Kinibeaminan

Our Water

An Assessment of Hiawatha First Nation's Water Supply

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Environmental Geosciences

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Executive Summary

1.1 Background

Hiawatha First Nation's water supply needs to meet the demands of a growing population and must be safe, healthy, sustainable, affordable and accessible. The existing water supply is compromised in some locations - there is insufficient quality, insufficient quantity, hardness and poor taste. Although the water supply is both safe and sufficient in many locations, there is a general community perception of poor quality water on the reserve. Many people are using bottled water for drinking purposes instead of their household water supply. As the population grows, there is and will be increased demand for housing and increased demand for water supply. This report provides information, assessments and a review of options to allow Hiawatha First Nation to improve the existing water supply and plan for the future.

1.2 Changing Federal Regulations

Water supply regulations for First Nations in Canada are changing. In June 2013, the Canadian Federal Government passed into law Bill S-8, "An act respecting the safety of drinking water on First Nation Lands". This law addresses health and safety issues on reserve lands by providing for regulations to govern drinking water and waste water treatment in First Nations communities. Regulations have not yet been developed, but are going to be made on a province-by-province basis to mirror existing provincial regulatory regimes, with adaptations to address the circumstances of First Nations living on those lands. These regulations are likely to include:

- roles and responsibilities for water management on First Nation lands;
- the quality of drinking water;
- the training and certification of water and wastewater system operators;
- the treatment of water and wastewater;
- the monitoring, testing, sampling and reporting; and
- the protection of sources of drinking water located on reserve.

Ultimately, these new regulations will probably direct chiefs and councillors to undertake risk management of water sources.

1.3 Evaluation of Hiawatha First Nation Water Supply and Solutions

Hiawatha First Nation retained Shared Value Solutions and Tim Lotimer and Associates to assist with the development of solutions for the community's water supply challenges.
The following activities have been undertaken:

- review and revised estimation of population projections
- review of previous water assessment reports

- limited review of well water records and well water quality
- review of spring water quality and potential for contamination
- assessment of some private wells
- mapping of hydrogeological conditions along Soper's Lane and Hiawatha Line
- evaluation of wells at the Life Centre
- evaluation of small-scale community systems
- development of community water supply options

1.4 Results of the Evaluation Relating to Water Quality

- The spring supply source, that services some homes along Paudash Street has very high nitrate levels and has likely been impacted by the application of fertilizer within the capture zone of this supply.
- Rice Lake has not been evaluated as a communal source by past engineering consultants, likely because of issues related to the treatability of the Lake water, which would make it very costly to use this supply.
- Groundwater quality meets the Ontario Drinking Water Standards in many locations but is typically hard and iron is often elevated causing nuisance problem such as staining of fixtures, difficulty producing soap suds and poor taste.
- 77 drilled wells (deep wells) were sampled. *E-Coli* was detected in 30% of these wells. These deeper groundwater supplies are much more protected from bacteria and viruses (pathogens) and it is probable that the *E-Coli* detections in these wells are related to well construction issues or failure to maintain the wells that allows pathogens to move from the surface and into the well.
- 16 dug or bored wells (shallow wells) were sampled. *E-Coli* was detected in 69% of these wells. The shallow groundwater is vulnerable to pathogens. The cause of pathogen occurrences in dug/bored wells may be a result of the well construction practices and/or because the shallow aquifer in which the wells are completed has become contaminated from on-site wastewater systems (septic systems) or another pathogen source. The observed *E-Coli* detections in the dug/bored wells are typical of shallow groundwater supplies.
- In some cases, wells have been completed in a manner that could allow the introduction of surface water into the well. This, commonly, occurs when the top of the well is cut-off below ground, in a well pit, to facilitate installation of the well pump.
- Certain areas of the Reserve have a more immediate need for an upgraded water supply, such as Paudash Street.

1.5 Results of the Evaluation Relating to Water Quantity

- An adequate individual water supply, from a water quantity perspective, can probably be developed from either a drilled or dug/bored well at most if not all locations on the Reserve. However, different well drilling technology may be required at some locations than at others and one method will not suit all locations on the Reserve.
- There are several shallow, sandy aquifers on the Reserve that could allow good wells to be completed. Geologic mapping that has been completed to date, using available water well records, show that these sandy aquifers are found in the area of Soper's Lane in the vicinity of the

Public Works shop and yard and Hiawatha Line, in the vicinity of the L.I.F.E Campus. There are other locations that could allow for productive wells, such as along Paudash St. In addition, there may be other areas in deeper underlying bedrock that could be used for productive wells.

- One factor that is often overlooked when evaluating groundwater supplies is the reliability of the well infrastructure (well casing, well screen and pump). For example, when the existing L.I.F.E. Centre well pump was removed from the well, it was observed that the pipe that brings water from the well to the surface was corroded and water had been continually spraying in the well. The well screen also had a thick deposit of minerals on it, reducing the flow of water into the well. Together these two factors decreased the productivity of the well.
- The sustainable capacity of the "Discovery Zone" communal supply has not been fully evaluated, but is likely in the 250,000 to 350,000 L/day range. The groundwater quality of the "Discovery Zone" wells meets the Ontario Drinking Water Standards but is hard and one of the wells has iron slightly above the aesthetic guideline.

1.6 Water Quality and Quantity Supply Alternatives

Existing Alternative: Develop and Improve Centralized System	Approximate Cost Per Household	Approximate Total Cost
a) Develop a communal surface water (lake/spring) supply system and distribute water throughout the reserve	More than $48,000	More than $9,300,000[1]
b) Develop a communal groundwater (well water) supply system and distribute water throughout the Reserve	$48,000	$9,300,000[1]
Advantages: • Adequate water supply across Hiawatha First Nation • Capital costs paid by AANDC		
Disadvantages: • Long and uncertain wait time until Federal funding would be available • High operations and maintenance costs paid by Band • Pumping facilities needed, costs paid by Band • Potential for stagnant water • Requires well qualified and experienced water operators		
Alternative 2: Address existing well problems	**Approximate Cost Per Household**	**Approximate Total Cost**
a) Upgrade existing wells to eliminate pathogen threat	$5,000	$965,000 (193 residences x $5000)
b) Upgrade and install new water treatment on existing wells	$14,500	Less than $2,800,000. Depends on #s needed

c)	Modify pumping systems to better accommodate demands	$3,000	Depends on #s needed
d)	Meet future demand with new individual wells	$15,000 - $20,000	$450,000-$600,000 (based on 30 new wells by 2031)

Advantages:

- Problem situations can be prioritized and work undertaken in short time frame
- Don't have to do everything at one time – can spread the work out over time
- Individuals pay for improvements
- Better potential to get AADNC funding in shorter time frame
- Low operations and maintenance costs

Disadvantages:

- People may not address their well problems without incentives
- Band will need to pay to decommission some wells

	Approximate Cost Per Household	Approximate Total Cost
Alternative 3: Develop small scale community systems (where existing wells can't be improved)	$14,700	$88,000 for one six-unit systems $440,000 for five six-unit systems

Advantages:

- Hiawatha First Nation has experience managing these systems
- Problem situations can be prioritized
- Don't have to do everything at one time – can spread the work out over time
- Can integrate with individual components of Alternative 2
- No pumping stations required
- Low chance of stagnant water
- May be able to more readily obtain AANDC funding based on lower costs (compared to centralized system)

Disadvantages:

- Band pays installation and operations and maintenance costs

Note: (1) based on First Nations Engineering Services Ltd, September from 2011, ($9.1 Million) with the addition of consumer price index inflation 1%). This estimate was based on a population of 328 and is therefore too low as the current population is already 370.

All three main alternatives would require protection of water sources to ensure a sustainable safe water supply. Previous engineering and hydrogeological reports have recommended a communal water supply as the preferred water supply option. However, communication with the Aboriginal Affairs and Northern Development Canada confirmed that funding for a centralized water treatment facility for Hiawatha First Nation would be at least a decade away if not longer. Many other First Nation communities in Canada have been prioritized by AANDC because of the severity of their water supply issues.

1.7 Recommendations

Given the long time horizon associated with building a water treatment plant, the impending changes to water regulations on First Nation lands and the immediate needs of Hiawatha First Nation, it is recommended that Hiawatha First Nation take steps to manage its own water supply and improve water quality on the reserve. These steps would include:

1. For each proposed program, develop an accurate scope, schedule and budget in advance of implementation.
2. Establishing a well maintenance program to address immediate needs.
3. Installing additional water treatment measures in specific areas where needed.
4. Developing small-scale communal water supply systems in priority areas.
5. Protecting the sources of drinking water across the reserve.
6. Undertaking a community-wide planning and education process to ensure that future home construction and development on the reserve has adequate water supply.
7. Establish building guidelines and inspection protocols for the installation of any new wells and septic systems on the reserve.
8. Creating economic development opportunities through building a well maintenance and water supply business and program. Partner with other Mississauga First Nations to develop possible services company that would include water, waste water and HVAC.
9. Seeking out business planning and development funding and other water supply funding from Federal and Provincial agencies to enable Hiawatha First Nation to take control of its water supply. These funding sources are available.
10. Develop community-wide mapping to show the distribution of water resources throughout the reserve.
11. Develop an emergency response plan for drinking water supplies.

Introduction

Hiawatha First Nation is evaluating the water supply system on the reserve to address current challenges and future community population growth. The existing water supply is compromised in some locations - there is insufficient quality, insufficient quantity, hardness and poor taste. Although the water supply is both safe and sufficient in many locations, there is a general community perception of poor quality water on the reserve. Many people are using bottled water for drinking purposes instead of their household water supply.

As the population grows, there is and will be increased demand for housing and increased demand for water supply. This analysis provides information and assessments that will allow Hiawatha First Nation to improve the existing water supply and plan for the future. Previous water supply studies have been reviewed in completing this evaluation.

This report outlines:

- Hiawatha First Nation water supply goal
- population growth estimates
- projected water demand estimates
- projected water supply estimates
- comparisons between individual water supply (wells) systems and communal systems
- relevant provincial and federal regulations
- a series of alternative water supply and water improvement options
- an evaluation of those water supply options
- recommended steps forward

Goal

The Hiawatha First Nation wishes to provide a safe, affordable and reliable water supply for its existing population and to prepare for increases in population into the future (2031 has been used for projections).

1.8 Population

The existing population in Hiawatha First Nation is higher than was predicted in the population projections developed by First Nations Engineering Services Ltd. (FNES) in 2011 as set out in the Table below:

Year	Predicted On-Reserve Population
1981	93
1991	141
2001	174
2011	200
2021 (projected)	*256*
2031 (projected)	*328*

Upon review of these figures, the Hiawatha First Nation indicates that these population estimates do not reflect the total community living on the Reserve. It was estimated that in 2013 there were 370 people living on the Reserve (237 Members and 133 non-Members). These figures do not include leased trailers at the seasonal trailer park on the Reserve. There is an additional estimated summer population of about 400 people (770 total summer population).

Hiawatha First Nation is projecting a 2021 population of about 450 people, likely remaining constant out to 2031. There are 160 year-round residences on Hiawatha First Nation. There are also 33 seasonal cottages. Combined, the total housing is 193.

1.9 Estimated Water Demand

A water supply/treatment facility should be designed to meet the projected maximum daily flow requirements, with peak demand met from storage, unless the source can provide more than the maximum daily demand. Estimates from Ontario's standards have been compared to First Nations Engineering Services' estimates to ensure that they are realistic.

1.9.1 Background Information for Individual Water Supply Sources

The Ontario Building Code (Table 8.2.1.3.A) for residential occupancy suggests water supply should be 1,600 L/day for a 3 bedroom dwelling and sewage flows of 750 L/day for a 1 bedroom dwelling are typically needed.

The Ontario Ministry of the Environment (MOE) (1996) Design Guidelines for private wells, include a per-person water supply requirement of 450 L/day with a peak demand of 3.75 L/min for a 120 minute period per-person and the well needs to have a minimum capacity of 13.7 L/min per household.

1.9.2 Background Information for Communal Water Supply Sources

MOE (2008) Design Guidelines for Drinking-Water Systems suggest that historically, domestic water demand typically used for design purposes ranges from 270 to 450 L/day per person.

The FNES water supply evaluation estimated a per capita demand of 325 L/day per person which is within the lower range of the MOE Design Guidelines. However, given the increased availability of water efficient fixtures in hardware and plumbing stores and the assumed use of these water efficient fixtures in the community; this figure has been used to prepare the following table outlining projected water demand.

Scenario	Population	Total water demand (L/day)
2013 residents	370	370 x 325 = 120,250
2013 residents + seasonal	370 + 400 = 770	770 x 325 = 250,250
2031 residents	450	450 x 325 = 146,250
2031 residents + seasonal	450 + 400 = 850	850 x 325 = 276,250

1.10 Estimated Sustainable Water Supply

To estimate the theoretical sustainable groundwater supply available on the Reserve, we have assumed that of the average annual precipitation of approximately 900 mm per year, groundwater recharge to the various aquifers should be approximately 50 to 100 mm per year. With the Reserve having a total land area of 11.4 km^2, the total estimated groundwater recharge is between 1,500,000 to 3,000,000 L/day, well in excess of the total water demand.

However, even though the estimated groundwater recharge is quite high, wells require specific geological conditions to allow their successful completion as discussed in the next section.

1.11 Hydrogeological Conditions

In general terms, the recharge (rainfall and snow melt) moves vertically downward through the soils (where the pore spaces are unsaturated) and eventually reaches the water table (below which the pore spaces are saturated). Once reaching the water table, groundwater continues to move through the various geologic materials until it eventually discharges to Rice Lake.

In order for a successful well to be drilled there must be permeable sediments/rocks present that allow water to move easily into a well.

It is known that there are several shallow, sandy aquifers, or permeable horizons, on the Reserve, that when encountered allow good wells to be completed. Geologic mapping that we have completed to date, using available water well records, show that these sandy aquifers are found in the area of Soper's Lane in the vicinity of the Public Works shop and yard (see Figure 1) and Hiawatha Line (see Figure 2), in the vicinity of the L.I.F.E Campus. There are other locations where sandy or other shallow aquifers could allow for productive wells, such as along Paudash Street. In addition, there may be other areas in deeper underlying bedrock that could be used for productive wells if there are sufficient fractures and cracks to allow for movement and storage of water.

Once the mapping of all of the Reserve wells is completed, it will be possible to update the cross sections to show the distribution of water resources throughout the reserve.

Note, for the figure below, "overburden" refers to layer of soils, sands and gravels that lie above the deeper bedrock. The locations of the cross sections are shown on Figure 3.

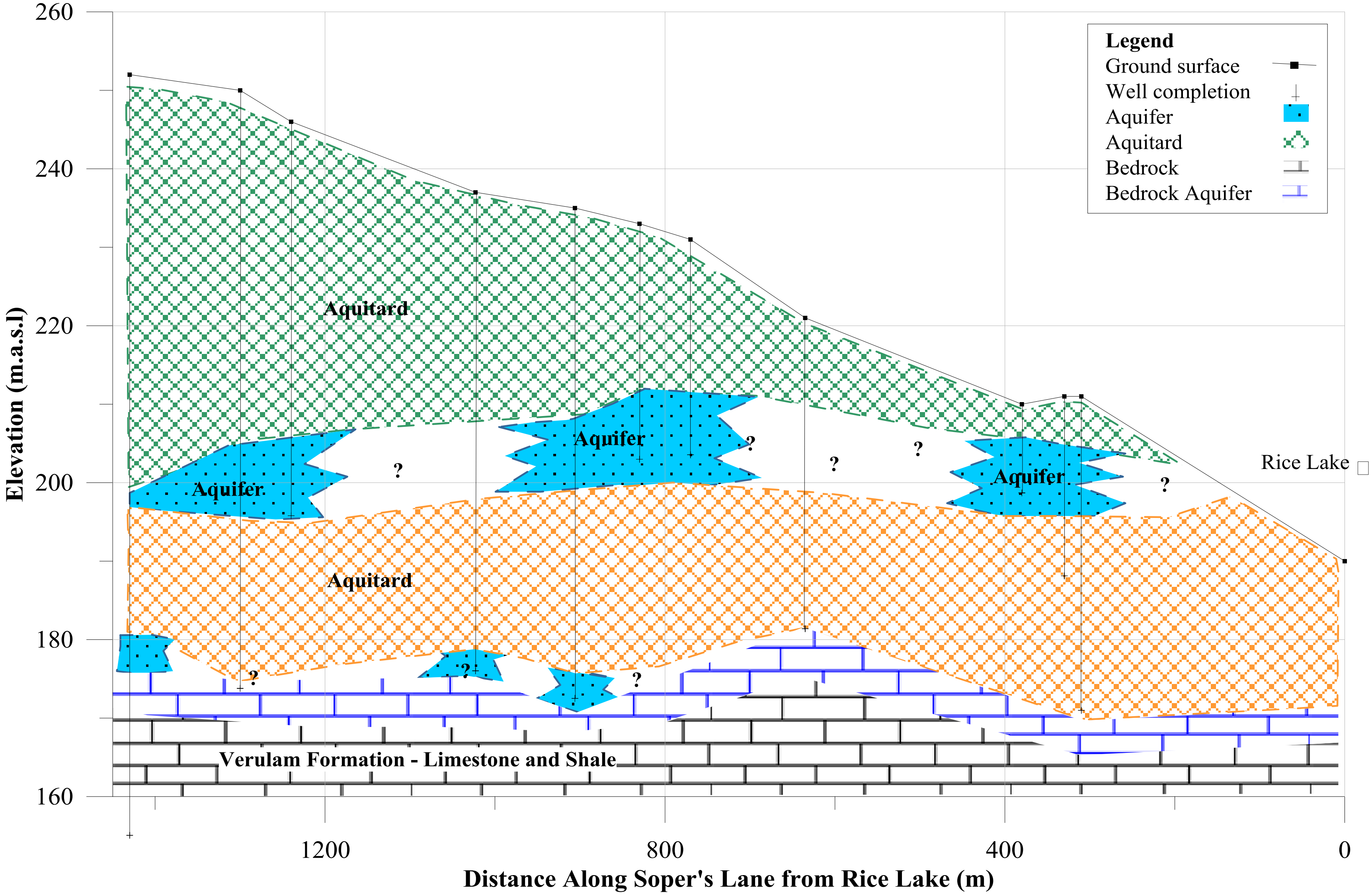


Figure 1 - Occurrence of the overburden aquifers and depth of wells along Soper's Lane based on water well records.

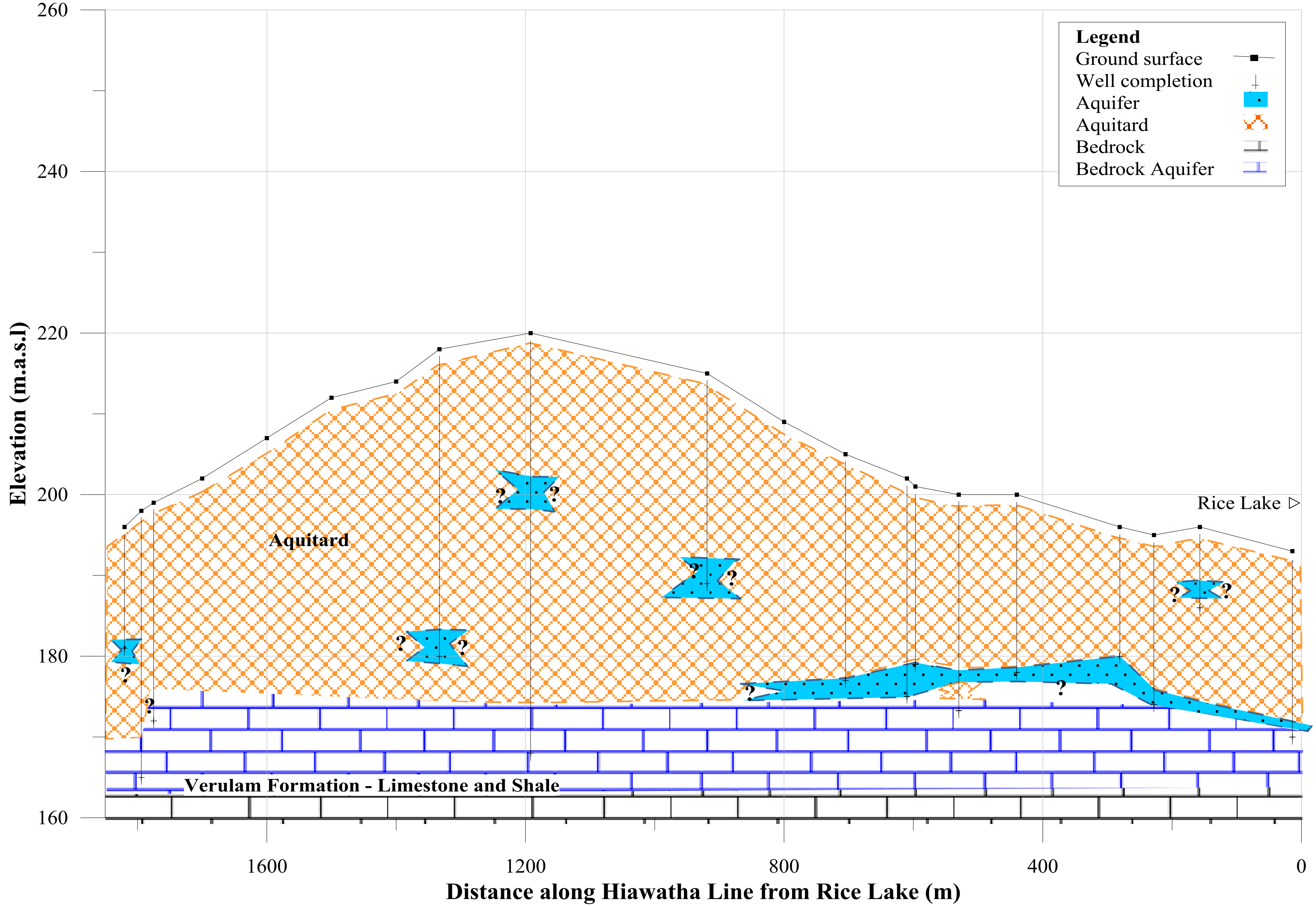


Figure 2 - Occurrence of the overburden aquifer and depth of wells along Hiawatha Line based on water well records.

Figure 3 - Locations of cross sections along Soper's Lane and Hiawatha Line.

It may be possible to complete a 3-dimensional conceptualization of the presence of aquifers on the Reserve, once the door-to-door survey of individual wells currently underway is completed this fall.

1.12 Water Supply Evaluation

There have been studies conducted in the past that have evaluated water supply on the Reserve.

1.12.1 Individual Supply Sources

Water source surveys were completed in 2005 and 2007 by Oakridge Environmental Ltd. (Oakridge). From these surveys, data was obtained for 154 of the 175 residences (88% of the community).

1.12.2 Water Sources

The results of the survey showed that the water supply sources were:

- 64% from drilled wells
- 20% from dug or bored wells
- 8% from Rice Lake
- 5% from the communal spring (on Paudash street)
- 3% had no water source

1.12.3 Well Yield

Of the 112 drilled wells, 85% indicated that the wells have never gone dry. 8% indicated that they had experienced a shortage of water. The yield of the remaining 7% is unknown.

Of the 36 dug or bored wells, 47% indicated that the wells have never gone dry. 33% indicated that they had experienced a shortage of water. The yield of the remaining 19% is unknown.

1.12.4 Well Water Quality

77 drilled wells were sampled. *E-Coli* was detected in 30% of these wells. There were no chemical water quality parameters that exceeded the health related Ontario Drinking Water Quality Standards (ODWS). Most wells produced hard water, with 51% of the wells having iron levels above the 0.3 mg/L threshold that causes staining and often turbidity. 65% of the wells had elevated turbidity and some had colour.

16 dug or bored wells were sampled. *E-Coli* was detected in 69% of these wells. There were no chemical water quality parameters that exceeded the health related Ontario Drinking Water Quality Standards (ODWS). All dug or bored wells produced hard water, with 19% of the wells having iron levels above the 0.3 mg/L threshold that causes staining and often turbidity. 25% of the wells had elevated turbidity and some had colour.

Figure 4 - Staining of toilet from high iron in well water

1.12.5 Spring Water Quality

E-Coli was not detected in this supply. The spring water quality has high nitrate of 9.1 mg/l. The Health Related ODWS for nitrate is 10 mg/L. The spring water is also hard.

1.12.6 Communal Supply Source

Rice Lake has not been evaluated as a communal source by past engineering consultants, likely because of issues related to the treatability of the Lake water, which would make it very costly to use this supply.

An evaluation of 6 potential communal groundwater sources was conducted by Oakridge. The preferred location was the "Discovery Zone". Four test pumping wells were drilled at the "Discovery Zone". These wells reportedly produced over 450,000 L/day during a pumping test. *E-Coli* was not detected in these wells. There were no chemical water quality parameters that exceeded the health related Ontario Drinking Water Quality Standards (ODWS). One of the wells had iron above the 0.3 mg/L threshold that causes staining and often turbidity.

1.12.7 Potential for Groundwater Contamination

The shallow groundwater is vulnerable to pathogens and on-site wastewater systems are probably the primary concern. The observed *E-Coli* detections in the dug/bored wells are typical of shallow groundwater supplies. The deeper groundwater supply is much more protected from pathogens and it is probable that the *E-Coli* detections in the drilled wells are related to well construction issues.

Nitrate is a good indicator of the potential for groundwater contamination. The levels of nitrate in some wells along Sopers Lane are higher than is generally found in the reserves' water, but lower than the Ontario Drinking Water Standards. The source of the nitrate has not been determined. The spring supply source, that services some homes along Paudash Street has very high nitrate levels and has likely been impacted by the application of fertilizer within the capture zone of this supply.

Note that iron and hardness are naturally occurring and typically not an indication of groundwater contamination.

In addition to agricultural the biggest threats to ground water contamination is the storage of fuel and on-site household wastewater/ septic systems.

1.12.8 Water Quality Treatment

Treatment of individual wells usually consists of:

1. pathogen inactivation
2. water softening and/or iron removal

Treatment of a communal groundwater supply always consists of:

1. confirmation that the aquifer is providing appropriate filtration or, if it is not, engineered filtration
2. primary disinfection for pathogen inactivation at the source
3. secondary disinfection of the distribution system

Treatment of a communal groundwater supply may also include lowering or removal of iron at the source and reduction of hardness at the end user.

1.12.9 Private Well Improvements

A 2013 survey of wells (see Appendix A) on the reserve found:

- 4 Wells did not have sufficient separation distance from septic.
- 1 Dug well did not meet separation radius from septic.

- 21 Wells did not meet setback distance from pollution source.
- 7 drilled well caps need to be replaced
- 6 drilled well caps need to be tightened (set screw replace)
- 13 dug/bored wells need casing repair or cement cap replaced
- 10 wells needed to be brought up to Ontario Regulation 903 standard
- 13 wells should be decommissioned

In some cases, wells have been completed in a manner that could allow the introduction of surface water into the well. This, commonly, occurs when the top of the well is cut-off below ground, in a well pit, to facilitate installation of the well pump. Flooding of the well pit may occur during periods of snow melt or intense rains. Often well seals do not seal effectively and allow this water into the well intake, resulting in poor microbial water quality. An example of a well in a well pit is shown below.

Figure 5 - Leaking well seal in a well pit

Upgrades to wells completed in a well pit include extension of the casing above ground and installation of a pit-less adapter to convey water from the well into the home.

Figure 6 - New PVC well casing used to extend well casing above ground and new pit-less adapter installed

1.12.10 Reliability of Wells

One factor that is often overlooked when evaluating groundwater supplies is the reliability of the well infrastructure (well casing, well screen and pump). The recent assessment of the L.I.F.E. Centre water supply can be used as a case example of these factors. For example, when the existing L.I.F.E. Centre well pump was removed from the well, it was observed that the riser pipe that brings water from the well to the surface was corroded and water had been continually spraying in the well.

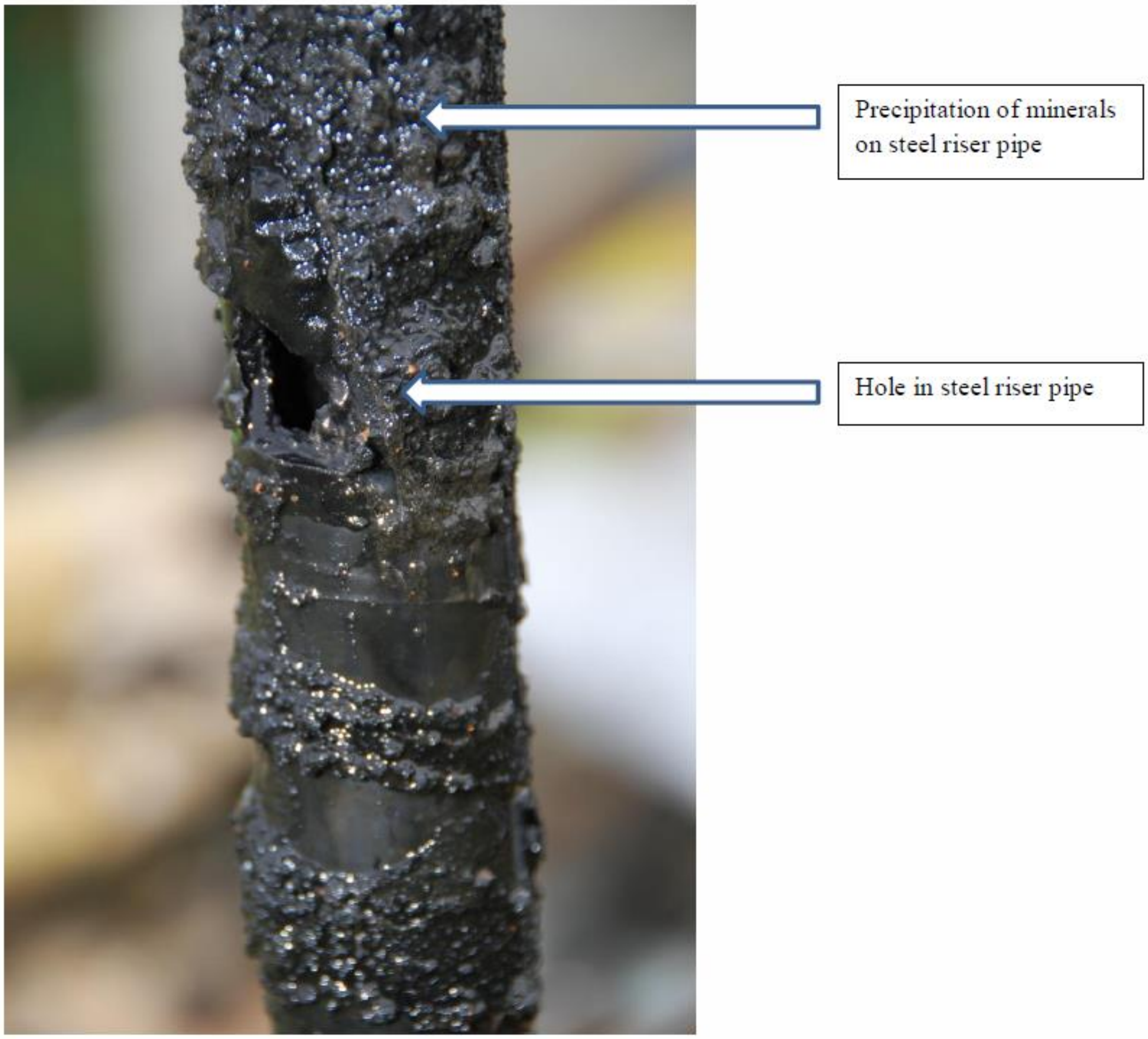
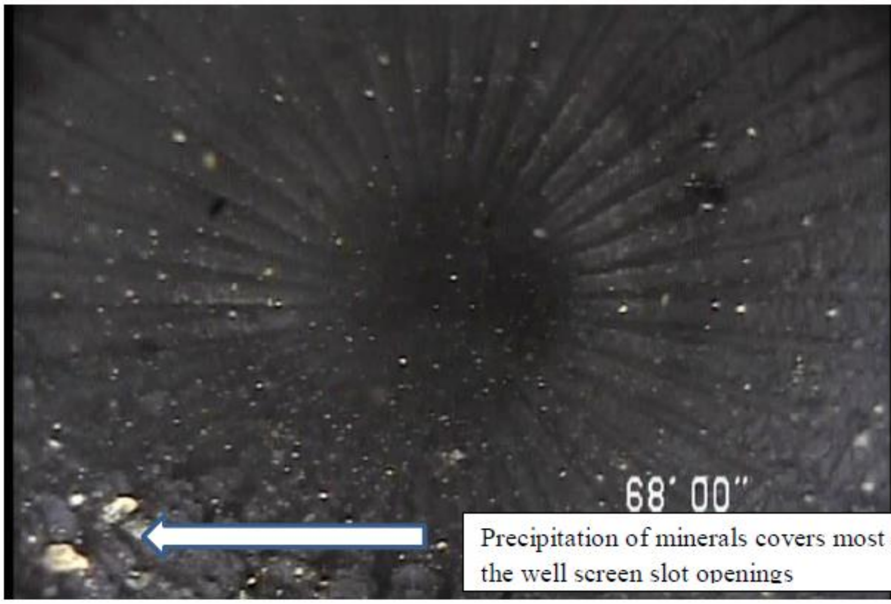


Figure 7 - Corroded riser pipe from L.I.F.E. Center well pump

In addition, there was a thick deposit of minerals coating the pipe.

Similar conditions were found in the well, where the well screen also had a thick deposit of minerals on it, reducing the flow of water into the well.

Video Image #3: South Well Top of Well Screen



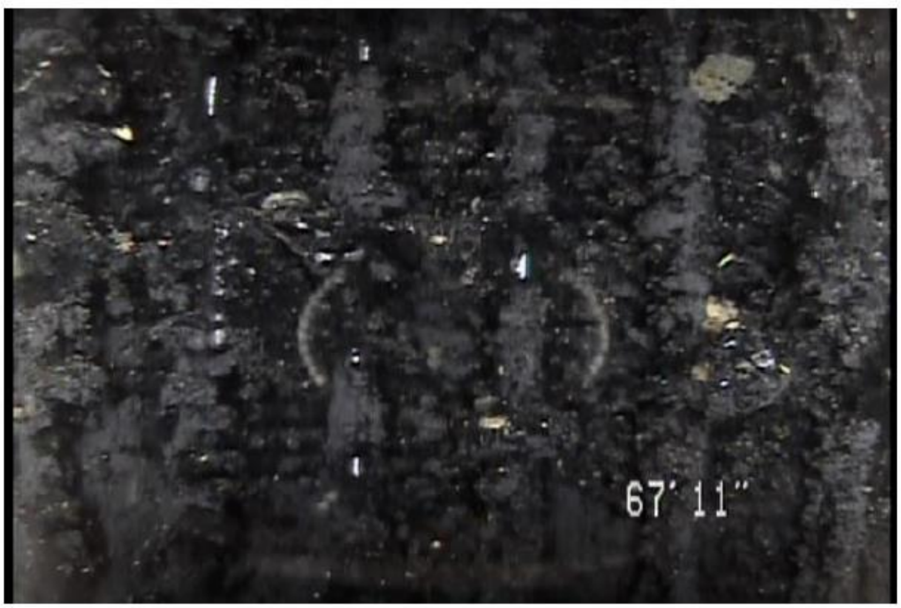


Figure 8 - South well top of well screen

Summary

An adequate individual water supply, from a water quantity perspective, can probably be developed from either a drilled or dug/bored well at most if not all locations on the Reserve. However, different well drilling technology may be required at some locations than at others and one method will not suit all locations on the Reserve.

From a water quality perspective, drilled wells have better microbial water quality than dug/bored wells. However, *E-Coli* was found in 30% of the drilled wells and 69% of the dug/bored wells. Groundwater quality meets the Ontario Drinking Water Standards but is typically hard and iron is often elevated causing nuisance problem such as staining of fixtures, difficulty producing soap suds and poor taste.

The sustainable capacity of the "Discovery Zone" communal supply has not been fully evaluated, but is likely in the 250,000 to 350,000 L/day range. The groundwater quality of the "Discovery Zone" wells meets the Ontario Drinking Water Standards but is hard and one of the wells has iron slightly above the aesthetic guideline.

Regulatory Issues

Province of Ontario Legislation that provides guidance applicable to Hiawatha First Nation:

1.13 Clean Water Act

Provides the basis for Source Protection, to eliminate significant water quality and water quantity threats to (municipal) drinking water systems. It is not directly concerned with individual water supply wells but many of the provisions of this can be applied to Hiawatha First Nation.

1.14 Safe Drinking Water Act

Establishes the Ontario Drinking Water Standards, sets out criteria for the disinfection of drinking water/treatment requirements of wells and licensing of municipal drinking water systems. It is also not directly concerned with individual water supply wells but many of the provisions in this act can be applied to Hiawatha First Nation.

1.15 Ontario Water Resources Act

Requires Permits to Take Water (for takings >50,000 L/day) and establishes standards for water wells (O.Reg. 903).

1.16 Water Opportunities Act

According to the Province, the Water Opportunities Act, will deliver these outcomes:

- make Ontario the North American leader in the development and sale of water conservation and treatment technologies
- encourage sustainable infrastructure and conservation planning using made-in-Ontario technologies to solve water, wastewater and storm water infrastructure challenges
- strengthens water efficiency and sustainable water planning for municipalities
- encourage all Ontarians to use water more wisely

1.17 Federal Government – Bill S-8

Federal water supply regulations for First Nations in Canada are changing. In June 2013, the Canadian Federal Government passed into law Bill S-8, "An act respecting the safety of drinking water on First Nation Lands". This law addresses health and safety issues on reserve lands by providing for regulations to govern drinking water and waste water treatment in First Nations communities. Regulations have not yet been developed, but are going to be made on a province-by-province basis to mirror existing provincial regulatory regimes, with adaptations to address the circumstances of First Nations living on those lands.

These regulations are likely to include:

- roles and responsibilities for water management on First Nation lands;
- the quality of drinking water;
- the training and certification of water and wastewater system operators;
- the treatment of water and wastewater;
- the monitoring, testing, sampling and reporting; and
- the protection of sources of drinking water located on reserve.

Ultimately, these new regulations will probably direct chiefs and councillors to undertake risk management of water sources.

Problem Statement

Poor bacterial water quality in some wells has resulted in widespread rejection of the groundwater on the Reserve as a safe drinking water source. Mitigation of the microbial quality and/or development of an alternative water supply may be desirable to meet the HFN's goal. While work is on-going to demonstrate the water supply characteristics of the HFN lands, it is apparent that there are a number of different options for improving the existing water supply or for developing new water supply systems. Several of these options are explored below.

Water Supply Improvement Options

Alternative 1: (Existing alternative) Develop and Improve Centralized System

A centralized system uses a common source, with water treated and then distributed throughout.

A. Develop a communal surface water supply system and distribute water throughout the Reserve

This option has not been considered by the previous consultants and it is outside of our scope to fully evaluate this option. It is possible that the surface water supply option has not been considered because:

- Issues related to the water intake length, potential for plugging from weeds, risk of damage from boats
- Variable turbidity of the raw water during storms or from boating
- Taste and odour problems
- Disinfection by-products that result from the organics in the raw water
- Complex water treatment plant requiring well qualified and experienced water operators
- Possible water quality impacts from discharges to the Otonabee River upstream of Rice Lake

B. Develop a communal groundwater supply system and distribute water throughout the Reserve

The existing "Discovery Zone" well field will produce about 345,000 L/day; enough to accommodate the average day demand of the 2031 design population. Some additional work is required to confirm the potential of the "Discovery Zone". This includes elimination of the well with elevated iron, to reduce overall treatment needs, construction of appropriate back-up wells and additional aquifer testing to confirm the yield. Source protection should be implemented at this location as soon as possible as it likely represents the best location for a communal groundwater system on the Reserve.

Other communal supply source areas – see 1B-1 and 1B-2 in the table below.

Alternative 2: Address Existing Well Problems

A decentralized system has individual wells that supply water to individual homes.

A. Upgrade existing wells to eliminate pathogen threat

The cause of the pathogen occurrences identified in previous studies in the drilled wells is likely a result of the original well construction practices, or failure to maintain the well, that allows pathogens to move from the surface and into the well. The cause of pathogen occurrences in dug/bored wells may be a result of the well construction practices and/or because the shallow aquifer in which the wells are completed has become contaminated from on-site wastewater systems or other pathogen source.

To rectify this, either a contractor is retained to inspect and upgrade the wells as necessary or the HFN develops staff to do this, as part of a routine well maintenance program.

B. Upgrade and install new water treatment on existing wells

An initial evaluation would build on previous collected individual well water quality assessments to determine what treatment is required for each water supply well from a health-protection perspective and what treatment is necessary to deal with aesthetic parameters.

Equipment for the treatment of well water may be complicated and requires on-going maintenance. Often more treatment equipment is installed than may be necessary. In some instances, it may be that the well was drilled deeper than may have been necessary. The increased depth results in poorer quality water being tapped, resulting in the need for additional treatment.

C. Modify pumping systems to better accommodate peak demands

Typically wells are drilled and constructed so that they meet the short term peak demands of the household. Newer pumping systems have been developed that utilize variable speed drive's and take better advantage of the storage in a well to meet peak demands. In the case of lower yielding wells (either drilled intentionally or due to the geologic conditions at the site) additional storage can be installed to accommodate peak demands.

D. **Meet future demand with new individual wells**

In this instance, as lots are developed on the Reserve, new individual wells are drilled. A standard would be developed for well construction and testing would be developed. Lot layouts would be developed that provides an envelope where wells could be installed and where on-site systems would be installed.

Alternative 3: Develop small scale community systems (where existing wells can't be improved) and distribute in specific local areas in accordance to need

Certain areas of the Reserve have a more immediate need for an upgraded water supply, such as Paudash St. This system would connect homes to a hybrid communal system that utilizes existing or upgraded well infrastructure (such as the 5-Plex or 6-Plex wells) and distribute water to homes with problems. The distribution system would be sized to allow future expansion to a single communal system at a later date.

SWOT Analysis of Potential Options

SWOT is:

1. **S**trengths: characteristics that give it an advantage over others
2. **W**eaknesses: characteristics that place the alternative at a disadvantage relative to others
3. **O**pportunities: elements that the project could exploit to its advantage
4. **T**hreats: elements in the environment that could cause trouble

Options	Strength	Weakness	Opportunities	Threats	Ballpark Capital Cost	Cost per Household
Alternative 1A. (existing alternative) Develop and improve communal surface water supply system and distribute water throughout the Reserve	Unlimited water supply Water source is close to area of highest need/use	Large variation in temperature may result in consumer rejection Difficult and costly to treat the water	A dependable water supply, from a water quantity perspective	Potential for contamination from areas outside of HFN control	>$9.3 m [1] for unlimited population	>$48,000
Alternative 1B-1. Develop the “Discovery Zone” communal ground water supply system and distribute water throughout the Reserve	“Discovery Zone” well field is essentially a proven supply of good quality water Requires only minimal treatment for disinfection	“Discovery Zone” well field is a long distance from the area of highest population density Further testing and well upgrades required to confirm supply and ensure redundancy of system	A dependable water supply, from a water quantity and water quality perspective	Potential for contamination from areas outside of HFN control	$9.3 m [1] based on 328 people	$48,000
Alternative 1B-2. Develop an alternate communal groundwater supply and	Other parts of the Reserve (such as Soper’s Lane) may also be	Requires additional property acquisition Requires additional	A more secure and dependable water supply, from a water quantity and water quality	Potential for contamination from areas outside of HFN control	$9.3 m [1]	$48,000

Options	Strength	Weakness	Opportunities	Threats	Ballpark Capital Cost	Cost per Household
distribute water throughout the Reserve	capable of providing water with good quality and quantity Water source is closer to area of highest water need/use Provides improved redundancy in case of failure of "Discovery Zone" supply Lower cost alternative	infrastructure Mixing of different water quality may impact water treatment requirements	perspective			
Alternative 2A. Upgrade existing individual wells to eliminate pathogen threat	Very low capital cost	Potential interference between wells Risk of low yield or poor water quality	Allows "hot spot" areas with problems to be prioritized for immediate action Supports a potential HFN business plan	Potential contamination from individual on-site wastewater systems, unused wells and/or wells that have not been properly decommissioned and from land use activities/areas outside of HFN control Requires on-going maintenance by individuals	$965,000 (193 residences x $5000)	$5000
Alternative 2B. Upgrade/install new water treatment on all individual	Very low capital cost	Improves water quality Improves public	Allows "hot spot" areas with problems to be prioritized for	Requires on-going maintenance by individuals	<$2.8m (depends on #s needed)	$14,500

Options	Strength	Weakness	Opportunities	Threats	Ballpark Capital Cost	Cost per Household
wells		perception of the quality of the water	immediate action Supports a potential HFN business plan	Requires on-going maintenance by individuals		
Alternative 2C Modify pumping systems to better accommodate demands					Depends on #s needed	$3000
Alternative 2D Meet future demand with new individual wells	Low capital cost	Potential interference between wells Risk of low yield or poor water quality	Supports a potential HFN business plan	Potential contamination from individual on-site wastewater systems, unused wells and/or wells that have not been properly decommissioned and from land use activities/areas outside of HFN control Requires on-going maintenance of wells by individuals	$450,000-$600,000 (based on 30 new wells by 2031)	$15,000 to $20,000 for any new wells needed
Alternative 3. Develop small scale community systems (where existing wells can't be improved)	Lower cost alternative Allows development of smaller sections of a communal system as need arises	Multiple sources may require different treatment More input from water operator required	Allows "hot spot" areas with problems to be prioritized for immediate action Supports a potential HFN business plan	Possibly lower potential for contamination from areas outside of HFN control	$88,000 for one six-unit systems; $440,000 for five systems	$14,700

Notes: (1) based on First Nations Engineering Services Ltd, September from 2011, ($9.1 Million) with the addition of consumer price index inflation 1%)

Recommendations

Given the long time horizon associated with building a water treatment plant, the impending changes to water regulations on First Nation lands and the immediate needs of Hiawatha First Nation, it is recommended that Hiawatha First Nation take steps to manage its own water supply and improve water quality on the reserve. These steps would include:

1. **For each proposed program, develop an accurate scope, schedule and budget in advance of implementation.**
2. **Establishing a well maintenance program to address immediate needs**. During the 2013 well survey (see Appendix A), some well problems were solved using existing Hiawatha First Nation staff. Many of the identified problems highlight the need for regular well inspection and maintenance. Of the problems identified in the survey, several of them could be addressed using Hiawatha First Nation staff. However, additional training may be required.
3. **Installing additional water treatment measures in specific areas where needed**. In certain areas, water treatment for taste and aesthetics could be installed to improve people's enjoyment and use of the water. This kind of treatment could be installed on a case-by-case or as-needed basis.
4. **Developing small-scale communal water supply systems in priority areas.** Certain areas of the Reserve have a more immediate need for an upgraded water supply, such as Paudash St. This system would connect homes to a hybrid communal system that utilizes existing or upgraded well infrastructure (such as the 5-Plex or 6-Plex wells) and distribute water to homes with problems. The distribution system would be sized to allow future expansion to a single communal system at a later date.
5. **Protecting the sources of drinking water across the reserve.** There are links between surface water and groundwater. People's activities on the land can in turn affect the quality of groundwater. Some of the groundwater challenges identified on the reserve to date, appear to be related to surface contaminants entering the groundwater and reducing its quality. Protecting water sources from threats is one way to safeguard ground water supplies for the long term.
6. **Undertaking a community-wide planning and education process to ensure that future home construction and development on the reserve has adequate water supply.** With increasing need for new housing, construction and development could make water supply issues worse. For example, the 2013 well survey identified four houses where septic systems were located too close to water supply wells. With increased planning and education these sorts of problems can be avoided in the future.
7. **Establish building guidelines and inspection protocols for the installation of any new wells and septic systems on the reserve.** Community-based building guidelines and protocols would add an additional layer of protection against the types of problems identified in #17 (above). These guidelines could be established to enable home builders to build in areas with sufficient water supply and water quality and to build in such a way that they will maintain a sustainable water supply.

8. **Creating economic development opportunities through building a well maintenance and water supply business and program**. Partner with other Mississauga First Nations to develop possible services company that would include water, waste water and HVAC. The identification and understanding of problems associated with Hiawatha First Nation water supply points to the need for ongoing well inspection and maintenance. While some of this work is being undertaken by the Band, a more fulsome program could be developed. It is likely that a small business could be set up for well inspection and maintenance. This business could service Hiawatha First Nation as well as neighbouring First Nation and non-native communities. Some additional training would be required. This business could also have a multi-community approach, and include neighbouring First Nations to provide additional services such as waste water and septic and HVAC. See Appendix B for additional details.
9. **Seeking out business planning and development funding and other water supply funding from Federal and Provincial agencies to enable Hiawatha First Nation to take control of its water supply.** These funding sources are available. There are Federal funding sources available to help establish new businesses in First Nation communities. In order to understand both viability of recommendation #19 and to determine how it could be set up, business planning and pre-feasibility planning are recommended. This planning could assess things such as market demand, management structures, inter-community agreements and skills and training requirements. It could also be used to identify where additional sources of project funding might be available.
10. **Develop community-wide mapping to show the distribution of water resources throughout the reserve**. A preliminary survey of water supply on the reserve was undertaken as part of this project. Greater understanding of water quality and quantity issues across the reserve would be beneficial to understand how best to manage development and construction in the future.
11. **Develop an emergency response plan for drinking water supplies.** Regardless of what measure are taken manage the water supply at Hiawatha First Nation, the protection of human health is a priority. It is recommended that Hiawatha First Nation establish an emergency response program to ensure that people can get quick access to clean water if there is an emergency or other chronic problems emerge.

Appendix A - Hiawatha Well and Septic GPS/GIS Project 2013

During this project it was discovered that quite a few wells were susceptible to contamination from surface water, insects, reptiles and rodents. One drilled well had a hornet nest, two bore wells had snakes living in it (one well had 26 snakes in it), and one dug well had a decaying rat in it. These problems were corrected with the help of the well owners and we chlorinated the wells and re-tested, the results came back potable.

The project enabled us to note deficiencies and concerns in community drinking water sources, from damaged casings, missing or damaged well caps, gardens around well heads, animals penned or tied near water sources, vehicles parked on or near source, to complaints of quality and quantity issues. There were only a few home owners that did not participate in this project.

- 143 drilled wells identified and documented
- 50 dug/bored identified and documented
- 16 lake fed sources identified and documented
- 13 spring fed sources identified and documented
- 4 Wells did not have sufficient separation distance from septic.
- 1 Dug well did not meet separation radius from septic.
- 21 Wells did not meet setback distance from pollution source.
- 7 drilled well caps need to be replaced
- 6 drilled well caps need to be tightened (set screw replace)
- 13 dug/bored wells need casing repair or cement cap replaced
- 10 wells needed to be brought up to Ontario Regulation 903 standard
- 13 wells should be decommissioned

Over 200 septic systems (tank or tank & bed) had been identified. Deficiencies noted on systems were caps missing/damaged, pump out lines damaged, some systems not working properly, not meeting separation standards, vehicles, boats, trailers parked on tile beds. An outhouse had a run off trench in front of it and a stream beside it that ran into the lake. Some owners complained that one cottager dumps septic sewage into lake.

Some of these deficiencies are quick fixes and/or inexpensive, but others will require a licensed technician to repair or decommission. The issues identified in this document all are risk reducing factors for source water protection and should be addressed to preserve the integrity of our drinking water.

For your consideration,

Tom Cowie

Appendix B – Business Development Opportunity

For the Supply and Services of Wells, Well Pumps, Water Treatment and On-Site Wastewater (Septic) Systems

Many of the water issues on the Reserve could be improved by a new Hiawatha First Nation company with expertise and equipment to do some or all of the following:

1. Service and replace existing well pumps and install new well pumps
2. Service and replace existing water treatment units and install new water treatment units
3. Assess and maintain existing wells
4. Service existing and install new on-site wastewater systems

Note that on-site wastewater systems is included as it may represent a significant source of contamination to the groundwater water resources and near-shore water quality in Rice Lake.

At some point in the future, this could be expanded to serve other nearby First Nations or non-native residents outside of the Reserve.

Start-up equipment costs would be $50, 000 - $1m. Space would be required in the existing public works yard and building.

In terms of human resources, a crew of two people (operator and helper) + an office administrator + part time manager would be required. The operator would require knowledge of heavy equipment operation, basic electricity and plumbing, advanced knowledge of wells and well water treatment. A second crew would be required if on-site wastewater systems are added.