

**Table A-1: Results of Hazard Screening and Groundwater at Risk of Containing Pathogens (GARP) Assessment**  
**Railway Well Field, City of Parksville, BC**

Railway #6: Well Tag No.: 107096; Plate ID No.: 13762				
Results of Hazard Screening and Assessment <sup>2</sup>				
Category	Hazard <sup>1</sup> No.	Description	Hazard Present? <sup>3</sup>	Comments
Water Quality Results	A1	Microbiological Test Results	N	Thurber Engineering Ltd. (1996) reported that samples collected from Railway #6 were analysed for parameters including bacteriological analysis and the results were "within the acceptable limits specified in the Guidelines for Canadian Drinking Water Quality"; however, the laboratory report was not available for review. City of Parksville records indicate that samples collected from Railway #6 in October 2010 and October 2019 were reported with total coliforms and <i>E. coli</i> at concentrations of <1.0 MPN/100 mL (Table G-1, APPENDIX G).
	A2	Turbidity	N	Samples collected from Railway #6 in October 2010 and October 2019 were reported with turbidity values of 0.34 and 0.4 NTU, respectively (Table G-1, APPENDIX G); these values were reported by the analytical laboratory.
	B1	Setbacks from Sources of Contamination	N	Railway #6 is situated at distances greater than the setback requirements specified in the HHR <sup>5</sup> from sources of probable contamination, private dwellings, cemetery and dumping grounds.
	B2	Flood Risk	N	The top of the well screen (i.e., intake depth) for Railway #6 is > 15 m bgs, at a depth of 29.6 m bgs (see well log and engineering drawing provided in APPENDIX E). The area around Railway #6 is not expected to be prone to flooding and the well is not within the natural boundary of a surface water body; Shelley Creek is the nearest surface water body, located over 600 m south from the well field (Figure 2). As observed during Site visit conducted during a precipitation event on 6 April 2023 and reported by the City, the area is not expected to be prone to flooding.
Well Location	B3	Hydraulic Connection to Surface Water	N	The well intake depth for Railway #6 is <15 m bgs (top of well screen is 29.6 m bgs per well log and engineering drawing provided in APPENDIX E). The Railway Well Field is over 600 m from Shelley Creek (Figure 2), the nearest surface water body (i.e., >150 m away), and no drainage ditches or ponded water (permanent or intermittent) are reported to be located within 150 m of Railway #6.
	B4	Viruses	Y	Railway #6 is located less than 40 m (i.e., < 300 m) of private residential properties along Wildgreen Way (south of well) and the 200-day time-of-travel zone for Railway #6 extends into the area of the residential properties to the south of the well (Figure 3). The individual septic systems that service these private residences may represent a potential source of enteric viral contamination to the aquifer. The surficial deposits at Railway #6 were described by the driller as comprising sandy, gravelly silt, sand and gravel to a depth of 2.7 m bgs, underlain by compact to dense sandy silt to a depth of 4.4 m bgs. Although these deposits, and an unsaturated thickness of approximately 8.8 m, are inferred to provide some protection to groundwater quality, there is uncertainty regarding the thickness, composition (i.e., confining properties) and extent of the deposits throughout the area. Other wells that are identified on the WELLS database as being present in the vicinity of the Railway Well Field could provide a preferential pathway for migration of contaminants to the aquifer if they were not closed properly.
	C1	Surface Sealing	Y	The well log for Railway #6 (APPENDIX E) indicates that a surface seal was installed through deposits described as sandy, gravelly silt, sand and gravel to a depth of 4.5 m bgs. The seal does not comply with the minimum length of 5 m that is specified in Part 3, Division 3 of the GWPR <sup>5</sup> ; however, the secure kiosk and drainage direction away from the wellhead are inferred to provide protection to Railway #6.
	C2	Well Caps and Covers	N	Railway #6 is secured with a distribution pipe that is sealed with a gasket and bolted to a steel flange (Photo B-10, APPENDIX B). This completion is interpreted to prevent persons, animals, foreign matter or water from entering the well, thereby meeting the requirements of Part 4 of the GWPR <sup>5</sup> .
Well Construction	C3	Floodproofing of Wells	N	Railway #6 is located in a locked kiosk that prevents unauthorized access to the well and migration of surface water to the wellhead (concrete slab floor of the kiosk is approximately 0.08 m [3-inch] above surrounding grade). Within the kiosk, the concrete floor is graded towards a drain that is located approximately 0.33 m (13-inch) from the well casing. The City did not provide detailed records for Railway #6, but the wellhead is inferred to be similar to Railway #4 and #7; the drawings for these wells indicate that the floor drains discharge to daylight, likely behind the concrete pad. Therefore, Railway #6 is interpreted to meet the floodproofing requirements outlined in Part 7, Section 63 of the GWPR <sup>5</sup> and Section 16 of the DWPA <sup>5</sup> .
	C4	Wellhead Protection	N	The casing stick-up for Railway #6 is reported on the engineering drawing (APPENDIX E) to be 0.37 m from the top of the well cap to the floor of the kiosk. The stick-up from the estimated top of well casing (i.e., the top of flange) to the floor to be approximately 0.35 m (13.75-inch), greater than the 0.3 m minimum required in the GWPR <sup>5</sup> . The well's location inside the secured kiosk drainage of water away from the wellhead towards a drain in the kiosk floor are interpreted to satisfy the requirements outlined in Part 3, Division 5 and Part 7 of the GWPR <sup>5</sup> and prevent surface water and foreign matter from entering the well.
	D1	Shallow Wells	N	Based on the well log and engineering drawing provided in APPENDIX E, the top of the well screen (i.e., well intake) for Railway #6 is 29.6 m bgs, a depth greater than 15 m bgs.
	D2	Vulnerable Aquifer	N	Aquifer 216 is classified by BC ENV <sup>6</sup> as with a moderate vulnerability to contamination from surface sources (i.e., IIB). Although the aquifer is reported by ENV (1996) as being unconfined in the southern portion of the aquifer, south of the railway, the well logs for the Railway wells suggest that confining deposits are present in the area of the well field.
Aquifer Type and Setting	D3	Karst	N	n/a: Quadra Sands Aquifer 216 is not a karst bedrock aquifer.
	<b>SUMMARY:</b> At Railway #6, Hazards B4 and C1 were screened as being present. Septic systems that are located on residential properties within 300 m of the well represent a potential source of viruses and Railway #6 is therefore At Risk for Hazard B4. The surface seal length of 4 m is less than the minimum requirement of 5 m specified in the GWPR <sup>5</sup> ; however, the current wellhead conditions are inferred to protect the well from contamination at ground surface and Railway #6 is therefore considered to be At Low Risk for Hazard C1. Based on the results of the Hazard Screening and Assessment, Railway #6 is considered to be GARP-viruses only.			

**Notes:** MPN/100 mL = most probable number per 100 millilitres (mL); m bgs = metres below ground surface; n/a = not applicable

- Hazard criteria identified in BC Ministry of Health (2017) Guidance Document for Determining Groundwater at Risk of Containing Pathogens (GARP) Version 3; GARP Guidance Document
- Hazard Screening and Assessment consisted of Level 1 investigation (Existing Records and Field Inspection), supplemented with capture zone analysis that is consistent with Level 2 or 3 investigation in GARP Guidance Document
- Y/N = Yes/No Hazard is/ is not present according to criteria outlined in GARP Guidance Document
- Hazards that were considered present were further assessed for the likelihood of being considered "At Risk" (i.e., water source potentially GARP) or "At Low Risk"
- HHR = BC Health Hazards Regulation (BC Reg 216/2011); GWPR = BC Groundwater Protection Regulation (BC Reg 39/2016); DWPA = BC Drinking Water Protection Act; EHO = Environmental Health Officer; BC ENV = BC Ministry of Environment and Climate Change Strategy

Table A-1: Results of Hazard Screening and Groundwater at Risk of Containing Pathogens (GARP) Assessment  
Railway Well Field, City of Parksville, BC

Railway #7: Well Tag No.: 107099; Plate ID No.: 13763			
Category	Hazard <sup>1</sup>	Results of Hazard Screening and Assessment <sup>2</sup>	Comments
No.	Description	Hazard Present <sup>3</sup>	Assessment <sup>4</sup>
Water Quality Results	A1 Microbiological Test Results	N	Thurber Engineering Ltd. (1997) reported that samples collected from Railway #7 were analysed for parameters including bacteriological analysis and the results were "within the acceptable limits specified in the Guidelines for Canadian Drinking Water Quality"; however, the laboratory report was not available for review. City of Parksville records indicate that samples collected from Railway #7 in November 2014 and February 2020 were reported with total coliforms and <i>E. coli</i> at concentrations of <1.0 MPN/100 mL (Table G-1, APPENDIX G).
	A2 Turbidity	N	Samples collected from Railway #7 in November 2014 and February 2020 were reported with turbidity values of 0.18 and <0.1 NTU, respectively (Table G-1, APPENDIX G); these values were reported by the analytical laboratory.
	B1 Setbacks from Sources of Contamination	N	Railway #7 is situated at distances greater than the setback requirements from sources of probable contamination, private dwellings, cemetery and dumping grounds, as outlined in the HHR <sup>5</sup> .
Well Location	B2 Flood Risk	N	The well log and engineering drawing for Railway #7 (APPENDIX E), indicates that the top of the well screen is at a depth of 26.7 m bgs (i.e., > 15 m bgs). Railway #7 is not located within the natural boundary of a surface water body, as the nearest surface water body (Shelley Creek) is located over 600 m south from the well field (Figure 2). The area is not expected to be prone to flooding, as indicated by the City and observed on 6 April 2023 during a precipitation event.
	B3 Hydraulic Connection to Surface Water	N	The top of the well screen for Railway #7 is > 15 m bgs, at a depth of 26.7 m bgs (see well log and engineering drawing, APPENDIX E). The Railway Well Field is over 600 m from Shelley Creek (Figure 2), the nearest surface water body (i.e., >150 m away), and no drainage ditches or ponded water (permanent or intermittent) are reported to be located within 150 m of Railway #7.
	B4 Viruses	Y	Railway #7 is located less than 30 m (i.e., < 300 m) of private residential properties along Wildgreen Way (south of well) and the 200-day time-of-travel zone for Railway #7 extends into the area of the residential properties to the south of the well (Figure 3). The individual septic systems that service these private residences may represent a potential source of enteric viral contamination to the aquifer. The surficial deposits at Railway #7 that were described by the driller as compact, sandy gravelly till to a depth of 3.1 m bgs and an unsaturated thickness of approximately 8.9 m are inferred to provide some protection to groundwater quality; however, there is uncertainty regarding the thickness, composition (i.e., confining properties) and extent of the deposits throughout the area. Other wells that are identified on the WELLS database as being present in the vicinity of the Railway Well Field could provide a preferential pathway for migration of contaminants to the aquifer if they were not closed properly.
	C1 Surface Sealing	Y	Railway #7 was installed with a surface seal to a depth of 4.5 m bgs (see well log in APPENDIX E), less than the minimum length of 5 m that is specified in Part 3, Division 3 of the GWPR <sup>5</sup> . The seal extends through deposits described by the driller as compact, sandy gravelly till to a depth of 3.1 m bgs that are inferred to be confining; the till is underlain by fine sand. The kiosk in which Railway #7 is secured and drainage direction away from the wellhead also provide protection to the well.
Well Construction	C2 Well Caps and Covers	N	Railway #7 is secured with a distribution pipe that is attached to the well casing with a bolted flange (Photo E-7, APPENDIX B) and sealed with a gasket. This completion is interpreted to prevent persons, animals, foreign matter and water from entering the well and, therefore, meets the requirements of Part 4 of the GWPR <sup>5</sup> .
	C3 Floodproofing of Wells	N	Railway #7 is located in a locked kiosk that prevents unauthorized access and provides protection from flood water. The concrete slab floor of the kiosk is approximately 0.08 m (3-inch) above surrounding grade and the floor inside the kiosk is graded to direct surface water away from the well and into a floor drain that is located 048 m (19-inch) from the well casing. The drain is reported on detailed drawings to discharge to daylight, at a location inferred to be behind the concrete slab. Railway #7 is therefore interpreted to meet the floodproofing requirements outlined in Part 7, Section 63 of the GWPR <sup>5</sup> and Section 16 of the DWPA <sup>4</sup> .
	C4 Wellhead Protection	Y	The engineering drawing for Railway #7 (APPENDIX E) indicates that casing stick-up from the top of the well cap to the floor of the kiosk is 0.17 m; however, during the site visit the stick-up from the estimated top of well casing (i.e., the top of flange) to the floor was measured to be 0.30 m (11.75-inch), thereby meeting the minimum required in the GWPR <sup>5</sup> . The well's location inside the secured kiosk is interpreted to provide protection to Railway #7 and water drains away from the wellhead towards a drain in the kiosk floor. Therefore, the wellhead conditions for Railway #7 are interpreted to satisfy the requirements outlined in Part 3, Division 5 and Part 7 of the GWPR <sup>5</sup> and prevent surface water and foreign matter from entering the well.
	D1 Shallow Wells	N	Top of well screen is reported on the well log and engineering drawing (APPENDIX E) as being at a depth of 26.7 m bgs (i.e., > 15 m bgs).
Aquifer Type and Setting	D2 Vulnerable Aquifer	N	Aquifer 216 is classified by BC ENV <sup>6</sup> as IIB, indicating a moderate vulnerability to contamination from surface sources. Although the aquifer is reported by ENV (1996) as being unconfined in the southern portion of the aquifer, south of the railway, the well logs for the Railway wells suggest that confining deposits are present in the area of the well field.
	D3 Karst	N	n/a: Quadra Sands Aquifer 216 is not a karst bedrock aquifer.
	SUMMARY:	The Hazard Screening identified Hazards B4, C1 and C4 as being present for Railway #7. Based on the potential for viruses from septic systems at residential properties within 300 m of the well, Railway #7 was assessed as being At Risk for Hazard B4. The casing stickup of 0.17 m and surface seal length of 4.5 m are less than the minimum requirements of 0.3 m and 5 m specified in the GWPR <sup>5</sup> , respectively; however, the wellhead completion in a secured kiosk within a fenced, locked compound are considered to provide adequate protection and the well was assessed as being At Low Risk for Hazards C1 and C4.	

Notes: MPN/100 mL = most probable number per 100 millilitres (mL); m bgs = metres below ground surface; n/a = not applicable

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- Y/N = Yes/No Hazard is/ is not present according to criteria outlined in GARP Guidance Document
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**APPENDIX B**

**Site Photos**



**Photo B-1:** Photo of the Railway Well Field taken on 27 February 2023, looking east. The Arrowsmith Potter's Guild store is visible in the centre of the photo and the Railway Wells are located along the vegetated areas past the yellow gates to the left (Railway #1, #2, #3 and #4) and right (Railway #5, #6 and #7).



**Photo B-2:** Photo of the Railway Well Field taken on 8 April 2023, looking east.





**Photo B-3:** View of the fenced compound that is located in the central portion of the Railway Well Field. The City advised that the compound is used by the E&N Railway for storage; no subsurface infrastructure or utilities were identified.



**Photo B-4:** View looking east towards the south Railway Wells, with Railway #7 visible in the background. Vehicular access is controlled with the locked gate.





**Photo B-5:** View of Railway #6 on 27 February 2023. Each well at the Railway Well Field is located in a locked, fenced compound and protected with a locked, steel kiosk. Residential property is visible in the background.



**Photo B-6:** View of Railway #6 on 7 April 2023.

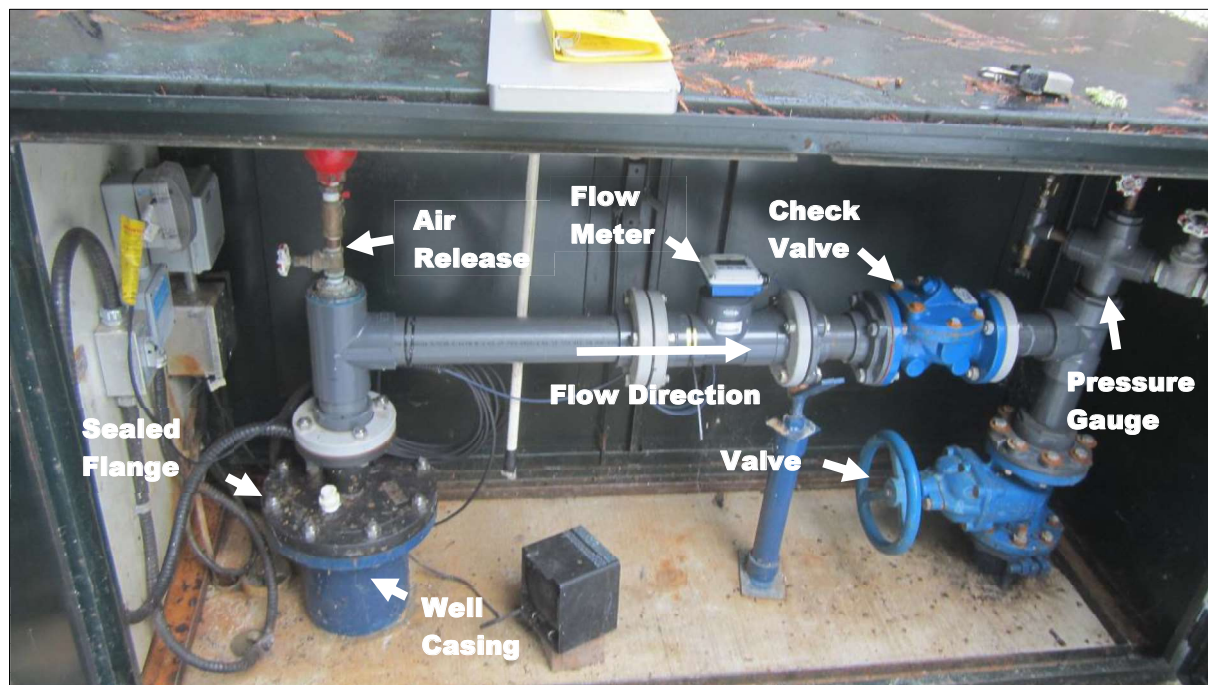




**Photo B-7:** View of Railway #7. The metal kiosk, which is typically locked, is secured to a concrete slab that is completed above surrounding ground surface and is graded away from the kiosk walls.



**Photo B-8:** View of the fenced compound and metal kiosk at Railway #5; the relatively larger kiosk includes an additional chamber that contains electrical controls for operation of the three Railway wells south of rail line (i.e., Railway #5, #6 and #7).



**Photo B-9:** View inside kiosk at Railway #4 with main components at the wellhead labelled. The concrete floor is graded to direct water away from the well casing to a drain (behind space heater that is visible to the right of the well casing).



**Photo B-10:** View of the kiosk floor at Railway #6 that is graded towards a drain that is inferred to discharge to shallow ground; detailed design drawings documenting the drain were not available for review.





**Photo B-11:** View of stainless steel flange that has been installed at Railway #2.



**Photo B-12:** View of wellhead at Springwood Well #1, located at the Springwood Water Complex, where groundwater from the well is chlorinated.



**Photo B-13:** View of chlorination equipment that is used to treat water at the pumphouse prior to being transferred to Reservoir No. 4.



**Photo B-14:** View of chlorine analyser at pumphouse to monitor residual chlorine in water prior to being transferred to Reservoir No. 4.