

5.32 Mayo - NNDFN Water Supply System

The Na-cho Nyak Dun First Nation (NNDFN) owns and operates the potable water and the open loop Ground Source Heat Pump (GSHP) systems that service the NNDFN Government House and NNDFN's bulk water supply facility, located in Mayo, Yukon. The system is classified as a Large Public Drinking Water Supply System under the Yukon Public Drinking Water Regulation. The system was commissioned in 2013 (MH 2016) and is regulated under the Public Health Act, General Regulations Sections 18 and 19 (YG Public Health Act, 1958/079), which requires safety measures and inspection for water and water sources for systems that provided for human consumption.

The potable water system is supplied with groundwater from two deep supply wells, Extraction Well 1A (NNDFN-SW2) and Extraction Well 1B (NNDFN-SW1R). Extraction Well 1B (NNDFN-SW1R) is a replacement well to the decommissioned supply well NND-SW1, which was damaged during pump installation (Tetra Tech 2013). NNDFN-SW1 was decommissioned in September 2012 in accordance with Y-DWR requirements as detailed in CGWA Guidelines for Water Well Construction (Tetra Tech 2013). The groundwater is treated for hardness (including iron and manganese removal) and is chlorinated prior to delivery and consumption (MH 2016).

The supply wells also provide a source of groundwater to the NNDFN's GSHP system (MH 2016). Once the groundwater passes through the GSHP system, the water is re-injected into the aquifer using a single injection well, NNDFN-IW1.

According to the water license for the NNDFN potable water and the GSHP systems, NNDFN can extract a maximum of 10.4 L/s (137 IGPM) from the two supply wells, and 92% of this water can be used for heating / geoexchange with the remaining 8% used for municipal consumption (Tetra Tech 2006).

The two supply wells and the injection well were cleaned and rehabilitated in September 2015 (MH 2016).

For the purpose of this project, well completion details and the chemical water quality data for the injection well (NNDFN-IW1) for the GSHP system will not be discussed further.

5.32.1 Data Compilation Methodology

Tetra Tech approached stakeholders including the water system owner/operator and regulatory bodies 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 NNDFN water supply system:

- Nacho Nyak Dun First Nation - Provided well rehabilitation report, confirmed the well configuration and use, and gave approval for use of Tetra Tech data for the project and reviewed the water system summary.

5.32.2 Hydrogeology

The "NNDFN Aquifer" is a well-protected, confined, deep aquifer. Results of the hydraulic testing conducted on the NNDFN wells indicate that there is a high degree of hydraulic connectivity between the wells and the transmissivity, storativity, and conductivity results for all the hydraulic testing were similar (Tetra Tech 2011). The aquifer has high transmissibility and is characterized as a highly conductive, confined sand and gravel aquifer (Tetra Tech 2011). Confined conditions typically present a higher degree of drawdown for similar aquifer materials (Driscoll, 1986). Confined aquifers as well as aquifers with high transmissivity typically have a very large radius of influence though the drawdown in surrounding wells is typically quite shallow (Driscoll, 1986). However, rapid hydraulic pressure response between the NNDFN wells does not mean the actual water flow or heat transfer would be unacceptably rapid between the wells (Tetra Tech 2011).

Results of the pumping tests on the NNDFN wells indicate that a hydraulic conductivity of about 2.3×10^{-4} m/s for the “NNDFN Aquifer” and a calculated transmissivity of about 1.3×10^{-2} m²/s and storativity of about 3.3×10^{-4} , respectively (Tetra Tech 2011). The calculated hydraulic conductivity is typical for conductive sand and gravel deposits and the calculated transmissivity and storativity are typical for a confined sand and gravel aquifer (Driscoll, 1986).

5.32.3 Summary of Wells

Well logs for the two water supply wells currently serving the NNDFN potable system are included in the GIS map and database portion of this project. The following tables summarize the completion characteristics of these two wells.

Table 5-84: NNDFN Mayo, Extraction Well 1 (NNDFN-SW2) Summary		
Well Construction Parameters	Details	Source
Date of construction	Well was completed by Impact Well Drilling in September 2010	Well log
Total well depth	104.8 m bgs	
Casing	8" (203 mm) OD Steel Well Casing	
Casing depth	99.4 m bgs	
Well screen	1.6 m 40 slot (1.02 mm) stainless steel well screen from 100 m bgs to 101.6 m bgs and 3.2 m 80 slot (2.03 mm) stainless steel well screen from 101.6 m bgs to 104.8 m bgs. The total well screen length is 4.8 m.	
Static water level	42.6 m bgs (October 6, 2010)	
Sanitary seal	Bentonite surface seal to 5.8 m bgs	
Wellhead completion	Locking well cap	Tetra Tech 2011
Wellhead stickup	0.63 m ags (September 2010)	
Well rated capacity	6.3 L/s (83 IGPM)	
Well GUDI status	Not assessed	
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

Table 5-85: NNDFN Mayo, Extraction Well 2 (NNDFN-SW1R) Summary		
Well Construction Parameters	Details	Source
Date of construction	Well was completed by Cathway Water Resources, in August 2012	Well log

Well Construction Parameters	Details	Source
Total well depth	95.9 m bgs	
Casing	8" (203 mm) ID Stainless Steel Well Casing	
Casing depth	92.9 m bgs	
Well screen	3 m 80 slot (2mm) stainless steel well screen from 92.9 m to 95.9 m bgs	
Static water level	42.8 m bgs (August 30, 2012)	
Sanitary seal	Bentonite surface seal to 4.6 m bgs	
Wellhead completion	Pitless unit	Tetra Tech 2013
Wellhead stickup	0.74 m ags	
Well rated capacity	9.5 L/s (125 IGPM)	
Well GUDI status	Not assessed	
Well Construction Comments:	Well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

5.32.4 Source Water Quality

Historical chemical water quality data available for review includes groundwater samples collected from the supply wells, including the decommissioned well NNDFN-SW1, between October 17, 2005 and September 1, 2012. Some of the samples were submitted to ALS Environmental and some were submitted to WSEI for laboratory analysis (Tetra Tech 2013). The results are summarized as follows:

- The groundwater chemistry observed in all three supply wells are similar;
- The water quality from all the wells was very hard, containing calcium-bicarbonate with significant amounts of magnesium (35.8 mg/L to 57.6 mg/L) and sulphate (86 mg/L to 97.4 mg/L);
- The pH in the water from the supply wells ranged from 6.95 to 8.16 on the dates sampled;
- Groundwater quality of the water from the three supply wells meets the GCDWQ for all parameters analyzed with the exception of TDS, total arsenic, total iron and total manganese;
- The TDS concentration in the water from the wells ranged 380 mg/L to 426 mg/L. Water from the three supply wells had the TDS concentrations exceeding the GCDDWQ AO of 500 mg/L at least once over the testing period;
- The total arsenic concentrations in water from all three supply wells exceed the GCDWQ MAC of 0.01 mg/L on the dates sampled. The reported total arsenic concentration ranged from 0.0355 mg/L to 0.0465 mg/L;
- The total iron concentrations in water from all three supply wells exceed the GCDWQ AO of 0.3 mg/L on the dates sampled. The reported total iron concentration ranged from 0.88 mg/L to 1.47 mg/L; and,

- The total manganese concentrations in water from all three supply wells exceed the GCDWQ AO of 0.05 mg/L on the dates sampled. The reported total manganese concentration ranged from <0.1 mg/L to 0.259 mg/L.

5.32.5 Water Treatment and Distribution

Table 5-86: NNDFN Mayo Water Treatment and Distribution Details		
Item	Details	Source
Owner/Operator	Na-Cho Nyak Dun First Nation	
Water source	Groundwater	Tetra Tech 2012
Wells serving the system	Extraction Wells 1 and 2 (for the potable system)	
Treatment type	RO and electro dialysis (to remove hardness and TDS), iron and manganese removal, and chlorination	MH 2016
Water users	NNDFN employees and residents	Tetra Tech 2012
Delivery method	Bulk delivery to NND residents, piped connection to the Government House	Tetra Tech 2013, NovaTec 2007
Age of system/last known update	Replacement water well SW1R drilled in 2013	Tetra Tech 2013

5.32.6 Source Water Protection Planning

There is no SWPP or AWPP in place for the NNDFN water supply system. Although the vulnerability of the aquifer is low, a SWPP would provide a valuable tool for identifying, monitoring and managing risks to the wells and aquifer and for protecting the groundwater resources in the Mayo area.

5.32.7 Water Supply Information Data Gaps

Tetra Tech has been involved in the development of the potable water system and the GSHP system for the NNDFN, in Mayo, Yukon. For the purpose of this project, the following data gaps were identified:

- There is no record of source water protection planning or GUDI assessment completed for this groundwater resource. Source water protection planning completed for this system could be incorporated into a greater SWPP for groundwater resources in the Village of Mayo.