Exploring Features of Ice Age Floods Near Richland, Washington

The two routes in this road guide pass geologic features formed by the Ice Age floods, as well as many of the local wineries and vineyards.

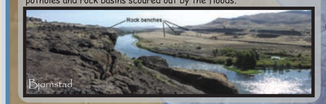
Outer Route

Mile

- **0.0** Start at the City of Richland's Columbia Point Marina Park, at the east end of Columbia Pt. Dr. and head west.
- **1.1** Turn left onto George Washington Way and then take the I-182 W ramp toward Yakima.
- **2.0** Take Exit 4 and merge on to WA-240 W toward Vantage.
- **3.4** Turn left on Dupontail Rd., then right; note younger slackwater deposits (brown) over older flood gravels (gray) in the bluff across the Yakima River (1). Return to highway 240 and proceed north.
- **6.6** Turn left onto WA-240 W toward Vantage.
- **12.4** At the turnout on the right side of WA-240, note the views of Rattlesnake Mountain, Lake Lewis Isles (2), and dune fields stabilized by vegetation. At the SE end of Rattlesnake Mountain is a landslide that occurred during the Ice Age.
- **14.7** Note Wanawish Dam on the left.
- **15.2** Turn left onto WA-225/Horn Rd. toward Benton City.
- **15.9** ••••• **Side Trip:** Turn left into Horn Rapids Park, turn left and proceed toward information kiosk and bathrooms. Kiosk contains information on local wildlife and vegetation, the Longmire Wagon Trail and Camp Columbia, a WWII federal prison that was present at Horn Rapids. A paved interpretive nature walk near the kiosk has signs describing the local vegetation. Near the boat launch is a bluff of ice-age flood gravels. Note the many different rock types in the exposure. Black basalt is the only native rock here. Return to Highway 225 and continue on Outer Route.
- **16.5** Note basalt outcrop on left across Yakima River.
- **19.0** Park and Hike: Rattlesnake Slope Trail System on public lands of the Washington State Department of Fish and Wildlife. See description in "On the Trail of the Ice Age Floods" by Bruce Bjornstad, 2006 (p. 198).
- **22.3** Note basalt outcrop and views of Red Mountain on the left, Horse Heaven Hills running from left to right directly ahead, and to the right, hummocks of the Chandler Butte landslide (3).
- **26.7** ••••• **Side Trip:** Turn left onto WA-224 toward West Richland and Red Mountain wineries (see Inner Route).
- **26.8** Follow signs to Kiona; proceed under freeway (I-182).
- **26.9** Proceed across train tracks on Webber Canyon Rd..
- **27.4** ••••• **Side Trip:** Turn right on McBee Rd. for a vista point and hike along the spine of the Horse Heaven Hills. Proceed up McBee Rd.. Note Mount St. Helens "Set S" ash is in slackwater flood deposits along the west side of the canal (0.3 miles). The double layer of ash is dated at about 15,400 years old. Note exposures of wind-blown sand and silt (loess) in road cut on left side of road. Once at the top of the ridge, you can park on the right and proceed along the ridge by foot or high clearance vehicle. Note the great views (Benton City, Rattlesnake Mountain, Lake Lewis Isles, gravel bar that diverted the Yakima River, present-day course of the Yakima River, White Bluffs, Blue Mountains near Walla Walla, and vineyards on Red Mountain). Additional views include the Badlands, Chandler Butte landslide complex, basalt cliffs above the Yakima River, and more distant Cascade volcanoes (Mt. Adams, Mt. Rainier, and Mt. Hood). Return to the Outer Route or continue to the radio towers farther along the ridge. On the return trip there are views of A&B Gravel Pit, an active gravel mining operation located in the bar that clogged/changed the flow of the Yakima River (Bjornstad 2006, p. 111). The Yakima River previously flowed through Badger Coulee, a 15-mile long valley. During the Ice Age floods, the coulee became plugged with flood deposits, causing the Yakima River to be diverted to its present course.
- **27.5** Continue east on Webber Canyon Rd., note slackwater deposits in roadcuts with exposures of Mount St. Helens "Set S" ash (4).
- **28.4** Turn left onto Badger Rd..
- **30.0** Note slackwater flood deposits along railroad cut.
- **31.7** Note Cañon del Sol Winery on the right.
- **33.1** ••••• **Side trip:** Turn left onto Dallas Rd. to visit the Goose Ridge and Gamache Wineries, and the Badger Mountain Ridgeline Trail. First, proceed on Dallas Rd. 3.0 miles to Goose Ridge Winery (3.0 miles). Continue another 0.2 miles, and pull off to the right for the Badger Mountain Ridgeline Trail. Proceed up the dirt road to the unimproved parking area on the right, from which you can hike or bike. Gated roads to the right and left are private. From Dallas Rd., proceed another 0.3 miles to Gamache Winery. The tasting room is under the freeway overpass on the right. Return to Badger Rd. to continue the Outer Route tour.
- **34.2** Note Eagle Butte on left, one of the Lake Lewis Isles (2).
- **37.9** Note large granite erratic on south (right) side of Badger Coulee (5).
- **40.5** Take the I-82 E ramp toward Umatilla.
- **44.4** Take exit to US-395 N toward Kennewick and Spokane.
  ••••• **Side Trip:** Do not exit. Continue for another 1.3 miles then take exit to CR-397. Merge left onto S. Finley Rd. (8.8 miles). Note that you are now crossing the Olympic-Wallowa Lineament (OWL), a major geologic structure. Merge left onto S. Sloan Rd. (0.9 miles) then turn right onto E. Riek Rd (0.3 miles), right again onto S. Piert Rd. (1.0 miles), and then left onto S. Meals Rd. (0.4 miles). Turn left onto Ayers Rd (4.4 miles) that dead-ends after 2.0 miles. Park and hike to the top of Wallula Gap (6) (Bjornstad 2006, p. 206). Return to US-395.

9 The Badlands

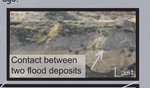
"The Badlands" is a spectacular erosional flood feature located along the Yakima River between Benton City and Prosser. The Badlands formed along a constriction in the Yakima Valley. Floodwaters racing UP the valley from the Tri-Cities were forced to flow faster through this bottleneck, and thus were more effective at eroding the basalt bedrock. Along with the eroded rock benches are several deep potholes and rock basins scoured out by the floods.



1 Yakima Bluffs

Evidence for two very old floods is exposed in bluffs along the banks of the Yakima River. Flood gravels with normal magnetic polarity and covered with a layer of soil-forming caliche indicate that one of the floods occurred over 200,000 years ago.

Below this are several slackwater flood rhythmites with reversed magnetic polarity deposited by a flood at least 780,000 years old, the age of the last major magnetic reversal.

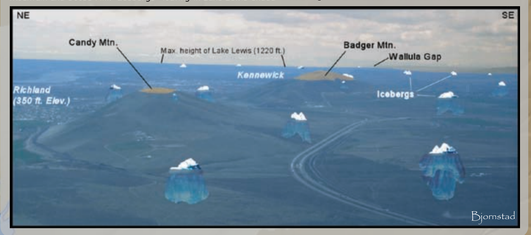


8 Smith Canyon Coulee

Lower Smith Canyon Coulee is a dry, shallow coulee that carried floodwaters coming off the Channeled Scabland into the Snake River valley northeast of the Tri-Cities. Older flood deposits at the floor of the coulee consist of basaltic flood gravels associated with an earlier Scabland flood. Above the flood gravels are slackwater flood deposits, laid down during the last flood(s) that flowed around the Channeled Scabland via the Columbia River valley.

2 Lake Lewis Isles

Lake Lewis Isles is the name given to several hills south of the Tri-Cities whose crests rose above maximum flood level (~1,200 feet) during Ice Age flooding, making them islands in Lake Lewis. Only the very tops of Badger and Candy Mountain rose above temporary Lake Lewis. Other temporary islands included Red Mountain and Goose Hill. Icebergs floating in Lake Lewis ended up getting pushed to margins of the Pasco Basin including the calmer waters around these islands. Calmer water also allowed fine-textured sediment, mixed with the floodwater, to settle out of suspension during flooding. This sediment is partially responsible for producing some excellent wines, including the area around Red Mountain.



3 Chandler Butte Landslide

The Chandler Butte landslide complex is a huge area of land along the north slope of the tall and steep Horse Heaven Hills between Benton City and Prosser. The landslide is apparent from the many low rounded hummocks that cover the hillside. Many separate sliding events occurred here, which likely occurred at the end of, or soon after, periods of Ice Age flooding.

The sudden addition of hundreds of feet of floodwater probably over-stressed the Earth's crust, which possibly resulted in earthquake-triggered landslides. Perhaps it is not a coincidence that sliding occurred here where the valley narrows and stronger flood currents could undercut the steep north flank of the Horse Heaven Hills.

4 Badger Coulee

Badger Coulee is a streamless, 15-mile-long valley marking the former course of the Yakima River along the Horse Heaven Hills just south of the Tri- Cities. During the Ice Age floods, flood deposits plugged the coulee and diverted the Yakima River north away from Badger Coulee. The most recent flood deposits in Badger Coulee consist of slackwater rhythmites.

Rhythmites are visible in roadcuts, especially along the west end of Badger Road where 20 rhythmites are exposed.

Toward the top of the slackwater beds lies a double layer of Mount St. Helens ash ("set S"), dated at about 15,400 years old. Far below slackwater rhythmites in Badger Coulee are older, gravelly flood deposits, signifying that much earlier, faster floodwaters once passed through Badger Coulee.

5 Erratics and Bergmounds

During Ice Age floods icebergs that floated in the Pasco Basin left behind ice-rafted debris. The debris included isolated, misplaced boulders, composed of rocks totally foreign to this area, called erratics. As larger icebergs melted, they sometimes left behind clusters of multiple erratics or distinct piles of ice-rafted debris, called bergmounds. In the Tri-Cities area erratics are found to an elevation of about 1,200 feet, an indication of the maximum depth for the floods. Granitic erratics, the most common type, are easy to spot in this region because of their light color. They stand out in stark contrast to the dark, local basalt and sparse, low-growing vegetation.

This particular erratic in Badger Coulee is estimated to weigh 100 tons and is located at an elevation of 850 feet, several hundred feet above the adjacent valley bottom (Bjornstad 2006, p. 110).

6 Wallula Gap

The floods only exodus from the Pasco Basin to the Pacific Ocean, was through this extremely narrow opening. During the largest Ice Age floods, almost twice as much water entered the 2-mile-wide Gap than could pass through. As a result floodwaters backed up behind this bottleneck forming temporary Lake Lewis, which would have drowned the Tri-Cities under 800 feet of water. Lake Lewis lasted only a week or less; the amount of time it would take for all the water to drain through the gap.

An ice-rafted erratic located high above the west side of Wallula Gap. This misplaced, granitic boulder melted out long ago from an iceberg carried by the Ice Age floods.

7 Wallula Gap

Wallula Gap, a natural water gap of the Columbia River through the Horse Heaven Hills, is one of the most significant and spectacular flood features along the floods' route. It is also a National Natural Landmark.

Outer Route cont.

Mile

- **51.9** Merge onto I-182 E/US-12 E. Stay on US-12 E for 18.8 miles crosses the Snake River and Walla Walla River. Note Wallula Gap (7).
- **55.1** ••••• **Side Trip:** Turn left on Kahlotus Rd. Notice flood deposits in Smith Canyon Coulee (3.3 miles) (8). Return to US-12 E.
- **70.7** Turn right onto US-730 and proceed into Wallula Gap.
- **72.2** Turn left into parking area and Two-Sisters Interpretive Sign. Return to Richland via US-12 W/I-182 W.

Inner Route and side trip to The Badlands

Mile

- **0.0** Start at the intersection of Van Giesen St/WA-224 and WA-240. Head west on WA-224 toward West Richland.
- **2.3** Note Flat Top Hill on the left. This hill was completely under water during maximum flood stages of Lake Lewis. A number of Columbian Mammoth skeletons (the state fossil of Washington) have been found in slackwater flood deposits in this area.
  ••••• **Side Trip:** The park here provides good hiking access to experience some great regional views.
- **5.6** Note Red Mountain on the right and Candy Mountain on the left. During the largest floods, only the tops of these local ridges were above the floods and are two of the Lake Lewis Isles (2). Return to WA-224.
- **5.9** Note the glacial erratic on side of the low hill to the left. These erratics were rafted in on icebergs (5).
- **8.3** Note Goose Hill on the left, another Lake Lewis Isle (2).
- **8.6** ••••• **Side Trip:** Turn right onto Sunset Rd., visit the Red Mountain AVA wineries, including Seth Ryan, Kiona, Hedges, and Hightower. Return to WA-224.
- **9.4** Note the basalt outcrop on the right. This volcanic rock is the bedrock of all the ridges and hills in the Pasco Basin.
- **9.5** ••••• **Side Trip:** Turn right onto DeMoss Rd. to visit other Red Mountain Wineries such as Terra Blanca and Oakwood. Notice the gray fine-grained slackwater flood deposits in the road bank.
- **9.9** Turn right onto WA-225 toward Benton City. Cross the bridge over the Yakima River. This river once flowed east through the 15-mile Badger Coulee to join the Columbia River. However, ice age flood deposits between Goose Hill and the Horse Heaven Hills caused the Yakima River to divert all the way through West Richland before joining the Columbia.
- **11.8** Proceed on WA-225 into Benton City. Turn left onto the Old Inland Empire (OIE) Hwy..
- **12.5** Note the fine-grained, layered slackwater deposits on both sides of the road. Watch for white layers of Mt. St. Helens ash (dated at about 15,400 years before present).
- **13.1** Notice the contact between older slackwater deposits and younger high energy gravels.
- **13.4** Enter "The Badlands" carved by the floods. Here the underlying basalt was eroded by the floods causing spectacular topographical features (9).
- **14.5** Good exposures of basalt badlands on both sides of the road.
- **16.2** Thick beds of slackwater deposits.
- **16.3** Heart of The Badlands. Rushing waters funneled around the Lake Lewis Isles and backed up the Yakima Valley, scouring out the basalt formations in front of you.
- **17.3** Irrigation ditch. Watch for ancient landslides on the Horse Heaven Hills escarpment across the valley.
- **19.2** District Line Rd.- Turnaround. The Chandler landslide complex (3) is visible on the Horse Heaven Hills escarpment. Retrace route to junction of WA-225; turn right to access I-82 E toward Richland.
- **24.4** Exit right onto I-182 E toward Richland.
- **27.0** ••••• **Side Trip:** To wineries and Badger Moutain Canyon Trail. Take Exit 3 and turn right onto Queensgate Dr. toward Keene Rd.. Turn right onto Columbia Park Trail for Tagaris, Barnard Griffin, and Bookwalter Wineries. Return to Queensgate Dr. and turn left onto Keene Rd., and then right onto Shockley Rd.. Follow the road to the left, turning onto Queensgate Dr.. Park and Hike access to Badger Mountain Canyon Trail is at the park at the end of Queensgate Dr.. Return to Richland.

Legend:

Height from maximum ancient Lake Lewis shoreline, in feet

- Over 1000
- 800 to 1000
- 600 to 800
- 400 to 600
- 200 to 400
- 0 to +200
- 0 to -200
- -200 to -400
- -400 to -600
- -600 to -800
- Below -600

- Outer Route
- Inner Route
- Side Trip

0 0.5 1 Miles

N

winery

lodging

ICE AGE FLOODS INSTITUTE

Richland

Map shows Cordilleran Ice Sheet and areas flooded during the Ice Age. Modified from O'Connor, J.E., and Costa, J.E., 2004, The world's largest floods, past and present- Their causes and magnitudes: U.S. Geological Survey Circular 1254, 13 p.

Location of Richland, relative to Washington's American Viticultural Areas (AVAs). Note relationship of the AVAs to areas impacted by the Ice Age floods. (www.washingtonwine.org)

Origin of the Ice Age floods

Driving through southeastern Washington, one can't help but notice the unusual landscape. When geologists first studied this area they recognized that glaciers and flowing water had played a large part in shaping the extraordinary landscape with its canyons (coulees), buttes, dry cataracts, boulder fields, and gravel bars. However, it took one geologist, J Harlen Bretz, to recognize that only huge cataclysmic floods could account for the phenomenal size and distinctive characteristics of the landforms.

Approximately 15,000 to 20,000 years ago, glacial lake outburst floods (jökulhlaups), principally from Glacial Lake Missoula, inundated eastern Washington. Glacial Lake Missoula formed at the end of the last Ice Age when a lobe of the Cordilleran Ice Sheet blocked the a tributary of the Columbia River along the Idaho-Montana border. Although we don't know the exact height of the ice dam, high-water marks on the mountainsides near Missoula, Montana indicate a depth of approximately 2,000 feet.

Every few dozen years, waters of the huge lake built to the point that the ice dam would fail. Each time the lake waters burst through, they caused catastrophic flooding throughout southeastern Washington. The last of these floods occurred about 15,000 years ago, as the front of the ice sheet finally retreated north into Canada.

This group of erratics on Red Mountain is evidence that an iceberg grounded on this hillside during one of the Ice Age floods. These rocks are granitic, much lighter in color than the brown to black volcanic basalt bedrock originating in the Columbian Basin. Therefore, the boulders must have come here from outside the basin.

What geologic features were created by the floods?

During the largest floods, approximately 500 cubic miles of water and glacial ice swept over the Washington landscape, creating tremendous channels and waterfalls as the water scoured the soil from the landscape and eroded away the basalt bedrock. The force of the rushing water was so great that the entire Lake Missoula may have drained in two days.

Icebergs (most likely from the breached ice dam), carrying large boulders of foreign rocks ("erratics") floated on the muddy flood-waters. The floating icebergs deposited erratics hundreds of miles from their origin, and hundreds of feet above the valley floor.

Illustration by Stev H. Ominski

As floodwaters swept overland, they encountered numerous flow restrictions that caused the flood waters to temporarily stall. This allowed sediment to form huge gravel bars and giant current ripple marks.

The most important flow restriction for the repeated emptying of the glacial lakes was Wallula Gap, a National Natural Landmark. This was the only outlet for flood waters to reach the ocean. Backed-up water repeatedly formed a giant temporary lake, Lake Lewis, which at times rose to an elevation of 1200 ft, submerging most of the Tri-Cities area with up to 900 ft of water.

These floods are a remarkable part of our natural heritage and have profoundly affected the geography and ways of life in the region. The legacy of the floods includes not only stark scabland and dramatic dry coulees and cataracts but also exceptionally fertile, productive farmland, and significant wetlands and aquifers. Today in the Tri-Cities area, we see evidence of how the floods carved out more than 50 cubic miles of earth, deposited hills of gravel, and scattered huge misplaced boulders high on the surrounding ridges. Follow the road guides provided here to experience some of these remarkable features for yourself.

For additional information about the Ice Age Floods visit www.iceagefloodsinstitute.org. Most geologic features in this road guide are described in more detail in a recent geologic field guide titled: "On the Trail of the Ice Age Floods" by Bruce Bjornstad.

Wineries in the vicinity of in the City of Richland

Richland Wineries

1. Barnard Griffin Winery
878 Tulip Lane
Richland, WA 99352
509-627-0266
www.barnardgriffin.com/

2. Bookwalter Winery
894 Tulip Lane
Richland, WA 99352
509-627-5000
www.bookwalterwines.com/

3. Gamache Vinters
23509 North Dallas Road
Richland, WA 99352
(509) 628-8156
www.gamachevintners.com

4. Goose Ridge Estate
16304 North Dallas Road
Richland, WA 99352
(509) 628-3880
www.gooseridge.com

5. Tagaris Winery
844 Tulip Lane
Richland, WA 99352
509-628-1619
www.tagariswines.com/

Kennewick Wineries

6. Badger Mountain Vineyard & Powers Winery
1106 S. Jurupa
Kennewick, WA 99338
509-627-4986
www.badgermtnvineyard.com/

7. Moonlight Sparkling Wine Cellars
4704 W. 12th Ave.
Kennewick, WA 99338
509-735-7237
www.moonlightcellars.com/

Pasco Wineries

8. Balcom & Moe Vineyard
2520 Commercial Ave.
Pasco, WA 99301
509-547-7307
www.owt.com/nwwines/balcom/

9. Claar Cellars
1081 Glenwood Road
Pasco, WA 99301
509-266-4449
www.claarcellars.com/
(north of map area)

10. Gordon Brothers Family Vineyards
671 Levey Road
Pasco, WA 99301
509-547-6331
www.gordonwines.com/

11. Preston Premium Wines
502 E. Vineyard Drive
Pasco, WA 99301
509-545-1990
www.prestonwines.com/

Benton City / Kiona Wineries

12. Blackwood Canyon
53258 N. Sunset PR NE
Benton City, WA 99320
509-588-7124
www.blackwoodwine.com/

13. Buckmaster Cellars
35802 Sunset Rd.
Benton City, WA 99320
509-628-8474
www.buckmastercellars.com/

14. Cañon de Sol
46415 E. Badger Road
Benton City, WA 99320
509-588-6311
www.canondesol.com/

15. Chandler Reach Vineyards
9506 W. Chandler Rd.
Benton City, WA 99320
509-588-8800
www.chandlerreach.com/

16. Fidelitas
48313 N. Sunset Road
Benton City, WA 99320
(509) 521-4433
www.fidelitaswines.com

17. Hedges Family Estate
53511 N. Sunset Road
Benton City, WA 99320
509-588-3155
www.hedgesfamilyestate.com/

18. Hightower Cellars
19418 E. 583 PR. N.E.
Benton City, WA 99320
509-588-2867
www.hightowercellars.com/

19. Kiona Vineyards Winery
44612 N. Sunset Road
Benton City, WA 99320
509-588-6716
www.kionawine.com/

20. Oakwood Cellars
40504 North Demoss Road
Benton City, WA 99320
509-588-5332
www.oakwoodcellars.com/

21. Sandhill Winery
48313 N. Sunset Road
Benton City, WA 99320
509-588-2699

22. Seth Ryan Winery
35306 Sunset Rd.
Benton City, WA 99320
509-588-6780
www.sethryan.com/

23. Tapteil Vineyard Winery
20206 E 583 PR NE
Benton City, WA 99320
509-588-4460
www.tapteil.com/

24. Terra Blanca Vintners
34715 North DeMoss Road
Benton City, WA
509-588-6082
www.terrablanca.com/

Wine and Geology

Close to the Columbia River, where the floodwaters were most energetic, the soil is very coarse with lots of gravel and boulders. Farther up the ridges and tributary valleys, where the floodwaters were much calmer, the soil is finer-grained. In many cases, the flood deposits and/or eroded basalt surfaces are overlain by wind-blown sand or silt (loess) derived from the Ice Age flood deposits.

Finer-grained soils seem to produce a little more earthiness and minerality in the wines, while those in the coarser sandier soils produce more purity of fruit.

The colorful maps to the left illustrate the strong correlation between the location of the Eastern Washington AVAs and those areas impacted by the Ice Age floods.

Eastern Washington's sunny, desert-like climate is also ideal for growing grapes. The area annually boasts more than 300 days of sunshine making it popular with vintners.

In the summer, hot sunny days followed by cool nights allow the fruit to ripen on the vine while achieving good acidic balance. Annually, the region receives only six to seven inches of rain, so many vineyards rely on irrigation systems. This climate and the nutrient-poor, well-drained soils permit vintners to control the amount of water and nutrients that the vineyards receive, and thus they have great control on when and how to stress the vines. Vines that are stressed by lack of nutrients or water have to work harder and are known for producing more intensely flavored grapes.

So, while you're surrounded by Washington's wine country, take time to look for evidence that enormous, ancient floods created the land that supports so many vineyards.

What is terroir?

Terroir is a French term for earth, or soil. However, in the wine industry, it not only includes reference to the type of soil (chalky, claylike, gravelly, sandy), but also to other geographic factors that might influence the quality of the finished wine such as altitude, position relative to the sun, angle of incline, and water drainage.

The geologic history of Eastern Washington State, particularly that of the Ice Age floods, and the way it has affected the soils and geographic features of Washington's vineyards, is integral to the terroir of Washington wines. Wine Press Northwest's website (www.winepressnw.com) quotes Dr. Alan Busacca as stating:

"The history of Glacial Lake Missoula and the Channeled Scablands is a fabulous geologic story and one that really sets the Northwest apart from any other place on Earth. ... The entire agricultural potential of Eastern Washington was created by these events."

American Viticultural Areas

Washington State has nine federally recognized American Viticultural Areas (AVAs) or appellations, eight of which are located in Eastern Washington. Richland, one of the Tri-Cities, is centrally located in the heart of Eastern Washington's wine country, lying within or adjacent to all eight of Eastern Washington's AVAs, with nearly 60 wineries located within an hour's drive.

One of the requirements in specifying an AVA is evidence that growing conditions such as climate, soil, elevation, and physical features are distinctive (a.k.a. terroir). Topography and soils of the Tri-Cities area below about 1000 feet in elevation are direct products of the Ice Age floods. The floods created lots of benches or terraces that promote cold air drainage away from the vineyards.

They also deposited vast amounts of nutrient-poor sediments that contain very little clay and promote balance between moisture retention and good water drainage. The unique well-drained soils, as it turns out, are nearly perfect for growing wine grapes (Wine Press Northwest).

Grape vines thrive on this flat, dry land sculpted by the floods. In the upper right photo, an ice-rafted erratic sits in the midst of a vineyard and in the bottom right photo, a local vineyard grows on sands and silts deposited during flooding.

Further Information:

If you're interested in further exploring the Ice Age floods, start with these resources:

Books

Cataclysms on the Columbia, by John Eliot Allen and Marjorie Burns, with Sam C. Sargent, 1986. This is a popular book on the Ice Age floods, with a focus on regions outside the mid-Columbia Basin.

On the Trail of the Ice Age Floods: A Geological Field Guide to the Mid-Columbia Basin, by Bruce Bjornstad, 2006. An in-depth guidebook to viewing evidence of the Ice Age floods in Washington's Columbia Basin.

Glacial Lake Missoula and its Humongous Floods, by David Alt, 2001. This is a good introductory book on the subject that serves as an Ice Age floods tour guide.

Mammoth bones found in flood deposits in W. Richland.

Video

Sculpted by Floods: the Northwest's Ice Age Legacy. This hour-long video was produced by KSPS, the public television station in Spokane and is a great primer on the floods.

Get the Dirt on Wine. This 90-minute documentary tells the awesome story behind the Washington State wine label beginning with the end of the last great Ice Age and how events from over 15,000 years ago contributed to the award winning wines that are being produced in Washington State today.

Mystery of a Megaflood. With the help of stunningly realistic animation, NOVA takes viewers back to the Ice Age to reveal what happened when the ice dams that held back Glacial Lake Missoula broke, unleashing titanic floods that greatly affected regional wildlife.

Accommodations in the City of Richland

1. Bali Hi Motel
1201 George Washington Way
Richland, WA 99352
509-943-3101

2. Clarion Hotel and Conference Ctr.
1515 George Washington Way
Richland, WA 99352
509-946-4121

3. Courtyard by Marriott
480 Columbia Point Dr.
Richland, WA 99352
509-942-8400
www.mariott.com

4. Desert Gold Motel & RV Park
611 Columbia Park Trail
Richland, WA 99352
(509) 627-1000
www.wrightsdesertgold.com

5. Economy Inn
515 George Washington Way
Richland, WA 99352
509-946-6117

6. Hampton Inn
486 Bradley Blvd.
Richland, WA 99352
509-943-4400
www.northwestinns.com/richland.html

7. Haney's Inn
2153 Stevens Drive
Richland, WA 99354
(509) 375-5058

8. Holiday Inn Express & Suites
1970 Center Parkway
Richland, WA 99352
509-737-8000
www.hiexpress.com

9. Horn Rapids RV Resort
2640 Kingsgate Way
Richland, WA 99354
(509) 375-9913
www.hornrapidsrvresort.com/

10. Motel 6
1751 Fowler Street
Richland, WA 99352
(509) 783-1250
www.motel6.com

11. Paragon Corporate Housing
2455 George Washington Way
Ste. D 114
Richland, WA 99354
(509) 943-0500
www.paragoncorporatehousing.com

12. Red Lion Hotel Richland
802 George Washington Way
Richland, WA 99352
509-946-7611
www.redlion.com

13. Richland Days Inn
615 Jadwin Ave.
Richland, WA 99352
509-943-4611

14. Shilo Inn
50 Comstock St.
Richland, WA 99352
509-946-4661
www.shiloinns.com

For information on hotel room availability in Richland, contact the Tri-City Visitor and Convention Bureau at (509) 735-8486 or http://www.visittri-cities.com

These photos show the variety of features found in the Columbia Basin as a result of the floods- thick sand and silt deposits, buried mammoth fossils, flat well-drained land, and silts containing clastic dikes. Photos by G.V. Last.

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Team Battelle (regionaloutreach.pnl.gov/team-battelle) is a staff-driven, volunteer program, which includes Battelle staff, their families and retirees. Team Battelle's mission is "to impact positively the quality of life in communities where Battelle staff live and work by supporting and initiating volunteer-driven programs and activities that meet the community's needs, capitalize on staff's interests, and are consistent with Battelle's corporate citizenship priorities."

The **Ice Age Floods Institute** (www.iceagefloodsinstitute.org) is a nonprofit, volunteer-based organization that is committed to educating about and expanding awareness for the Ice Age floods as a significant part of the nation's, and the world's, natural heritage. The Institute sponsors field trips and lectures; facilitates the exchange of information among interested individuals, organizations and agencies; and works to expand the range of interpretive resources and materials available to the public. The Lake Lewis Chapter is based in the Tri-Cities, Washington, and represents south-central and southeastern Washington and the adjacent areas in Oregon and Idaho.

Exploring Features of Ice Age Floods Near Richland, Washington