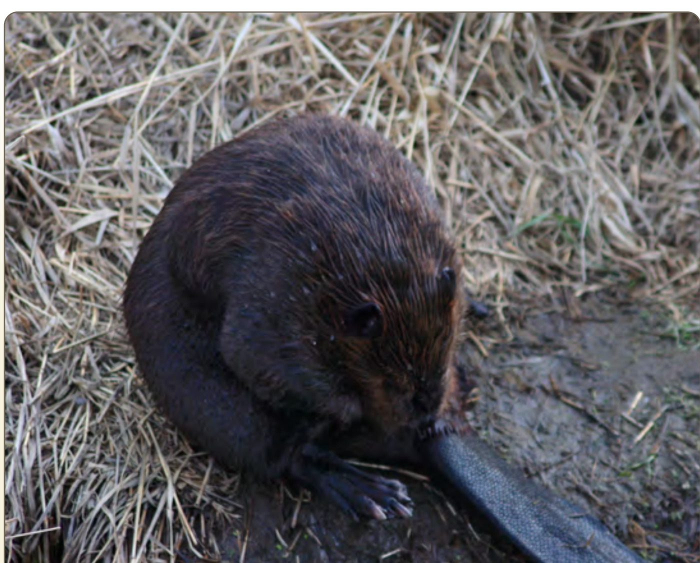
Prepared in cooperation with Clean Water Services

Beaver Dams and Their Effects on Urban Streams in the Tualatin River Basin, Northwestern Oregon

Key Findings and Implications for the Tualatin River Basin

- The effects of beaver dams and ponds on hydraulics, floodplain inundation, suspended-sediment transport and deposition, and water quality are nuanced and vary, depending on the characteristics of a stream reach and the beaver dams along that reach.
- Within a single stream reach, beaver dams and ponds can provide benefits in some seasons, but challenges in other seasons. For example, beaver dams and ponds can temporarily store storm run-off during high-flow periods but lead to elevated water temperatures in summer where ponded reaches lack shade from riparian vegetation.
- Consideration of stream reach and beaver dam characteristics is important for understanding the potential effects of beaver dams and ponds and assessing the potential benefits and challenges associated with beaver dams and beaver-assisted restoration projects.



Introduction

In response to growing interest in beaver-assisted restoration in the Tualatin River Basin of northwestern Oregon (fig. 1), the U.S. Geological Survey (USGS), in partnership with Clean Water Services, collected data from 2016–17 and completed a series of studies to: (1) inventory known locations of beaver dams and activity in the Tualatin River Basin (Smith, 2017), (2) estimate the number of beaver dams in the Tualatin River Basin as of 2017 and the potential number of beaver dams that could be supported with riparian vegetation improvements (White and others, 2025a), and (3) assess the effects of beaver dams and ponds on storm hydrology, hydraulics, and floodplain inundation (White and others, 2025b), suspended-sediment transport and deposition (Doyle and others, 2025), and water quality (Smith and others, 2025) along two urban stream reaches (Fanno Creek at Greenway Park and Bronson Creek between Kaiser and Saltzman Roads; fig. 1). This fact sheet summarizes the results of these studies and implications for beaver-assisted restoration in the Tualatin River Basin.

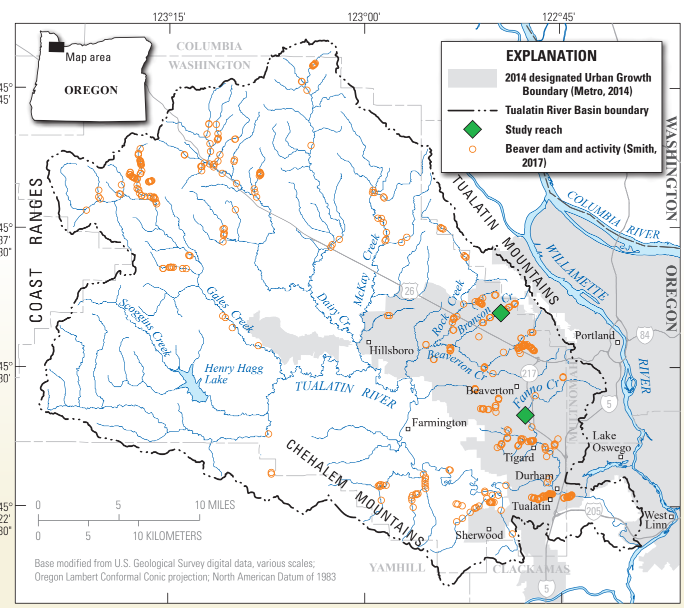


Figure 1. Locations of beaver dams and beaver activity and study reaches along Fanno Creek at Greenway Park and Bronson Creek between Kaiser and Saltzman Roads in the Tualatin River Basin, northwestern Oregon.

Abundance and Distribution of Beaver Dams in the Tualatin River Basin

Scientists from the USGS created an inventory to document activity by American beavers (*Castor canadensis*) and validate estimates of the total number of beaver dams in the Tualatin River Basin. This inventory was based on USGS field surveys in 2016 of beaver dams, lodges, and chew marks (indicators of beaver foraging) and observations made from 2011 to 2019 by other organizations. The inventory documented more than 650 beaver dams and 100 locations with beaver lodges or chew marks throughout the basin (fig. 1; Smith, 2017). Although this inventory does not comprehensively document all beaver activity in the basin, it provides a foundation for understanding beaver activity during 2011–19.

Estimates of the Number of Current and Potential Beaver Dams

The Beaver Restoration Assessment Tool (BRAT; Macfarlane and others, 2017) is an application for estimating the number of beaver dams along streams. Scientists from USGS modified the BRAT to account for the local topography of the Tualatin River Basin and then estimated the number of beaver dams as of 2017 (White and others, 2025a; White, 2025a). They also estimated the potential number of beaver dams that could be supported if riparian vegetation conditions are improved in the future. As of 2017, beavers had sufficient habitat to build an average of 6 dams per kilometer of stream channel outside of Portland's Urban Growth Boundary and 3 or more dams per kilometer of stream channel within the Urban Growth Boundary

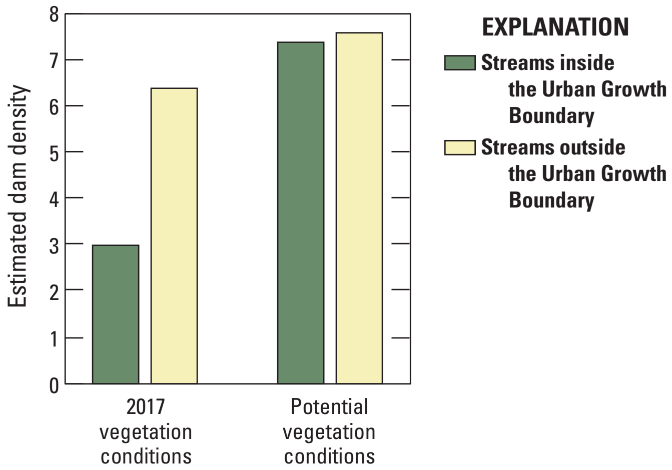


Figure 2. Bar graph showing the estimated potential number of beaver dams per kilometer of stream channel under 2017 conditions and with modeled increases of riparian vegetation along streams within and outside the Urban Growth Boundary in the Tualatin River Basin, northwestern Oregon, as determined with the modified Beaver Restoration Assessment Tool from White and others (2025a) and White (2025a).

(fig. 2). Dam building was often limited by stream power outside the Urban Growth Boundary and by a lack of riparian vegetation within the Urban Growth Boundary. Improving riparian vegetation may increase dams to about 7 dams per kilometer of stream channel outside and within the Urban Growth Boundary. Increasing the amount of riparian vegetation has many other benefits, such as providing shade and decreasing water temperature in small streams.

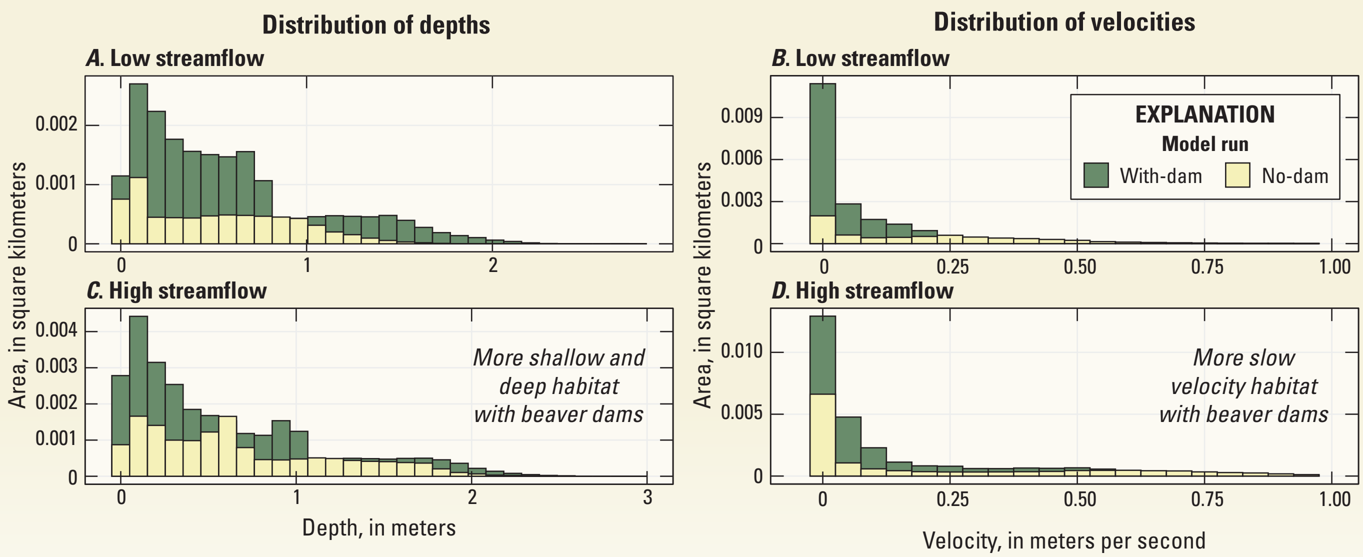


Figure 3. Distributions of modeled water depths and velocities at low streamflows (1 cubic meter per second; *A*–*B*) and high streamflows (4 cubic meters per second; *C*–*D*) for *with-dam* and *no-dam* model scenarios for the Fanno Creek study reach (encompassing stream section upstream of, ponded by, and downstream of beaver dams) in the Tualatin River Basin, northwestern Oregon, from White and others (2025b) and White (2025b).

Effects on Water Movement and Floodplain Inundation

Hydraulic models were used by USGS scientists to assess how water moves through the Fanno Creek and Bronson Creek study reaches and inundates adjacent floodplains with and without beaver dams and ponds (White and others, 2025b; White, 2025b). Beaver dams and ponds cause these reaches to temporarily store more water during storms, but they do not substantially alter the rate or total amount of flow moving through the reaches. Beaver dams also create a greater range of water depths and velocities compared to reaches without beaver dams (fig. 3*A–D*). Stream slope, side channels, and ponds further influence how beaver dams and ponds affect water movement and storage duration.

Effects on Suspended-Sediment Transport and Deposition

USGS scientists estimated that beaver dams and ponds trapped about 11 percent of the suspended sediment entering the Fanno Creek reach and 89 percent entering the Bronson Creek reach over a 12-month period in 2016–17 (fig. 4; Doyle and others, 2025). Differences in the observed "capture rate" of suspended sediment between the two reaches were associated with differences in beaver dam and stream reach characteristics, stream-floodplain connections, and riparian vegetation.

Scientists from USGS also estimated the amount of sediment trapped in the south pond, a beaver pond inundating about 8,000 square meters in the Fanno Creek reach, using field survey techniques and computer mapping analyses. This beaver pond trapped more than 250 metric tons of sediment over 4 years (Doyle and others, 2025). For context, Fanno Creek, near its confluence with the Tualatin River, exports an average of about 7,200 metric tons of suspended sediment over 4 years (Keith and others, 2014). Together, these results indicate that this one beaver pond trapped about 1/30 (or about 3 percent) of the annual suspended-sediment load moving through Fanno Creek over 4 years. A series of beaver ponds along the stream network, therefore, has the potential to trap considerable amounts of sediment moving through urban streams.

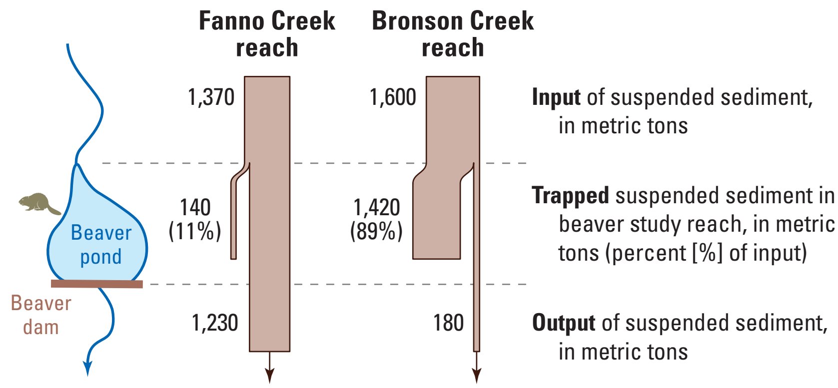


Figure 4. Estimated suspended-sediment loads along the Fanno Creek and Bronson Creek study reaches (encompassing stream sections upstream of, ponded by, and downstream of beaver dams) in the Tualatin River Basin, northwestern Oregon, as computed by Doyle and others (2025).

Effects on Summer Water Temperature

Water temperatures were measured upstream, downstream, and within beaver ponds along the Fanno Creek and Bronson Creek study reaches by USGS scientists using continuous water-quality monitors (Smith and others, 2025). In both reaches, beaver dams and ponds warmed water temperature in summer (fig. 5). Water leaving the Fanno Creek reach typically was warmer (maximum warming of 4.3 degrees Celsius) than water entering the reach. This warming was attributed to the south pond, a large and shallow beaver pond with little riparian shade. About 600 m downstream of the study reach, water temperature cooled where the channel was narrow, deep, and well shaded. Water in the Bronson Creek reach warmed in the ponded section (maximum warming of 2.7 degrees Celsius) where beavers built in-channel ponds in the narrow, deep, and relatively shaded channels, but cooled again downstream, resulting in water with similar daily maximum temperatures entering and exiting the reach. The cooling in the downstream portion of the Bronson Creek reach was attributed to the exchange of water and heat between the channel and its saturated floodplain. Overall, the magnitude and pattern of water-temperature changes associated with beaver dams depended on the surface area and depth of the beaver ponds as well as the amount of riparian shade and stream-groundwater interactions.

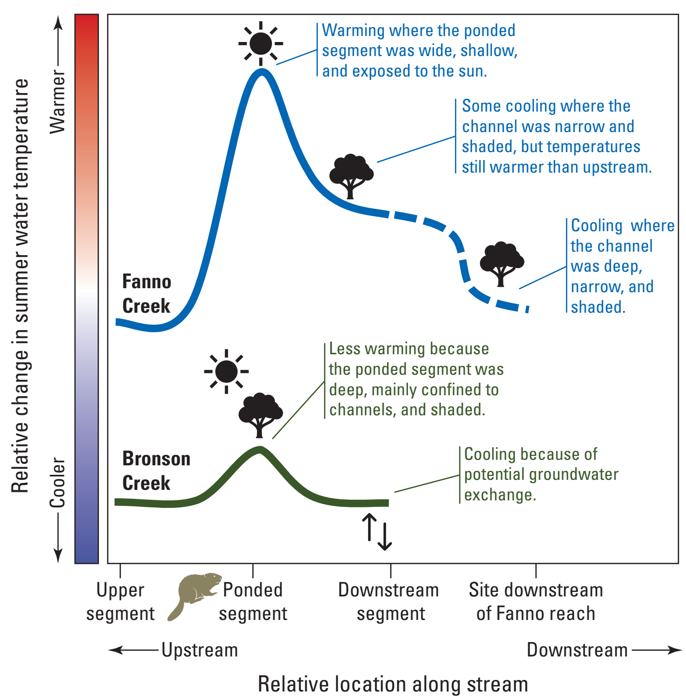


Figure 5. Conceptual diagram of water-temperature changes during summer along the Fanno Creek and Bronson Creek reaches (encompassing stream segments upstream of, ponded by, and downstream of beaver dams) in the Tualatin River Basin, northwestern Oregon, based on data from Smith and others (2025).

Water-Quality Variability in a Beaver Pond

Water temperature and dissolved-oxygen concentrations (the amount of oxygen available to fish and other aquatic organisms) are important parameters of water quality affected by beaver dams and ponds. USGS scientists documented the spatial variability in water-quality conditions associated with beaver dams and ponds by measuring water temperature and dissolved-oxygen concentrations throughout the Fanno Creek reach on four summer afternoons in 2016 and 2017 (Poor, 2020; Smith and others, 2025). Generally, the unshaded and shallow areas of the south pond had warm water temperatures that were highly productive, resulting in algal photosynthesis that created very high (that is, supersaturated) dissolved-oxygen concentrations (fig. 6). The narrow, relatively deep, and shaded channels had cooler water temperatures and lower dissolved-oxygen concentrations. In the main and old channels that were deep and shaded, a lack of photosynthesis combined with substantial consumption of dissolved oxygen from the decomposition of leaves and wood in the sediments resulted in low oxygen concentrations. These measurements reinforce that water-quality conditions throughout a beaver pond can vary greatly because of differences in riparian shade, sun exposure, wetted surface area, sediment thickness, water depth, and other factors and that these water-quality conditions will vary in stream reaches with physical characteristics that are different than the Fanno Creek study reach.

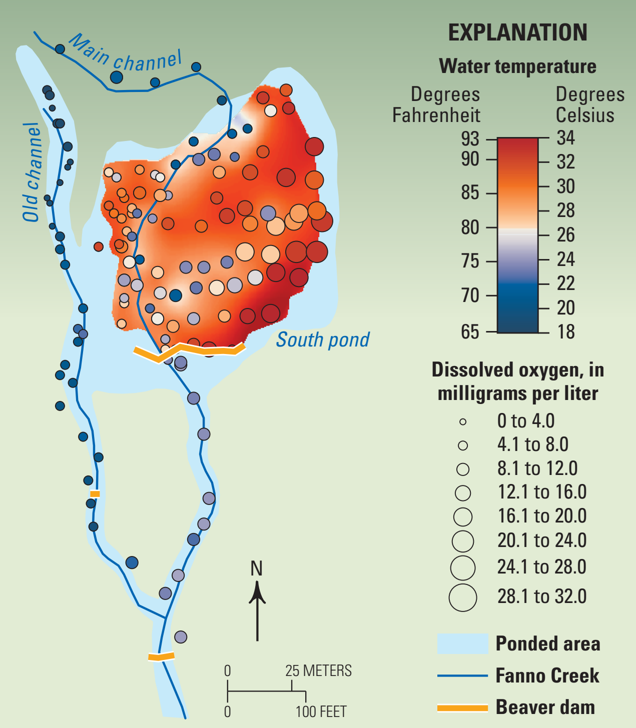


Figure 6. Measurements of water temperature and dissolved oxygen collected between 4:00 and 7:30 p.m. on August 11, 2016, in a ponded beaver reach with dams in Fanno Creek at Greenway Park, in the Tualatin River Basin, northwestern Oregon, as documented by Poor (2020) and Smith and others (2025). The circles show the measurement locations, where the size of the circle represents the dissolved-oxygen concentration and the color inside the circle represents the measured water temperature. All measurements shown were collected at 10 centimeters below the surface of the water. Water temperatures were spatially interpolated between the measurement points to produce the resulting color map.

Implications for Management and Habitat Restoration

Beavers build dams in streams throughout the Tualatin River Basin. Gaps in the abundance of riparian vegetation appear to be the primary physical factor limiting beaver dam building along these urban streams (White and others, 2025a). Results from the beaver dam distribution modeling can be combined with information about nearby land-use and infrastructure to identify stream reaches where human or other activities may impact beaver dam building. For example, stream reaches adjacent to private lands, roads, recreational trails, or culverts may be less suitable for beaver-assisted restoration than stream reaches surrounded by public land with minimal infrastructure.

Beaver dams and ponds along the Fanno Creek and Bronson Creek study reaches had measurable effects on hydraulics, sediment transport, and water quality (White and others, 2025b; Doyle and others, 2025; Smith and others, 2025). These beaver dams and ponds also created habitats used by native turtles, amphibians, and wading birds in this urban landscape (Carol Murdock and Tracey Dulin, Clean Water Services, written commun., 2017). Urbanization often leads to habitat impairments because of reduction in riparian vegetation, channelization, and changes in hydraulics and sediment transport. Beaver dams and ponds can effectively mitigate some of these changes associated with urbanization, but there are potential benefits and trade-offs.

Collectively, these studies indicate that the physical effects of beaver dams and ponds in urban areas vary greatly and depend on stream reach and beaver dam characteristics. This results in three important considerations for beaver-assisted restoration:

1. Generalized statements about the effects of beaver dams and ponds on stream hydraulics, habitat, and sediment transport can be made. However, such generalized statements are often insufficient at conveying (1) the wide variability in the type and magnitude of physical effects associated with beaver dams and ponds and (2) how those effects can vary seasonally and spatially within a single beaver-affected stream reach or along river networks. Developing realistic expectations for beaver-assisted restoration depends on consideration of the characteristics of stream reaches and beaver dams and ponds and how those characteristics interact over space and time to shape physical habitat (Larsen and others, 2021; Nash and others, 2021).

2. Beaver dams and ponds provide many benefits (such as increasing water storage and habitat diversity), but in some cases may also cause challenges (such as flooding of private property or local infrastructure and elevated water temperatures in summer). Resource managers may need to weigh such benefits against potential challenges associated with beaver dams and ponds.

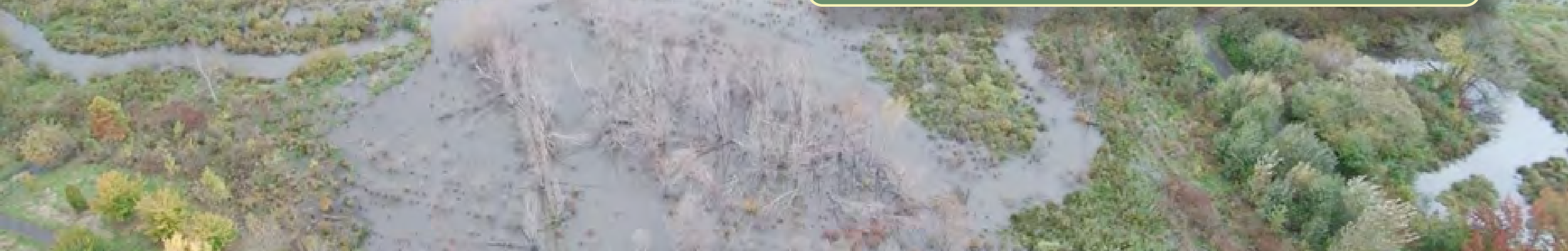
3. Integrating the influence of stream reach and dam characteristics as well as recognized benefits and challenges associated with beaver dams and ponds into beaver-assisted restoration plans may help resource managers minimize human-beaver conflict, communicate any challenges, and maximize project benefits.

Examples of Benefits and Challenges Associated with Beaver Dams and Ponds

- **Example 1:** Beaver dams and ponds create a wider range of water depths, velocities, and aquatic habitats compared to streams without beaver dams and ponds (fig. 3; White and others, 2025b). However, beaver ponds with shallow areas exposed to the sun or areas that are deep and stagnant may cause summer water-quality conditions (fig. 6; Smith and others, 2025) that are problematic for some aquatic species. Water leaving shallow and unshaded beaver ponds also may be warmer than upstream conditions. The downstream extent of this warming will vary depending on the surface area of the beaver pond and downstream conditions (such as riparian shading and channel width and depth). Effects of beaver dams and ponds on water quality are expected to be the most pronounced during the summer and in stream reaches where beaver dams create wide, shallow, and unshaded ponds.

- **Example 2:** Beaver dams temporarily trap substantial amounts of sediment (fig. 4; Doyle and others, 2025), reducing downstream suspended-sediment loads while dams persist. However, organic matter is also deposited along with the sediment. Bacteria in the streambed naturally decompose this organic matter, and in doing so can decrease dissolved-oxygen concentrations. Lower dissolved-oxygen concentrations may be problematic for some aquatic species in summer. Nutrients and contaminants that adhere to sediment particles can affect water-quality conditions when the particles are sequestered in beaver ponds.

- **Example 3:** Beaver dams and ponds temporarily store water during storm events. This storage can result in the inundation of nearby private property or public infrastructure, such as recreational trails.



Full Results of the Study

This fact sheet is based on a study documented by four U.S. Geological Survey Scientific Investigations Reports (Doyle and others, 2025; Smith and others, 2025; White and others, 2025a and 2025b). Chapter A (White and others, 2025a) documents the locations of beaver dams in the Tualatin River Basin and how many beaver dams the stream network could support with existing and improved riparian vegetation. Chapter B (White and others, 2025b) describes the effects of beaver dams and ponds on hydrologic and hydraulic responses of storm flows. Chapter C (Doyle and others, 2025) characterizes the effects of beaver dams and ponds on the transport and deposition of suspended sediment. Chapter D (Smith and others, 2025) describes the effects of beaver dams and ponds on longitudinal, spatial, and seasonal water-quality patterns.

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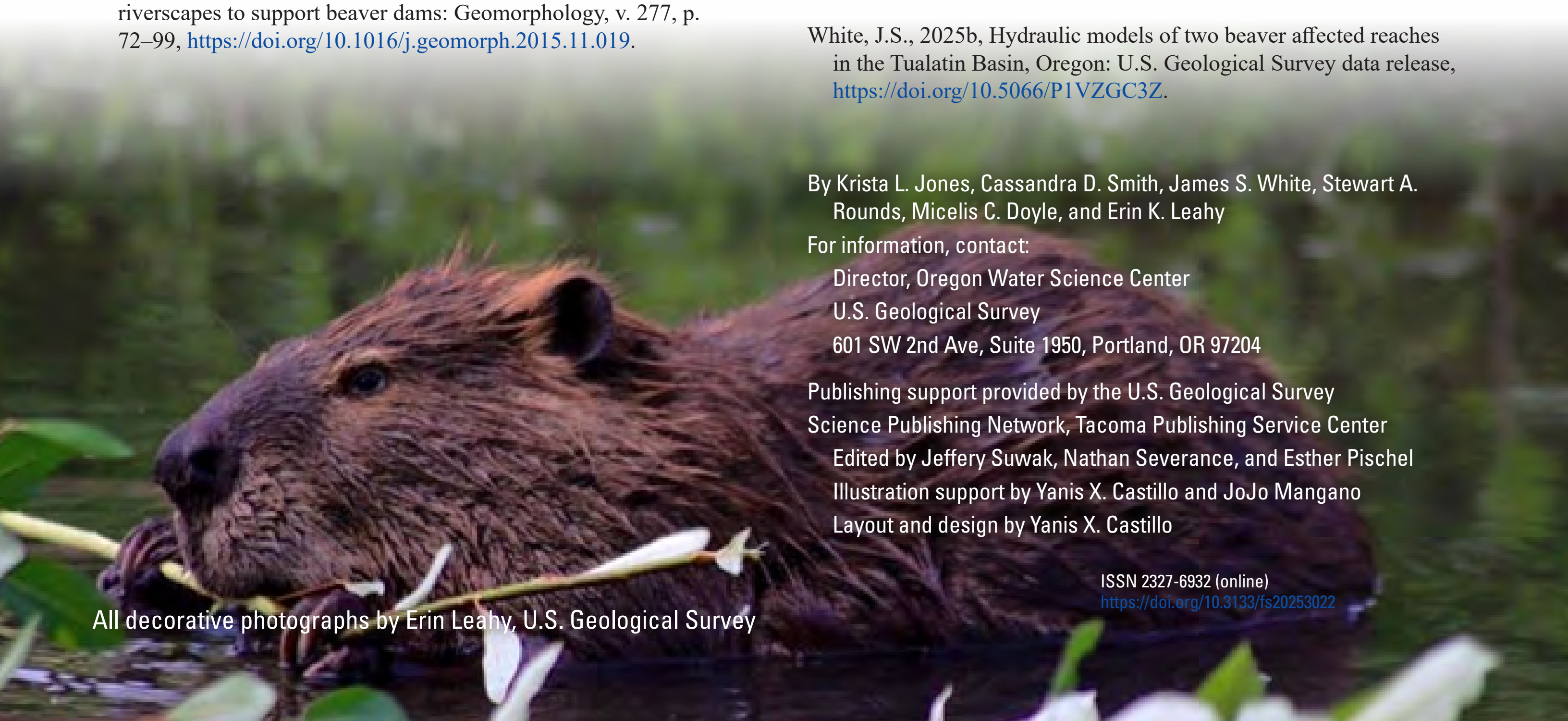

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