Hydrogeologic Framework of the Spokane Valley – Rathdrum Prairie Aquifer

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Background

The Spokane Valley–Rathdrum Prairie aquifer is the sole source of drinking water for more than 500,000 residents in Spokane County, Washington, and Bonner and Kootenai Counties, Idaho. The area includes the rapidly growing cities of Spokane, Spokane Valley, and Liberty Lake, Washington, and Coeur d'Alene and Post Falls, Idaho. Recent and projected urban, suburban, and industrial/commercial growth has raised concerns about future effects on water availability and water quality in the Spokane Valley–Rathdrum Prairie (SVRP) aquifer, and on the Spokane and Little Spokane Rivers. The SVRP aquifer is composed of the unconsolidated coarse-grained gravel, cobbles, boulders, and some sand primarily deposited by a series of catastrophic glacial-outburst floods. The material deposited in this high-energy depositional environment is coarser grained than is typical for most basin-fill deposits, resulting in one of the most productive aquifers in the world. Scattered fine-grained layers composed mostly of clay and silt exist throughout the aquifer and likely were deposited in large pro-glacial lakes in the path of the Missoula floods.

The Washington Department of Ecology, Idaho Department of Water Resources, and U.S. Geological Survey have conducted a joint investigation of the SVRP aquifer to develop a comprehensive data set that will provide an improved scientific basis for ground and surface-water management. Part of this data set includes an analysis of the hydrogeologic framework of the study area using historical and recently collected data.
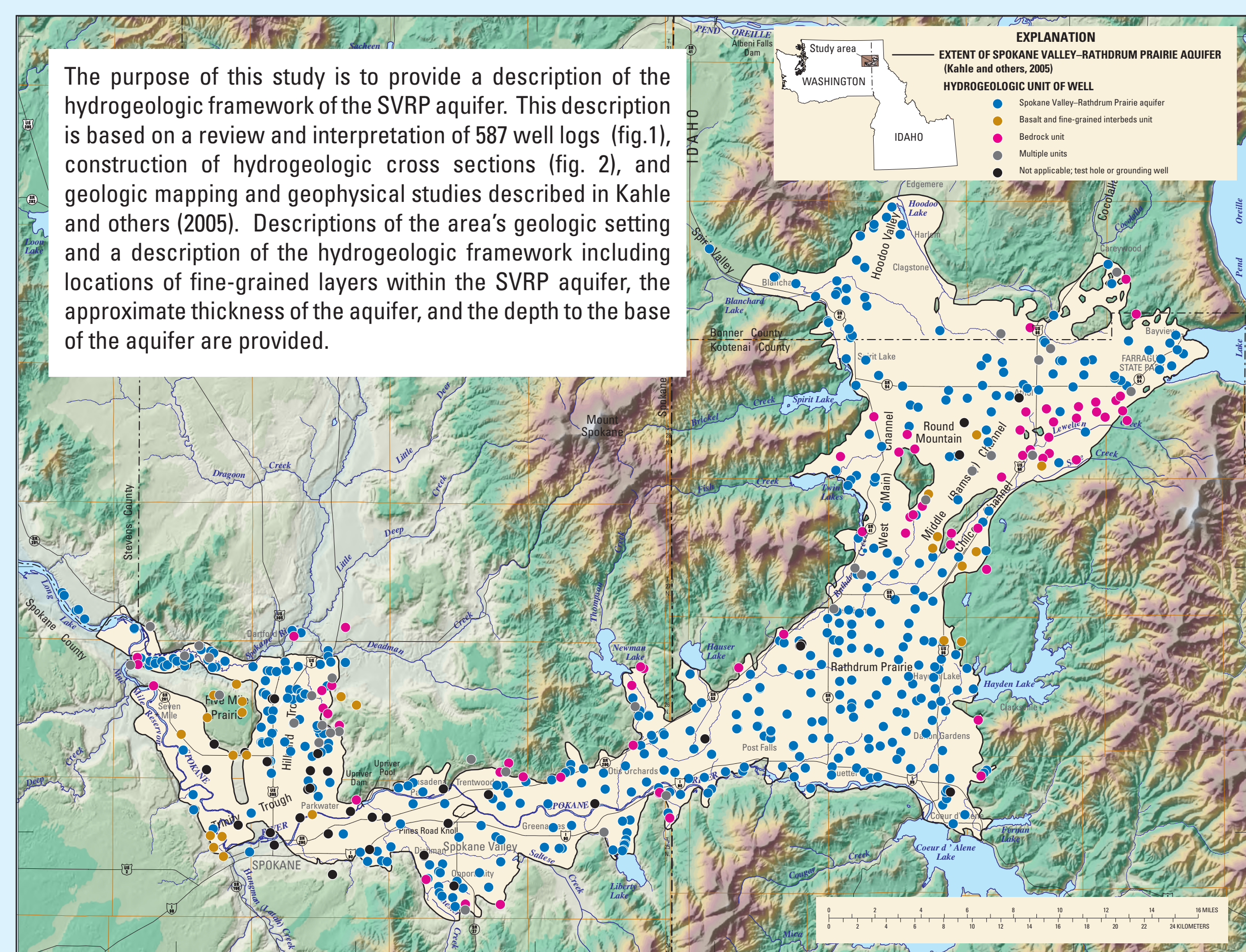
Objectives

The purpose of this study is to provide a description of the hydrogeologic framework of the SVRP aquifer. This description is based on a review and interpretation of 587 well logs (fig.1), construction of hydrogeologic cross sections (fig. 2), and geologic mapping and geophysical studies described in Kahle and others (2005). Descriptions of the area's geologic setting and a description of the hydrogeologic framework including locations of fine-grained layers within the SVRP aquifer, the approximate thickness of the aquifer, and the depth to the base of the aquifer are provided.

Figure 1. Location and hydrogeologic unit of project wells in the Spokane Valley-Rathdrum Prairie aquifer study area, Washington and Idaho.
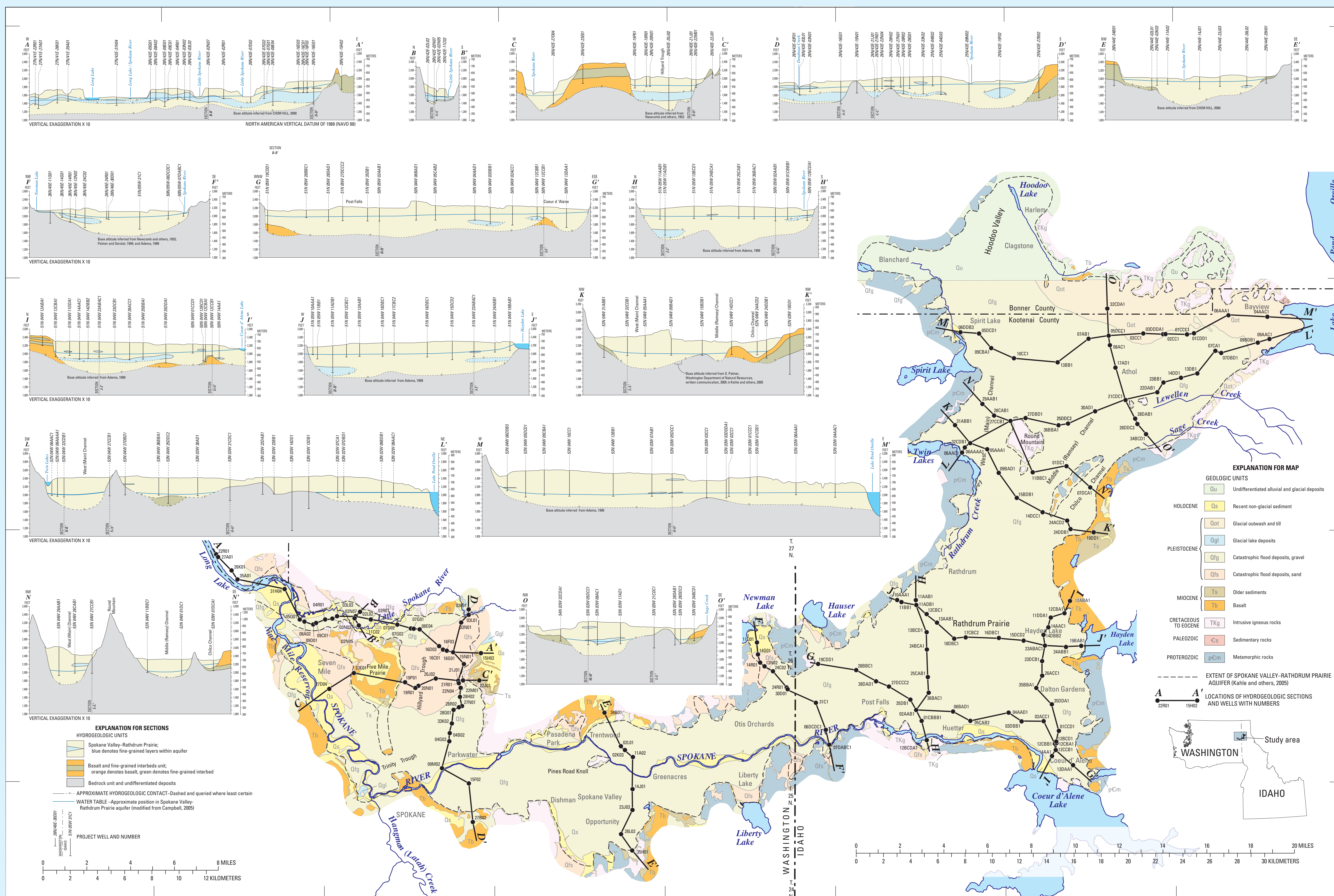

Figure 2. Map and hydrogeologic sections showing location of wells, surficial geology, and hydrogeologic units in the Spokane Valley-Rathdrum Prairie aquifer study area, Washington and Idaho.

Geologic setting

A simplified geologic model of the Rathdrum Prairie and Spokane Valley includes the ancestral Rathdrum-Spokane River valley being filled with generally unknown amounts of Miocene basalts and interbedded sediments followed by a period of downcutting, repeated cycles of glacial and interglacial sedimentation, and finally the repeated and catastrophic cycles of outburst flooding from glacial Lake Missoula (fig. 3). In most places, the SVRP aquifer is bounded by bedrock of pre-Tertiary granite (TKg), metasedimentary rocks (p m) or Miocene basalt (Tb) and associated sedimentary deposits (Ts) (fig. 2).
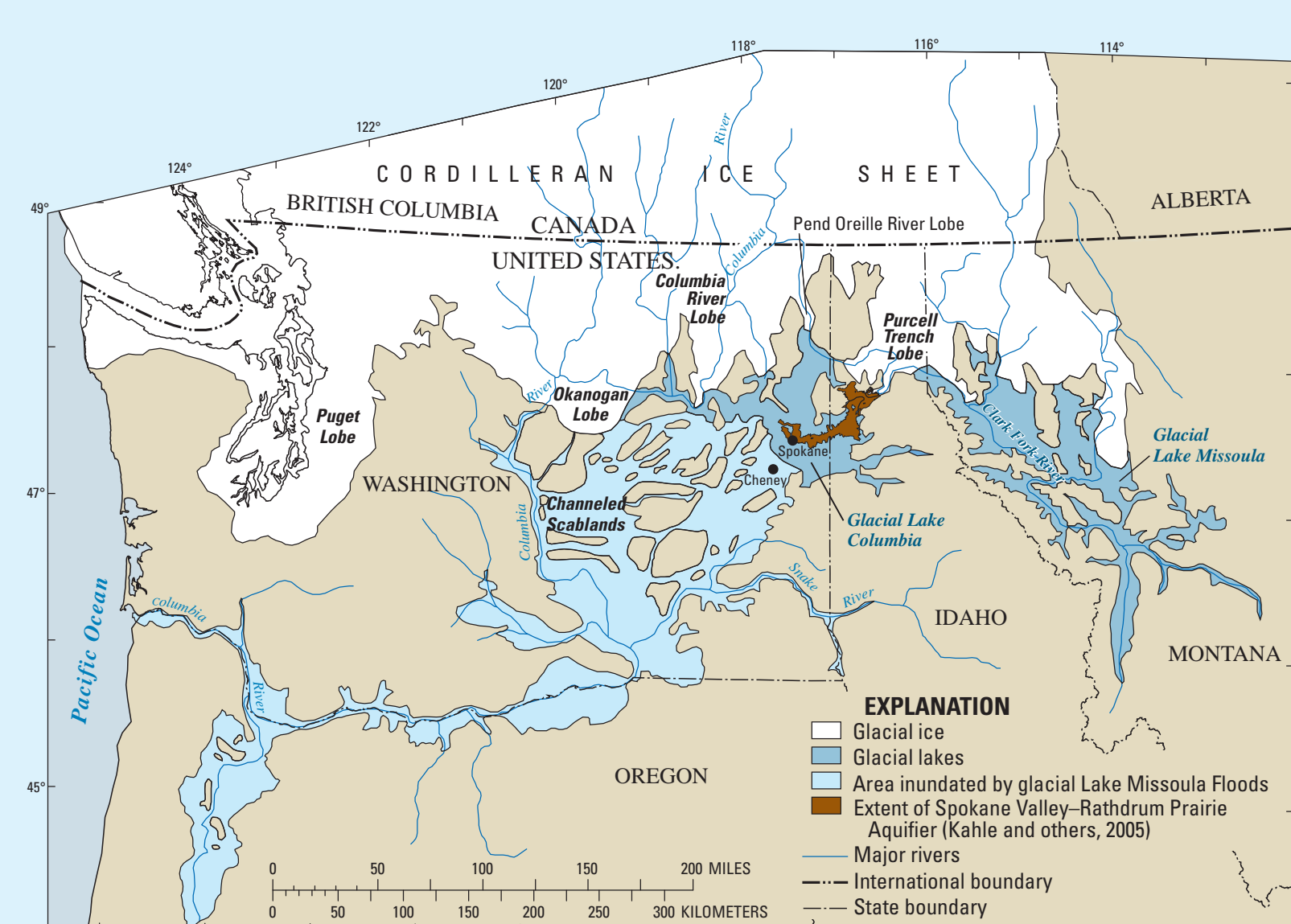

Figure 3. Extent of glacial ice and glacial lakes in northern Washington, Idaho, and parts of Montana (modified from Allen and Burns, 1986, and Atwater, 1986).

Fine-grained layers within the SVRP aquifer

In the Hillyard Trough, a massive fine-grained layer with an average thickness of 215 ft separates the aquifer into upper and lower units; in the Little Spokane River Arm of the aquifer the layer has a more variable surface elevation and an average thickness of 130 ft (fig. 4a). Most of the Spokane Valley is devoid of fine-grained layers except near the margins of the valley and near the mouths of lakes. In the Rathdrum Prairie, multiple fine-grained layers are scattered throughout the aquifer with thicknesses ranging from 1 to more than 135 ft. (fig. 4b).

Figure 4a. Approximate location and surface elevation of a fine-grained layer within the Hillyard Trough and Little Spokane River Arm of the SVRP aquifer, Washington.
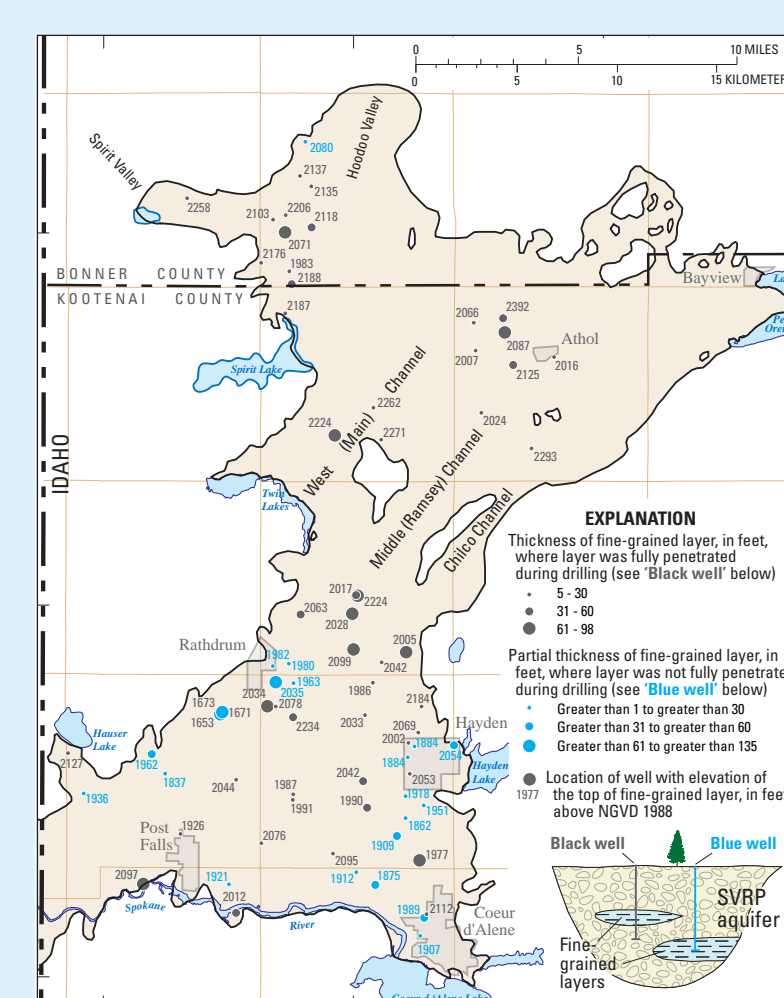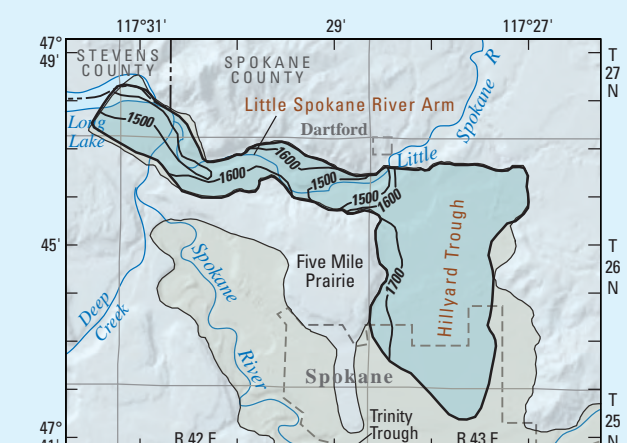

Figure 4b. Locations of wells with fine-grained layers within the Rathdrum Prairie portion of the SVRP aquifer.

Base of aquifer and aquifer thickness

Based on well log data and the inferred base-of-aquifer from the hydrogeologic sections (fig. 2), the elevation of the base of the aquifer ranges from less than 1,800 ft near the outlet of Lake Pend Oreille to less than 1,200 ft near the aquifer's outlet near Long Lake (fig. 5a). The thickness of the aquifer is more than 800 ft in the northwestern part of the northern Rathdrum Prairie, through the West Channel area, and through the west-central part of the Rathdrum Prairie. In Washington, the areas of greatest thickness, more than 600 ft, are mapped in the central parts of the Spokane Valley, the City of Spokane, and the Hillyard Trough (fig. 5b).
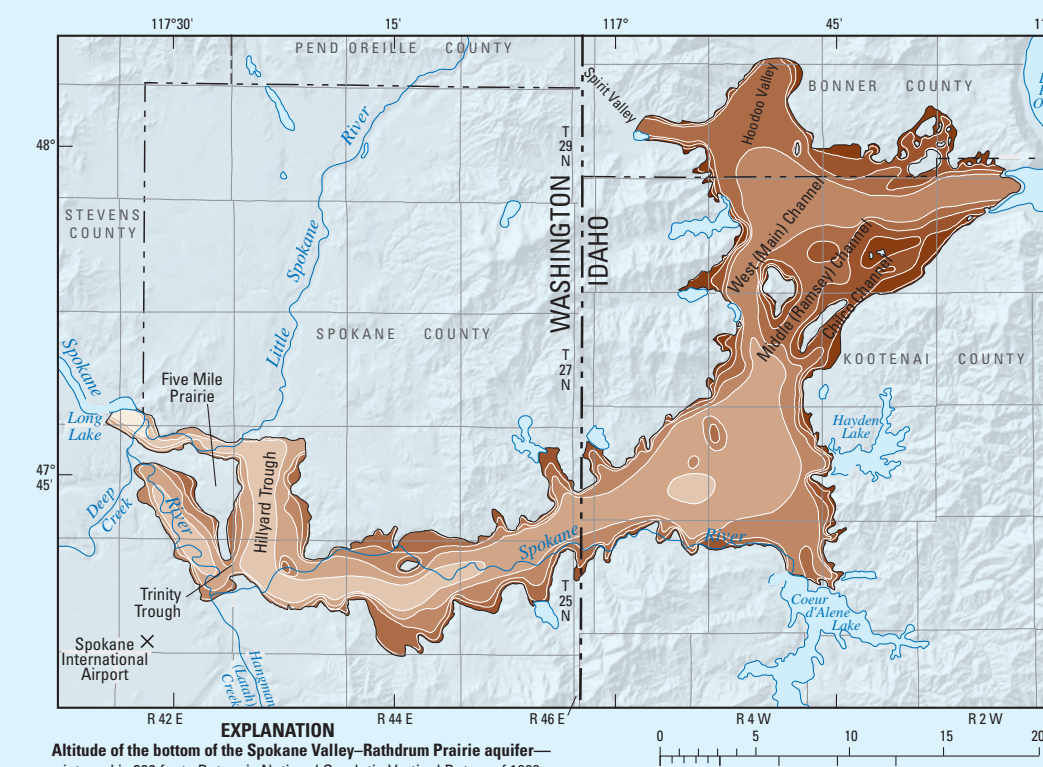

Figure 5a. Approximate elevation of the base of the SVRP aquifer.
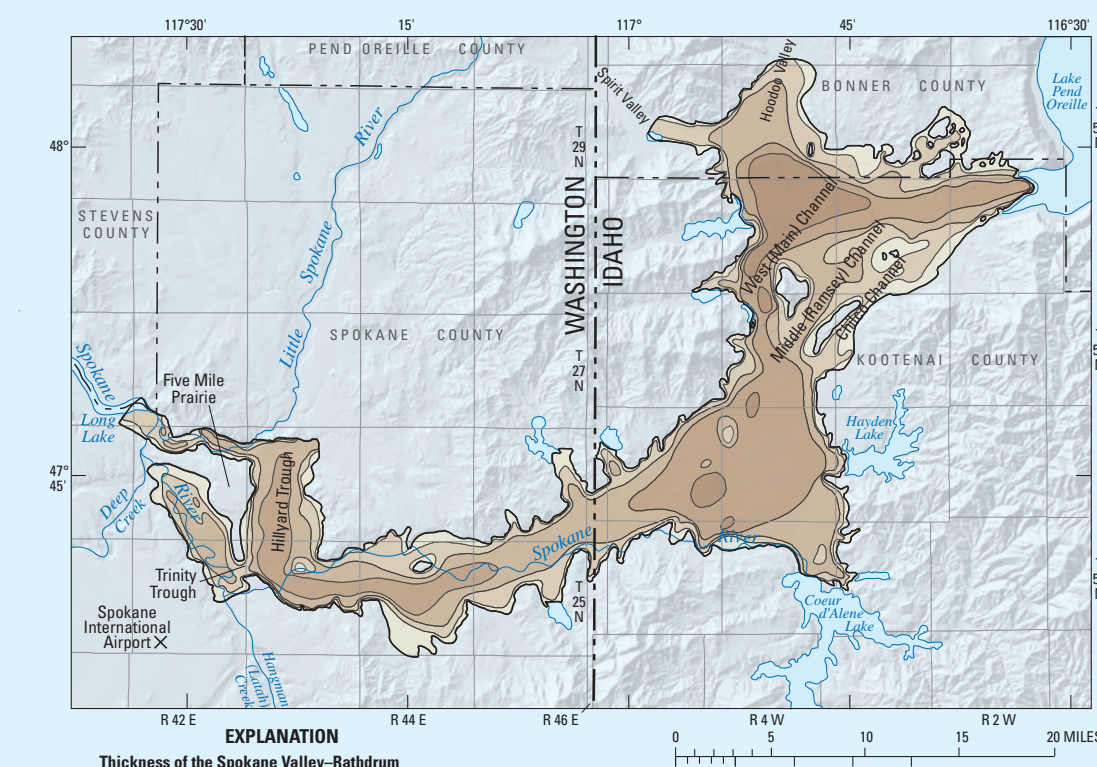

Figure 5b. Approximate thickness of the SVRP aquifer.

References

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Additional Information

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Spokane Valley-Rathdrum Prairie Hydrologic Study
http://www.idwr.state.id.us/hydrologic/projects/svrp
http://wa.water.usgs.gov/projects/svrp