5.31 Mayo - Village of Mayo Water Supply System

The Village of Mayo (VoM) is located at the confluence of the Mayo and Stewart Rivers and is accessed via the Silver Trail (Highway 11). Mayo has a population of approximately 200 residents (Yukon Bureau of Statistics 2016). The Village of Mayo community water supply is, under normal circumstances, owned and managed by the Village of Mayo, but is currently under partial management of YG-CS while upgrades are completed on the system. Water is delivered by a combination of piped and trucked distribution. Upgrades including the isolation of the former CWW1 from the water supply system, addition of CWW1a, and CWW2 to the water supply system, additional water treatment and upgrade of the chlorination system, were completed in 2015. Further upgrades that are planned include decommissioning of CWW1 and commissioning of CWW4.

The Mayo community water supply system 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) and is also regulated under the Yukon Drinking Water Regulations - Guidelines for Part II - Bulk Delivery of Drinking Water (YG 2007).

5.31.1 Data Compilation Methodology

Tetra Tech approached stakeholders including water system operators, owners and regulators 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 Mayo Water Supply System:

- Village of Mayo – Provided EHS water quality reports, reviewed the data summary and provided review comments.
- YG Community Services (the client) – YG CS provided data for water treatment, well completion details and Source Water Protection Plan.
- YG Environmental Health – YG EHS provided data and review comments for the Mayo Water Treatment system.

5.31.2 Hydrogeology

Mayo is located on a low alluvial plain consisting of fluvial sand and gravel over glaciolacustrine silt and clay till. Bedrock mapped in the area includes argillaceous sandstone, bedded shale, fine to course grained quartz-rich sandstone and quartz-pebble conglomerate.

VoM cold water wells CWW1a, CWW2, CWW3 and CWW4, which supply potable water to the VoM community water supply system, are completed at depths of 7.5 to 8.8 m bgs. The old community water supply well, CWW1 is a dug well that was completed at 7.6 m bgs in a shallow aquifer consisting of alluvial sands and gravels. CWW1 was taken out of service as it is not currently in compliance with current best practice well construction guidelines. The four current water supply wells are completed in the same area as CWW1 and are completed at similar depths in the same aquifer.

From the well logs of the four current village water supply wells, the shallow VoM aquifer consists of primarily sand and gravel and extends to 8.5 m bgs in all four well locations. There is some evidence of fine grained soils overlying CWW2; however the lack of a confirmed confining layer in the three other well logs confirms that the aquifer is unconfined. Lacustrine fine-grained silt, unsuitable for targeting as a water supply underlie the VoM Aquifer and extend from approximately 8.5 m bgs to 165 m bgs. The natural groundwater flow direction in the vicinity of the VoM

wellfield is inferred to be south-southwest towards the Stewart River (EBA 2000). The shallow unconfined aquifer is hydraulically connected to the Mayo and Stewart River.

A deep, confined aquifer is also present beneath the Village of Mayo. The two warm water wells used for tempering the temperature of the community water supply are completed in a confined artesian aquifer overlain by 165 m of lacustrine fine grained silt (EBA 2000). The water from the deep warm water wells is of poor quality and would require treatment if to be considered for potable use. The recharge source for this deep confined aquifer is not known.

5.31.3 Summary of Wells

There are five cold water supply wells and two warm water supply wells connected to the VoM community water supply system. Currently CWW1a, CWW2, CWW3 and CWW4 are in use. CWW1 is not in service, but pipework is still in place connecting it directly to the water reservoir, bypassing the water treatment plant. The two warm water wells produce non-potable water which is used in a heat exchange system with the cold water wells to prevent freezing. CWW1A and CWW4 both have variable frequency drive (VFD) control which allows automatic modulation the water output based on water drawdown, allowing wells to be pumped as efficiently as possible in recognition of demands. CWW2 and CWW3 pump at their maximum outputs until the water level draws down to a level sensor, at which time the pump is shut off.

The four active wells are grouped to deliver water to the VoM water system as follows:

- Group 1: CWW1A and CWW2;
- Group 2: CWW3;
- Group 3: CWW1A and CWW4; and,
- Group 4: CWW2 and CWW4 (This group is never used)

Review of SCADA data (logged water elevations and pumping rates) indicates that since March 2016, Group 1 and Group 2 are typically used and duty is generally cycled between these two groups. VoM consider that if CWW3 was to go out of service, the remaining three wells would be insufficient to meet the VoM water demand (Scott Hamilton pers. Com); and further engineering investigations are currently being completed to provide recommendations to address this.

Logs for the six VoM community water system well are included in the GIS mapping portion of this project. The following tables summarize the completion characteristics of the VoM wells.

Table 5-77:VoM CWW1a Summary

Well Construction Parameters	Details	Source
Date of construction	The well was completed by Midnight Sun Drilling Inc. in July 2013	Summit Environmental 2013
Total well depth	8.69 m bgs	
Casing	12" (305 mm) ID Steel Well Casing	
Casing depth	5.79 m bgs	

Table 5-77:VoM CWW1a Summary

Well Construction Parameters	Details	Source
Well screen	2.9 m of 100 slot (2.54 mm) telescopic Variperm well screen exposed from 5.79 m bgs to 8.69 m bgs	
Static water level	2.64 m bgs (July 6, 2013)	
Sanitary seal	Bentonite surface seal to 4.57 m bgs	
Wellhead completion[1]	Pitless unit with vented, watertight well cap. The wellhead is located within the fenced WTP enclosure and also within a heated, lockable wellhouse. The well cap has provision to be locked using padlocks.	Tetra Tech 2017
Wellhead stickup	0.73 m ags (at well completion)	Summit Environmental 2013
Well rated capacity	13 L/s (172 IGPM)	
Well GUDI status	Not assessed (Likely GUDI based on the status of the other wells in the field)	
Well Construction Comments:	The well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

Table 5-78: VoM CWW2 Summary

Well Construction Parameters	Details	Source
Date of construction	The well was completed by Impact Drilling Ltd. in October 2010	Tetra Tech 2010
Total well depth	7.85 m bgs	
Casing	10" (254 mm) ID Steel Well Casing	
Casing depth	6.33 m bgs	
Well screen	0.61 m 40 slot (1.02 mm) stainless steel well screen from 6.33 m bgs to 6.94 m bgs 0.91 m 80 slot (2.03 mm) stainless steel well screen from 6.94 m bgs to 7.85 m bgs	
Static water level	2.75 m bgs (October 19, 2010)	
Sanitary seal	Bentonite surface seal to 5.5 m bgs	

Table 5-78: VoM CWW2 Summary

Well Construction Parameters	Details	Source
Wellhead completion	Pitless unit with vented, watertight well cap. The wellhead is located within the fenced WTP enclosure and also within a heated, lockable wellhouse. The well cap has provision to be locked using padlocks.	Tetra Tech 2017
Wellhead stickup	Unknown	
Well rated capacity	5.1 L/s (67 IGPM)	Tetra Tech 2010
Well GUDI status	Likely GUDI	Tetra Tech 2010 (based on results of AECOM 2010 GUDI study)
Well Construction Comments:	The well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.	

Table 5-79: VoM CWW3 Summary

Well Construction Parameters	Details	Source
Date of construction	Ensign Coring and Drilling September 2011	AECOM 2011
Total well depth*	7.43 m bgs	
Casing	15" (381 mm) ID Steel Well Casing	
Casing depth*	5.91 m bgs	
Well screen	1.52 m of 100 slot (2.54 mm) telescopic Variperm well screen exposed from 5.91 m bgs to 7.43 m bgs	
Static water level	2.38 m bgs (September 2011)	
Sanitary seal	Bentonite grout surface seal to 3.0 m bgs	
Wellhead completion	Pitless unit with vented, watertight well cap. The wellhead is located within the fenced WTP enclosure and also within a heated, lockable wellhouse. The well cap has provision to be locked using padlocks.	Tetra Tech 2017
Wellhead stickup	0.7 m (approx.)	Summit 2013a (from photograph)

Table 5-79: VoM CWW3 Summary

Well Construction Parameters	Details	Source
Well rated capacity	18.2 L/s (240 IGPM)	AECOM 2011
Well GUDI status	GUDI	
Well Construction Comments:	The well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.*Note that these depths appear different on the log. The well completion details were taken from the AECOM summary table including in the well completion report (AECOM 2011).	

Table 5-80: VoM CWW4 Summary

Well Construction Parameters	Details	Source
Date of construction	Ensign Coring and Drilling September 2011	AECOM 2011
Total well depth*	8.83 m bgs	
Casing	15" (381 mm) ID Steel Well Casing	
Casing depth*	7.31 m bgs	
Well screen	1.52 m of 100 slot (2.54 mm) telescopic Variperm well screen exposed from 7.31 m bgs to 8.83 m bgs	
Static water level	3.03 m bgs (September 2011)	
Sanitary seal*	Bentonite grout surface seal to 3.0 m bgs	
Wellhead completion	Pitless unit with vented, watertight well cap. The wellhead is located within the fenced WTP enclosure and also within a heated, lockable wellhouse. The well cap has provision to be locked using padlocks.	Tetra Tech 2017
Wellhead stickup	Unknown	
Well rated capacity	6.2 L/s (82 IGPM)	
Well GUDI status	GUDI	
Well Construction Comments:	The well was constructed to meet Canadian Groundwater Association Well Construction Guidelines.*Note that these depths appear different on the log. The well completion details were taken from the AECOM summary table including in the well completion report (AECOM 2011).	

Table 5-80: VoM CWW4 Summary		
Well Construction Parameters	Details	Source

Table 5-81: VoM WWW1 Summary (no longer in use)

Well Construction Parameters	Details	Source
Date of construction	The well was completed in 1975 with upgrades in 1986	Tetra Tech 2010
Total well depth	255 m bgs	
Casing	10" (254 mm) ID Steel Well Casing	
Casing depth	~252 m bgs	
Well screen	3 m total of well screen from 252 m bgs to 255 m bgs ▪ 4 slot (0.10 mm) stainless steel well screen ▪ 20-slot (0.51 mm) stainless steel well screen	
Static water level	~20 psi artesian pressure (July 21, 2009)	
Sanitary seal	Unknown	
Wellhead completion	Sealed well cap to account for artesian pressure, wellhead located well shack	Tetra Tech 2010
Wellhead stickup	Unknown	
Well rated capacity	56.7 L/s (760 IGPM)	Tetra Tech 2010
Well GUDI status	Not assessed	
Well Construction Comments:	It is not known if the well is completed with a sanitary surface seal, thus the well may not be completed in accordance with the Canadian Groundwater Association Well Construction Guidelines.	

Table 5-82: : VoM WWW2 Summary

Well Construction Parameters	Details	Source
Date of construction	The well was completed by Impact Drilling Ltd. in October 2010	Tetra Tech 2010
Total well depth	250.6 m bgs	
Casing	12" (305 mm) ID Steel Well Casing	
Casing depth	245.5 m bgs	
Well screen	5.1 m of 40-slot (0.51 mm) stainless steel well screen from 245.5 m bgs to 250.55 m bgs	
Static water level	~24 psi artesian pressure (July 21, 2009)	
Sanitary seal	Bentonite surface seal to 5.5 m bgs	
Wellhead completion	Sealed well cap to account for artesian pressure, wellhead located well shack	Tetra Tech 2010
Wellhead stickup	Unknown	
Well rated capacity	16.4 L/s (216 IGPM)	Tetra Tech 2010
Well GUDI status	Not assessed	
Well Construction Comments:	It is not known if the well is completed with a sanitary surface seal, thus the well may not be completed in accordance with the Canadian Groundwater Association Well Construction Guidelines.	

5.31.4 Source Water Quality

Water quality results were collected from all four wells as part of the well completion process, and water from all wells was found to meet the Guidelines for Canadian Drinking Water Quality (GCDWQ) for health based MACs and aesthetic objectives for the parameters tested on the dates sampled. All four water supply wells are considered to all be completed within the same aquifer, which is generally reflected in water quality results.

- The water from the four wells is calcium-bicarbonate type;
- The laboratory measured pH from the four wells ranges from 7.17 to 7.81; and,
- The water from all four wells is considered medium with a measured hardness of approximately 102 to 114 mg/L (as CaCO3).

5.31.5 Water Treatment and Distribution

Table 5-83:Village of Mayo Water Treatment and Distribution Details

Item	Details	Source
Owner/Operator	Village of Mayo	p.c. V. Sarrazin (Associated Eng.) June 2016
Water source	Groundwater under the influence of surface water	
Wells serving the system	CWW1a, CWW2, CWW3, CWW4	
Treatment type	Cartridge filtration (5 micron and 1 micron), UV disinfection and chlorination	
Population served	~200	Yukon Bureau of Statistics 2016
Delivery method	Piped and trucked	p.c. V. Sarrazin (Associated Eng.) June 2016
Age of system/last known update	System upgrades ongoing. Most recent upgrades completed in 2015	p.c. V. Sarrazin (Associated Eng.) June 2016

5.31.6 Source Water Protection Planning

The Village of Mayo is located within the traditional territory of the Na-Cho Nyak Dun First Nation, and the townsite of Mayo was established in 1903 as a river community and a service centre for mining activities in the area. The all-weather road linking Mayo to Whitehorse was completed in 1950. Today the Silver Trail (Highway 11) begins in Stewart Crossing on the Klondike Highway, passes through Mayo and leads to the Elsa mining camp and the small community of Keno. Today industrial activity in Mayo is still primarily related to transportation and services for mining projects and other activities in the area with other services in place to serve Mayo residents and tourism in the area.

Source Water Protection Planning for the Village of Mayo community water supply wells in the form of a Well Head Protection Plan (WHPP) was completed in 2013 (Summit 2013a and 2013b). The WHPP is included in the GIS map and database portion of this project.

Summit completed the WHPP in consultation with VoM. The WHPP is based on the 2010 British Columbia Comprehensive Source-to-Tap Assessment Guideline (BC-CSTTA). Summit identified the well capture zones using a combination of the Calculated Fixed Radius method and the Hydrogeological Mapping method outlined in the BC-CSTTA. The mapped capture zones, shown in the GIS map, are bounded by the Mayo and Stewart rivers as they were found to have enough volume relative to predicted pumping rates to create flow boundaries.

Potential sources of contamination identified during the WHPP process included petroleum storage, special waste permits, historical petroleum spills and potentially degraded septic system components. Summit assessed the risk associated with the potential contaminant sources, and recommended that VoM develop the following:

- A risk management plan with specific recommendations addressing water monitoring, fuel storage, wellhead protection, community education, underground infrastructure, and herbicide and pesticide use;

- A raw water monitoring program that details the frequency of sampling events and the parameters to be tested with the frequency of sampling events based on the severity of risk each contaminant source was assigned; and,
- An organizational framework and additional emergency actions to be included in the VoM Emergency Response Plan in the event of an emergency involving contamination of the drinking water aquifer.

The wellhead stickup completion details are not included in the current WHPP, these details are pertinent in regards to potential for flooding, traffic or other surface hazards to create impacts to the wells. These details should be recorded during the next update to the WHPP.

5.31.7 Water Supply Information Data Gaps

Tetra Tech was able to consult with all identified stakeholders regarding this system and obtained review comments from the system operator. This summary is completed to our knowledge to March 2017. In the course of this data compilation, we have identified the following data gaps:

- The new water well CWW1a should be incorporated into the Source Water Protection Plan upon completion of the water system upgrades.
- Wellhead stickup height at all four water supply wells should be confirmed.