

5.0 WATER SYSTEM SUMMARIES

5.1 Beaver Creek – White River First Nation Water Supply Systems

Beaver Creek is the home of the White River First Nation and is located on the Alaska Highway at km 1870.6. Beaver Creek has a population of approximately 93 residents (Yukon Bureau of Statistics 2016). White River First Nation (WRFN) owns and operates two public drinking water systems, referred to as System 1 and System 2, in Beaver Creek, Yukon. The systems each have redundant groundwater wells supplying water to the treatment plants that following treatment (filtration, chlorination) and storage is distributed to users via piped distribution networks. Wells 1a and 1b serve System 1, and Wells 2a and 2b serve System 2. System 1 provides water to a total of 20 service connections, and is classified as a Large Public Drinking Water Supply System under the Yukon Drinking Water Regulations – Guidelines for Part I – Large Public Drinking Water Systems (YG 2007). Though System 2 only provides water to 7 connections, it is classified by YG-EHS as a Large Public Drinking Water Supply System under the Yukon Drinking Water Regulations – Guidelines for Part I – Large Public Drinking Water Systems (YG 2007).

5.1.1 Data Compilation Methodology

Tetra Tech approached stakeholders including water system operators and owners to let them know the project was in progress and to request their assistance in compiling the most complete data set possible. Through the process of compiling the data, Tetra Tech has had communication with the following parties regarding the WRFN Water Systems:

- White River First Nation – Confirmed that the most up to date information had been captured in the 2012 LPDWSA and other Tetra Tech projects, and gave approval for use of Tetra Tech reports and data for the project.

5.1.2 Hydrogeology

Beaver Creek is located on a broad glaciofluvial plain with the nearest bedrock outcrops occurring approximately 4 km northeast and northwest of the community (Gordey and Markpeace 2003). The subsurface soils in Beaver creek consist of sand and gravel units with veneers of organic soils (Gordey and Markpeace 2003). Regional groundwater flow in the Beaver Creek area is driven by infiltration in the upland areas to the west and southwest of Beaver Creek and discharge to the Beaver Creek drainage (Tetra Tech 2013). The groundwater flow direction has been found to be in a north to northeast direction with a hydraulic-gradient of about 0.001 m/m and a flow-velocity of about 6.5 m/day (Tetra Tech 2004, Tetra Tech 2013).

The WRFN systems are used to supply domestic water to WRFN residents of Beaver Creek as well as to the WRFN administration and government buildings. The four wells serving the two WRFN public water supply systems are completed in glaciofluvial sands and gravels.

The WRFN wells are completed in the Beaver Creek aquifer, which is considered to be an unconfined and in some places semi-confined aquifer (Tetra Tech 2013). The Beaver Creek aquifer is utilized by both the community water system and by private domestic water users with their own water wells. Tetra Tech completed an analysis of the vulnerability of the Beaver Creek aquifer in 2012 based on the semi-quantitative ISI (Ontario Ministry of Environment 2001). The ISI value for the Beaver Creek Aquifer was found to be 35, which suggests medium vulnerability to surface sources of contamination.

The nearest surface water body to the WRFN wells is Beaver Creek, which is about 1,100 m up-gradient of the closest wells (1a/1b) (Tetra Tech 2012a). The four wells serving the WRFN system have been screened for GUDI status and all have been determined to be not under the direct influence of surface water (i.e. Non-GUDI) (Tetra

Tech 2007, Tetra Tech 2008, Tetra Tech 2012a). Well 2a required a retrofitted surface seal, completed in 2007, to achieve the non-GUDI status (Tetra Tech 2007).

5.1.3 Summary of Wells

Logs for the four WRFN public wells serving System 1 and System 2 are included in the GIS map produced for this study. The following tables summarize the completion characteristics of the WRFN wells.

Table 5-1: WRFN, Well No. 1a Summary		
Well Construction Parameters	Details	Source
Date of construction	The well was completed by Double D Drilling Ltd. in September 2006.	Well log
Total well depth	34.7 m bgs	
Casing	6" (152 mm) ID Steel Well Casing	
Casing depth	31.7 m bgs	
Well screen	3 m 20 slot (0.51 mm) stainless steel well screen from 31.7 m bgs to 34.7 m bgs	Tetra Tech 2008
Static water level	15.0 m bgs (September 18, 2006)	Well log
Sanitary seal	Bentonite surface seal to 6 m bgs.	
Wellhead completion	Pitless unit	Tetra Tech 2013
Wellhead stickup	0.6 m ags	Tetra Tech 2008
Well rated capacity	4.6 L/s (60 IGPM)	
Well GUDI status	Non-GUDI	Tetra Tech 2012a
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

Table 5-2: WRFN, Well No. 1b Summary		
Well Construction Parameters	Details	Source
Date of construction	The well was completed by Double D Drilling Ltd. in August 2007	Well Log
Total well depth	35.0 m bgs	
Casing	6" (152 mm) ID Steel Well Casing	
Casing depth	33.8 m bgs	

Table 5-2: WRFN, Well No. 1b Summary

Well Construction Parameters	Details	Source
Well screen	1.2 m 100 slot (2.54 mm) stainless steel well screen from 33.8 m bgs to 35.0 m bgs.	
Static water level	14.6 m bgs (September 14, 2007)	
Sanitary seal	Bentonite surface seal to 6 m bgs.	
Wellhead completion	Pitless unit	Tetra Tech 2013
Wellhead stickup	0.6 m ags	Tetra Tech 2008
Well rated capacity	8.3 L/s (110 IGPM)	
Well GUDI status	Non-GUDI	Tetra Tech 2012a
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

Table 5-3: WRFN, Well No. 2a Summary

Well Construction Parameters	Details	Source
Date of construction	The well was completed by Midnight Sun Drilling Co. Ltd. in November 1983	Well Log
Total well depth	35 m bgs	
Casing	178 mm	
Casing depth	33.8 m bgs	
Well screen	1.2 m 20 slot (0.5 mm) stainless steel well screen from 33.8 m bgs to 35 m bgs	
Static water level	14.6 m bgs (September 14, 2007)	
Sanitary seal	6 m bgs	Tetra Tech 2013
Wellhead completion	Pitless unit	
Wellhead stickup	>0.5 m ags	Tetra Tech site visit 2016
Well rated capacity	4.2 L/s (55 IGPM)	Tetra Tech 2006
Well GUDI status	Non-GUDI	Tetra Tech 2007
Well Construction Comments:	Well was upgraded in 2007 with sanitary seal, pitless unit and casing extension to meet Canadian Groundwater Association Well Construction Guidelines (Tetra Tech 2008).	

Table 5-4: WRFN, Well No. 2b Summary

Well Construction Parameters	Details	Source
Date of construction	Well was completed by Double D Drilling in August 2007.	Well log
Total well depth	34.4 m bgs	
Casing	6" (152 mm) ID Steel Well Casing	
Casing depth	33.2 m bgs	
Well screen	1.2 m 100 slot (2.54 mm) stainless steel well screen from 33.2 m bgs to 34.4 m bgs.	
Static water level	13.75 m bgs (September 10, 2007)	
Sanitary seal	Bentonite surface seal to 6 m bgs	Tetra Tech 2013
Wellhead completion	Pitless unit	
Wellhead stickup	0.6 m ags	Tetra Tech 2008
Well rated capacity	8.3 L/s (110 IGPM)	
Well GUDI status	Non-GUDI	
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

5.1.4 Source Water Quality

The water supplied from the four WRFN public water supply wells comes from the Beaver Creek Aquifer; very similar chemistry is observed in all of the Community wells which are completed at similar depths within the same aquifer. The water from the four wells can be classified as calcium-bicarbonate type and is moderately hard (Tetra Tech 2008).

Tetra Tech collected samples from the WRFN water systems on five different dates between 2006 and 2010. In addition to this monitoring, samples were collected from the systems in 2011 and 2012 as part of GUDI assessment work and AWPP updates. In the samples reviewed, all parameters have been within the GCDWQ MAC and AO with the exception of a raw water sample retrieved in March 2007 from Well 1a which had an iron concentration in excess of the GCDWQ AO of 0.3 mg/L and a turbidity measurement greater than 1 NTU (Tetra Tech 2011). Test results for all treated water yielded results have been within the GCDWQ (Tetra Tech 2011, Tetra Tech 2012b, and Tetra Tech 2013).

Laboratory water quality results from 2012 can be found in the AWPP in the attached GIS database.

5.1.5 Water Treatment and Distribution

Table 5-5: WRFN System 1 Water Treatment and Distribution Details		
Item	Details	Source
Owner/Operator	White River First Nation	Tetra Tech 2008
Water source	Groundwater	
Wells serving the system	Wells No. 1a and No. 1b	
Treatment type	Filtration (10 and 1 micron steps) and chlorination	Tetra Tech 2015
Number of connections	20 connections	
Delivery method	Shallow bury low flow recirculating piped water distribution system	
Age of system/last known update	System upgrades ongoing. Most recent upgrades completed in 2011. The design work and permitting are completed, and work is planned to expand System 1 to serve an additional 15 service connections in a proposed new WRFN subdivision	Tetra Tech 2015 Current projects with Tetra Tech

Table 5-6: WRFN System 2 Water Treatment and Distribution Details		
	Details	Source
Owner/Operator	White River First Nation	Tetra Tech 2008
Water source	Groundwater	
Number of wells serving the system	Wells No. 2a and No. 2b	
Treatment type	Filtration (10 and 1 micron steps) and chlorination	Tetra Tech 2015
Number of connections	7 connections	
Delivery method	Shallow bury low flow recirculating piped water distribution system	
Age of system/last known major work	System modifications are planned. Most recent upgrades completed in 2011.	Current projects with Tetra Tech

5.1.6 Source Water Protection Planning

Source water protection planning in the form of an AWPP was completed in 2007 and updated in 2012 (Tetra Tech 2012b). The updated 2012 AWPP is included in the GIS mapping portion of this project.

Beaver Creek was established as a community in the 1950s shortly after the completion of the Alaska Highway. There is very little industrial activity in Beaver Creek and potential sources of contamination in the area of the WRFN water supply system are primarily related to domestic septic fields, ASTs, livestock holding pens and historical fuel spills.

The Beaver Creek WRFN AWPP was developed and updated by White River First Nation representatives with technical input and consulting services provided by Tetra Tech. A risk based approach was used to create the AWPP. Tetra Tech identified the well capture zones using a combination of analytical method based on the Theim Equation and groundwater flow modelling using the Waterloo Hydrogeologic Inc. Visual MODFLOW modelling code (Version 3.1.0.86). Visual MODFLOW is based on the USGS MODFLOW code and simulates groundwater flow in three-dimensions using the finite-difference method in either steady state or transient mode. The modelling showed long narrow capture zones which Tetra Tech modified for the AWPP to add a safety factor by using a 'buffer zone' around the AWPP area.

The AWPP was updated in 2012 to capture changes and updates to potential risks to the groundwater resource. Tetra Tech emphasized the following key conclusions:

- There had been no identified contamination in groundwater sampled from the Community Wells; however, any release of contaminants within the identified capture zones would represent a potential risk to the aquifer and water quality of the Community Wells;
- A total of 11 wells had been decommissioned in accordance with the Canadian Groundwater Association - Guidelines for Water Well Construction;
- Water quality results from the Community Wells did not suggest that up-gradient septic fields and manure pile storage are currently impacting the water quality of the wells; however, septic fields and manure pile storage had the potential to impact the Beaver Creek Aquifer and community wells;
- The identified risks to the Community Wells were from livestock manure storage; leachate from septic fields; potential releases and spills from Aboveground Storage Tanks (ASTs); and other potential spills; and
- ASTs located outside of the well capture zones were identified as potential sources of contamination, for which environmental concerns should be addressed.

From the 2012 update, Tetra Tech made several recommendations which are included in the attached AWPP, included in the GIS map and database portion of this summary.

5.1.7 Water Supply Information Data Gaps

There are no known gaps with respect to source water protection in the White River First Nation community at Beaver Creek and Tetra Tech was able to obtain all known reports and data for the purposes of this summary. There are some remaining recommendations for risk reduction/mitigation that WRFN have been working towards.