just by looking at it, but it either empties to a nearby waterbody or directly into the ground.

So, there's a good possibility that your neighbor's motor oil could eventually reach the SVRP Aquifer, and contaminate our drinking water source.

Call your local Stormwater Utility hotline to find out where your storm drain empties, or to report any problems with it. And, remember, only rain down the storm drain!

Sincerely,
Storm Drain Dan

Pollution in Stormwater

Water will carry a bit of everything it touches. Stormwater runoff becomes a really big problem for our rivers, lakes, and aquifer when pollutants from our everyday activities like lawn care, car maintenance, and dog walking are left on the ground for stormwater to wash away.

Other things left in the street can clog storm drains and cause the flooding that the storm drain was meant to prevent.

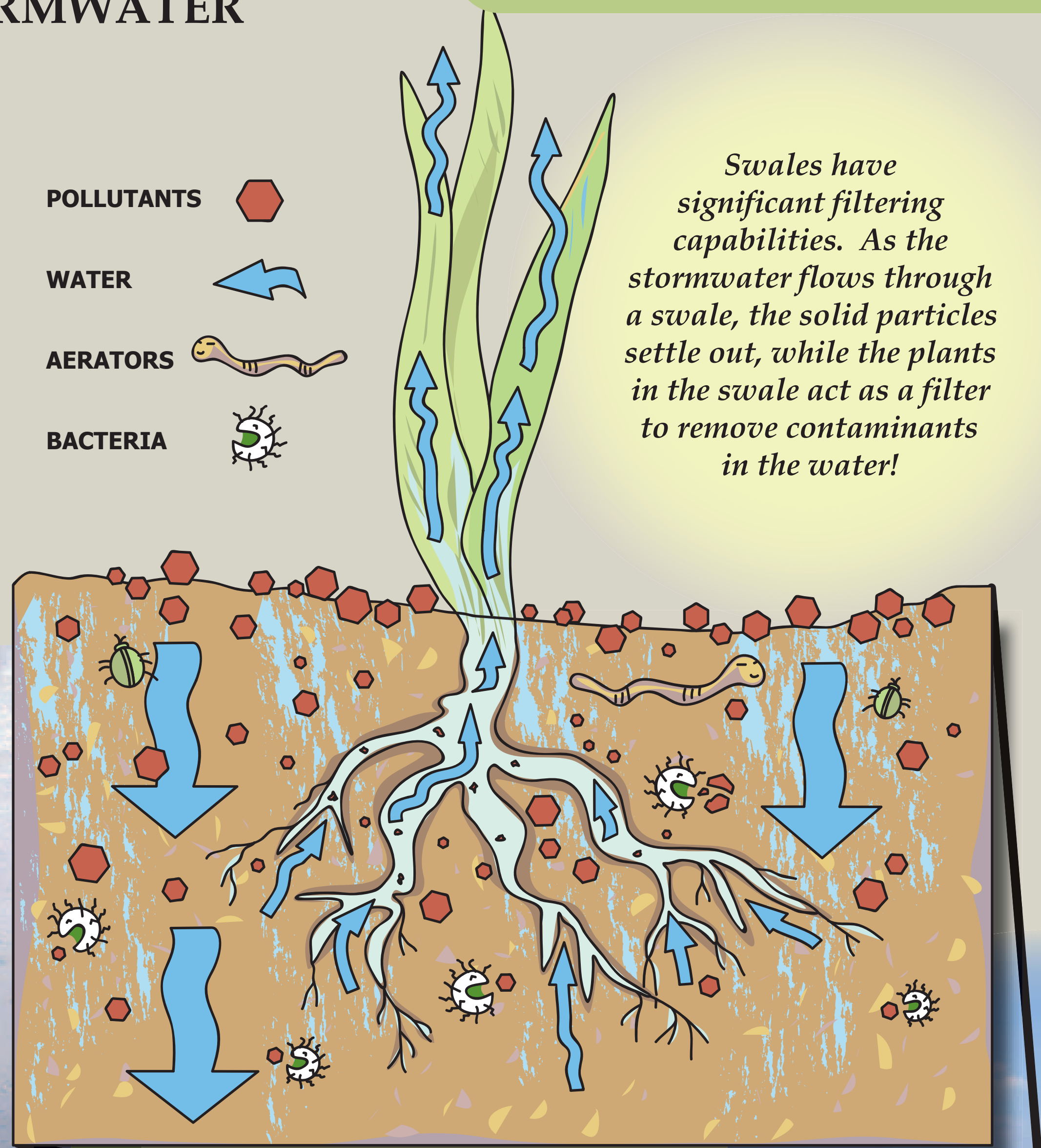
STORMWATER SWALES & THE AQUIFER

SWALES: THE NATURAL WAY TO CAPTURE STORMWATER

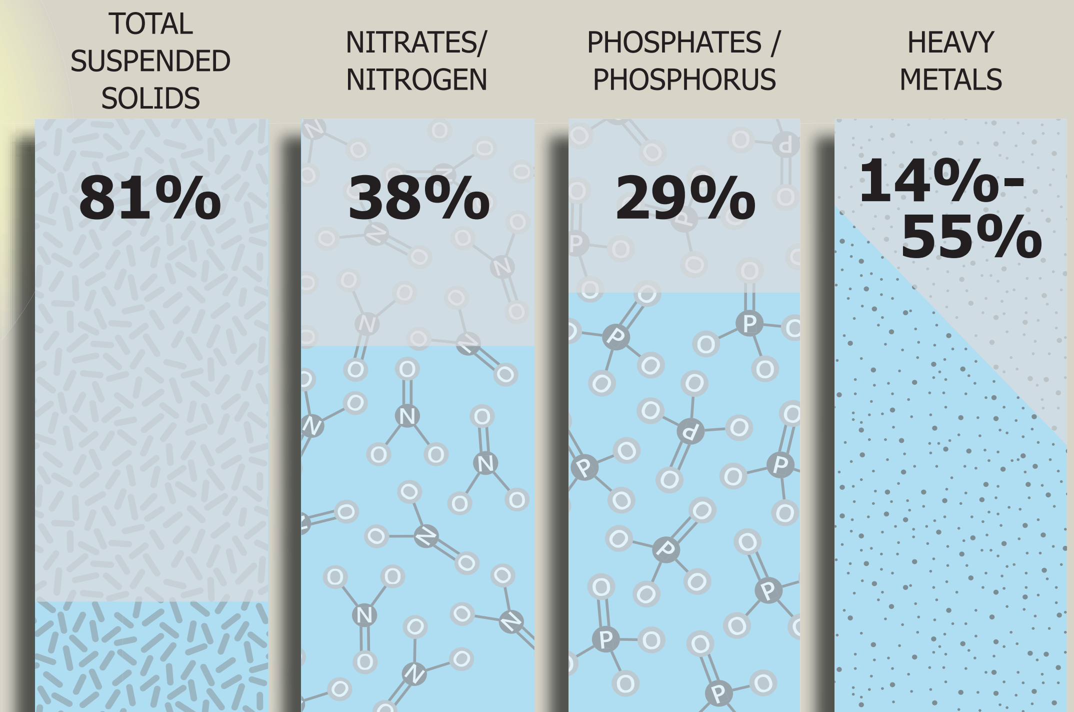
When it rains, the water runs over pavement and other hard surfaces, picking up pollutants along the way. Much of this polluted stormwater runoff historically flowed only to storm drains, which ultimately empties into rivers, lakes, or infiltrates to the SVRP aquifer.

In recent years, local governments have been turning to swales rather than storm drains and drywells to manage runoff. In fact, swales are now the preferred method to handle stormwater runoff!

Swales not only provide for immediate collection of stormwater to reduce flooding, but the ponding of rainfall and snowmelt in the swale allows the water to naturally soak into the ground.



How Much Pollution Can Swales Remove from Stormwater?



Source: EPA NPDES Menu of BMPs - Grassed Swales, 1997

LOW-IMPACT DEVELOPMENT: NATURALLY REDUCING STORMWATER RUNOFF

Low-impact development (LID) preserves and recreates natural landscape features, minimizing hard surfaces and their effects to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. LID techniques can include bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and porous pavement.

Porous pavement prevents stormwater runoff and allows any rain or snowmelt to soak through the pavement itself and into the soil below. Rain barrels store the rain from rooftops to use for watering lawns or other plants. Vegetated rooftops can reduce stormwater runoff and act as insulation. Rain gardens and bioretention facilities function like swales and are planted with native and ornamental grasses, shrubs, and trees to filter stormwater. Rain gardens can easily be installed in your front yard to reduce stormwater runoff. Bioretention facilities are engineered for water quality and flow control.

LID over the SVRP Aquifer

You can spot LID facilities over the SVRP aquifer in many places, inlcuding the Panhandle Health District in Hayden, Coeur d'Alene High School, Broadway Avenue near Maple in Spokane, and Country Homes Boulevard in Spokane County. You can even see rain barrels in residential yards!

THE FOUR IMPORTANT FUNCTIONS OF A SWALE

Adsorption: The pollutants in water attach to the surface of soil particles, where roots and bacteria can use them, or where they just remain indefinitely.

Storage: Roots, insects, and worms increase the space between soil particles, making more room for stormwater storage.

Plant Uptake: Water, nitrogen, phosphorus, and other trace elements are used for plant growth.

Recharge: The excess stormwater (the water not used by the plants) recharges the groundwater supplies in the aquifer via infiltration.

While the inlet could use a bit of weeding, this swale is otherwise well-maintained and free of trash, debris, and sediment.

SWALE MAINTENANCE TIPS FOR HOMEOWNERS

A properly maintained swale can help to keep our aquifer clean. The following list will assist homeowners by ensuring their swale can manage runoff efficiently:

- Mow grassed swales to promote healthy growth.
- Don't replace the grass or plants with rocks.
- Minimize the use of lawn and/or garden chemicals.
- Avoid overwatering; water should pond in the swale only when it rains.
- Remove sediment, litter, branches, leaves, and other debris that accumulates at the inlets so that runoff can flow into the swale.
- Dig up and replace any dead plants or patches of grass.

75 YEARS OF SEWER

The region's wastewater management strategies have developed over the past century in recognition of the need to protect the Spokane Valley – Rathdrum Prairie (SVRP) aquifer and Spokane River.

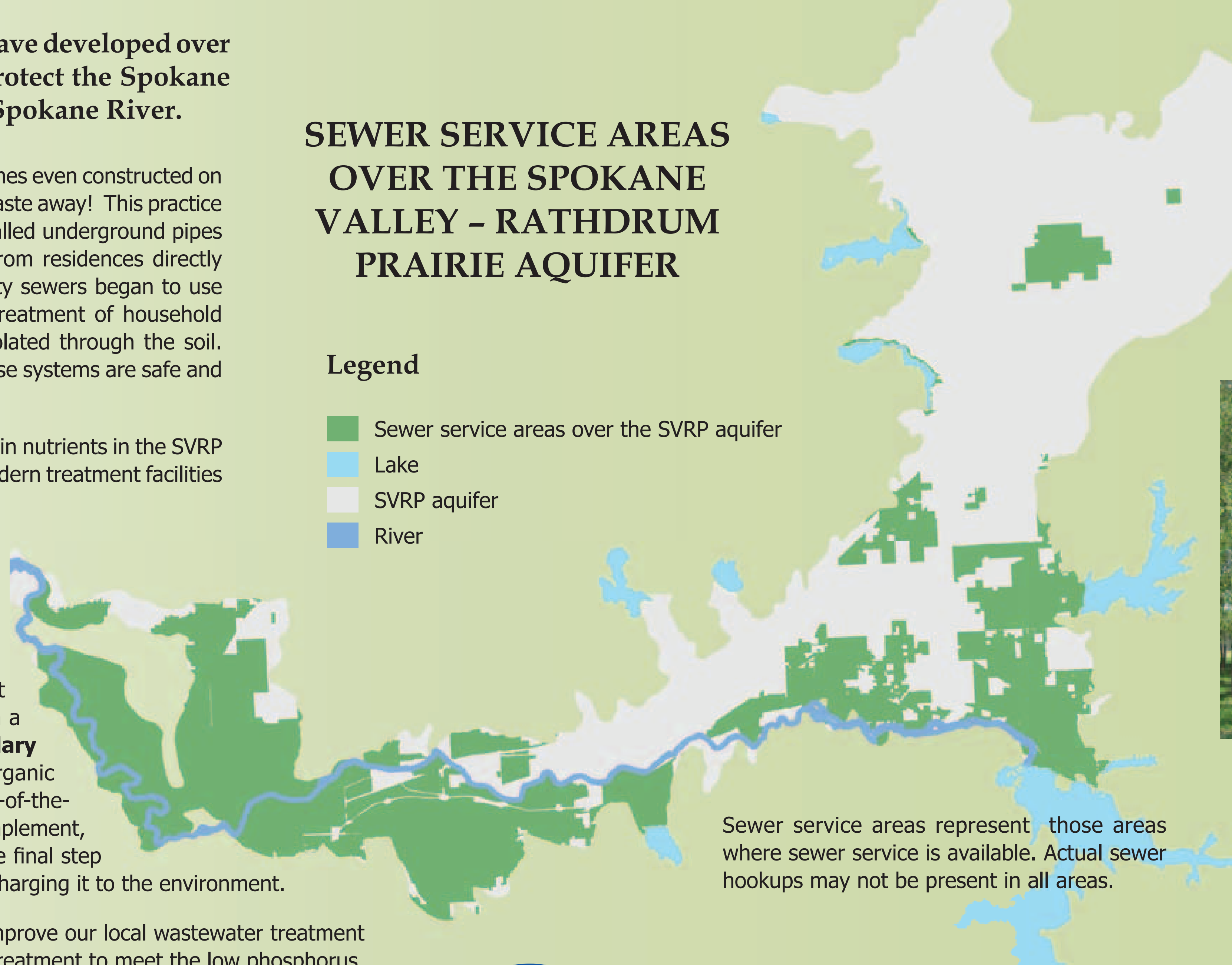
Outhouses were originally used, sometimes even constructed on the nearest creek, to quickly carry the waste away! This practice was common in cities, which later installed underground pipes to carry wastewater and stormwater from residences directly to the river. Areas without access to city sewers began to use septic systems, which allowed some treatment of household wastewater in a septic system it percolated through the soil. Rural areas still use septic systems for wastewater disposal; these systems are safe and efficient when properly built and maintained.

Septic systems in high density population areas led to increases in nutrients in the SVRP aquifer. Over time, local municipalities have built sewers and modern treatment facilities to clean and dispose of wastewater.

The purpose and goal of modern wastewater treatment is to separate waste solids from water, treat the water with biological and chemical processes, and discharge the water as clean as possible to protect the environment. **Primary treatment** allows the largest materials to settle out of the wastestream and oils and grease to float to the top, similar to what happens in a septic tank. The removed solids are processed in a digester and further dewatered before reuse or disposal. **Secondary treatment** then uses biological processes to remove the organic contaminants from the water. **Tertiary treatment** is a state-of-the-art technology that facilities in the region are beginning to implement, and uses microscopic filtration to remove smaller particles. The final step disinfects the water to remove viruses and bacteria before discharging it to the environment.

Local municipalities have invested significantly to continually improve our local wastewater treatment facilities. Local municipalities are now required to use tertiary treatment to meet the low phosphorus, ammonia, and oxygen demand standards intended to increase dissolved oxygen levels and support aquatic life in Lake Spokane.

SEWER SERVICE AREAS OVER THE SPOKANE VALLEY – RATHDRUM PRAIRIE AQUIFER



Sewer service areas represent those areas where sewer service is available. Actual sewer hookups may not be present in all areas.

Recycled Water

Water recycling is a permitted activity that is currently used in Idaho on the Rathdrum Prairie. Wastewater from the cities of Hayden, Hayden Lake, and Spirit Lake along with Farragut State Park and Silverwood Theme Park is treated and used seasonally to irrigate various crops. The most common crops are native forest, alfalfa, and poplar trees. These plants can consume large amounts of water for irrigation and also use the nutrients in the recycled water in place of fertilizer.

The amount of water applied to these crops is restricted to only what the plants need, to limit the amount of recycled water and nutrients that can seep past the roots. How do farmers know how much water to use? Farmers use weather stations in the area along with crop and soil data to predict how much irrigation can be applied. They also monitor the amount of water in the soil and the nutrients in the plants to ensure that the right amount of recycled water is being applied. Special monitoring wells have been completed in the Rathdrum Prairie Aquifer next to the irrigated fields and are regularly tested to ensure there are no water quality impacts.

1939 Coeur d'Alene completed its secondary-level wastewater treatment plant, one of the first of its kind in the world.

1940s Spokane residents were informed of the need for a treatment facility and expanded sewer system. Those in opposition called it "a terrific barrage of propaganda."

1958 Spokane opens its treatment plant, now called the Riverside Park Water Reclamation Facility (RPWRF).

1971 Liberty Lake Sewer and Water District was formed by a vote of the residents. The treatment plant was completed in 1982.

The Clean Water Act was enacted in 1972, mandating secondary wastewater treatment.

1975 Spokane County began sewer construction in Spokane Valley to eliminate septic tanks. In 1980, Spokane City and County agreed to allow up to 10 mgd to flow from this area to the RPWRF.

1977 Panhandle Health District adopted the "5-acre rule" to limit septic system density over the SVRP aquifer.

1985 The Post Falls treatment facility came online, allowing 7,000 people to be removed from septic systems.

1986 Hayden Area Regional Sewer Board (HARSB) formed. HARSB completed its secondary treatment facility by 1992.

2012 Construction is completed on the Spokane County Water Reclamation Facility, which uses state-of-the art tertiary treatment to remove pollutants.

2021 All facilities discharging to the Spokane River must operate tertiary treatment technology to meet current standards.

1940 1950 1960 1970 1980 1990 2000 2010 2020

The illustrations on this page show concentrations of nitrate in the Spokane Valley – Rathdrum Prairie (SVRP) aquifer through time. Under natural conditions in our aquifer, nitrate occurs in low concentrations, typically 1 to 2 parts per million (ppm). Nitrate in drinking water above 10 ppm may cause illness. Septic systems, fertilizer, and stormwater are potential sources of elevated nitrate levels in the SVRP aquifer.

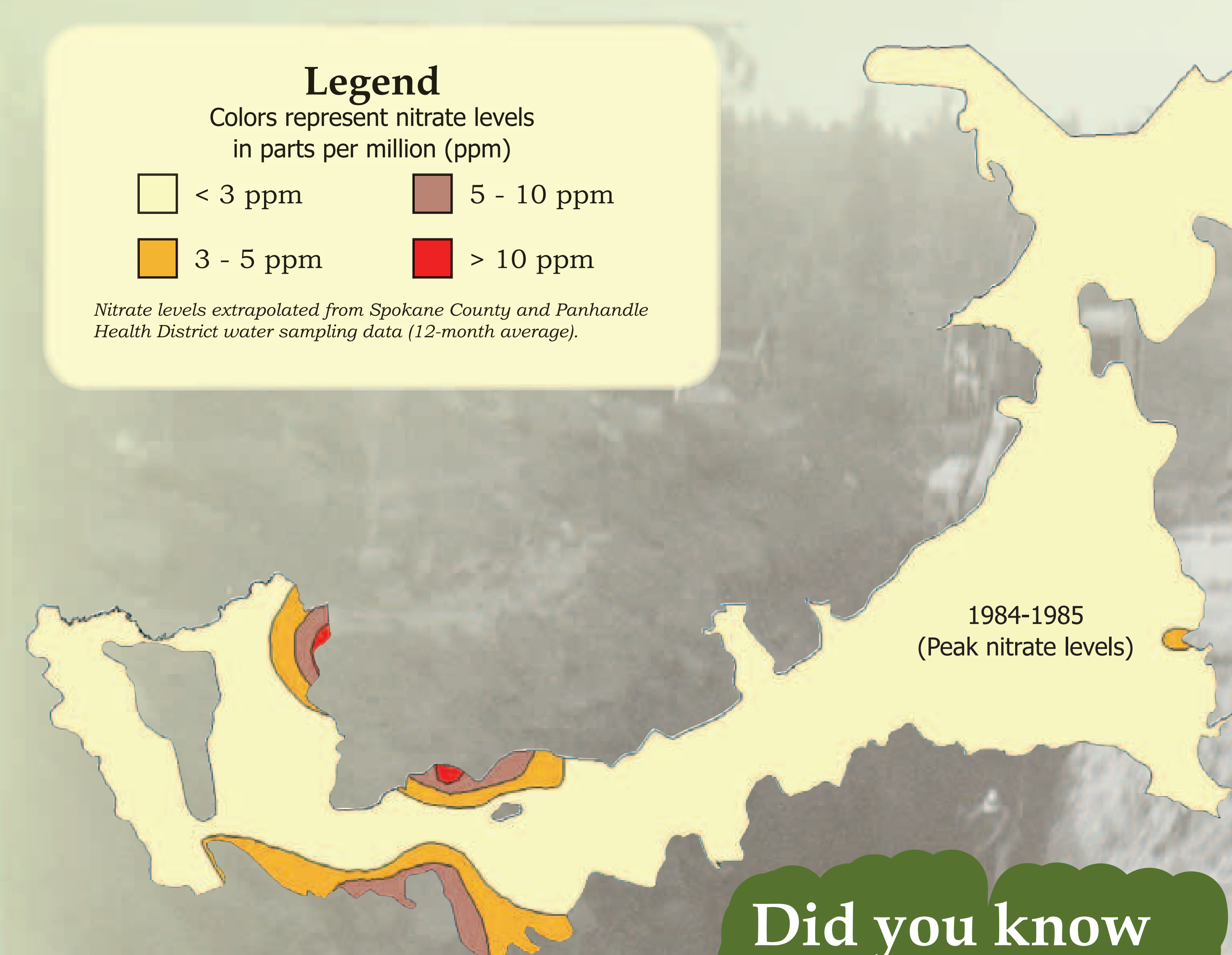
These nitrate concentration maps are from water years 1985 and 2013. In 1985 a major effort on both sides of the state line was initiated to reduce septic system contamination of the SVRP aquifer through installation of piped sewer collection systems. The maps show that on-going SVRP aquifer protection programs have decreased the nitrate contamination despite significant population increases. The main program is installation of sewers. The groundwater in the SVRP aquifer remains some of the best quality water available anywhere.

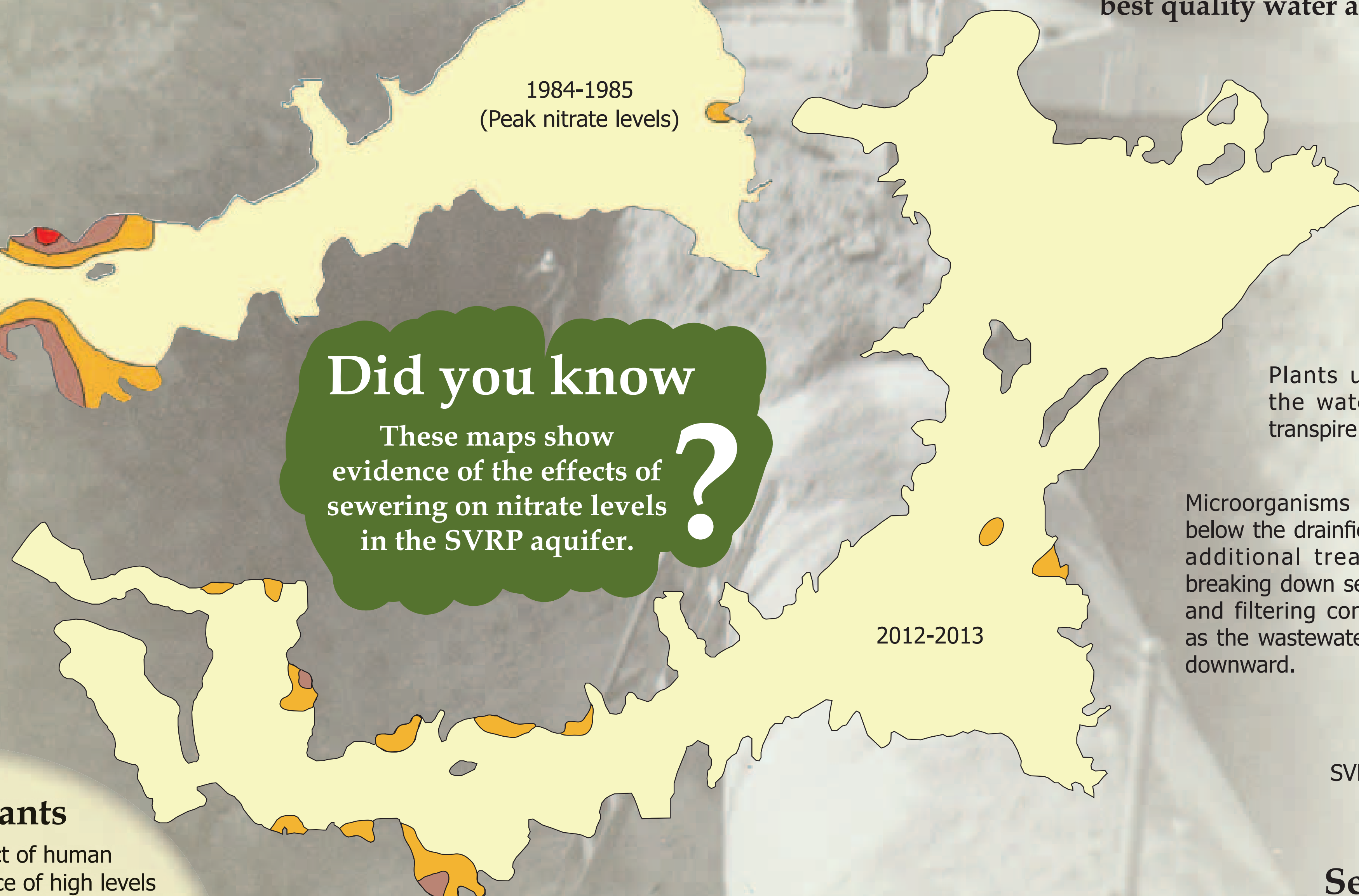
Legend

Colors represent nitrate levels in parts per million (ppm)

- < 3 ppm
- 5 - 10 ppm
- 3 - 5 ppm
- > 10 ppm

Nitrate levels extrapolated from Spokane County and Panhandle Health District water sampling data (12-month average).



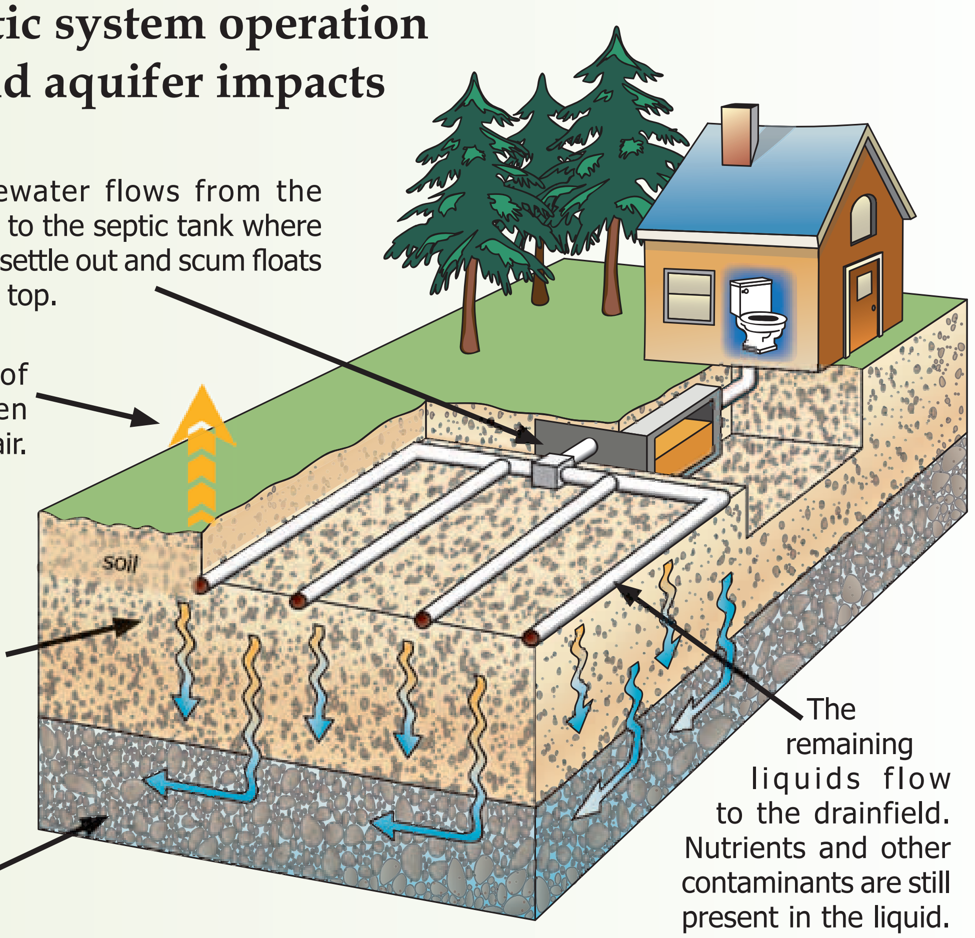


Did you know

These maps show evidence of the effects of sewering on nitrate levels in the SVRP aquifer.

Note: The latest aquifer boundary is slightly different than previous versions because it reflects minor adjustments resulting from the 2007 Bi-State Aquifer Study.

Septic system operation and aquifer impacts



Contaminants

Nitrate is a by-product of human activities, and the presence of high levels of nitrate in groundwater is an indicator that other by-products of human activity may also be present. Other possible contaminants include phosphorous, petroleum products, heavy metals, and industrial chemicals. Traces of some of these other contaminants have occasionally been found in local aquifer wells. On-going monitoring and protection programs are essential to protect the high quality of aquifer water.

Septic System Maintenance

- Be cautious about chemical or biological additives. Research has shown that additives provide little to no benefit.
- Inspect your system annually to measure sludge and scum levels.
- Pump your septic tank every 3 to 5 years based on results of annual inspections.
- Keep a grass cover over the drainfield to help use some of the available nutrients and aid in evapotranspiration.
- Keep trees from growing over the drainfield. Roots from the trees can plug or damage the lines.

For more information, see the Lake*A*Syst Manual in Idaho or the Spokane Regional Health District website in Washington.

Background picture: 1961 installation of City of Spokane treatment plant bypass pipe.

AQUIFER PROTECTION – BUSINESS

We are fortunate to have many types of businesses in our area including aerospace; agriculture; vehicle maintenance and fueling; machining; manufacturing; metal fabrication; surface mining/ concrete and asphalt; and heavy equipment manufacturing and maintenance. Unfortunately, all these businesses present a potential risk to groundwater when they store and use chemicals.

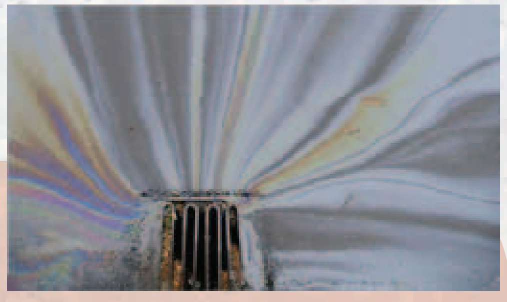
RISKS

Did you know? There are tens of millions of gallons of chemicals stored over our SVRP aquifer.

Sometimes chemicals are intentionally applied to the ground for our benefit. They may present a risk especially if unintentionally released, misapplied, or overused.

Storage containers may leak or their contents can be displaced by stormwater if left unprotected outside.

Underground storage tanks can leak and their contents can end up in the SVRP aquifer.



Precipitation can carry contaminants into storm drains that discharge into the SVRP aquifer or into our lakes and rivers.

Transferring chemicals between containers or to a vehicle presents a risk of a spill and release to the ground.

Wastewater from washing vehicles, commercial carpet cleaning, metal plating, and numerous other manufacturing and industrial processes can pollute our water if it is not disposed of properly.

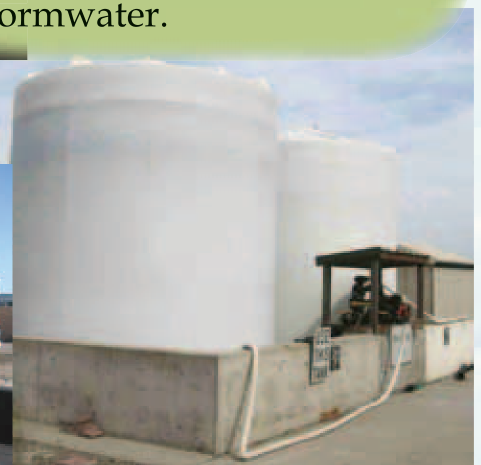
Stormwater can enter open dumpsters, contact garbage, and leak the polluted water to storm drains.

AQUIFER PROTECTION – BUSINESS

CHEMICAL STORAGE & HANDLING

Store chemicals and hazardous waste in secondary containment to keep spills from spreading and moving. Chemicals stored outside should be covered to keep out stormwater.

Plastic containment for drums



Concrete containment

Poly-geotextile containment

SOLUTIONS - Best Management Practices at Businesses

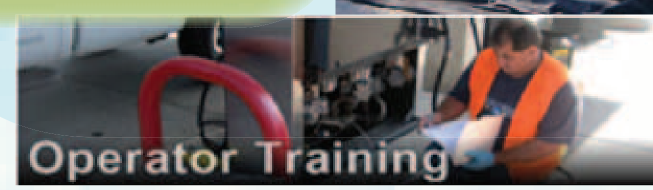
To minimize risk, businesses are asked (or required) to implement best management practices (BMPs). BMPs are methods using current knowledge and technology to provide the best acceptable control and/or treatment of the three main sources of contamination: chemical storage and handling; process wastewater; and contaminated stormwater.

UNDERGROUND STORAGE TANKS

Underground storage tanks (USTs) are used to store petroleum or other hazardous liquids. There are nearly 300 active UST sites, often with multiple tanks at each site, operating over the Spokane Valley – Rathdrum Prairie aquifer that are regulated by state UST programs.

Every UST facility must be inspected at least once every 3 years.

All owners and operators of USTs are required to complete training in how to properly identify, operate, and maintain UST components.

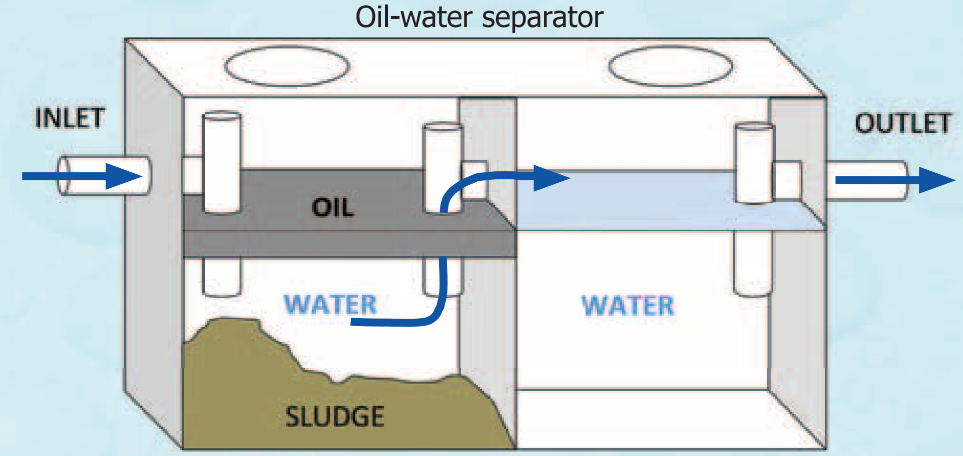


STORMWATER

Rain and snow can mix with contaminants at industrial sites. The contaminants can come from historical practices or from current storage and handling. The most common way stormwater becomes contaminated is at fueling sites where drips, overfills, and drive-offs are common.

All contaminated stormwater at fueling businesses must be collected on a concrete pad and passed to a drain then through an oil-water separator.

Oil-water separator



Oil-water separators work because fluids, such as oils and fuels, which are less dense than water, float and remain in the first chamber, the heavy sludge sinks to the bottom where it can be removed and disposed of properly. Oil-water separators must be cleaned regularly to remain effective.

PROCESS WASTEWATER

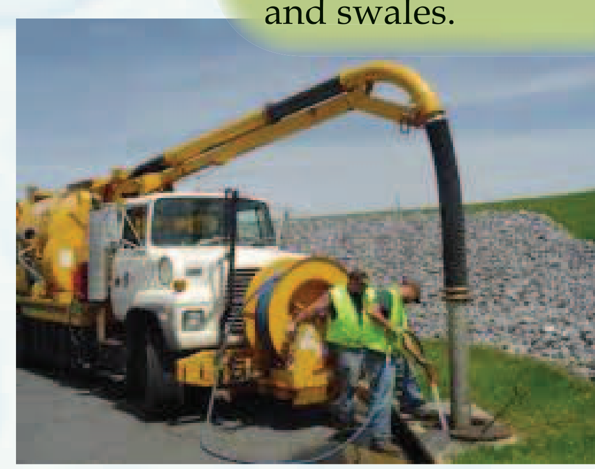
Commercial wastewater must be discharged to a public sewer when permitted and possible. When that is not possible, the wastewater must be contained on site and evaporated (if permitted) or hauled to an acceptable waste disposal site.

Wastewater retention pit with mechanical evaporator

Passive wastewater evaporation pond

Have a spill plan and spill clean-up materials ready at all times.

Regularly inspect, maintain, and clean drywells in parking lots and swales.



Sweep parking lots, work areas and streets instead of washing them to a storm drain.

AQUIFER PROTECTION – HOME

Use safe housekeeping practices when storing, handling, and disposing of harmful materials, including automotive fluids, cleaning products, fertilizers and pesticides, fluorescent lights, medications, paint, and swimming pool or hot tub chemicals.

Household Hazardous Waste

Many products that we use every day contain hazardous materials that can be dangerous to people, water, and the environment!

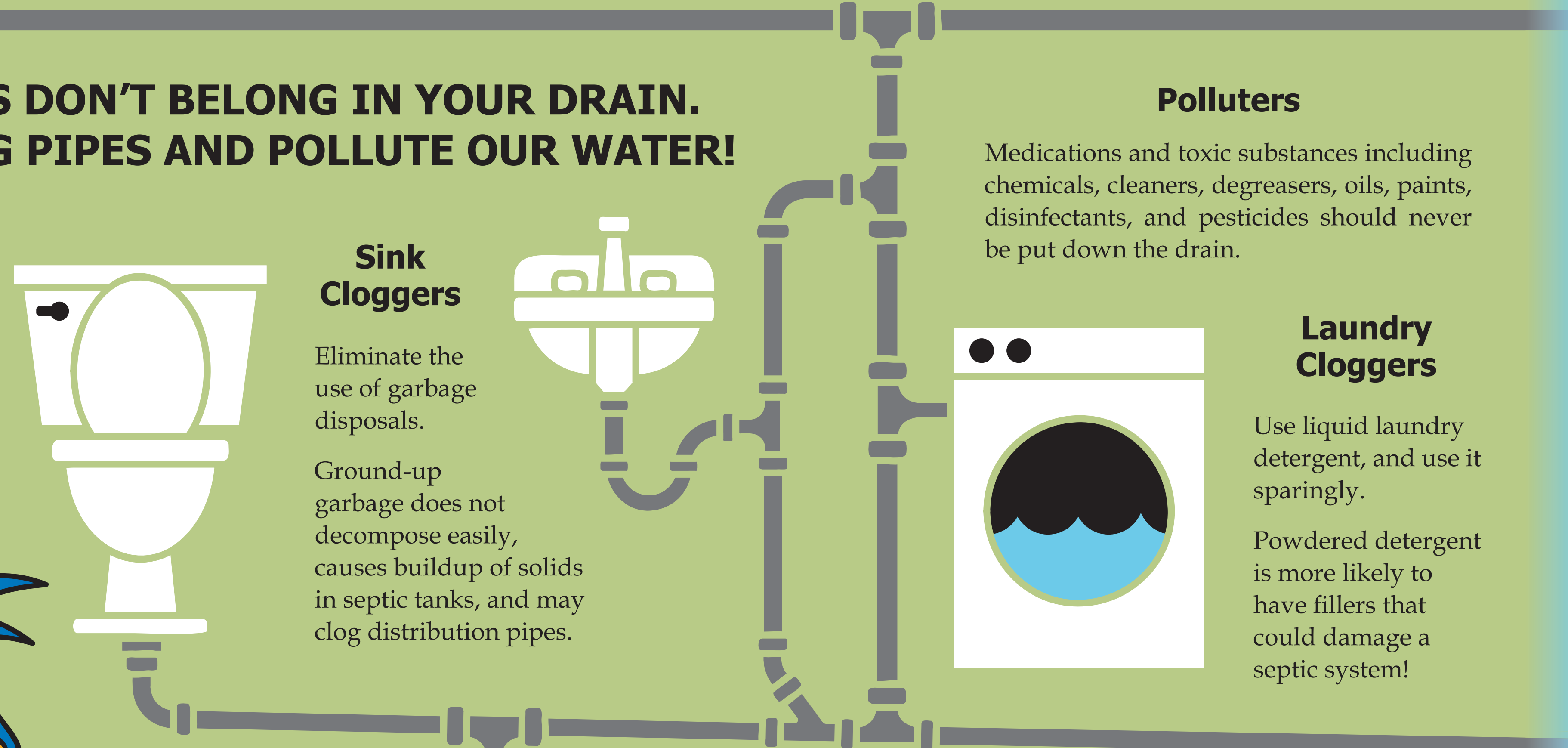
WHAT TO DO

- Use products that are non-toxic and environmentally friendly.
- Read and follow directions carefully when using any hazardous product.
- Store products in their original containers and label them clearly.
- Store products above basement flood level, and off the ground in garages and sheds.

WHAT NOT TO DO

- ✖ Don't throw toxic substances or their containers in the trash.
- ✖ Never pour leftover products down sink drains or into the toilet.
- ✖ Never mix leftover products.
- ✖ Do not dispose of household hazardous waste in streams, rivers, or lakes.
- ✖ Do not dump toxics into storm drains.

SOME THINGS DON'T BELONG IN YOUR DRAIN. THEY CAN CLOG PIPES AND POLLUTE OUR WATER!



Toilet Cloggers

Household drains and toilets are designed to take only used water, human waste, and toilet paper.

Many products, like wipes, claim to be "flushable." But that doesn't mean these items are treatable in the wastewater system!

Sink Cloggers

Eliminate the use of garbage disposals.

Ground-up garbage does not decompose easily, causes buildup of solids in septic tanks, and may clog distribution pipes.

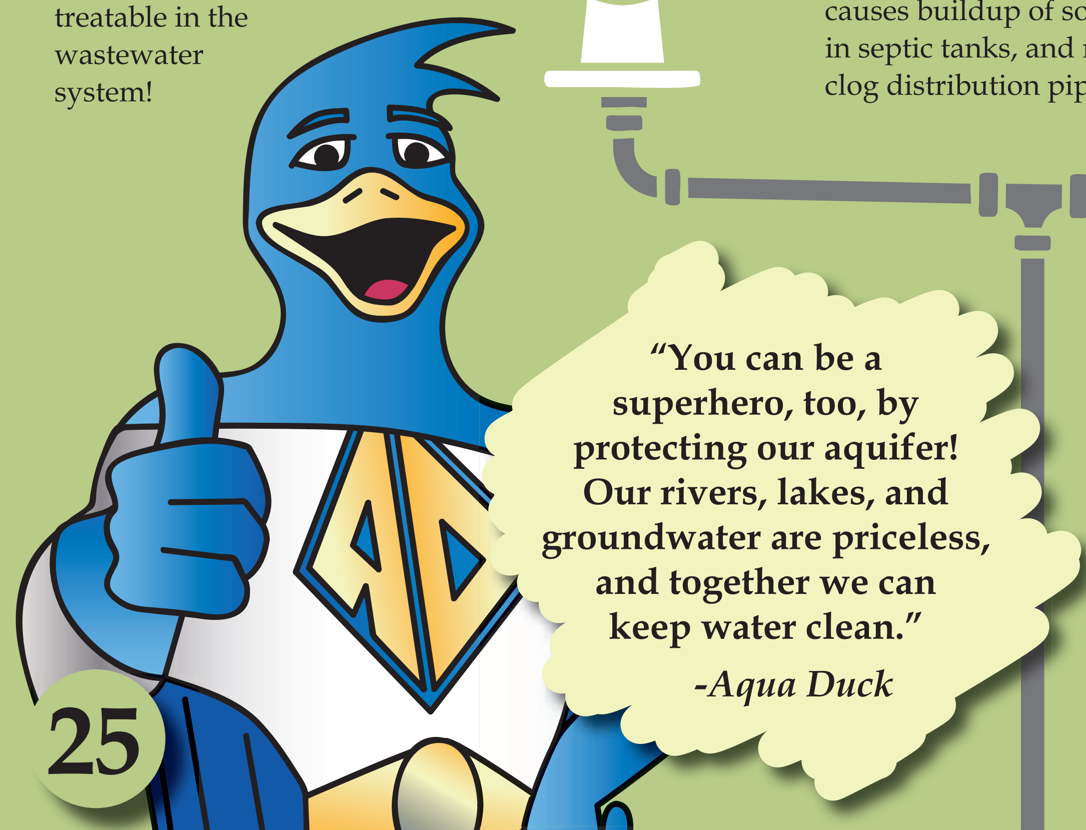
Polluters

Medications and toxic substances including chemicals, cleaners, degreasers, oils, paints, disinfectants, and pesticides should never be put down the drain.

Laundry Cloggers

Use liquid laundry detergent, and use it sparingly.

Powdered detergent is more likely to have fillers that could damage a septic system!



"You can be a superhero, too, by protecting our aquifer! Our rivers, lakes, and groundwater are priceless, and together we can keep water clean."

-Aqua Duck

Remember, what goes down the drain doesn't just disappear, it ends up in our water! The following list of items should never be poured down the drain or flushed in the toilet:

✖ Baby wipes	✖ Coffee grounds	✖ Food	✖ Nursing pads
✖ Band-aids	✖ Condoms	✖ Grease	✖ Paper towels
✖ Bandages	✖ Cotton balls	✖ Hair	✖ Plastic bags
✖ Chemicals	✖ Dental floss	✖ Kitty litter	✖ Q-tips
✖ Chewing gum	✖ Diapers	✖ Kleenex	✖ Rags
✖ Cigarette butts	✖ Eggshells	✖ Medications	✖ Vitamins
✖ Cleaning wipes	✖ Feminine products	✖ Napkins	✖ Wrappers

11 WAYS to conserve WATER *in the* HOME

1. Shorten shower times, and choose showers over baths.
   A full bathtub requires 70 gallons of water, while a 10-minute shower uses 25 gallons!
2. Only wash full loads in the dishwasher.
3. Only wash full loads of clothes, and use a front-loading washing machine and suds savers to save water.
4. Use a stopper in the sink if washing dishes by hand.
5. Use a broom, not a hose, to clean driveways and sidewalks.
6. Know where the water shut-off valve is in your home.
7. Repair leaky pipes, running toilets, and dripping faucets ASAP.
   Faucets that drip once per second waste over 3,000 gallons a year!
8. Keep a pitcher of water in the fridge rather than letting the water run in the sink until it turns cold.
9. Install aerators and flow reducers in sinks and bath faucets.
10. Replace old appliances and fixtures with energy-efficient models. Look for the EPA Water Sense and Energy Star Logos!
11. Convert older toilets to low-flow with a displacement device.

LET'S PULL THE PLUG ON E-WASTE!

WHAT IS E-WASTE?

E-waste consists of all discarded, surplus, obsolete, and broken household or business electronic devices and electric appliances.

A typical 17-inch computer contains roughly 2.2 pounds of lead. Lead is a toxic substance that may cause lead poisoning!

WHY IS E-WASTE A PROBLEM?

Printers, computers, televisions, and cell phones contain toxic heavy metals such as cadmium, lead, mercury, and chromium.

Disposing of electronic items in the garbage means these toxins could be released into the environment through landfill leachate or incinerator ash.

E-WASTE LEACHATE & THE AQUIFER

As rainwater flows through a landfill, it dissolves many of the toxic compounds found in e-waste.

The contaminated landfill water, called leachate, eventually escapes the many layers of landfill liner. When the leachate reaches groundwater, it can be lethal to humans. For the SVRP aquifer, this could threaten the drinking water for over 500,000 people.

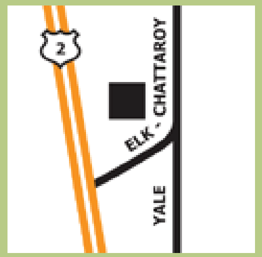
SPOKANE COUNTY WASTE DISPOSAL SITES

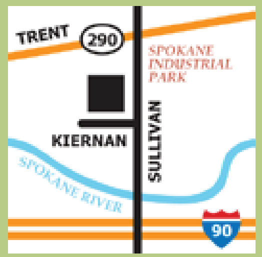
Office - 509.477.3604 **Hotline - 509.477.6800**

Regional facilities in Spokane County accept trash, recyclables, organics and yard waste, household hazardous waste, construction and demolition waste, and appliances.

Waste to Energy Facility
2900 S. Geiger Boulevard
Spokane, WA 99224

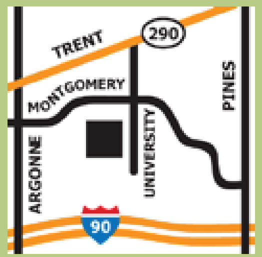
North County Transfer Station
22123 N. Elk-Chattaroy Road
Colbert, WA 99005





Valley Transfer Station
3941 N. Sullivan Road
Spokane Valley, WA 99216

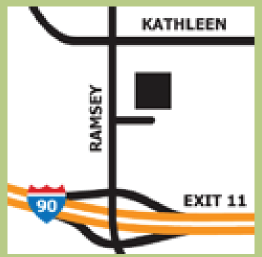
University Transfer Station
2405 N. University Road
Spokane Valley, WA 99206
Office - 509.924.5678



KOOTENAI COUNTY WASTE DISPOSAL SITES

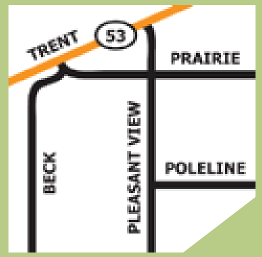
Office - 208.446.1430 **Hotline - 208.446.1433**

Kootenai County provides two, full-service transfer stations. The transfer stations are open to the general public and waste-hauling companies.



Ramsey Transfer Station
3650 N. Ramsey Road
Coeur d'Alene, ID 83815

Prairie Transfer Station
15580 W. Prairie Avenue
Post Falls, ID 83854



NOTE: All waste disposal facilities in Kootenai and Spokane Counties are closed on the following holidays: New Year's Day, Memorial Day, 4th of July, Labor Day, Thanksgiving Day, and Christmas Day.

For information regarding solid waste collection facilities within Bonner County, visit:
bonnercounty.us/solid-waste

ELECTRONIC WASTE BREAKDOWN IN THE UNITED STATES

56%	Televisions	10%	Business Electronics	6%	Household Electronics
18%	Electronics Packaging	6%	Monitors	4%	PCs

ACCORDING TO RESEARCH, E-WASTE IS GROWING AT 3X THE RATE OF OTHER MUNICIPAL WASTE!

LOCAL RESOURCES FOR WASTE MANAGEMENT

Coeur d'Alene Lake*A*Syst
www.ourgem.org/documents/landowners/hazardouswastes.pdf

Idaho Department of Environmental Quality
www.deq.idaho.gov/media/1074/deq-recycling-guide.pdf

Panhandle Health District
www.phd1.idaho.gov

Spokane County Regional Solid Waste System
www.spokanecounty.org/utilities/solidwaste

EnviroStars Waste Directory
www.spokanewastedirectory.org

Kootenai County Solid Waste
www.kcgov.us/departments/solidwaste

Spokane City Solid Waste
www.spokanecitysolidwaste.com

City of Spokane Valley
www.spokanevalley.org/solidwaste

STATE AND FEDERAL RESOURCES FOR WASTE MANAGEMENT

IDAHO

The Idaho Department of Environmental Quality provides information on household hazardous waste and pollution prevention, and offers regulatory and technical assitance.

To visit their website, go to:
www.deq.idaho.gov

WASHINGTON

Households, small businesses, school districts, small governments, and charities can recycle products free of charge through E-Cycle Washington.

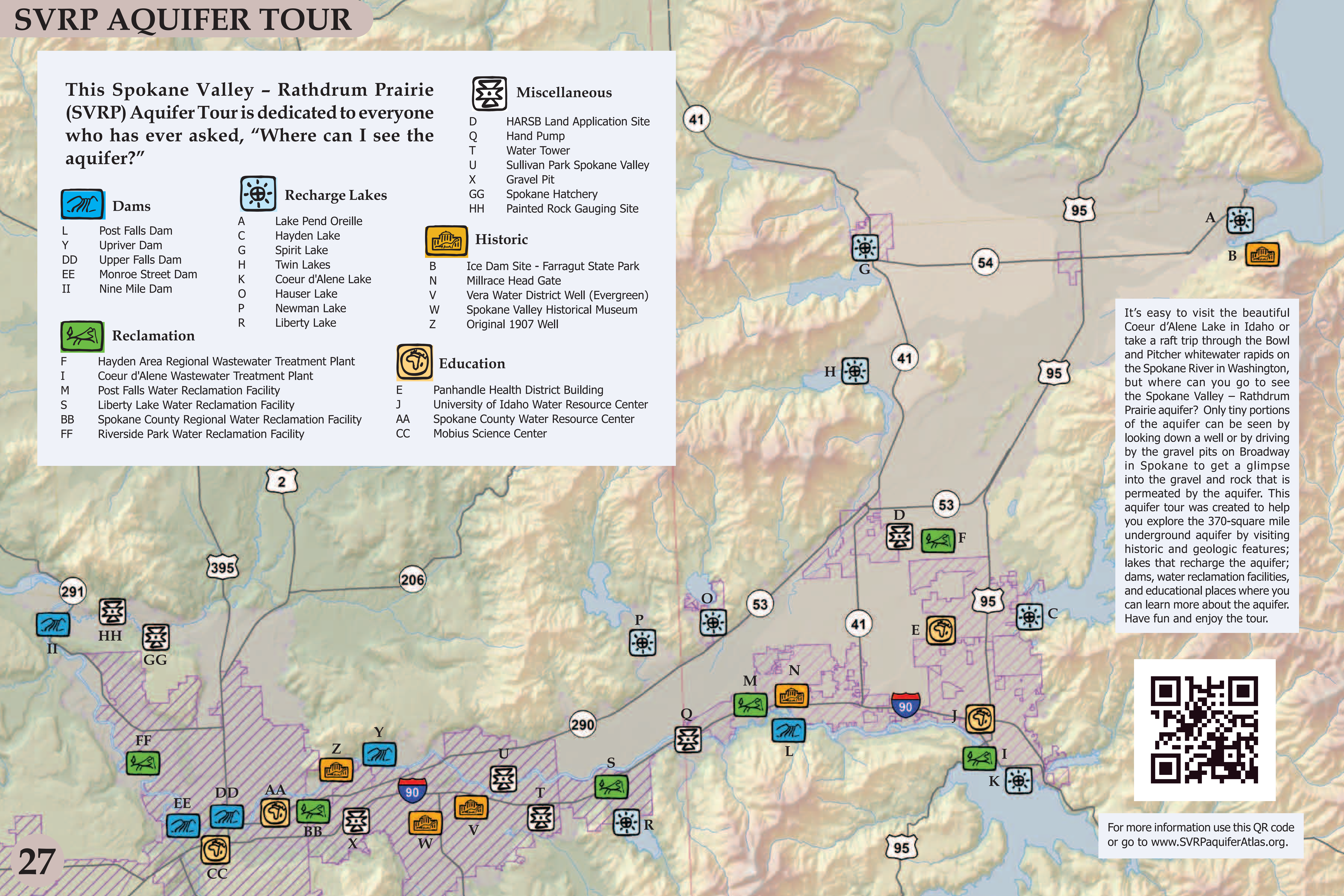
To find electronic recycling services in your area, call 1-800-RECYCLE or visit:
1800recycle.wa.gov

U.S. ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency offers information on proper waste disposal, household hazardous waste, and recycling.

For more details about computers and their impact on landfills, visit:
www.epa.gov/waste

SVRP AQUIFER TOUR



This Spokane Valley – Rathdrum Prairie (SVRP) Aquifer Tour is dedicated to everyone who has ever asked, "Where can I see the aquifer?"

Dams

L	Post Falls Dam
Y	Upriver Dam
DD	Upper Falls Dam
EE	Monroe Street Dam
II	Nine Mile Dam

Recharge Lakes

A	Lake Pend Oreille
C	Hayden Lake
G	Spirit Lake
H	Twin Lakes
K	Coeur d'Alene Lake
O	Hauser Lake
P	Newman Lake
R	Liberty Lake

Reclamation

F	Hayden Area Regional Wastewater Treatment Plant
I	Coeur d'Alene Wastewater Treatment Plant
M	Post Falls Water Reclamation Facility
S	Liberty Lake Water Reclamation Facility
BB	Spokane County Regional Water Reclamation Facility
FF	Riverside Park Water Reclamation Facility

Miscellaneous

D	HARSB Land Application Site
Q	Hand Pump
T	Water Tower
U	Sullivan Park Spokane Valley
X	Gravel Pit
GG	Spokane Hatchery
HH	Painted Rock Gauging Site

Historic

B	Ice Dam Site - Farragut State Park
N	Millrace Head Gate
V	Vera Water District Well (Evergreen)
W	Spokane Valley Historical Museum
Z	Original 1907 Well

Education

E	Panhandle Health District Building
J	University of Idaho Water Resource Center
AA	Spokane County Water Resource Center
CC	Mobius Science Center

It's easy to visit the beautiful Coeur d'Alene Lake in Idaho or take a raft trip through the Bowl and Pitcher whitewater rapids on the Spokane River in Washington, but where can you go to see the Spokane Valley – Rathdrum Prairie aquifer? Only tiny portions of the aquifer can be seen by looking down a well or by driving by the gravel pits on Broadway in Spokane to get a glimpse into the gravel and rock that is permeated by the aquifer. This aquifer tour was created to help you explore the 370-square mile underground aquifer by visiting historic and geologic features; lakes that recharge the aquifer; dams, water reclamation facilities, and educational places where you can learn more about the aquifer. Have fun and enjoy the tour.

For more information use this QR code or go to www.SVRPaquiferAtlas.org.

2015 SVRP Aquifer Atlas Edition Team

Reanette Boese - SC
Gary Stevens - IDEQ
Amanda Hess - SC
Jeremy Jenkins - LLSWD
Rick Barlow - PHD
Aaron Clary - CoSV
John Covert - WDOE
Jim Ekins - UI
Mike Galante - IWAC
Tonilee Hanson - SAJB
Laura Laumatia - CdAT
Mike LaScuola - SRHD
Rob Lindsay - SC
Sandy Phillips - SRHD
Lynn Schmidt - CoS

Acronyms

CdAT	Coeur d'Alene Tribe of Indians
CoS	City of Spokane
CoSV	City of Spokane Valley
EPA	US Environmental Protection Agency
EWU	Eastern Washington University
HARSB	Hayden Area Regional Sewer Board
IDEQ	Idaho Dept. of Environmental Quality
IWAC	Idaho Washington Aquifer Collaborative
LLSWD	Liberty Lake Sewer and Water District
PHD	Panhandle Health District
SC	Spokane County
SAJB	Spokane Aquifer Joint Board
SRHD	Spokane Regional Health District
USGS	US Geologic Survey
UI	University of Idaho Extension
WDOE	Washington Department of Ecology

In Appreciation

This is the first version of the Spokane Valley – Rathdrum Prairie Aquifer Atlas without James D. MacInnis, P.E. taking the lead and doing the major portion of the work on design, layout, and text. It is also the first version without Beatrice B. Lackaff creating all the maps. Several photos taken by them are included in this edition as a way to continue their involvement. Thanks to both of them for all their hard work in the past.

FOR MORE INFORMATION

The Spokane Valley – Rathdrum Prairie (SVRP) Aquifer Atlas 2015 Edition is online at: www.SVRPaquiferAtlas.org. The QR code at the left will also take you to the website.

This website has links for all the agencies involved in creating this atlas and the following topics:

- Geology
- Ice Age Floods
- Hydrogeology
- Water Use
- Water Companies
- Sewers & Septic Systems
- Stormwater
- SVRP Aquifer Monitoring
- Business Best Management Practices

RESOURCE GUIDE FOR EDUCATORS AND PARENTS

This is a stand-alone publication that provides lesson plans, activities, student projects, and other educational resources related to the SVRP aquifer. These are tied to ID/WA core educational standards. It is available for free download as a PDF document at www.SVRPaquiferAtlas.org. The guide uses the SVRP Aquifer Atlas for lessons in science, technology, engineering, math (STEM), and other areas.

Printing Sponsors

These organizations provided funds to print this SVRP Aquifer Atlas Edition.

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Spokane Aquifer Joint Board

City of Spokane

Spokane Regional Health District

Department of Ecology, State of Washington

Spokane County

Other printing sponsor:

Idaho Water Resources Research Institute

2015 SVRP Aquifer Atlas Edition printed by National Color Graphics, Spokane, WA

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Page 8: 2004 photo=Jim MacInnis from Arbor Crest Winery; Timeline data=Atlas Team; Rathdrum Prairie, Ca 1952=Museum of North Idaho, Coeur d'Alene, ID; Expo '74 photo=Washington State Archives, Eastern Region Branch, City of Spokane Planning Department EXPO'74 Photograph Collection; Stateline aerial photo=Paul Hsieh, USGS; Rathdrum Prairie photo, 2008=Bea Lackaff; Post Falls dam photo=Avista; Rathdrum Prairie from Mt Spokane photo=Reanette Boese. Vera photo=Vera Water and Power; lead=Reanette Boese.

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Page 10: Graphics=Reanette Boese; Corbin Ditch photo= Museum of North Idaho, Coeur d'Alene, ID; Irrigation ditches & Wooden flume photos= Modern Electric Water Company; Irrigation pipes photo=Northwest Museum of Arts & Culture/Eastern Washington State Historical Society, Spokane, Washington, L87-1. 2105-08; Upriver well construction photo=CofS; Crop circle satellite photo=Conerstonemapping.com; Lead =Jeremy Jenkins

Page 11: Conceptual cross-section=USGS SIR 2007-5041, Figure 6; SVRP ground water flow map=USGS SIR 2007-5044, Figure 22; Recharge and precipitation graph=created from information in USGS SIR 2007-5036; Precipitation map=USGS SIR 2005-5227, Figure 3; lead=Gary Stevens.

Page 12: River and aquifer graph=Gary Stevens from USGS SIR 2007-5044; River gaining and losing reaches graphics=Amanda Hess, modified from USGS Circular 1376; Spokane River gaining/losing reaches graph=Gary Stevens; Spokane River gaining/losing reaches map=modified from USGS SIR 2005-5227, figure 8; gaining reach photo=John Covert; losing reach photo=John Patrouch; lead=Gary Stevens.

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Page 16: Spokane County map=Spokane County Water Demand Forecast Model Report, 2011, Figure 14; Rathdrum Prairie map=based on Rathdrum Prairie Aquifer Water Demand Projections, 2010, Figure 2; Spokane County water use projection graph=Spokane County Water Demand Forecast Model Report, 2011, Figure 15; Idaho Camp water use projections graph=Rathdrum Prairie Aquifer Water Demand Projections, 2010, Table 29; lead=Reanette Boese.

Page 17: Map=Reanette Boese; sampling photo=Misha Van Mansum; lead=Reanette Boese and Gary Stevens.

Page 18: Deicing truck photo=Rachel Wolfson blog; Lake Spokane photo=WDOE; Washington chloride graph data=SC; Idaho chloride graph data=PHD; Idaho well graph data=USGS well ID 475439116503401; Washington well graph data=USGS well ID 474011117072901; monitoring well graphic=modified from Amanda Hess; lead=Reanette Boese.

Page 19: Flooded street photo=YouTube video by Dimka9698; Erosion photo=Spokane County Stormwater Utility; Spokane River photo=City of Spokane; Lake photo=City of Coeur d'Alene; storm drain photo=City of Wilmington; treatment plant photo=City of Spokane; storm drain and drywell graphic=Amanda Hess; swale photo=Reanette Boese; Storm Drain Dan graphic=Amanda Hess; clean out photo=www.treesonsanpedrostproject.com; pollution graphic=Amanda Hess; lead=Amanda Hess, Lynn Schmidt, and Aaron Clary.

Page 20: Rain garden photo=City of Spokane; graphics=Amanda Hess; pollution removal graphic=Amanda Hess from EPA NPDES, 1997; grassed swale photo=Spokane County Stormwater; lead=Amanda Hess, Lynn Schmidt, and Aaron Clary.

Page 21: Outhouse photo=unknown; Sewer service areas map=Lynn Schmidt; tree photo=Wisconsin DNR; 1958 Spokane treatment plant construction photo=City of Spokane archives; 1982 Liberty Lake treatment plant photo=Liberty Lake Sewer and Water District; EPA logo=from EPA website; HARSB photo=HARSB website; Spokane County facility=Spokane County; lead=Lynn Schmidt and Rob Lindsay.

Page 22: Nitrate 1984-1985 graphic=Jim MacInnis, 2009 SVRP Aquifer Atlas; Nitrate 2012-2013 graphic=Lynn Schmidt; Septic system graphic=Amanda Hess; 1961 City of Spokane pipe photo=City of Spokane archives; lead=Lynn Schmidt and Rob Lindsay.

Page 23: Deicing truck photo=City of Spokane; fertilizer truck photo=Wikimedia Commons; dumpster photo=Sandy Phillips; drums photos=PHD; UST and backhoe photo=WDOE website; Leaking UST=Montana DEQ ; Chemical transfer photos=PHD; Stormwater photo=PHD; Oil slick photo=CoS website; Carpet cleaning van photo=WDOE; Fuel island and vehicle washing photos=PHD; lead=Rick Barlow and Sandy Phillips.

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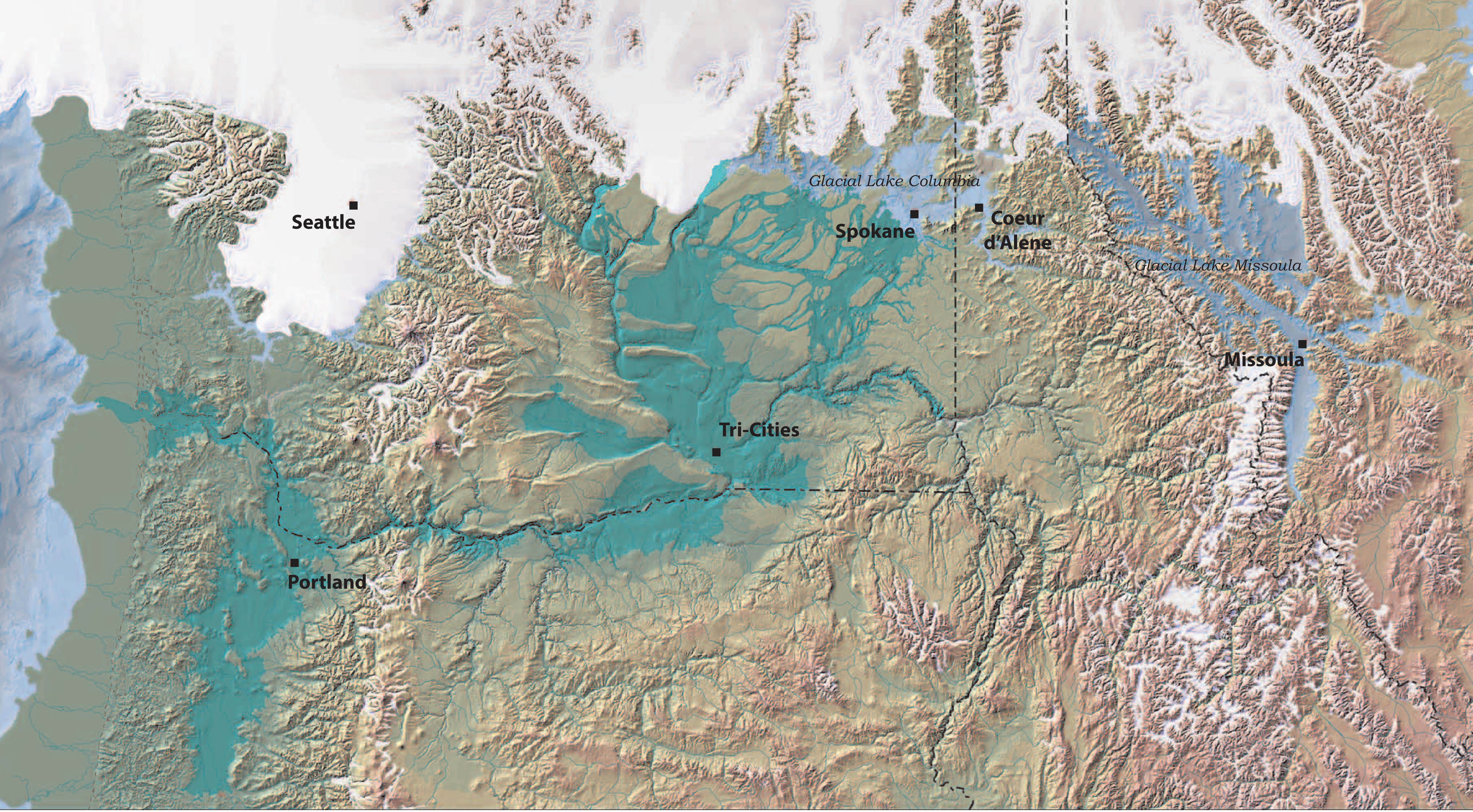
Page 25: Graphics=Amanda Hess; WaterSense and Energy Star logos=EPA; Aqua Duck=SAJB; lead=Tonilee Hanson and Laura Laumatia.

Page 26: Graphics=Amanda Hess; Recycle Man=Spokane Indians Baseball Team ; lead=Tonilee Hanson and Laura Laumatia.

Page 27: Map=Reanette Boese; lead=Aaron Clary and Tonilee Hanson.

Back cover: Image Jeff Silkwood's US Forest Service poster, "Glacial Lake Missoula and the Channeled Scablands" Adapted for atlas by Spokane County GIS.

Resource guide for educators and parents lead=Jim Ekins.



The Pacific Northwest During the Last Ice Age: 18,000 to 12,000 Years Ago

This map depicts the Pacific Northwest during the late Pleistocene Epoch based on available scientific evidence. Several interesting conditions relative to modern times are evident. The present city of Missoula, Montana, was under Glacial Lake Missoula, the lake responsible for generating the floods that created the aquifer sediments. The flood paths are shown in green. Present day Spokane, Washington, and Coeur d'Alene, Idaho, were also under water from Glacial Lake Columbia that was created when glacial ice blocked the Columbia River. The present location of Seattle, Washington, was under a lobe of the glacial ice sheet. The vast amounts of water trapped in the ice sheet caused the Pacific Ocean level to drop about 300 feet, and the ocean shore retreated several miles from its present location. A full-size map developed by Jeff Silkwood, "Glacial Lake Missoula and the Channeled Scablands", is available from the Ice Age Flood Institute.