

# Summary for Spokane County WRIA 54 2012-2013

## *Subsurface Projection of the Stratigraphy of the Columbia River Basalt Group and Paleodrainages in the West Plains Area*

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### **Introduction**

Understanding the extent and orientation of the Columbia River Basalt Group in the West Plains of Spokane County is paramount as they host multiple groundwater aquifers. We attempted to gather data to better project the upper contacts of significant CRBG units. To complete tasks we analyzed a number of samples from the field and water/monitoring wells. Analyzed stratigraphic sections and wells act as benchmarks for CRBG stratigraphy, which is vital to our understanding of the distribution of the basalts and paleodrainage interpretation in the West Plains.

Two of the wells that we analyzed are located just outside the boundary of WRIA 54; however, the information is needed to complete the task. One of the wells is Water Well #5 in the City of Cheney and is a major portion of Reidel (2005), who advanced geochemical discrimination in the CRBG. In order to project the CRBG stratigraphy from these two wells we also collected and have submitted numerous well logs located along the borders and also in adjacent WRIA areas, namely WRIA 34 (Palouse) and WRIA 56 (Latah/ Hangman).

### **TASK I – Administration**

Deliverables for this tasks consisted of informal Quarterly Reports that were e-mailed to Michael Hermanson with Spokane County. This task also included working with EWU faculty and staff to better the project and working with local ArcGIS experts to complete the needed tasks. It also required the dismissal of Mike Hamilton, L.G. due to poor communication skills, he was listed on the contract.

### **TASK II – Geochemical Discrimination & West Plains Database**

#### **Methods**

The aim of sampling was to procure samples of the purist possible basalt. Many times samples of CRBG contain oxidized weathering surfaces, or even secondary minerals, and clay. The following methods on sampling show that we took great care in procuring, preparing, and analyzing the CRBG samples.

Samples from outcrops were chosen where basalt stratigraphy could be observed in massive sections, thus decreasing the potential for sampling rock that was deposited by mass wasting. We attempted to collect samples that were clean of weathering and secondary mineralization (i.e. not vesicular or discolored). Samples were crushed to manageable sizes in the field (~2cm in length on all sides) and placed in sample bags and give a unique sample number, which will always be associated with that sample. Field notes will be taken during collection of each sample including a brief description of the outcrop, GPS location, elevation from map/altimeter, date, sample collector, and general appearance of the sample.

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Samples from borings were supplied to Eastern Washington University by Spokane County (Michael Hermanson) and URS (Jeff Leppo). Samples were selected based upon descriptions of the wells, wells were not drilled or described for this project and the principle investigator was not present during any of the drilling. Highly vesicular and fractured samples and samples with dense secondary mineralization were not selected to ensure quality analyses. Samples were rinsed with distilled water and sonicated to remove clays and secondary mineralization.

Cleaned samples were taken to the Peter Hooper Geochemical Laboratory at the Washington State University campus in Pullman, WA. Samples were crushed and fused for X-ray fluorescence (XRF) analyses. Methods for sample prep and analyses are further described on the laboratory website [www.sees.wsu.edu/Geolab/note/xrf.html](http://www.sees.wsu.edu/Geolab/note/xrf.html).

### Sample Location & Results

Results of analyses were interpreted using Hooper (2001). Sample descriptions, locations, and assigned CRBG member are presented below:

**KR1** is a hand sample taken from the Key Rock quarry in Marshall, Washington. Stratigraphy in the Marshall area is not well understood due to fingering of basalts into paleodrainage system. The sample was dark gray and from approximately 15 feet below the upper contact of the basalt unit. The overlying 15 feet of basalt contained abundant vesicles. The chemistry of this sample is comparative to the Priest Rapids Member of the Wanapum basalts.

**G:** Samples 1 and 2 were taken along W Euclid Road between N Garfield Road and N Rambo Road along Deep Creek. These samples were collected to determine the basalt stratigraphy of the lower Sentinel Bluff of the area. We determined that that basalt block to the south of Euclid Road and along the north bank of the creek was a large mass-wasting deposit based up on CRBG stratigraphy. The results from both samples are comparative to the Sentinel Bluff Member of the Grande Ronde basalts.

**CH:** Samples 9, 10, & 11 were collected along W Charles Road between W Dover Road and W Old Charles Road. This section of road climbs from approximately 1900 to over 2300 feet elevation and provides road cuts of the Grande Ronde basalts. Three samples were collected to determine the Sentinel Bluff stratigraphy of the area. Derkey and others (2007) mapped a unique layer of a sub-member (flow-unit), Four Mound. We did not identify the Four Mound sub-member of the Sentinel Bluff member or the Grande Ronde basalts. Based upon analyses that Dr. Pritchard ran for the McCollum's WRIA 2011-2012 WRIA 54 grant the valley bottom (less than 1900 feet elevation) is dominated by Wapshilla Ridge member of the Grande Ronde basalts.

**B7 (MW7), B8 (MW8), and B9 (MW9):** Cuttings from borings drilled under supervision by Northwest Land and Water. The last two to three digits of the sample name denote the upper sample depth in feet below ground. Locations for the wells were supplied by Spokane County. Well descriptions with general locations are presented in multiple reports by the consultant. An additional five (5) samples were submitted for analyses by Northwest Land and Water.

**R4 (MW4) and R7 (MW7):** Monitoring wells from the Spokane County Raceway in Airway Heights, WA. The last two to three digits of the sample name denote the upper sample depth in feet below ground. Samples were supplied by Jeff Leppo of URS.

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**CC1:** Samples from 80 and 120 foot depth were analyzed from Cheney Water Well #5 to verify the lower contact of the Wanapum basalts. Many deeper samples from this well are presented in Reidel (2005).

*Results were submitted to Spokane County on March 5, 2013.*

### **Well Log Interpretations**

Using analyses from this project and Dr. Linda McCollum's 2011-2012 project we interpreted an additional 400+ water well reports. A majority of these wells have been located using a handheld GPS by Dr. Linda McCollum with assistance by Michael McCollum, Michael Hamilton, and Dr. Chad Pritchard. A draft database of approximately 174 wells was established by Michael Hamilton from his past work in the area, which required extensive edits and re-interpretation. The remaining 226+ wells were added to this database. Water Well Reports were generally accessed through the Washington State Department of Ecology Water Well Report Viewer (available at: <http://apps.ecy.wa.gov/welllog/>); though some well reports were used from current and past geologic studies by private consultants (not associated with this project). An edited spreadsheet that contains these data was submitted to the County on June 5, 2013.

### **TASK III – Mapping Basalt Stratigraphy**

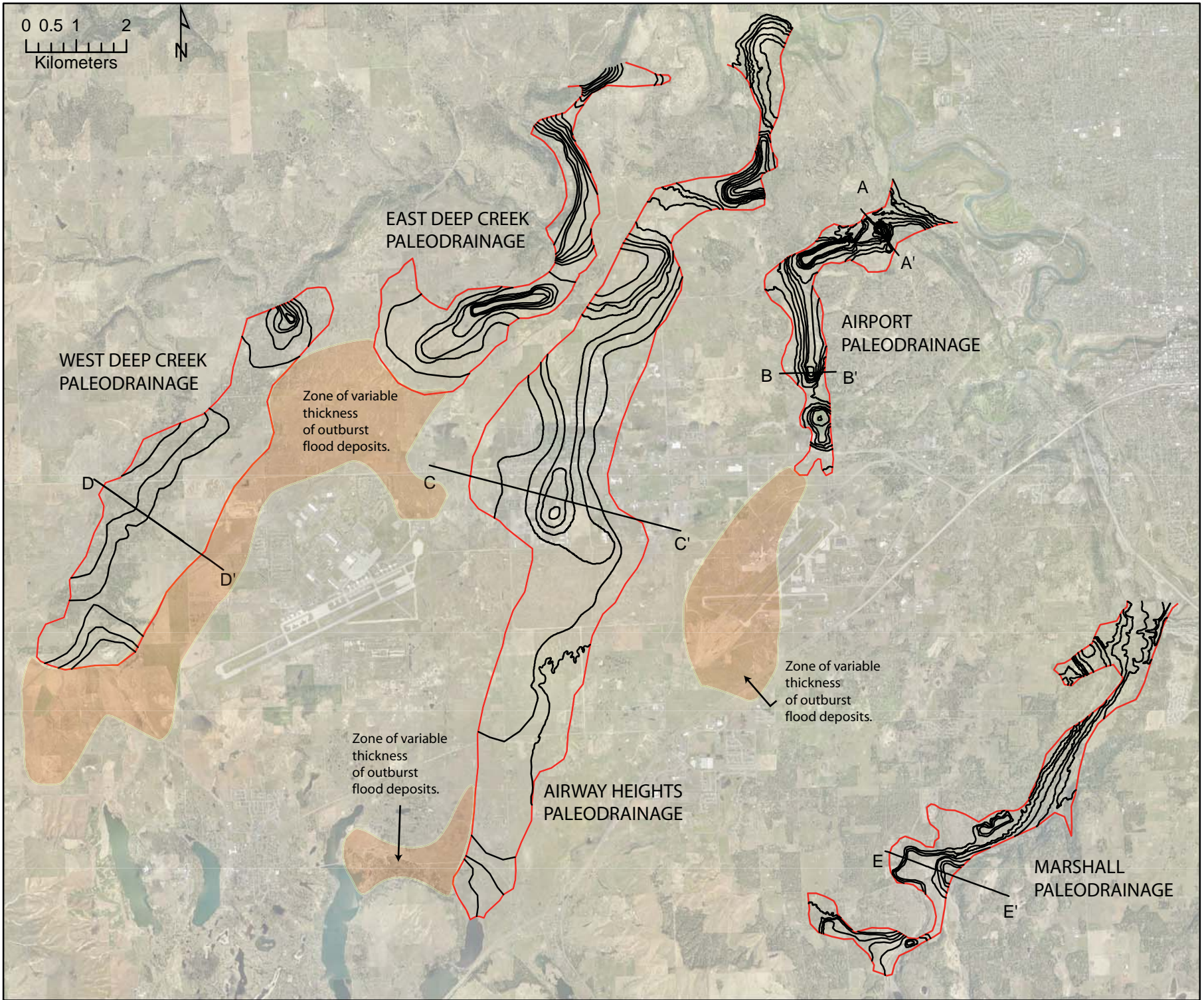
To assist in making a structural contour map of the formation and member surfaces the Spokane County database was re-interpreted based upon results from Task II. The initial intent of this task was to produce a database of 1000 wells that described major contacts. During further discussions with Michael Hermanson (Spokane County) we determined that a review of approximately 1000 wells from the working database with Spokane County would be more beneficial. An edited spreadsheet that contains these data was submitted to the County on June 5, 2013.

### **TASK IV – Paleodrainages**

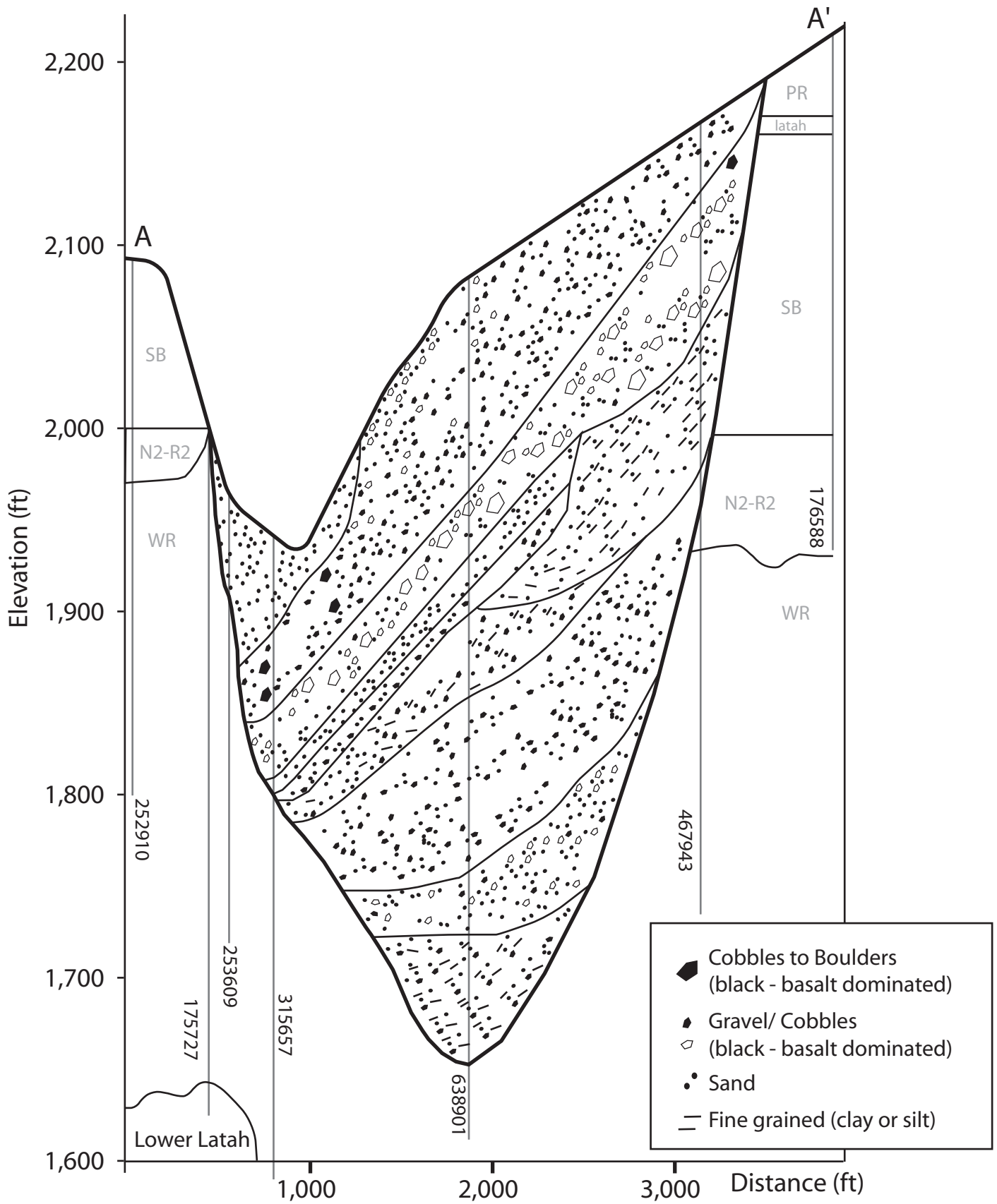
With the assistance of Shawna Ernst we completed a model for contouring the base of paleodrainages in the study area. We identified a new channel that runs eastward through the town of Marshal, WA. We also added the West Deep Creek paleodrainage, which we believe is a lag deposit or delta type deposit from Pleistocene outburst floods and gently slopes to the west. Generalized cross sections were constructed from water well reports and available geologic maps. Updated CRBG interpretation was completed by this study and presented in the cross-sections.

### **References**

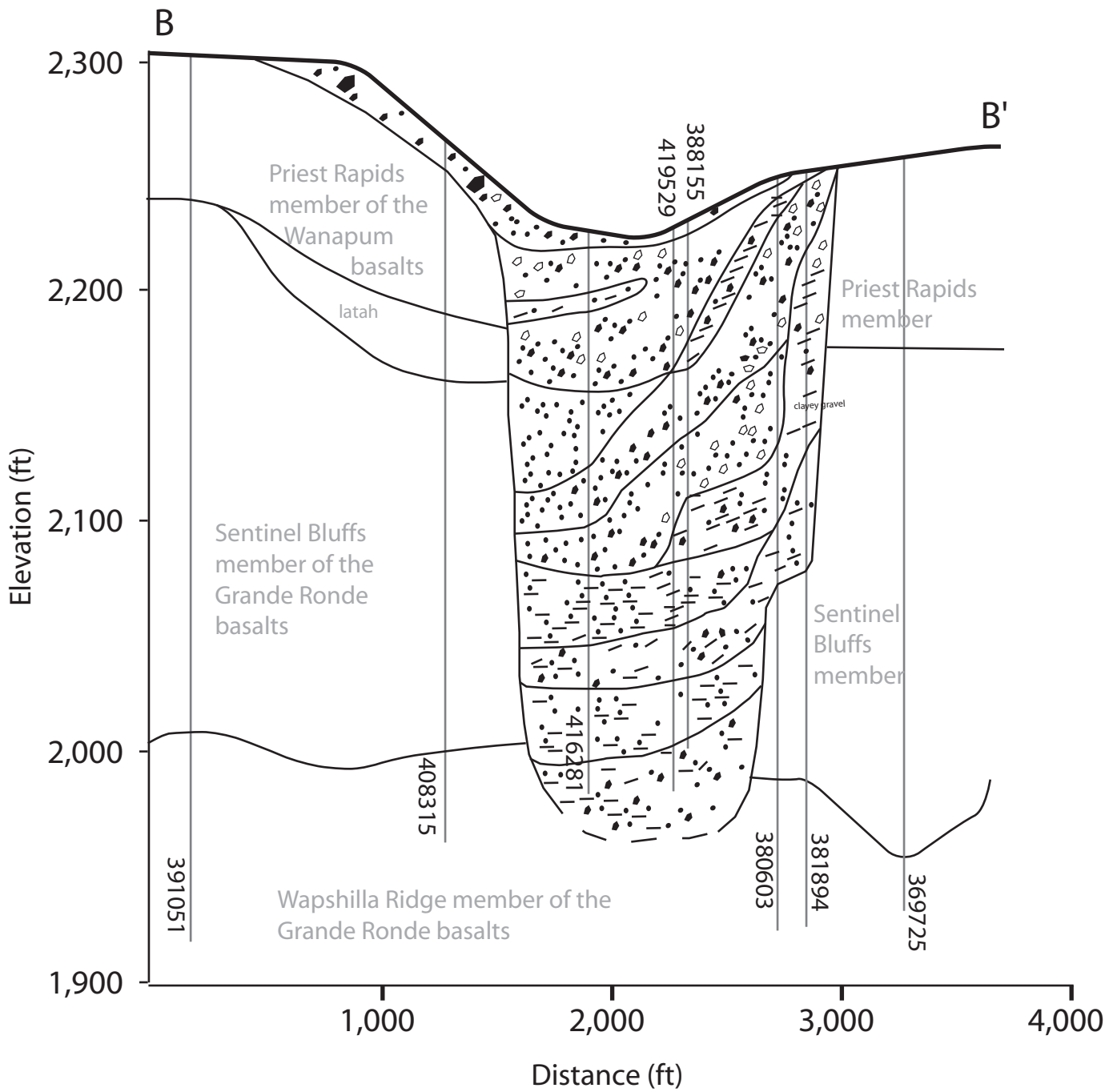
- Derkey R. E., and Hamilton, M. M., 2007. Geologic map of the Four Mound Prairie 7.5-minute quadrangle, Spokane and Stevens Counties, Washington. Washington Division of Geology and Earth Resources Geologic Map GM66, 42 x 36 in. color sheet, scale 1:24,000.
- Hooper, PR (2000) Chemical discrimination of Columbia River basalt flows: Geochemistry, Geophysics, Geosystems, v 1, no.1, doi: 10.1029/2000GC000040.
- Reidel, S.P., 2005, A lava flow without a source: The Cohasset Flow and its compositional components, Sentinel Bluffs Member, Columbia River Basalt Group. *Journal of Geology*, v. 113:1-21.



**Modeled contours for the base of paleodrainages.** Note that these contours are at a 7.5-min. quad scale and do not contain local elevations presented in the associated geoscience studies. These data were interpreted from well logs on record with the WA Dept. of Ecology and available in the associated geoscience studies, which are subject to interpretation. Zones with questionable relationships to the paleodrainage are outlined in orange. Contours completed by Shawna Ernst and Chad Pritchard, PhD, LG, WRIA 54, June 2013. Map and cross sections are not intended for site work or larger scale interpretation.

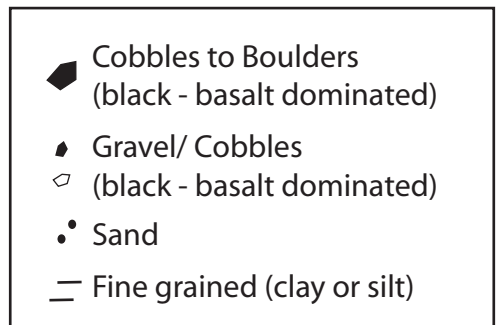


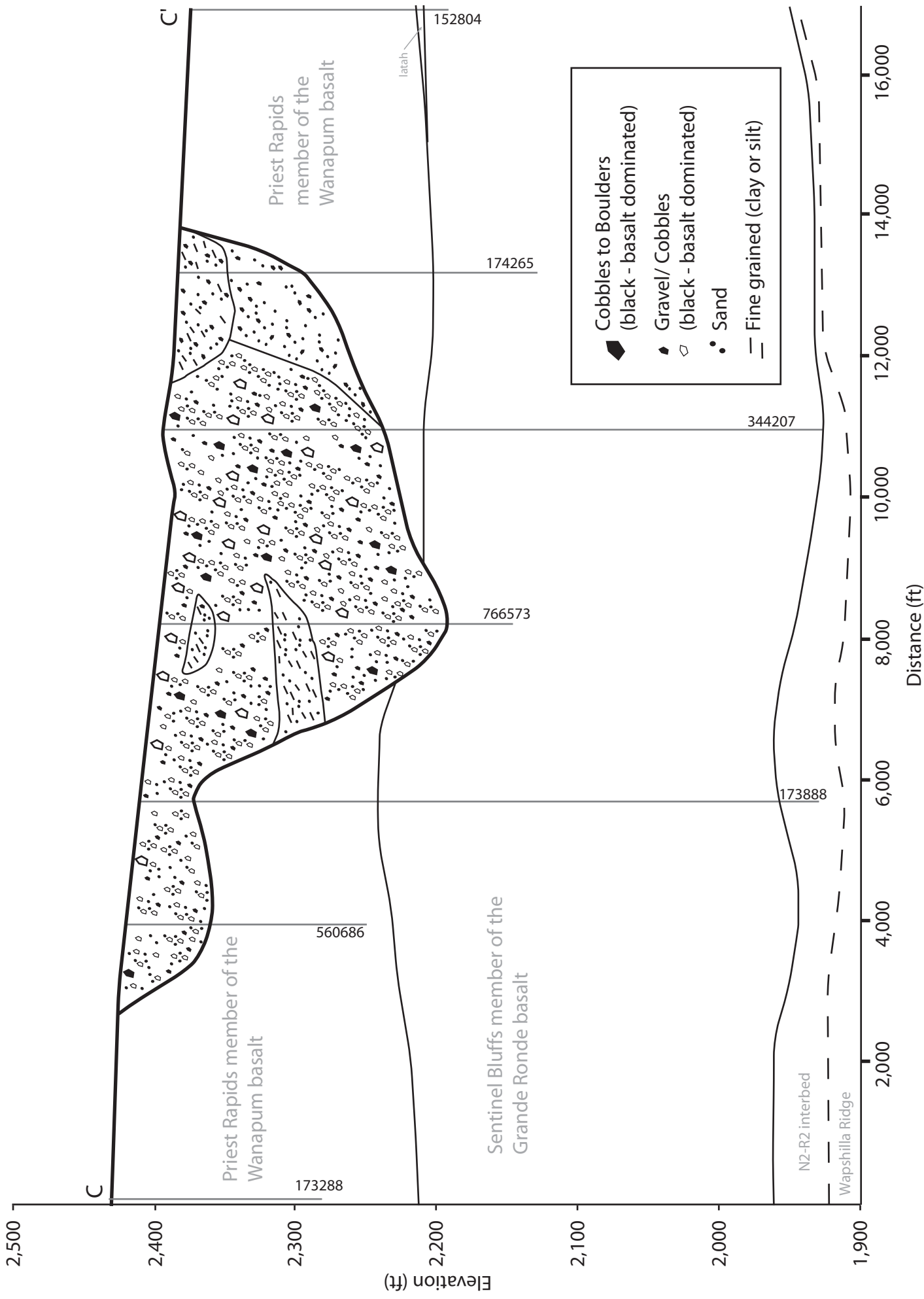
**A to A' cross section with generalized paleodrainage fill.** Vertical exaggeration of 10 times (V:H = 1:10). Grossly generalized beds. Bedding measured in the field appears to dip about 10 to 20 degrees in the direction of flow, due to vertical exaggeration lithology appears to be dipping more steeply, up to 50 - 65 degrees. PR - Priest Rapids member of the Wanapum basalt. SB - Sentinel Bluffs, WR - Wapshilla Ridge members of the Grande Ronde basalt, interbed = R2-N2. WA Dept. of Ecology Well ID's next to well. Cross section presents a localized deeper section of the drainage than modeled by ArcMap.



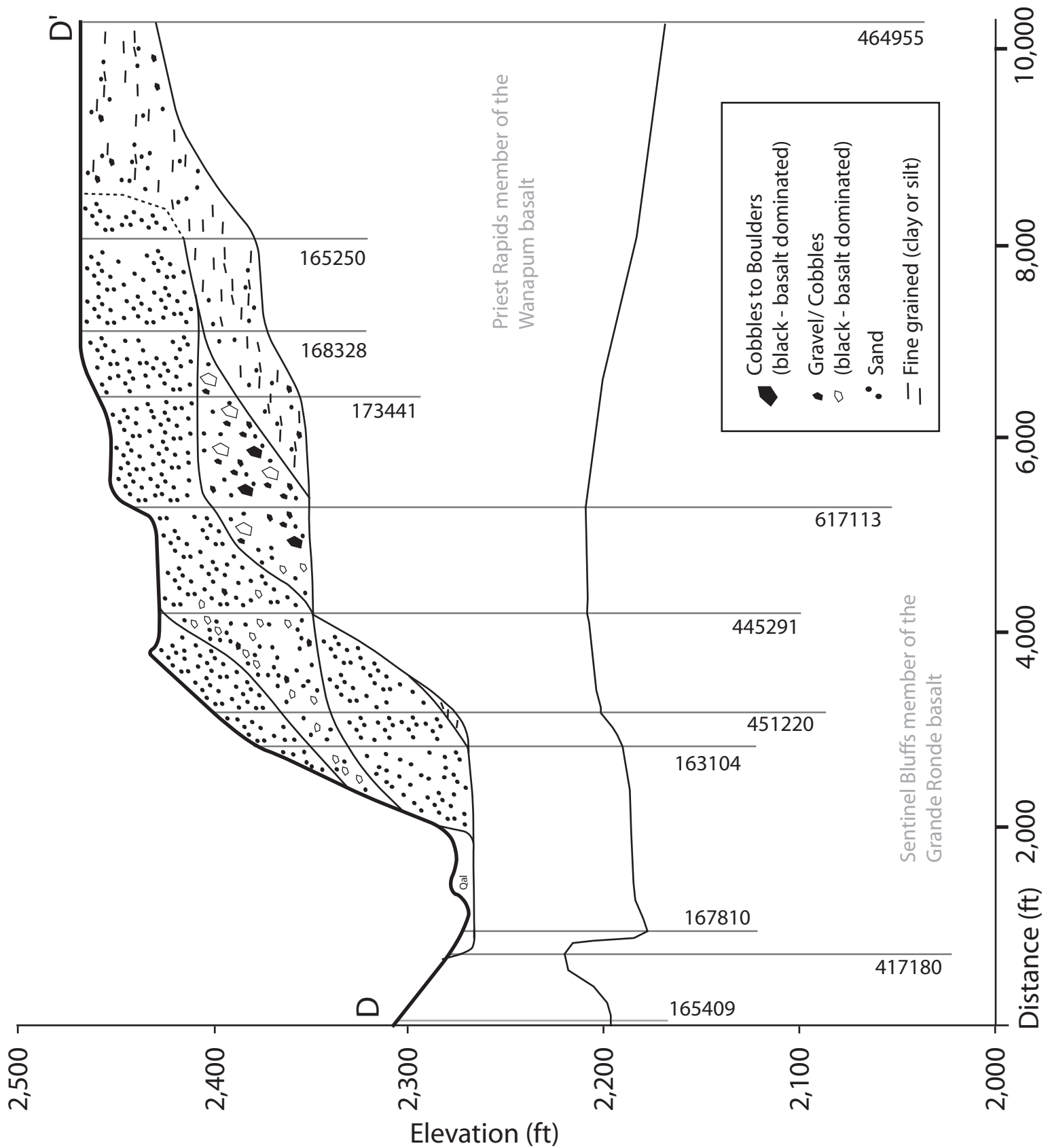
**B to B' cross section with generalized paleodrainage fill.**

Vertical exaggeration of 10 times (V:H = 1:10). Grossly generalized beds. Bedding measured in the field appears to dip about 10 to 20 degrees in the direction of flow, due to vertical exaggeration lithology appears to be dipping more steeply, up to 50 - 65 degrees. WA Dept. of Ecology Well ID's next to well. Again, cross sections contain more detail than could be presented in the ArcMap model.



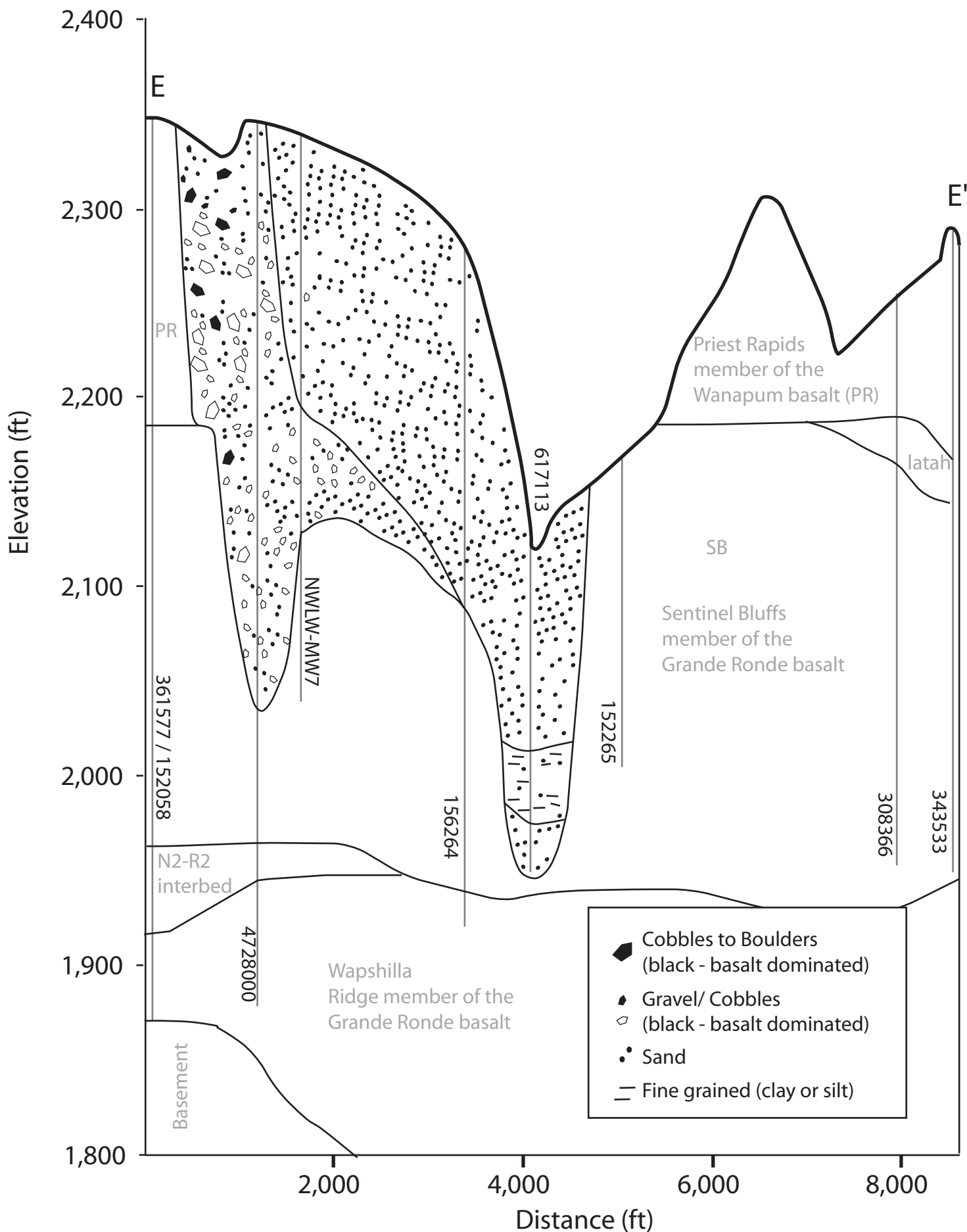


**C to C' cross section with generalized paleodrainage fill.** Vertical exaggeration of 20 times (V:H = 1:20). Grossly generalized beds. Bedding measured in the field appears to dip about 10 to 20 degrees in the direction of flow, due to vertical exaggeration lithology appears to be dipping more steeply, up to 50 - 65 degrees. Wapshilla Ridge is a member of the Grande Ronde basalt. WA Dept. of Ecology Well ID's next to well. Note that geophysical surveys for the ASR well display horizontal strata because they were completed perpendicular to this cross section or parallel with strike projected forsets.

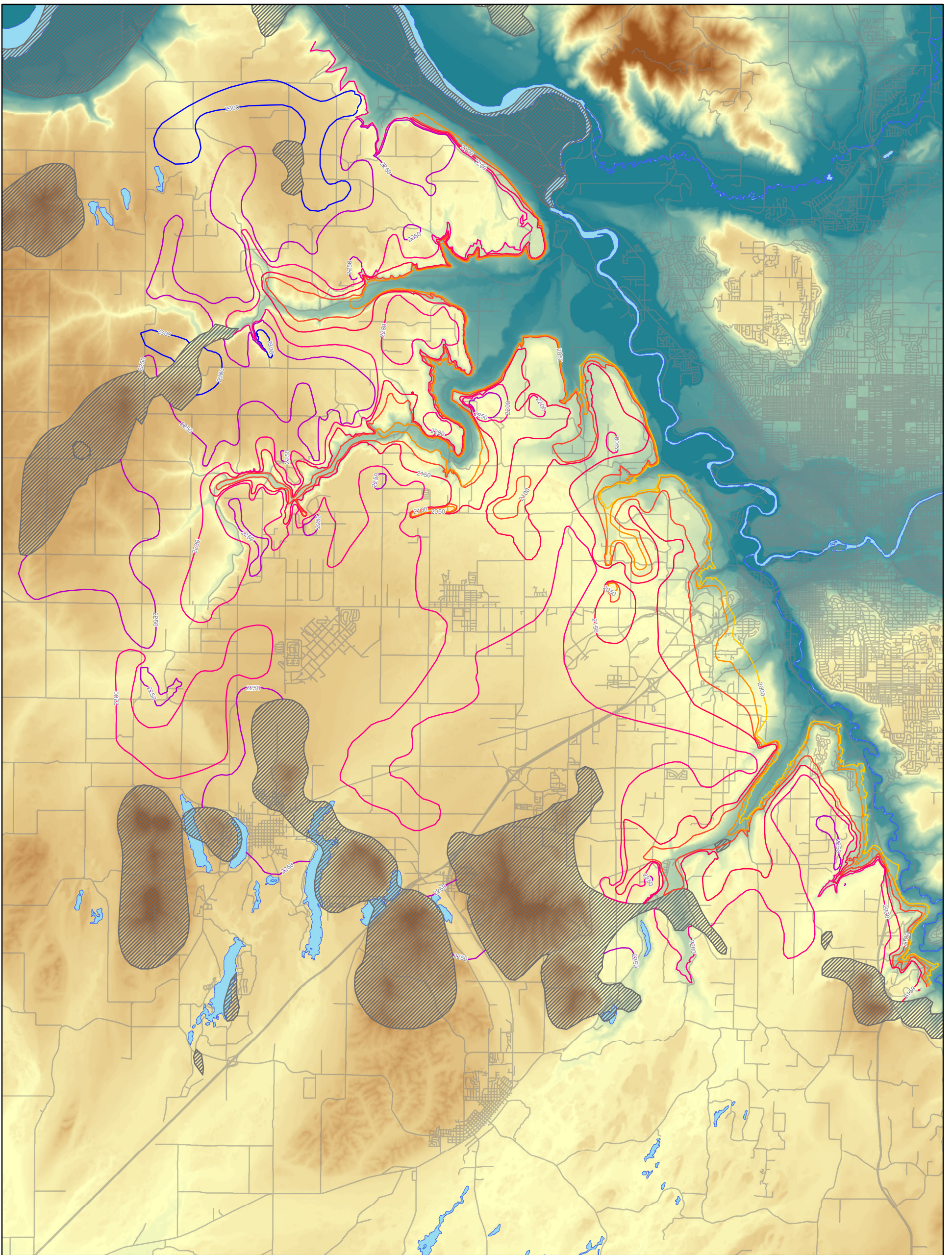


**D to D' cross section with generalized paleolake fill.** Vertical exaggeration of 20 times (V:H = 1:20). Grossly generalized beds. Bedding measured in the field appears to dip about 10 to 20 degrees in the direction of flow, due to vertical exaggeration lithology appears to be dipping more steeply, up to 65 - 75 degrees. WA Dept. of Ecology Well ID's next to well. Qal - alluvial deposits. This portion of the paleodrainages represents a lake shore type setting, not a channel as the other contours presented in this study. Again, the cross sections provide more localized detail than presented by the contour model.





**E to E' cross section with generalized paleodrainage fill.** Vertical exaggeration of 20 times (V:H = 1:20).  
 Grossly generalised beds. Bedding measured in the field appears to dip about 10 to 20 degrees in the direction of flow, due to vertical exaggeration lithology appears to be dipping more steeply, up to 50 - 65 degrees. WA Dept. of Ecology Well ID's next to well



## Surface Contours Grand Ronde Formation - Sentinel Bluffs Member

West Plains Area of Spokane County, Washington

Notes: Contours were developed by Spokane County Water Resources from data points of the elevation of the top of the Sentinel Bluffs member. Data points derived from geochemical analysis and water well report interpretation conducted by Dr. Chad Pritchard, Eastern Washington University.

1 0.5 0 1 Miles

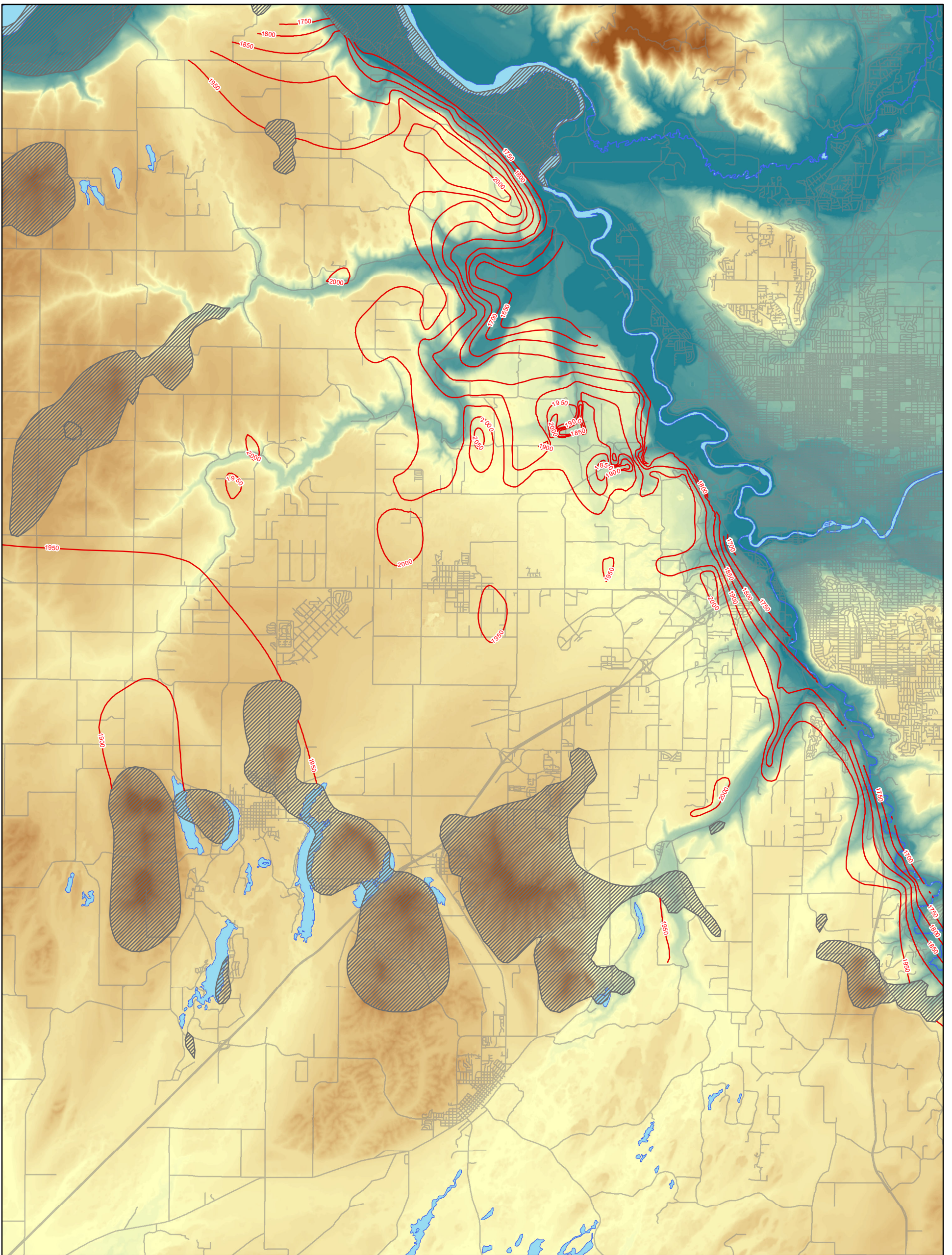


### Sentinel Bluffs Surface Contour - 50 ft intervals

- 2000
- 2050
- 2100
- 2150
- 2200
- 2250
- 2300
- Surface & Near Surface Basement Rock



West Plains Hydrogeology  
Ecology Grant G1200159



**Surface Contours**  
**Grand Ronde Formation - Wapshilla Ridge Member**

West Plains Area of Spokane County, Washington

- Wapshilla Ridge Surface Contour - 50 ft intervals
- Surface & Near Surface Basement Rock

1 0.5 0 1 Miles



Notes: Contours were developed by Spokane County Water Resources from data points of the elevation of the top of the Wapshilla Ridge member. Data points derived from geochemical analysis and water well report interpretation conducted by Dr. Chad Pritchard, Eastern Washington University.



**SPOKANE COUNTY**  
 WATER RESOURCES

West Plains Hydrogeology  
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