Aquifer Name: North Castlegar Bedrock Aquifer

Aquifer Number: 0513

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A. AQUIFER DESCRIPTION FOR AQUIFER 0513

A.1 CONCEPTUAL UNDERSTANDING OF HYDROSTRATIGRAPHY

A.1.1 AQUIFER EXTENTS

The aquifer is north of the Columbia and Kootenay rivers (see Figure 1; Lengyel et al. 2024). The aquifer is a bedrock aquifer. 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 bounded by Upper Arrow Lake and the Columbia and Kootenay rivers, and the West Arm of Kootenay Lake in the south and the east. The rest of the aquifer boundaries were delineated based on inferred groundwater divides (ridges) drawn using surface licensing watershed boundaries. The aquifer was mapped outside the extent of well development; thus, uncertainty exists with aquifer properties.

A.1.2 GEOLOGIC FORMATION (OVERLYING MATERIALS)

Fulton et al. (1984) described the area of the aquifer to be overlain by sandy till, alluvium, glaciolacustrine silt, clay, and sand, and glaciofluvial sand and gravel. Aquifer 0513 may be locally overlain by the sediments of overburden aquifers 0501, 1117, and 1276. Depth to bedrock ranges from 0.3 to 147.8 m. The average depth to bedrock is 18.5 m. Bedrock outcrops at higher elevations.

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

Aquifer 0513 is composed primarily of fractured igneous intrusive rock (granite and granodioritic) of the Cenozoic and Mesozoic eras. There is a portion of granite and metamorphic rock (gneiss) that is of the Paleozoic Era, and a small section of sedimentary rock of the Mesozoic 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; and 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 composed of fractured rock. Depth to groundwater varies from shallow to deep. The average depth to water is 24.5 m and average depth to bedrock is 18.5 m. The aquifer is generally 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 along the floodplain of the Columbia River (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 further away from the river (in areas of topographical high 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 water levels recorded in the provincial groundwater wells database (GWELLS) range from artesian to deep (139.6 m). There are 24 wells with artesian groundwater conditions within the aquifer, located along the Kootenay River. 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 along the topographic gradient from higher elevation in the north/northwest to lower elevation towards the south/southeast along the Columbia and Kootenay rivers.

No information has been identified on the primary porosity and permeability of the bedrock unit. Based on the type of material (primarily igneous intrusive rocks) and 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 (and possibly be the main source) 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. Recharge may occur through the overlying overburden aquifers 1117 and 1276. The aquifer may also be recharged by overlying tributaries of the Columbia and Kootenay rivers where the intervening overburden is thin; however, spatial and temporal understanding of this recharge mechanism 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 and Kootenay rivers and their minor tributaries, Upper Arrow and Kootenay lakes which form the southern and eastern boundaries of aquifer 0513) is expected. As the bedrock has been faulted and fractured throughout the Study Area, hydraulic connection to other aquifers (including the overlying overburden aquifers 0501, 1117 and 1276) is inferred; 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

Based on the water quality comments of the GWELLS database, two wells indicated an elevated water hardness as water quality concerns. Well yields for 325 out of 336 (excluding eleven wells that were dry or had no reported well yield) wells within the aquifer range between 0.02 L/s and 6.3 L/s with a geometric mean of 0.5 L/s, indicating an aquifer with generally moderate productivity with localized zones of low and high productivity.

There is a mix of domestic and commercial wells within aquifer 0513 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
20020322	1	Major	Initial mapping of aquifer	N/A
20160426	2	Minor	Revision of aquifer	Lowen Hydrogeology Consulting Ltd.
20230202	3	Major	Remapping and consolidation of aquifers	Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, PhD, P.Geo.

Author of first mapping not available