Aquifer Name: Sunset Prairie Bedrock Aquifer

Aquifer Number: 0595

Date of Mapping: February 10, 2023

Authors: Tibor Lengyel, M.Sc., P.Geo., Judit Deri-Takacs, Ph.D., and Andrew Hinnell, Ph.D., P.Geo.

A. AQUIFER DESCRIPTION FOR AQUIFER 0595

A.1 CONCEPTUAL UNDERSTANDING OF HYDROSTRATIGRAPHY

A.1.1 AQUIFER EXTENTS

The aquifer is along the Kiskatinaw River on its western and northern side, between the community of Progress and the confluence of the Kiskatinaw River and the Peace River. It is a bedrock aquifer delineated based on water licensing watershed boundaries and surface water bodies within a regionally extensive geological/hydrostratigraphic unit. The aquifer is bounded by the Kiskatinaw River to the east and water licencing watershed boundaries in the other directions (Lengyel et al. 2023, Figure 1). The bedrock aquifers to the north, west and south of the aquifer (589, 591, 0631, 0634, and 1275) are part of the same geological/hydrostratigraphical unit.

A.1.2 GEOLOGIC FORMATION (OVERLYING MATERIALS)

The aquifer is overlain by variable thickness of till and glaciolacustrine deposits with areas reporting veneers only. Seventy of the 91 wells associated with the aquifer reported fine-grained material (clay, till), three reported sand and fines (silty sand), and two reported coarse-grained material (sand and gravel) on the surface. The thickness of the overlying material ranges from 1.2 to more than 200 meters.

A.1.3 GEOLOGIC FORMATION (AQUIFER) – 5A FRACTURED SEDIMENTARY ROCK

The bedrock aquifer is comprised of sediments of the Dunvegan and Kaskapau formations. The Dunvegan Formation and Kaskapau Formation are interpreted to be a regionally continuous hydrostratigraphic unit. The Dunvegan Formation consists of massive conglomerate, fine- to coarse-grained sandstone, and carbonaceous shale (Massey et al. 2005), while the Kaskapau Formation mostly consists of shale, siltstone, and sandstone.

Permeability may be associated with both the primary and the secondary porosity (through fractures) of the formations. The Dunvegan and Kaskapau formations are described in further detail by Lengyel et al. (2023).

The aquifer is interpreted to be a confined aquifer based on the thickness and type of overlying materials.

A.1.4 VULNERABILITY

Depth to groundwater varies from shallow to deep. Pumping test derived estimates for transmissivity and hydraulic conductivity are 69 m^2/d and 7.7 m/d, respectively, at provincial observation well OW-416

(Well Tag Number [WTN] 104707), and 16 m^2/d and 0.8 m/d, respectively, at provincial observation well OW-417 (WTN 104708) (Baye et al. 2016). Surficial mapping by Reimchen (1980) and borehole logs indicate that the bedrock aquifer is primarily covered by fine-grained materials of variable thickness (see Section A.1.3). 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) and in reviewed research wells (Goetz 2021) range from shallow (0.6 m) to deep (85.3 m). Flowing artesian conditions were encountered at three wells (WTN 75478 and 75480, and EERI-11). There are two active bedrock provincial observation, OW 416 (WTN 104707) and OW 417 (WTN 104708) and two inactive provincial observation wells, OW-111 (WTN 22879) and OW-112 (WTN 22892) within the extents of 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 towards the Kiskatinaw River and its tributaries.

A.2.2 RECHARGE

Recharge to the aquifer could occur via distributed infiltration of precipitation and snowmelt through the thin overburden (Baye et al. 2016). Much of the recharge is expected to occur in the spring associated with snowmelt. The aquifer may also be recharged by the overlying minor tributaries of the Kiskatinaw River and/or regional groundwater flow in the bedrock units. However, the spatial and temporal understanding of these recharge pathways as well as vertical flow potential within the bedrock are uncertain and further investigation is required to be evaluated.

A.2.3 POTENTIAL FOR HYDRAULIC CONNECTION

Groundwater in the aquifer is in direct hydraulic connection with its neighbouring bedrock aquifers 0589, 0591, 0631, 0634, and 1275 that are all part of a continuous hydrostratigraphic unit. Hydraulic connection may also exist between aquifer 0595 and overlying overburden aquifers (i.e., 0592, 594, and 596) where the intervening sediments are permeable.

Groundwater in the aquifer may also be in direct hydraulic connection with the minor tributaries of the Kiskatinaw River and wetlands in the west and north, where the thickness of the overburden separating them is thin.

A.3 WATER MANAGEMENT

A.3.1 ADDITIONAL INFORMATION ON WATER USE AND MANAGEMENT

Three wells reported elevated iron and hardness content for wells WTN 54157, 39097, and 39092, with additional comment on hydrogen-sulfide smell of water in well 54157. Baye et al. (2016) reported exceedances for arsenic, iron, manganese, sulphate, TDS, and hardness in some of the bedrock wells within the area of aquifer 0595. Stated yields in the well records range from 0.03 to 6.3 L/s, with a geometric mean of 0.54 L/s indicating moderate productivity with localized zones of both low and high productivity. Groundwater is used commonly for domestic purposes (52 out of 91 wells). In addition, wells with observation, commercial, and unknown purposes were also recorded in GWELLS.

A.3.2 ADDITIONAL ASSESSMENTS OR MANAGEMENT ACTIONS

Baye et al. (2016) concluded that recharge occurs in upland areas by precipitation percolating through the till, however the exact recharge source of the regional bedrock aquifer is currently uncertain and requires further investigation.

Aquifer 0595 is part of the Dunvegan and Kaskapau formations. Bedrock aquifers in the weathered and fractured Dunvegan and Kaskapau formations in the Study Area (0589, 0591, 0593, 0595, 0633, and 1275) are inferred to be part of the same hydrostratigraphic unit and are interpreted to be continuous on a regional scale (see Lengyel et al. 2023). The aquifer is differentiated from adjacent aquifers (0589, 0591, 0633, 1275) based on regional groundwater flow paths and major geographic features. Water management decisions for the aquifer may require assessment of adjacent aquifers, especially where development is near the aquifer boundaries.

A.4 AQUIFER REFERENCES

Baye, A., Rathfelder, K., Wei, M., and Yin, J., 2016. Hydrostratigraphic, hydraulic and hydrogeochemical descriptions of Dawson Creek-Groundbirch areas, Northeast BC. Victoria, Prov of B.C. Water Science Series 2016-04.

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

Goetz, A. M., 2021. Regional groundwater conditions in northeast BC: Results from a monitoring well network in an area of historical and ongoing unconventional natural gas development. M.Sc. Thesis, University of British Columbia, Vancouver, B.C.

Lengyel, T., Deri-Takacs, J., Hinnell, A. C, & Clague, J. J. 2023. Kiskatinaw-Peace Aquifer Mapping and Hydrostratigraphic Characterization. Victoria, B.C.

Massey, N.W.D., MacIntyre, D.G., Desjardins, P.J. & Cooney, R.T. 2005. Geology of British Columbia. Ministry of Energy and Mines, BC Geological Survey, Geoscience Map 2005-3.

Reimchen, T.H.F, 1980. Surficial Geology Dawson Creek; Geological Survey of Canada, Map 1467A, 1:250000 scale map.

A.5 REVISION HISTORY

Date	Version	Revision Class	Comments	Author
2011	1	Major	Initial mapping of aquifer	Lowen Hydrogeology Consulting Ltd. 2011
02/10/2023	2	Major	Aquifer boundaries updated to include hydraulically connected geologic formations	Tibor Lengyel, M.Sc., P.Geo., Judit Deri-Takacs, Ph.D., Andrew Hinnell, Ph.D., P.Geo.