

Aquifer Name: Trail/Warfield Bedrock Aquifer

Aquifer Number: 1281

Date of Mapping: February 2nd, 2023

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A. AQUIFER DESCRIPTION FOR AQUIFER 1281

A.1 CONCEPTUAL UNDERSTANDING OF HYDROSTRATIGRAPHY

A.1.1 AQUIFER EXTENTS

Bedrock Aquifer 1281 is located west of the Columbia River in the vicinity of Trail B.C. (see Figure 1; Lengyel et al. 2024). Bedrock forms a regionally extensive geological/hydrostratigraphic unit. The extent of the aquifer is defined based on topography, major surface water features, and water licensing watershed boundaries. The aquifer is bound by the Columbia River in the east. The western and northern boundaries have been defined by the surface licensing watershed boundaries and are a representation of topography in the area. In the south, the aquifer is bound by the U.S. border; however, the aquifer is expected to be continuous in this direction.

A.1.2 GEOLOGIC FORMATION (OVERLYING MATERIALS)

Fulton et al. (1984) described the area of the aquifer to be overlain by sandy loam and loamy till, silty till, alluvium, and glaciofluvial sand and gravel along the Columbia River floodplain. Sections of the till are described to be thin and discontinuous with thickness up to 2 m in some regions. Aquifer 1281 may be locally overlain by the sediments of overburden aquifers 0483, 0484, and 1277. Depth to bedrock ranges from 0.6 to 45.7 m. The average depth to bedrock is 12.5 m. Bedrock outcrops at higher elevations.

A.1.3 GEOLOGIC FORMATION (AQUIFER) – SUBTYPE: 6B – FRACTURED CRYSTALLINE ROCK

The aquifer is comprised primarily of igneous intrusive rock (granodioritic and granites) and fractured volcanics (basaltic and some unknown) of the Mesozoic and Cenozoic eras. There are some sections comprised of fractured sedimentary rocks (mudstone, siltstone, shale, fine clastic) of the Paleozoic Era (Cui et al. 2017).

As the bedrock has been faulted and fractured throughout the area of the aquifer and surrounding region, and well yields change over short distances and do not appear to be correlated with bedrock type, secondary permeability is expected to be dominant in all types of bedrock; as such, all these rocks may act as aquifers. Accordingly, bedrock aquifers are expected to extend across lithological boundaries.

A.1.4 VULNERABILITY - MODERATE

The bedrock aquifer is comprised of fractured rock. Depth to groundwater varies from shallow to deep. The average depth to water is 19.8 m and the average depth to bedrock is 12.8 m.

The bedrock aquifer is confined; however, some areas throughout the aquifer show higher vulnerability (i.e., where permeable deposits are overlying the aquifer, overlying material is thin, and at higher elevations where the aquifer outcrops). There are artesian wells within the aquifer. Vulnerability across the aquifer ranges from moderate (where the aquifer is confined by overlying sediments [and where most of the development is expected to occur] and where the risk of contamination from land use is expected to be higher) to high (in topographically elevated areas where bedrock outcrops and overlying material is thin). The overall vulnerability of the aquifer to surface contamination has been qualitatively assessed to be moderate.

A.2 CONCEPTUAL UNDERSTANDING OF FLOW DYNAMICS

A.2.1 GROUNDWATER LEVELS AND FLOW DIRECTION

Static groundwater levels recorded in the provincial groundwater wells database (GWELLS) range from artesian to deep (79.2 m). There are eight wells with artesian groundwater conditions dispersed throughout the aquifer. There are no provincial observation wells within the aquifer.

The groundwater surface is interpreted to be a subdued representation of the topography based on regional interpolation of groundwater surface elevations. Groundwater is interpreted to flow from higher elevations toward lower elevations (i.e., toward the Valley of Highway 22 and toward the Columbia River floodplain.

No information has been identified on the primary porosity and permeability of the bedrock unit. While based on the type of material (basaltic volcanic rocks at some places), they may be high. However, based on the large variation of reported well yields over short distances, flow is expected to occur primarily through fractures.

No information is available on how faults impact groundwater flow in the area. Fracturing associated with the faults is interpreted to enhance permeability.

A.2.2 RECHARGE

Recharge to the aquifer varies depending on depth to bedrock. In areas where the overburden is thick, surficial recharge to the aquifer is likely limited. The infiltration of precipitation and snowmelt is expected to focus on areas where fine-grained overburden is thinner and in areas of higher topographic elevations where overburden is absent, and the bedrock outcrops at surface (Fulton et al. 1984). Much of the recharge is expected to occur in the spring associated with snowmelt. The aquifer may also be recharged by overlying tributaries of the Columbia River where the intervening overburden is thin. Aquifer 1281 may recharge overburden aquifers 0483, 0484, and 1277; however, the spatial and temporal understanding of recharge mechanisms is uncertain and further investigation is required to confirm these hydraulic connections.

A.2.3 POTENTIAL FOR HYDRAULIC CONNECTION

Hydraulic connection to various surface water bodies (primarily the Columbia River, which forms the eastern boundary of aquifer 1281, and its minor tributaries) is expected. As the bedrock has been faulted and fractured throughout the Study Area, hydraulic connection to other aquifers (including the overlying overburden aquifers 0483, 0484, and 1277) may be possible should the fractures in the aquifer be continuous on a regional scale; however, the extent of the fracture network and its continuity requires further study. Hydraulic connection with overburden aquifers may be limited should low permeability layers separate them.

A.3 WATER MANAGEMENT

A.3.1 ADDITIONAL INFORMATION ON WATER USE AND MANAGEMENT

Reported well yields for 84 out of 87 wells (excluding three wells that had no reported well yield) within the aquifer range between 0.06 L/s and 6.3 L/s, with a geometric mean of 0.55 L/s, indicating an aquifer with moderate productivity with localized zones of low to high productivity. No other water quality or quantity concerns were reported in the water quality comments of the GWELLS database.

There is a mix of domestic, commercial, irrigation and water supply system wells within the aquifer based on well purpose recorded in GWELLS.

A.3.2 ADDITIONAL ASSESSMENTS OR MANAGEMENT ACTIONS

No water availability or water budget studies have been completed in the area.

A.4 AQUIFER REFERENCES

Berardinucci J. and K. Ronneseth, 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.

Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J. 2017. British Columbia Digital Geology. BC Ministry of Energy Mines and Petroleum Resources, BC Geological Survey Open File 2017-8, 9p. Data Version 2019-12-19.

Fulton, R.J., Shetsen, I., and Rutter, N.W., 1984. Surficial geology, Kootenay Lake, British Columbia-Alberta. Geological Survey of Canada, Open File 1084, 1:1,000,000 scale.

Geographic datasets from the BC Data Catalogue, accessed December 2022 <https://data.gov.bc.ca/>.

Lengyel, T., Verma, S., Deri-Takacs, J., and Hinnell, A. 2024. Aquifer Mapping in the Kootenay/Boundary Region of British Columbia: Creston, Rossland, Castlegar, and Salmo. Water Science Series, WSS2024-05. Prov. B.C., Victoria B.C.

A.5 REVISION HISTORY

Date	Version	Revision Class	Comments	Author
20230202	1	Major	Initial Mapping of Aquifer	Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, PhD, P.Geo.