# ICE AGE FLOODS

## LANDMARKS LEFT BEHIND


Garden of the Gods NNL, CO
Photo by P. Hernandez

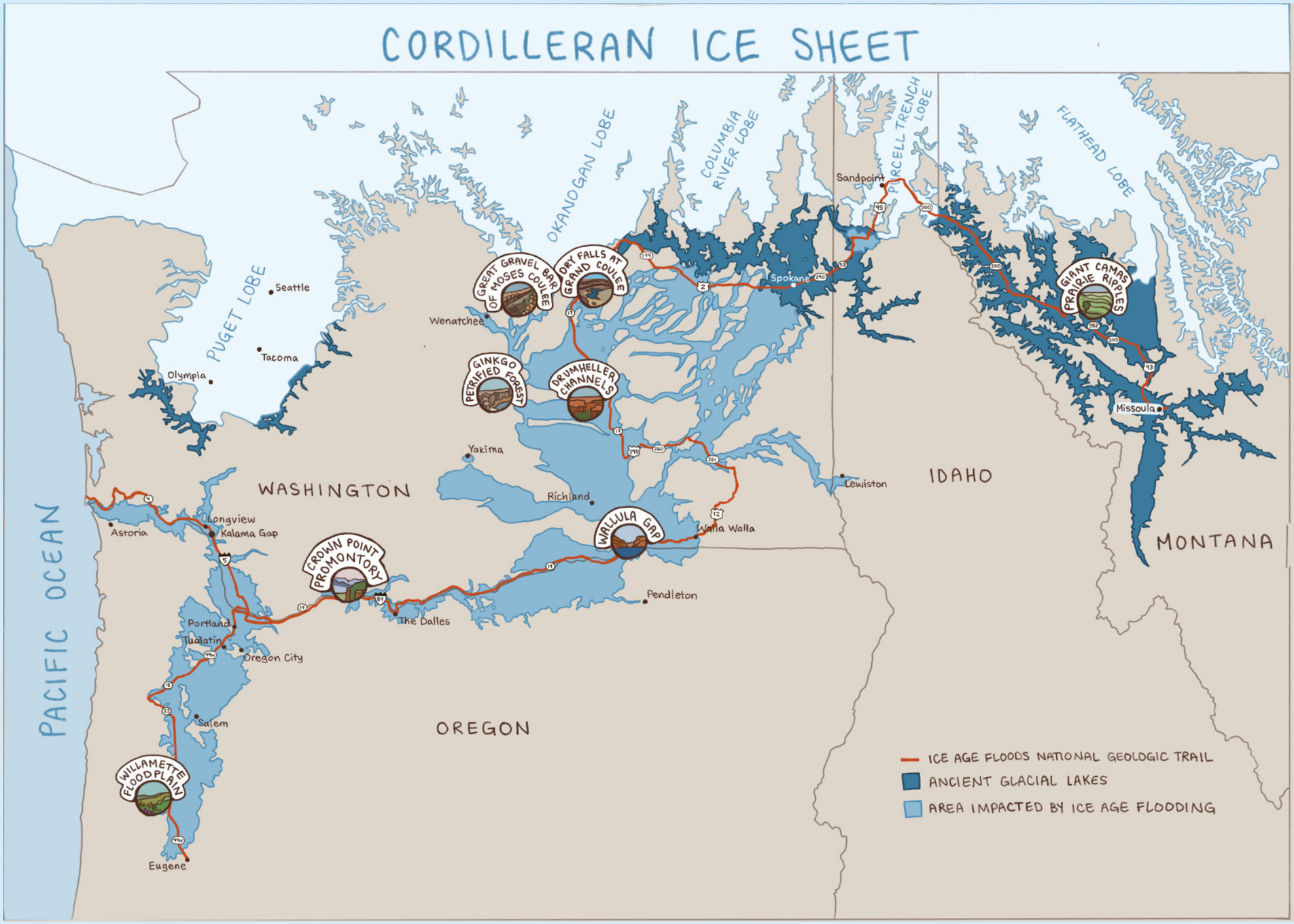
Point Lobos State Reserve NNL, CA
Photo by K. Stophel

The National Natural Landmarks Program recognizes and encourages the conservation of sites that contain outstanding biological and geological resources. Over 600 sites across the country have been designated by the Secretary of the Interior for their condition, illustrative character, rarity, diversity, and value to science and education. The National Park Service administers the program and works cooperatively with landowners, managers, and partners to promote conservation and appreciation of our nation's natural heritage. All eight sites featured in this handout are visible and/or accessible along secondary highways. Please go to https://www.nps.gov/iafl for more information about the Ice Age Floods trail.

To find out more, go to: www.nps.gov/nnlandmarks

National Natural LANDMARKS PROGRAM

Brochure developed and illustrated by Sander Moffitt for the National Natural Landmarks Program




## Ice Age Floods: Landmarks Left Behind

### Who

The National Natural Landmarks (NNLs) program showcases over 600 exceptional natural sites across the United States, including eight landmarks that tell the story of the Missoula Ice Age Floods.

### What

These eight NNLs illustrate the dramatic effects of cataclysmic flooding that occurred during the last Ice Age, revealing how powerful natural forces sculpted the region. The floods left behind breathtaking geological features, such as deeply eroded coulees, basalt columns, immense ripple marks, and ancient waterfalls.

### Where

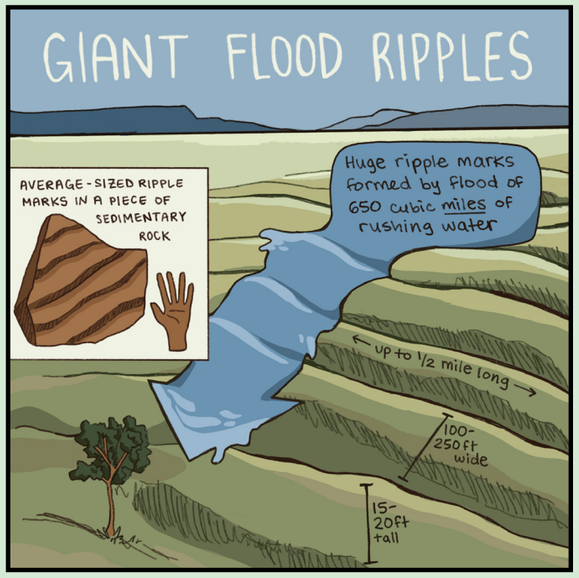
The landmarks are located along the Ice Age Floods National Geologic Trail, which spans Montana, Idaho, Oregon, and Washington. Together, they tell the story of the geologic processes that altered the landscape of 20,000 miles of the Pacific Northwest.

### When

At the end of the last Ice Age, approximately 18,000 to 15,000 years ago, lobes of the Cordilleran Ice Sheet in western Montana began to melt, forming enormous glacial lakes behind natural ice dams. As the pressure built, the ice dams burst. This unleashed a catastrophic wall of water that carved its way across the Pacific Northwest, dramatically reshaping extensive portions of the landscape. These floods occurred many times. Geologists still study the landscape to better understand the number and scale of these flood events.

### How

The scale of the gravel bars, ripple marks, and features of the channeled scabland both awed and stumped scientists in the early 20th century. How big a flood would it take to make these features? Where did all the water come from? How many floods occurred? Over decades, scientists pieced the story of the massive Ice Age floods together by reading the landscape. Today visitors can explore those same landscapes and gain an appreciation for the strength of natural forces.

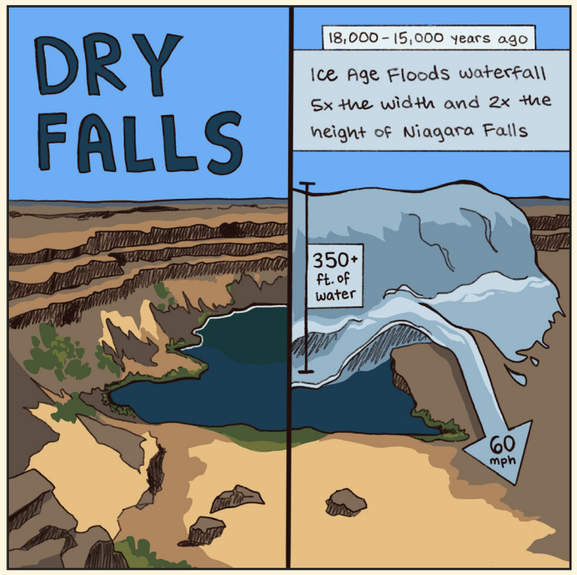



**Giant Flood Ripples - Glacial Lake Missoula NNL**

In Western Montana lies a striking testament to the Ice Age: the giant flood ripples of Glacial Lake Missoula. This massive lake was held back by the Cordilleran Ice Sheet around 15,000 years ago. When the ice dam failed, the lake emptied across the Columbia Plateau, draining waters up to 1,000 feet deep at a peak rate of 400 million cubic feet per second – comparable to 1500x the rate of the Columbia River. This devastating flooding sculpted immense flood-deposited bars and ripples.

Camas Prairie Basin showcases some of the most dramatic features of the Glacial Lake Missoula NNL, with ripple ridges towering 15-20 feet high, spreading 100-250 feet wide, and stretching up to half a mile. Best viewed from above, these ripples vividly illustrate the power of glacial floods.

NPS Photo - Glacial Lake Missoula

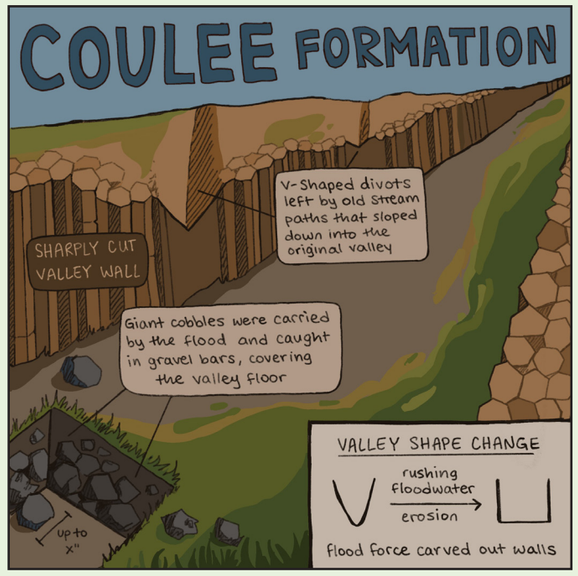



**Dry Falls - Grand Coulee NNL**

Roughly 250 miles west of the Glacial Lake Missoula giant flood ripples, the floodwaters poured over the lip of what is now Dry Falls. Floodwaters hundreds of feet deep and rushing over 60 miles per hour eroded the canyon upstream and formed a mile-wide, 350-foot-high waterfall–twice the height of Niagara Falls.

The repeated high-energy Ice Age floods rapidly plucked apart the bedrock basalt, significantly transforming the landscape. Today, the dramatic cliffs and cataract formations stand as a monumental record of the floods' immense force, earning the Grand Coulee NNL its national significance.

NPS Photo - Grand Coulee




**Coulee Formation - Great Gravel Bar of Moses Coulee NNL**

The Moses Coulee in Washington tells the story of the cataclysmic flooding that sculpted its sharp-edged canyon and deposited the Great Gravel Bar. Violent torrents of water weakened the basalt columns, plucking them off and carrying them away. This erosion transformed the valley into a steep-walled coulee (deep gulch or ravine). Today, V-shaped divots remain along the rim of the coulee, marking the locations of streams of ice sheet runoff that flowed into the valley before the Ice Age floods.

The floodwaters deposited a 3.2-mile-long, 200-foot-high tear-drop-shaped gravel bar, recognized as the largest flood-related bar in the region. The Great Gravel Bar of Moses Coulee NNL highlights the immense erosive and depositional forces of the Ice Age floods.

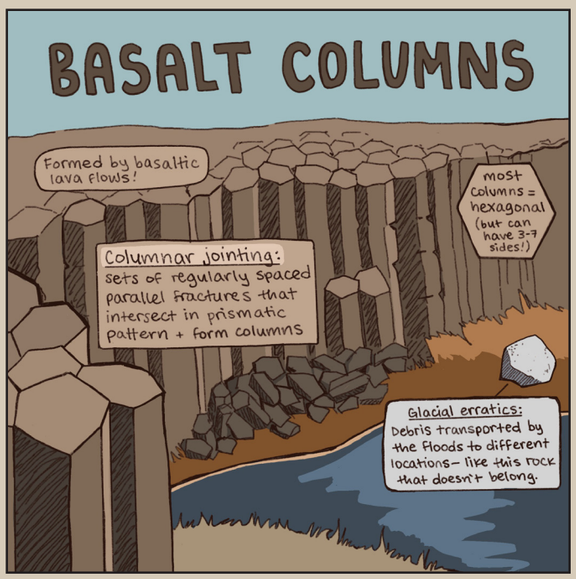
NPS Photo - Great Gravel Bar of Moses Coulee


**Butte-and-Basin Scabland - Drumheller Channels NNL**

The Drumheller Channels in central Washington showcase an extraordinary butte-and-basin scabland carved by raging Ice Age floods. As waters funneled through this area, they plunged 50 feet per mile, stripping away up to 400 feet of rock and sediment.

The resulting landscape is a labyrinth of steep-sided buttes and interconnected dry channels. Best viewed from the Drumheller Channels NNL viewpoint, this dramatic terrain exemplifies the transformative power of the Ice Age floods.

Photo by Rebecca Latson - Drumheller Channels

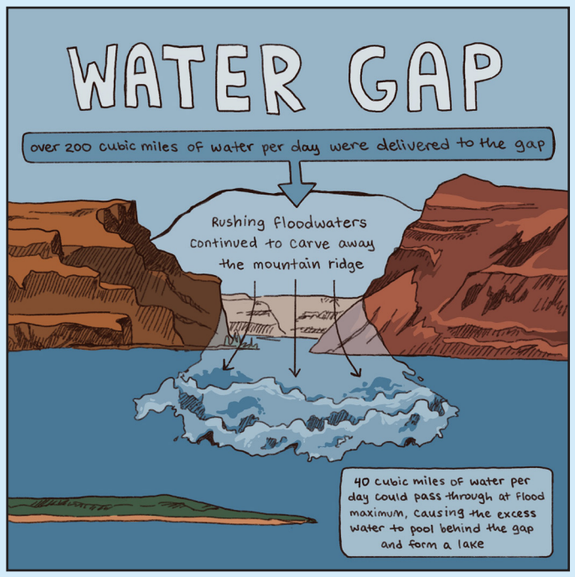



**Basalt Columns - Ginkgo Petrified Forest NNL**

The hexagonal basalt columns at Ginkgo Petrified Forest State Park are a striking reminder of the Columbia Basin's volcanic past. These columns—formed millions of years ago through columnar jointing as lava cooled and contracted—create geometric patterns of intersecting cracks at roughly 120-degree angles.

Striking examples of basalt columns can be seen from the park's visitor center grounds overlooking the Columbia River. Designated an NNL primarily for its diverse assemblages of Miocene petrified wood, this site also features hundreds of ice-rafted erratics, remnants of the Ice Age floods that reshaped the landscape.

Photo by T. Watson - basalt columns in Washington

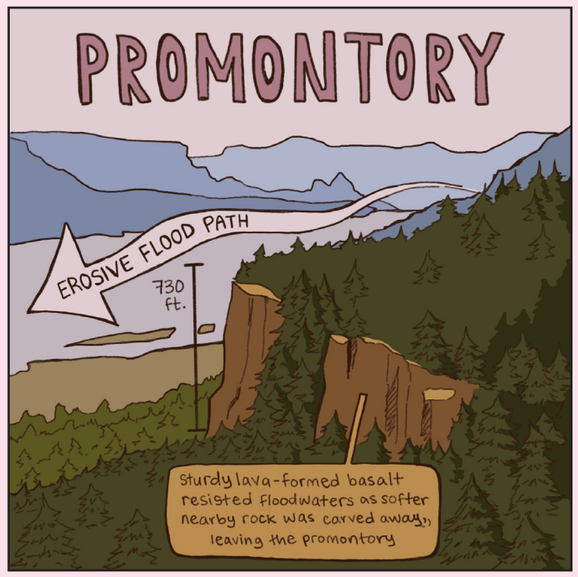



**Water Gap - Wallula Gap NNL**

Wallula Gap, a two-mile-wide basalt gorge in southeastern Washington, is a dramatic bottleneck carved by Ice Age floodwaters. With over 200 cubic miles of water arriving daily but only 40 cubic miles discharging, floodwaters backed up to form Lake Lewis, which reached depths of 1,200 feet.

Wallula Gap is the largest, most spectacular, and most significant of the several large water gaps through basalt anticlines in the Columbia Basin. Today, Wallula Gap NNL offers illustrative evidence of the magnitude of the Ice Age Floods, and can be seen along US 12 near Pasco, Washington.

NPS Photo - Wallula Gap

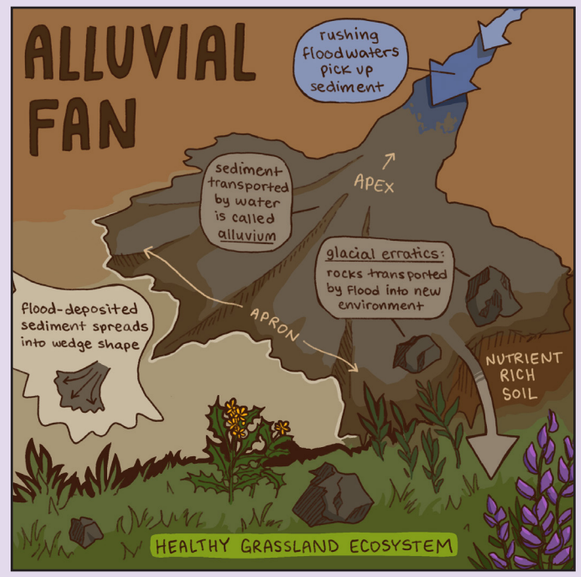



**Promontory - Crown Point NNL**

At nearly 730 feet above the Columbia River, northwestern Oregon's Crown Point provides a breathtaking vantage point over the steep and rugged Columbia River Gorge. Rushing floodwaters swept through the region, carving away softer conglomerate rock and sandstone. This exposed the erosion-resistant basaltic columns that shaped the Crown Point Promontory.

While Crown Point highlights the violent forces of Ice Age flooding, it also illustrates the gradual stream valley formation that occured as rivers cut through the rising Cascade Range. Crown Point NNL offers visitors an unparalleled view of this layered geologic story.

Photo by J. Miller - Crown Point Promontory




**Alluvial Fan / Plain - Willamette Floodplain NNL**

The fertile Willamette Valley in Oregon owes much of its richness to the Ice Age floods. As floodwaters surged through the Columbia River Gorge, they backed up behind the narrower Kalama Gap, creating a bottleneck effect similar to the one at at Wallula Gap. The waters slowed and spread out across the valley floor. This created a vast alluvial fan plain: a 200-foot-thick layer of nutrient-rich sediment deposited by multiple, interconnected alluvial fans.

These deposits, combined with the valley's temperate climate, have nurtured thriving grasslands for thousands of years. The Willamette Floodplain NNL, located in the William L. Finley National Wildlife Refuge, protects this ecological legacy.

Photo by E. Alverson & L. Kolakowsky - Willamette Floodplain