# The Place We Cross the Water: *Whychus Creek*

**ECOLOGICAL SUPPLEMENT**


PRODUCED BY

THE UPPER DESCHUTES WATERSHED COUNCIL

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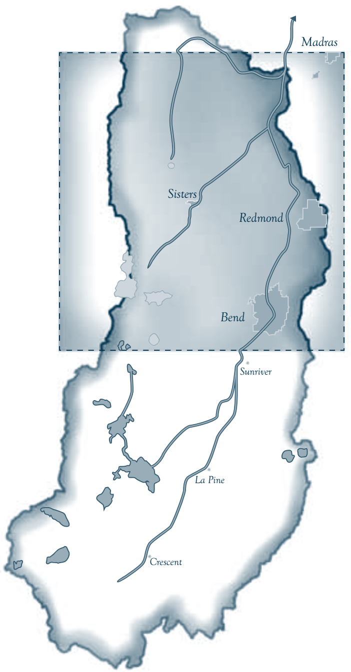
# The Place

WE CROSS THE WATER

WHYCHUS CREEK




UPPER DESCHUTES SUBBASIN


5 Miles

# Ecological Indicators:
## Evaluating Stream Health

Although local memory of spawning steelhead in Whychus Creek has long since faded, the reintroduction that began in 2007 launched new hope that steelhead will once again return to the creek after an absence of more than 40 years.

While this new hope brings tremendous investments in habitat restoration, renewed partnerships to help the creek and many opportunities for scientific research, it also shines a spotlight on one simple question asked repeatedly by the community at large:

Is Whychus Creek healthy?

The answer depends entirely upon your perspective. Is this question about the holistic watershed, including forests, rangeland and urban areas? Or, is this question just focused on the creek corridor? Does 'healthy' mean that you can drink the water without getting sick? That the water is clear? That it supports native redband trout? Or steelhead trout? A 'blue ribbon' fishery? Or, simply that the creek is pretty?

In the science of watershed management, there are many ways to answer these questions and examine each of the deeper layers that cut across the overlapping disciplines of hydrology, ecology, forestry and many others. However, distilling these technical disciplines into simple indicators that illustrate the health of the watershed is difficult because watersheds function as an interconnected network of biological, physical and chemical processes that affect everything from the clarity of the water to the severity of floods and the frequency of forest fires.

Given this complexity, practicality dictates that a short publication must focus on only a few simple indicators that describe the health of Whychus Creek. These indicators must be presented in terms that are interesting and meaningful to readers of many different backgrounds and with varying degrees of scientific training. And, just as importantly, they must be simple, technically accurate and based on readily available data. With these criteria in mind, our focus is on the following four general indicators:

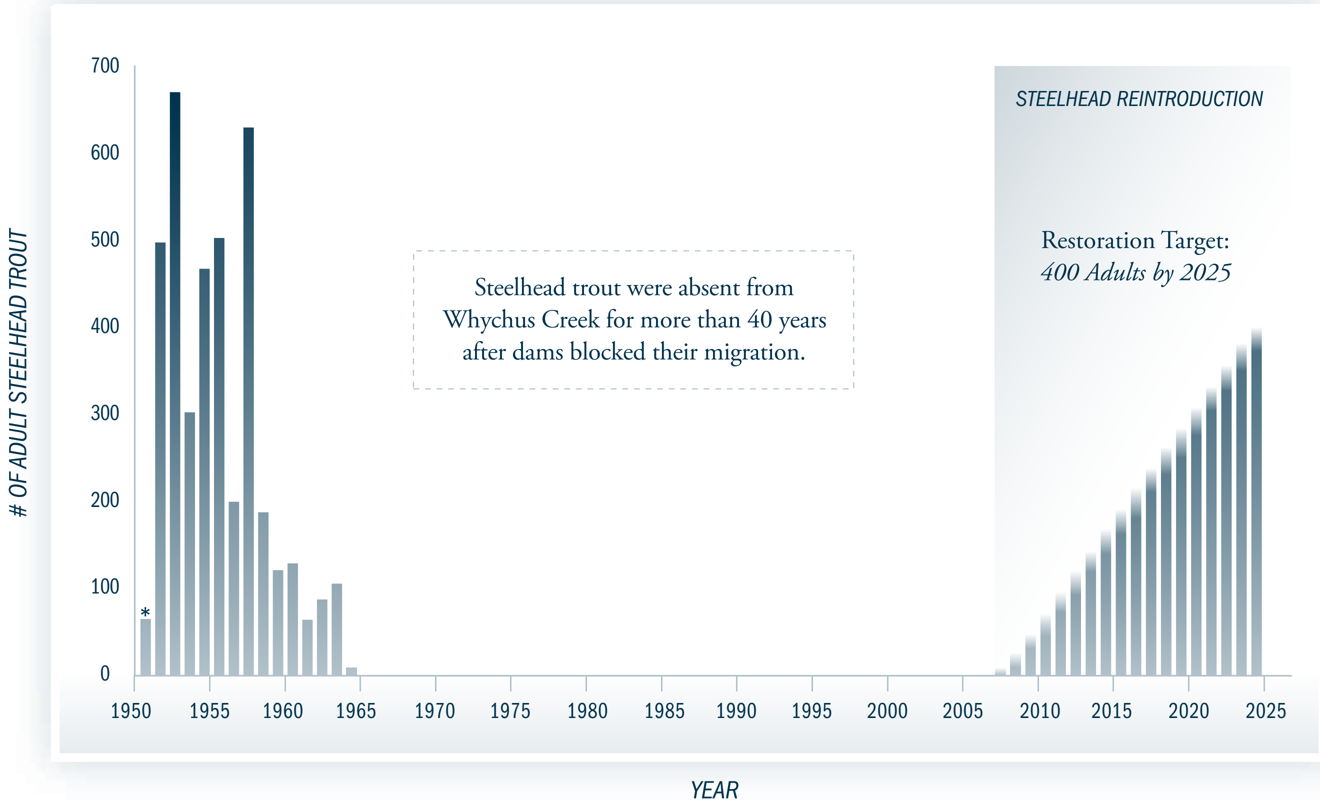
**Fish Populations**
What is the population size of an iconic native fish species, such as steelhead trout?

**Fish Habitat**
Does the creek provide suitable habitat for native fish?

**Water Temperature**
Does the water remain cool enough during the summer months to support native fish?

**Instream Flow**
Is there sufficient streamflow in the creek during the summer months to support a healthy creek?

While there are no perfect ecological indicators that can tell the complete story of a complex interconnected ecosystem, these four can provide a brief window into the health of Whychus Creek. And, as they are refined over time, they can provide a common language for measuring, evaluating and communicating about the health of the creek.




**History of Adult Steelhead in Whychus Creek**

Steelhead trout surveys in the 1950s to 1960s identified as many as 619 adults in Whychus Creek.[1] Even though these surveys were conducted many years after impacts in Whychus Creek reduced available habitat, they provide an important backdrop for the ongoing steelhead trout reintroduction program. Reintroduction began in 2007 and will continue for many years to come. (Note: * denotes incomplete data).

# Steelhead Trout:

## Reintroducing a Native Species

A steelhead trout spawning in the Deschutes River basin will likely travel thousands of miles on its journey down the Columbia River, to the Pacific Ocean and back again. Along the way, a myriad of factors–fishing, predation, dams, ocean conditions and others–will play into the probability of any single fish completing the multi-year cycle from egg to spawning adult. Ultimately, only a few percent will actually survive to complete their journey back home to their natal spawning grounds. Even though steelhead can spawn more than once, very few fish will survive to complete several successful spawning cycles.

With so many factors contributing to the life cycle of a steelhead trout, the absence of steelhead in Whychus Creek does not tell a complete story about the health of the creek. However, tracking the presence of steelhead trout does tell us something important about our progress in restoring this iconic species. It helps answer: Is the reintroduction working? Is Whychus Creek healthy enough to support spawning steelhead?

No one knows how many steelhead spawned in Whychus Creek before European settlement began in the 1800s. However, some rather optimistic estimates are as high as 9,000 spawning adults and it is widely accepted that Whychus Creek was one of the most productive steelhead streams in Central Oregon.[1] Distributed evenly along the 35 miles of Whychus Creek that were accessible to steelhead, 9,000 adults would result in an average of one fish every 21 feet.

The only quantitative survey data is from the 1950s to early 1960s, which is more than 50 years after diversions began to dewater Whychus Creek and during the same time period as the construction of the Pelton Round Butte Dams. As a result, these data represent only the waning years of steelhead trout in Whychus Creek and tell us little about the ultimate potential of the creek. Nevertheless, the surveys in the 1950s to 1960s counted a high of 619 adults in the 1952-1953 season, but estimated that there were as many as 1,000 in the creek. However, by 1965 there were only 10 adults counted and the population disappeared soon thereafter.[1]

Ironically, the extirpation of steelhead in Whychus Creek was not caused by blockage of the upstream migration of adult steelhead but instead by problems with the downstream migration of young smolts. The construction of the Pelton Round Butte dams created the massive Lake Billy Chinook at the confluence of the Deschutes, Crooked and Metolius Rivers. This reservoir, with its tangled web of currents, proved to be too much for migrating smolts. The mixing of cold water from the Metolius River and warm water from the Crooked and Deschutes Rivers created circulation patterns that led the smolts astray, such that they never found their downstream passage.

## *Are we making progress?*

The reintroduction of any species that has been absent for 40 years is complex business. There are issues of genetics, changes in habitat and dam retrofits. And, because of the complex life cycle of steelhead, reintroduction could fail even if Whychus Creek were perfectly healthy.

However, when nearly 200,000 steelhead fry were released in 2007, we passed an important milestone on the path to seeing steelhead trout in Whychus Creek for the first time in more than 40 years. With these first experimental fish instream and many more releases to follow in subsequent years, we must now wait and see how many are successful in their return as adults.

While waiting for the first adult steelhead to return in 2010 or 2011, we can look to other aspects of Whychus Creek to examine its health, including fish habitat, water quality and stream flow.

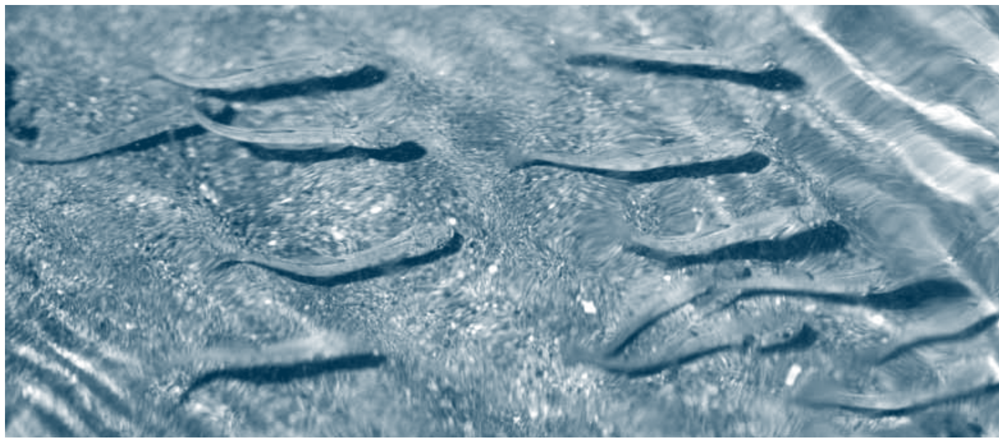


PHOTO **JIM YUSKAVITCH**

# Fish Habitat:

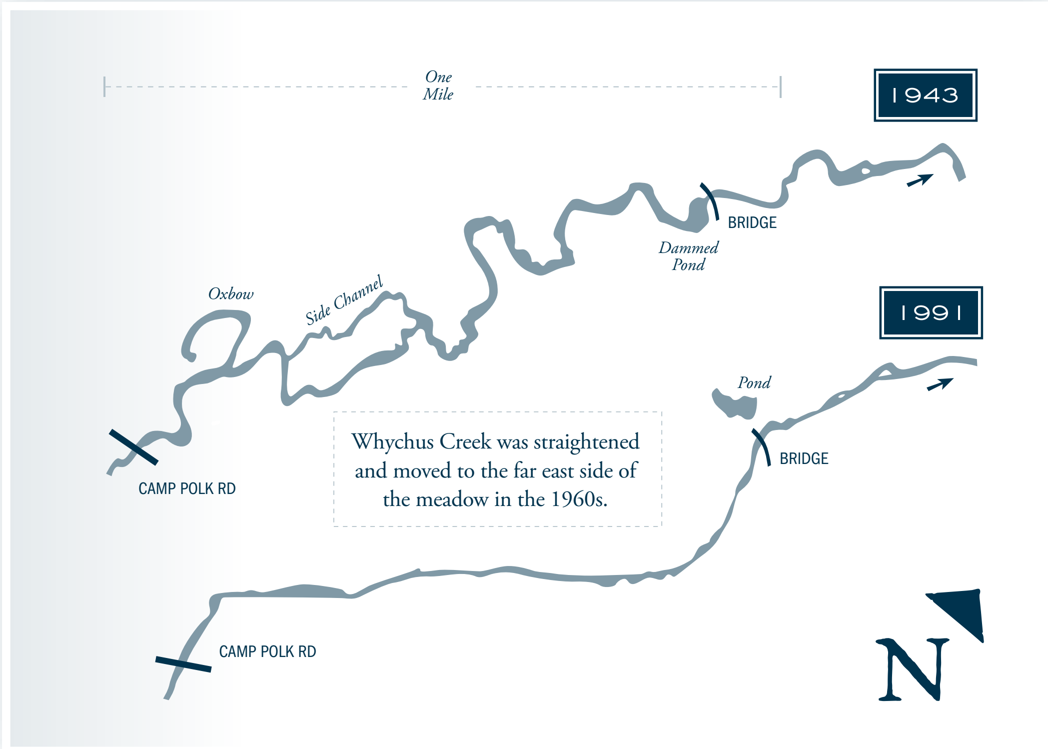
## Restoring a Healthy Creek

Throughout its life cycle, a steelhead trout will be in Whychus Creek at least twice: once as an egg, fry and smolt, then again several years later when it returns as a spawning adult. During each of these periods, it will have slightly different habitat needs. In the early stages, it will need well-oxygenated water, good sources of food and emergent vegetation along the banks of the creek. As a spawning adult, it will also need deep pools, good cover from woody material and abundant spawning gravels.

Since the early European settlers moved into the Whychus Creek area, fish habitat along the creek has been impacted by a suite of changes on the landscape. Livestock grazing, urban development, irrigation diversions and other activities have all gradually affected the quality of fish habitat. And, some more extreme events, such as the channelization of 18 miles of creek in the 1960s, have wrecked havoc on specific reaches of the creek.[2]

Some of the most devastating effects of channelization are exemplified at Camp Polk Meadow, a site where extensive research has been conducted and comprehensive stream restoration plans are underway. Here, channel modifications reduced habitat diversity, one of the key components of a healthy aquatic ecosystem. Important habitat features like pools, oxbows, side channels and riparian vegetation were lost as the creek was straightened and berms were built to contain flood flows. In addition, the straightened channel has brought increased flow velocities and accelerated erosion, resulting in channel instability many years after the bulldozers have left the creek. At one specific site, for example, the creek banks remain so unstable that more than 13 feet of bank erosion was measured during one month in 2007.[3]

The combined effects of channelization and other land management practices ultimately influence the quality of available fish habitat. To measure this, fish biologists have been surveying the length of Whychus Creek, collecting data on substrate, cover, pools and other attributes. By running these data through HabRate, a computer model, biologists can score specific reaches of creek as 'good', 'fair' or 'poor' habitat for spawning or rearing steelhead trout. Based on 2007 data, the 35.2 miles of potential spawning habitat for steelhead trout are made up of 0.0 miles of 'good', 28.4 miles of 'fair' and 6.8 miles of 'poor' quality habitat.[4] Given that Whychus Creek historically provided some of the best habitat for spawning steelhead, these data suggest that we have a long way to go in our collective effort to restore habitat for a self-sustaining population.




### Channelization of Whychus Creek

Channelization efforts in the 1960s straightened many reaches of Whychus Creek, resulting in significant losses to important habitat such as oxbows and side channels.[4] At Camp Polk Meadow, where channelization severely impacted important spawning habitat, collaborative restoration projects will help re-create spawning areas, wetlands, floodplains and other important components of the creek ecosystem.

## *Are we making progress?*

Our baseline understanding of habitat conditions has vastly improved over the last few years because new investments in steelhead reintroduction and associated habitat restoration have fueled more field surveys and studies than at any time in the past. In 2008, more than 20 miles of Whychus Creek will be surveyed to help refine our understanding of habitat conditions.[4] This will bring a better understanding of needs and opportunities, which will help guide investments in management and restoration. Over the long term, this will help us track and evaluate our collective progress in restoration.

In addition, many habitat restoration projects are currently underway, with benefits that fish and wildlife will 'feel' by 2010. These include new projects to protect riparian areas, restore instream habitat and reconnect floodplains damaged during the channelization of the 1960s. More than five miles worth of restoration projects are currently in design and many others are lying in waiting. While several years are often needed to fully design, implement and see the benefit of habitat restoration, the long-term trajectory is promising. There is more energy, commitment, and investment in habitat restoration now than at any time in the past.

PHOTO **SCOTT McCAULOU**

# Water Temperature:

## Staying Cool for Native Fish

In some parts of the United States, water quality can be quite easy to assess. Rivers can be so polluted that they may smell funny, flow in toxically vibrant colors or even catch on fire (the Cuyahoga River in Ohio was so polluted that it actually caught fire twice).

We are very fortunate not to face these kinds of toxic pollution in Whychus Creek. However, there are other aspects of water quality, such as temperature, that are less obvious to the casual observer but just as critical for important fish species such as resident redband trout or anadromous steelhead trout.

In Whychus Creek, water temperature is an important ecological indicator because redband and steelhead trout require cool, clean water. However, many human activities along the creek have caused water temperatures to climb as high as 24°C / 75°F, which is well above the 18°C / 64°F maximum temperature standard established by the State of Oregon to protect native fish.[5] While some creeks in Central Oregon may naturally flow with this kind of warm water, Whychus Creek is naturally very cold, with temperatures that would not likely exceed 16°C / 61°F under undisturbed conditions.[6]

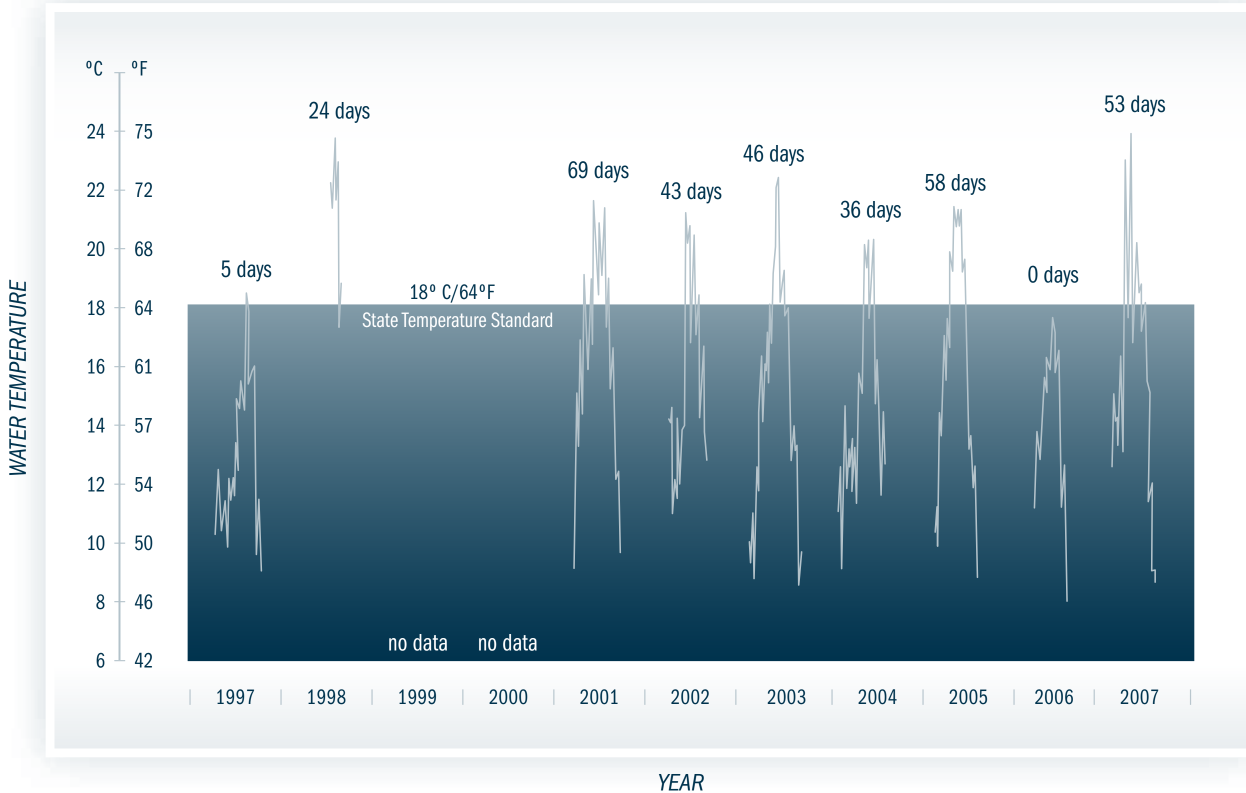
If we can understand how we have caused the stream temperatures to rise, we can respond by working together to reduce temperatures back into a range that better reflects natural variability. During this process, which may take a few decades, we can use measurements of temperature to track our collective progress in restoration.

### Are we making progress?

Research has shown that water temperature is directly related to the amount of instream flow. When irrigation diversions reduce instream flow, temperatures rise. When more water is left instream, temperatures drop.[5 6 7]

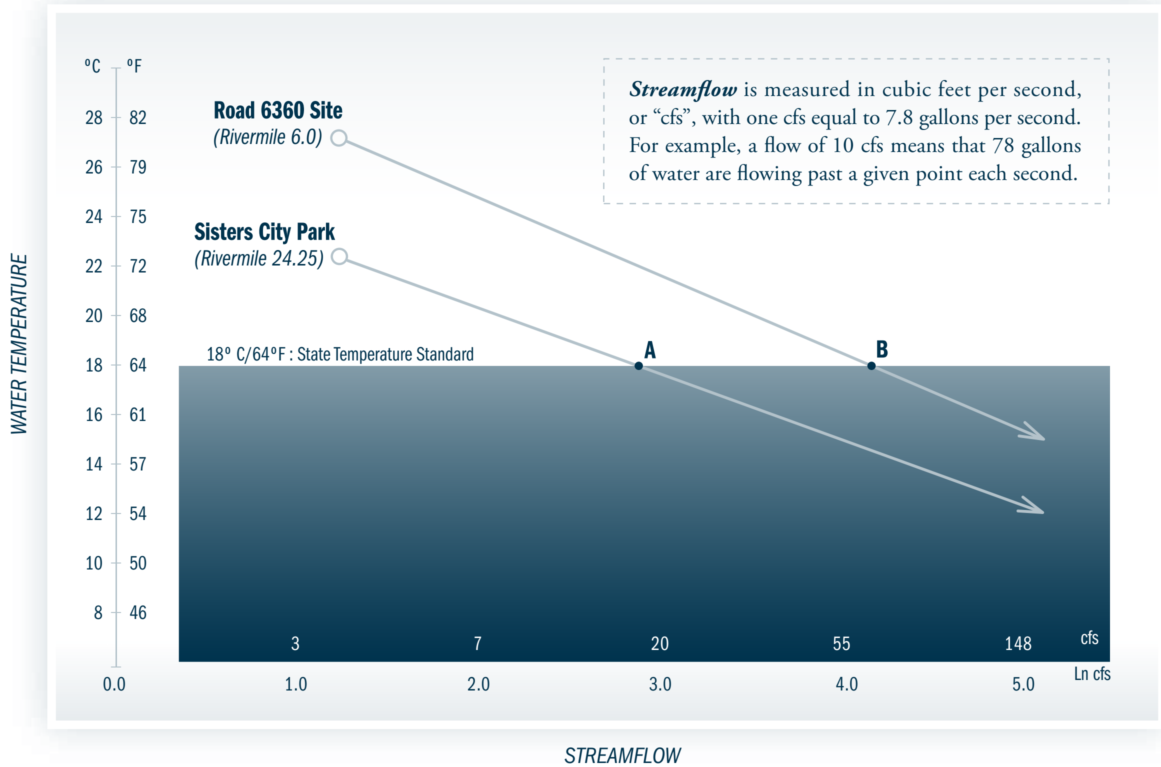
However, the precise relationship between temperature and flow is very complicated because the flow needed to maintain temperatures below the 18°C / 64°F standard is different in different reaches of Whychus Creek. For example, maintaining 18°C / 64°F in the downstream reaches of Whychus Creek (Rivermile 6.0) may require up to three times the amount of water that is needed to maintain the same temperature at the Sisters City Park (Rivermile 24.25). While some natural downstream warming is expected, the rate of warming has been increased significantly by reduced instream flow.[5 6 7]

Despite these complexities, the good news is that each year since 1999 more and more water has been left instream through water conservation projects championed by irrigators and conservation organizations.[8 9] While annual variations in climate, shade from riparian vegetation, quality of wetlands and other factors will continue to influence water temperature, the continued progress in flow restoration is an important trend that will ultimately bring valuable benefits for the health of Whychus Creek.




**Whychus Creek Water Temperatures, 1997-2007**

Data collected by many local organizations over the past 10 years have shown that Whychus Creek water temperatures exceeded the 18°C / 64°F standard between zero and 69 days per year.[5] While climate, snowpack and other natural variations can affect water temperature, studies have shown that Whychus Creek would remain far cooler if flows were increased by decreasing the volume of water diverted.[6]




## Temperature-Streamflow Relationship in Whychus Creek

Data from 2003 to 2006 indicate that temperatures in Whychus Creek are inversely correlated with the natural logarithm of streamflow, meaning that water temperatures tend to decrease as streamflows increase.[5] Point A shows that the state temperature standard of 18°C / 64°F was met at the Sisters City Park when there was approximately 20 cubic feet per second (cfs) of flow instream. Point B, representing a monitoring site 18 miles downstream, illustrates that the state standard was met when there was approximately 60 cfs instream. This reflects how temperatures increase as the creek flows downstream and that the location of the monitoring site is critical to understanding how streamflow and temperature are related.

# Instream Flow:
## Rewatering the Creek

Because water temperature is so closely linked to the volume of water flowing downstream, another critical indicator of the health of the creek is flow. How much water is flowing in the creek?

The first irrigation diversions began in Whychus Creek in 1871 and by 1912 summer flows in portions of Whychus Creek were entirely diverted for irrigation use.[1] For the next three generations, there was little attention paid to whether or not any water was left in the creek during the hot summer months. In fact, up until the mid 1990s, there were many years when reaches of Whychus Creek ran dry.

Today, portions of Whychus Creek are still reduced to a trickle as almost 90% of the water is diverted upstream of Sisters. The result is a very strange and highly modified streamflow that varies greatly depending upon where you are. For example, in an average July you might observe the following along the creek:

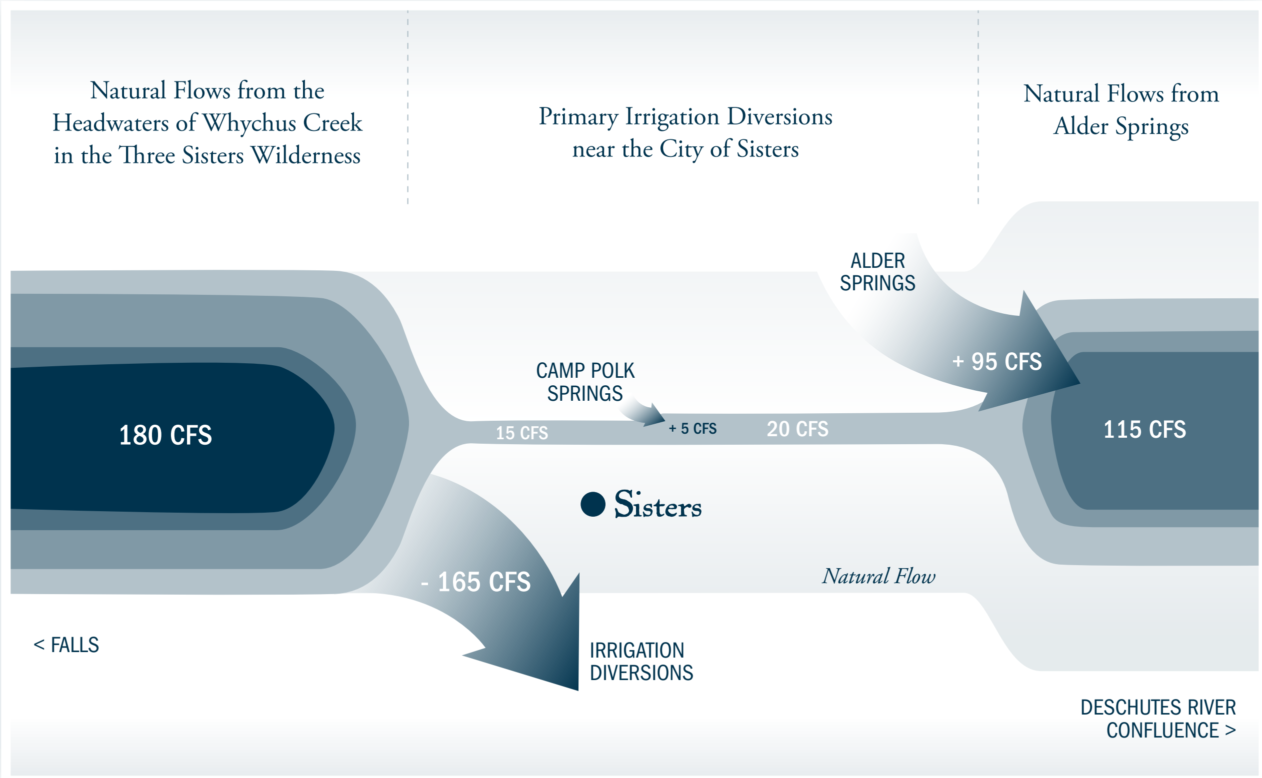
- **180 cubic feet per second (cfs)** flowing in the Deschutes National Forest upstream of Sisters (above any diversions);
- **15 cfs** flowing through the Sisters City Park (after most of the diversions); and
- **115 cfs** flowing at the mouth (after Alder Springs has added cold, clean water).[8 9]

In addition to affecting stream temperature, these types of streamflow modifications may also alter many other physical, chemical and biological processes critical to overall stream health. For example, reduced water availability in the summer may hamper growth of riparian vegetation, thus reducing habitat for terrestrial and aquatic wildlife and contributing to increased erosion along the streambanks. These changes in vegetation patterns and bank stability can, in turn, alter spawning and rearing habitat, streamside wetlands and other components of the ecosystem.

### *Are we making progress?*

Although the vast majority of the water in Whychus Creek continues to be diverted in the summer months, summer minimum instream flows at the Sisters City Park have risen from zero cfs to approximately 20 cfs over the last 10 years.[8 9] While this is barely more than 10% of natural flow, it represents a tremendous accomplishment resulting from the dedicated collaboration and multi-million dollar investments of the local irrigation district, farmers and conservation organizations. Creative strategies in voluntary water marketing, brokering, conservation and transfers have all been used to help improve streamflow while retaining water necessary for agricultural needs.

Significant hurdles remain. Keeping Whychus Creek cool enough for native fish throughout its entire length will require more instream flow than is currently present during the summer months.[6 7] While this flow may not be socially, economically or politically feasible in the immediate future, continued collaboration on flow restoration projects is one of the most effective ways to continue the important progress of the past 10 years.




**Streamflow in Whychus Creek**

Streamflow in Whychus Creek is reduced to approximately 10% of natural flow during the summer irrigation season. The diversions leave more than 20 miles of Whychus Creek with very little instream flow, causing increased water temperatures and other ecological impacts. Ongoing streamflow restoration projects are making important progress in restoring these summer instream flows.

# Progress in Restoration:

## Working for a Healthy Creek

In watershed management, clear 'Yes' or 'No' answers are notoriously elusive as the interconnected web of factors–terrestrial and aquatic, immediate and cumulative, physical and biological–all play into how we answer seemingly simple questions.

However, indicators can often help us better capture, understand and communicate about conditions in a creek such as Whychus. While they can simplify and clarify our communication to some extent, indicators simultaneously remind us that we should not place too much emphasis on any single factor in a specific place at a specific time. For example, while water quality may be nearly pristine upstream of Sisters in the winter, it may be very poor 20 miles downstream the following summer. Therefore, how should we answer the question, 'Is Whychus Creek healthy?'

The four indicators presented here tell complementary stories of Whychus Creek as a living stream with some significant challenges. At the same time, however, Whychus Creek is the focus of tremendous investment and committed community action, all pointing toward a future with cleaner water, stronger native fish populations and better habitat than at any time in the past several decades.

As this progress in restoration continues, we should periodically check back on core indicators to see how Whychus Creek evolves. Are steelhead adults successfully spawning in Whychus Creek? Is summer water temperature declining? Are instream flows moving toward a more natural condition? Are habitat restoration projects making a difference?

With enhanced understanding, we can also begin exploring new indicators that examine other aspects of the biological, physical and chemical processes in Whychus Creek and its watershed. Many critical ones, such as forest health, invasive species, or fish passage, are not included here but should be examined in the future. As this work continues, our suite of indicators will expand, our understanding and communication will become richer, and our commitment to protecting and restoring Whychus Creek will become more firmly rooted in our community.

# Endnotes

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