Aquifer Name: Montrose Bedrock Aquifer

Aquifer Number: 0486

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A. AQUIFER DESCRIPTION FOR AQUIFER 0486

A.1 CONCEPTUAL UNDERSTANDING OF HYDROSTRATIGRAPHY

A.1.1 AQUIFER EXTENTS

The northwestern boundary of the Montrose Bedrock Aquifer is a fault line (along Beaver Creek; see Figure 1, Lengyel et al. 2024) where multiple dry (no yield) bedrock groundwater wells indicate the absence of active groundwater flow. The extent of the rest of the aquifer is defined based on topography, major surface water features, and water licensing watershed boundaries within a regionally extensive geological/hydrostratigraphic unit. The aquifer is bounded by the Columbia River in the southwest. The Columbia River is inferred to be a regional discharge boundary for the groundwater flow system. The northeastern, eastern, and southeastern boundaries of the aquifer were delineated based on inferred groundwater divides (ridges) and were drawn using surface licensing watershed boundaries. The boundaries are a representation of topography (extent of the drainage basin) in the area. The eastern groundwater divide (ridge) is defined by the Blizzard Mountain range.

Aquifer 0486 has been consolidated with the former bedrock aquifer 0494.

A.1.2 GEOLOGIC FORMATION (OVERLYING MATERIALS)

Fulton et al. (1984) described the area of the aquifer to be overlain by silty till, sandy loam, loamy till, and alluvium. Aquifer 0486 may be locally overlain by the sediments of overburden aquifers 0484 and 1284. Sections of the overlying till are described to be thin and discontinuous with thickness up to 2 m in some regions. Depth to bedrock ranges from 0.6 to 61.0 m. The average depth to bedrock is 13.3 m. Bedrock outcrops at higher elevations.

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

Aquifer 0486 is comprised mainly of fractured volcanics (basaltic) of the Mesozoic Era (Cui et al. 2017). Some fractured sedimentary rocks (mudstone, siltstone, shale, fine clastic) occur along the northwestern boundary. Bedrock outcrops at higher elevations.

As the bedrock has been faulted and fractured throughout the area of the aquifer and surrounding region, secondary permeability is expected in all types of bedrock; as such, all these rocks may act as aquifers. Accordingly, bedrock aquifers are expected to extend across lithological boundaries.

The aquifer was mapped outside the extent of well development; thus, uncertainty exists with aquifer properties.

A.1.4 VULNERABILITY - MODERATE

The bedrock aquifer is comprised of fractured rock. Depth to groundwater varies from shallow to moderately deep. The average depth to water is 19.2 m and average depth to bedrock is 13.3 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). Sections of the overlying geology are described as thin and discontinuous. 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 a higher risk of contamination from land use may be expected) to high (in topographically elevated areas where overlying material is thin or absent and bedrock outcrops). 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 (76.2 m). There are four wells with artesian groundwater conditions within 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 primarily toward Beaver Creek in the north, and the Columbia River in the west (i.e., from locations of high elevation head to locations of low elevation head).

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), the primary porosity and permeability could be moderate to high. Based on the large variation of reported well yields over short distances, flow is inferred to occur primarily through fractures.

No information is available on how faults impact groundwater flow in the area. While fracturing associated with the faults is assumed to enhance permeability, based on the spatial association between dry wells and the fault delimiting the aquifer in the north, the regional fault is interpreted to act as a barrier to groundwater flow.

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 0484 and 1284. The aquifer may also be recharged by overlying tributaries of the Columbia River 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

Bedrock wells may be hydraulically connected to the overlying overburden aquifers (0484 and 1284).

Most bedrock wells of the aquifer are on the Beaver Creek/Columbia River floodplain. Hydraulic connection to various surface water bodies (rivers, creeks, and lakes) in the area 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 studies.

Hydraulic connection across aquifer boundaries defined by inferred groundwater divides may also be possible contingent on the presence of fractures. Thus, aquifer 0486 may be hydraulically continuous with aquifer 0493.

A.3 WATER MANAGEMENT

A.3.1 ADDITIONAL INFORMATION ON WATER USE AND MANAGEMENT

Based on the water quality comments in the GWELLS database, three wells reported elevated water hardness. Reported well yields for 98 out of 115 wells (excluding 17 wells that were dry or had no reported well yield) within the aquifer range between 0.03 L/s and 18.2 L/s, with a geometric mean of 0.5 L/s, indicating an aquifer with generally moderate productivity with localized zones of both low and high productivity.

There is a mix of domestic and commercial wells within aquifer 0486 based on GWELLS well purposes.

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.

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

Lengyel, T., Verma, V., Deri-Takacs, J, and Hinnell. A. 2023. 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
20020302	1	Major	Initial mapping of aquifer	N/A
20230202	2	Major	Remapping and consolidation of aquifers	Tibor Lengyel, M.Sc., P.Geo., Simrat Verma, M.Sc., and Andrew Hinnell, PhD, P.Geo.

Note: Author of first mapping not available