Ice Age Floods at Dry Falls

Lower Grand Coulee

Soap Lake/Ephrata, Washington

Our Lower Grand Coulee chapter of the Ice Age Floods Institute focuses on the beautiful Coulee Corridor National Scenic Byway. We serve Grant County and beyond, where we have 300 days of sunshine,140 lakes and only around eight inches of rainfall per year.

We investigate the geological mystery of the Missoula Floods as it applies to this area, particularly Dry Falls, the centerpiece of this Disneyland for geologists. We are seeking answers to a geological mystery of what happened and how it happened thousands of years ago. We do this to unravel the mystery that was initially unlocked only 100 years ago from the breathtaking geological hints that were left behind. Nobody really knows what happened, but we are still making new discoveries each year and investigating the mystery to this day.

We are local people meeting monthly in Soap Lake, WA, to plan hikes, gather geological samples, assist at Dry Falls Visitor Center, participate in local festivals, and distribute information such as in your hand now. You are invited to come help solve the mystery, and while here you can enjoy our playground, including: the Ephrata Fan, the Great Blade, Steamboat Rock, Ancient Lakes, Drumheller Channels, Sun Lakes, Lenore Caves, the Potholes Area, Soap Lake, and more. To learn more, to attend a presentation, or to help with our mystery, please visit us at **https://IAFI.org/lower-grand-coulee/.**

ICE AGE FLOODS INSTITUTE

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Northrup Lake

FOLLOWING THE PATHWAY

During the last glacial cycle of the ice-age some 80,000 to 14,000 years ago, continental glaciers and repeated massive floods carved many of the unique distinguishing features of the Northwest's interior landscape.

This is your local guide to dramatic evidence of those cataclysmic forces, from spectacular canyons and cliffs to waterfalls and vast, flood-eroded scablands, that can be witnessed with a short road trip.

It is our hope that you will use this guide to explore these fascinating geological features in our region and will want to learn more about the dramatic ice-age story of glaciers and floods.

OF THE GREAT FLOODS

Key resources for understanding the geology of the Mid-Columbia region:

On the Trail of the Ice Age Floods

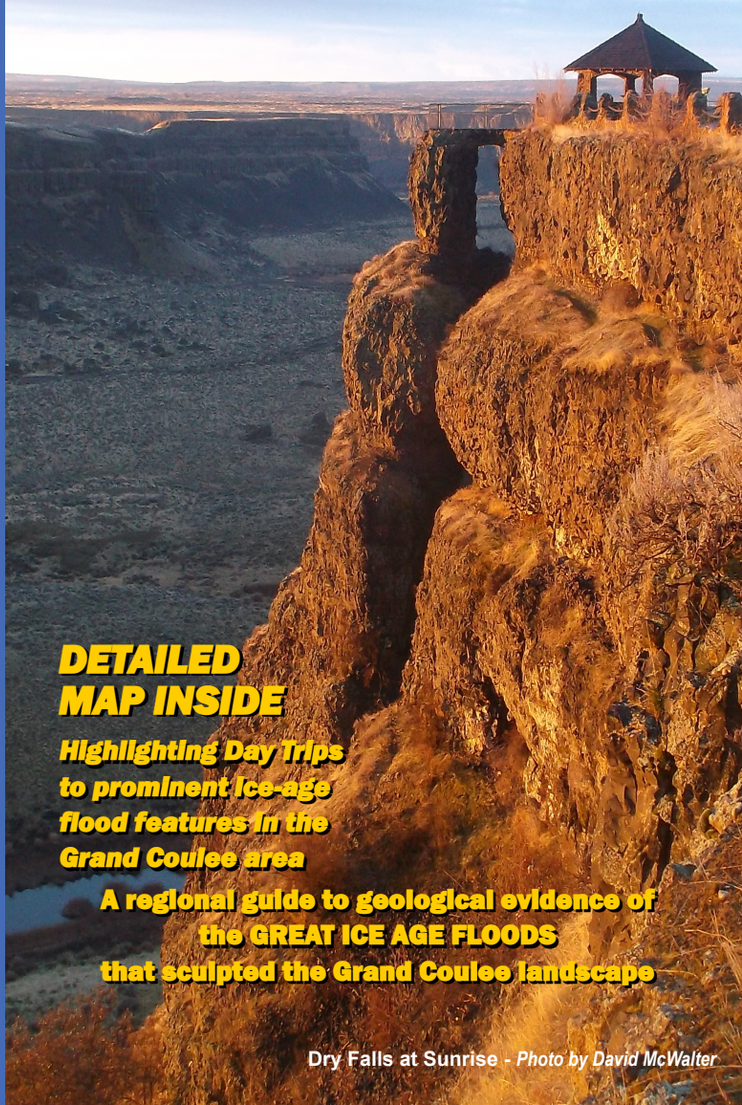
Bjornstad, B. N., Vols. 1 & 2

Keokee Co. Publishing, Inc., Sandpoint, ID

Learn MORE at IAFI.org or facebook.com/IceAgeFloods/

A GUIDE TO THE INCREDIBLE ICE AGE FLOODS IN THE GRAND COULEE AREA

Our Cataclysmic Floodscape



DETAILED MAP INSIDE

Highlighting Day Trips to prominent Ice-age flood features in the Grand Coulee area

A regional guide to geological evidence of the GREAT ICE AGE FLOODS that sculpted the Grand Coulee landscape

Dry Falls at Sunrise - *Photo by David McWalter*

Interesting Flood Facts!

During the main phase of the Ice Age Floods the large Okanogan lobe of the Cordilleran Ice Sheet occupied much of the Waterville Plateau, blocking the Columbia River and diverting the massive combined floodwaters of Glacial Lakes Missoula and Columbia south along the fractured bedrock fold bounding the Waterville Plateau.

As the combined floodwaters poured south they fell over lips in the underlying basalt layers, forming submerged waterfalls (cataracts) that migrated (retreated) upstream, creating steep-sided, deep and wide valleys (coulees) as bedrock was torn away from the cataract face.

One major cataract, whose incised path is now the Upper Grand Coulee, developed near the southern end of the Waterville plateau and migrated north to the Columbia River. A second major cataract developed further south in the Soap Lake area and retreated north to Dry Falls. Its incised path is now the Lower Grand Coulee.

When the floodwaters reached the southern ends of both the Upper and Lower Grand Coulee they spread out, depositing a thick and extensive "expansion" fan across broad flat plains. In testament to the force of the floodwaters, the broad plain south of Ephrata is now covered with large boulders that were carried a mile or more before they began to settle out of the slowing flow.

Dry Falls at the head of the Lower Grand Coulee is 400 feet high and 3.5 miles wide; over five times the width of Niagara Falls. It is estimated that ten times the combined flow of all the current world rivers once poured over those falls that are now completely dry. Once the Okanogan ice sheet that obstructed the Columbia River receded the later floods followed the normal course of the Columbia River, leaving the falls and the entire Grand Coulee dry.

Banks Lake now occupies the Upper Grand Coulee. It is artificially filled by water pumped from Lake Roosevelt and is a key part of the Columbia Basin Project that distributes irrigation water over much of the basin.

The Story of the Great Ice Age Floods

During the peak of the last Ice Age, a vast Cordilleran continental ice sheet covered southwestern Canada and the northern parts of Washington, Idaho and Montana. An eastern Purcell lobe of the ice sheet descended into the Idaho panhandle, blocking the Clark Fork River with an ice dam thousands of feet thick.

Water rising behind the dam flooded the valleys of Montana creating Glacial Lake Missoula – a great inland lake stretching over 200 miles to the east with a volume of water greater than Lake Erie and Lake Ontario combined.

The rising lake waters periodically caused the ice dam to fail, resulting in sudden, cataclysmic floods that rushed across northern Idaho and the Channeled Scablands of eastern and central Washington, through the Columbia River Gorge, and into Oregon's Willamette Valley, before emptying into the Pacifc Ocean at the ancient mouth of the Columbia River. Glacial Lake Missoula would have drained in just a few days as a volume of floodwaters greater than all the rivers of the world combined roared across the landscape at up to 60+ mph.

Now imagine this happening not once but dozens, perhaps even hundreds of times as the advancing continental glacier built a new ice dam!

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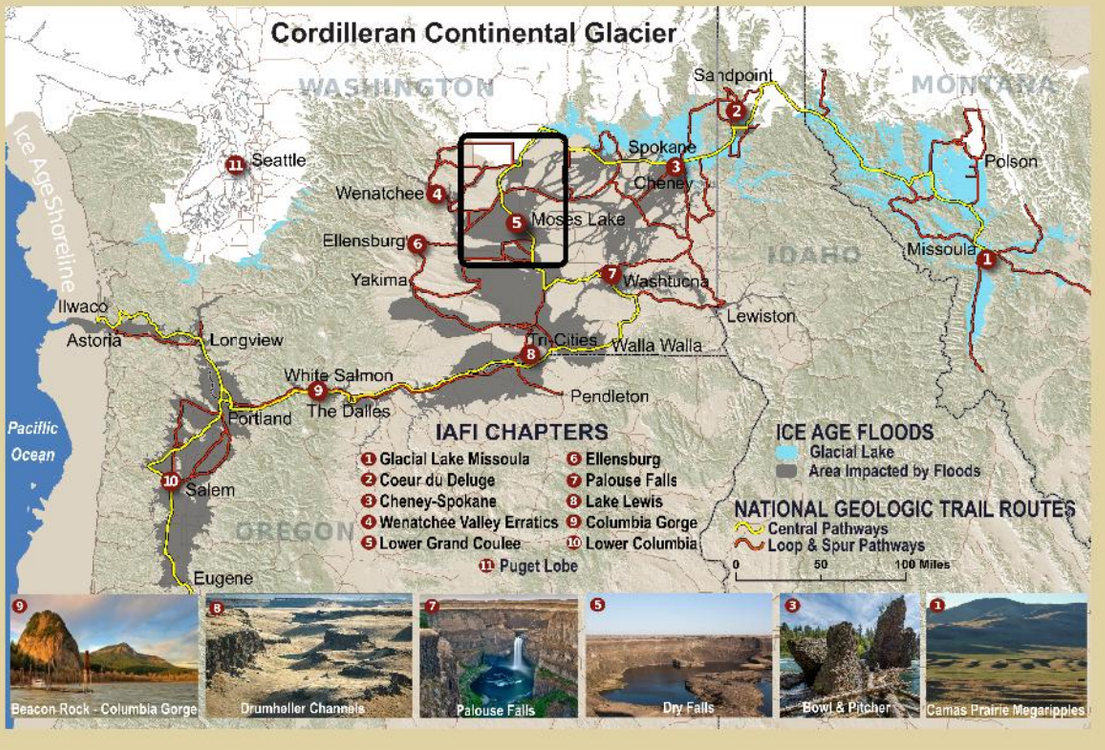
ICE AGE FLOODS
NATIONAL GEOLOGIC TRAIL

Ice Age Floods National Geologic Trail

Since the 1990's the Ice Age Floods Institute (IAFI) has worked to create and to build support for the Ice Age Floods National Geologic Trail.

The Ice Age Floods National Geologic Trail is essentially a network of marked touring routes extending across parts of Montana, Idaho, Washington, and Oregon, with several special interpretive centers located across the region. Many interested parties are being brought together in a collaborative and effective interpretive program at a remarkably low cost, despite the extraordinary size of the region.

The Trail is being developed under the National Park Service on existing public lands, with no changes in jurisdiction and no threats to private property rights. The role of the National Park Service is to coordinate and manage the planning of the project and the telling of the story, without taking custodianship of public and private lands.



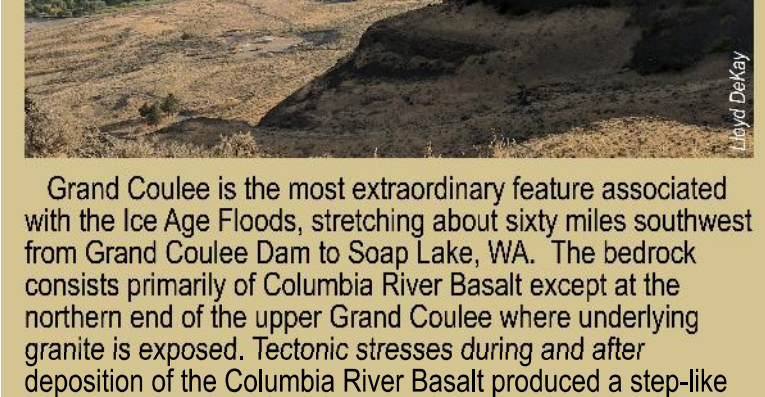
Ice Age Floods Features in the Lower Grand Coulee

Grand Coulee is the most extraordinary feature associated with the Ice Age Floods, stretching about sixty miles southwest from Grand Coulee Dam to Soap Lake, WA. The bedrock consists primarily of Columbia River Basalt except at the northern end of the upper Grand Coulee where underlying granite is exposed. Tectonic stresses during and after deposition of the Columbia River Basalt produced a step-like fold in the basalt, called a monocline, that forms the coulee's west boundary and caused the Waterville Plateau to be uplifted over 1,300 feet.

The upper and lower Grand Coulees both formed by 'waterfall retreat' as MIssoula floodwaters plunged over and tore away at exposed faces of Columbia River Basalt flows and gouged deeply into underlying basalt flows, leaving a series of depressions now occupied by scenic lakes (Soap, Lenore, Blue, and Park Lakes). As floodwaters shot out of the coulees they deposited huge boulder-covered debris fans at their mouths.

The upper Grand Coulee waterfall retreated some 21 miles northward, eventually destroying itself when it breached the divide with the Columbia River valley near the present site of the North Dam of Banks Lake! As the Ice Age Floods waned the lower Grand Coulee retreat ended at Dry Falls before it could continue into the Hartline Basin or upper Grand Coulee.

As wide and deep as the Grand Coulee is, it was insufficient to hold the entire Missoula floodwaters discharge. A continuous water surface, extending locally as wide as 15 miles across the entire flood complex, sent water down similar, but smaller, parallel coulees to the east and created spectacular loess (wind blown soils) islands, butte and basin scabland, and cataract-canyons that make the Grand Coulee one of the most interesting areas of the Channeled Scablands.



Soap Lake is a 95 foot deep, two-mile-long plunge-pool and flood-scoured depression located in the lower Grand Coulee. The lower Grand Coulee was created similar to the upper Grand Coulee above Dry Falls, when the Okanogan glacial lobe blocking the Columbia River near the present Grand Coulee Dam sent floodwaters churning through the Grand Coulee system, developing a retreating waterfall that began at the mouth of the lower Grand Coulee.

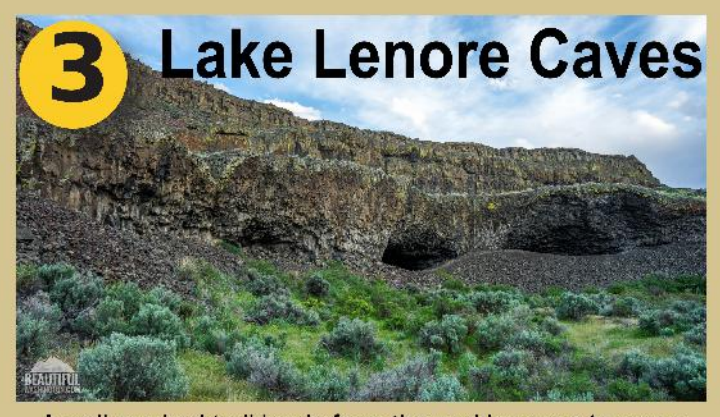
In wetter times following the ice-ages the lake stood much higher than at present against the large deposit of flood debris that dams the lower end of Soap Lake. Increasing aridity caused evaporation and concentration of dissolved minerals that turned Soap Lake into an alkali lake with a deep meromictic layer of mineral-rich water that has remained intact for thousands of years! Strong winds create waves that beat against the shore, forming a soapy froth from which the lake gets its name.

The mineral rich waters of Soap Lake are thought to have medicinal and therapeutic qualities. Native Americans have been using the Soap Lake area for millennia, and starting in the early 1900's spa resorts developed where thousands of tourists came annually to drink, bathe, and apply the mineral rich muds.

Missoula floodwaters and entrained debris exploded into the Quincy Basin from the mouth of the lower Grand Coulee in a torrent of water and rocks. Floodwater flows initially exceeded 60 mph and over 600 feet deep near the mouth of the lower Grand Coulee, then slowed rapidly southward as the flow spread out. Large boulders, buoyed by the dense and viscous sediment-charged floodwaters, were carried a mile or more before settling out of the slowing flow. The largest of these, "Monster Rock", is about 25 feet in diameter and weighs over 1500 tons! Monster Rock likely was ripped from the lower Grand Coulee and any jagged corners were rounded off as it tumbled along in the flood flow.

This 400-foot-tall abandoned waterfall cataract separates the head of the Lower Grand Coulee from the downstream edge of the Hartline Basin. The cataract rim extends much farther to the east than the alcoves and plunge pool lakes (Dry Falls and Green Lakes) visible from the Dry Falls Visitor Center viewpoint. A tall blade of basalt (Umatilla Rock) mostly obscures the Red Alkali-Green Lakes basin and the cataract rim of Monument Coulee on its east side. The Dry Falls complex is about 2.5 times taller than Niagara Falls and considerably wider with the farthest visible eastern rim about 1.2 miles away.

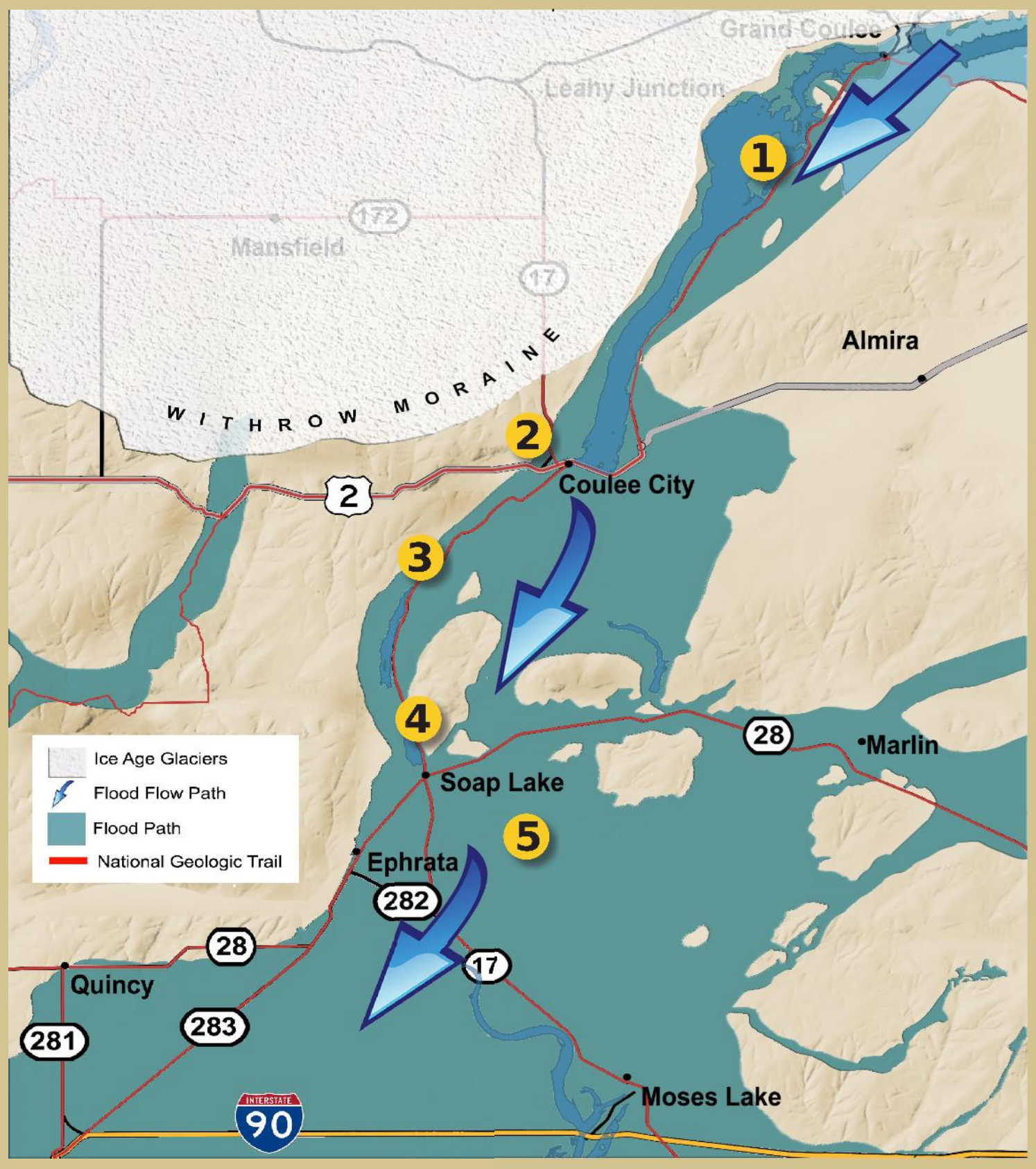
The "footprints" of the Ice Age Floods are unmistakable here. The semi-arid climate retards weathering and erosion of the flood features here, leaving the area looking much like it did when catastrophic floods ended about 15,000 years ago. The awesome size and power of those floods is difficult to imagine. The flood depth here was over 700 feet, with 400 feet of water below the rim and another 300 feet above! Flow velocities are estimated to have been close to 70 mph. At maximum flood flow the Dry Falls site was actually just a dip in the water surface (a subfluvial waterfall system) rather than a cascading waterfall like Niagara Falls.



A well-marked trail leads from the parking area to some of the caves where some petroglyphs still remain, and where, for at least 5,000 years, they furnished temporary overnight camps and storage for hunters and gatherers whose villages were located elsewhere along the Columbia River and its tributaries.

The lower (colonnade) and upper (entablature) cooling units of various individual Columbia River Basalt flows are visible here in the coulee walls. Contacts between flows are sometimes challenging to pick out. Some flows pinch out against older flows, perhaps where they cover an irregular surface or fill shallow valleys between flows. Multiple thin layers in a localized area may be the result of pulses of lava during a single eruptive event flowing out over a partially hardened prior pulse.

Lake Lenore and the rock shelter "caves" may have formed either simply by differential erosion in weak rock horizons, or by high velocity Missoula floodwaters preferentially excavating large blocks (mostly colonnade) from the coulee's basalt walls. Post-flood weathering created the talus slope that furnishes easy access to the caves.



The floodwaters sped up again near the south end of Quincy Basin where they roared down narrow escape routes in the Drumheller Channels area and through three major spillways (Crater, Potholes & Frenchman Springs Coulees) that lead westward into the Columbia River valley.

The boulder field here is one of several sites used by NASA scientists to anticipate conditions on Mars. Similar fan-shaped deposits on Mars resemble the Ephrata Fan and probably have a similar cause. About 90% of the rocks covering the Ephrata fan are basalt, torn from the nearby upstream basalt bedrock, and about 10% are granitic, derived from the floors of upper Grand Coulee, Northrup Canyon and areas further upstream. The value of such a site for Mars exploration is that one general locality would have samples of nearly every type of rock found further upstream.

This site was also investigated by Jet Propulsion Lab geologists to evaluate the feasibility of a similar landing site on Mars. The ideal site would have less than 1% of its surface covered by rocks one meter or more in diameter that could puncture the landing airbags or deflect the module, resulting in potential destruction or serious damage to the lander. Fortunately both Rovers landed at appropriate places and survived the landing

Find an interactive map and additional details online about these and other Ice Age features in the area at https://iafi.org/floodscapes/