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Report for:

TOWN OF NANTON REGIONAL WATER STUDY HIGH RIVER WATER SUPPLY

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Town of Nanton
1907 – 21 Avenue
Nanton, AB T0L 1R0

August 1, 2023
File: N:\2630\017-00\00

Attention: Neil Smith
Chief Administrative Officer

Dear Neil:

Re: Regional Water Study
High River Water Supply

We are pleased to submit a copy of the above-noted study. We thank you for the opportunity to be of service and to have prepared this study on your behalf. We look forward to assisting you in implementing the recommendations within the study.

Should you have any questions or require additional information, please contact the undersigned at (403) 317-3649.

Yours truly,

MPE ENGINEERING LTD.

A handwritten signature in blue ink, which appears to read "Luke Schoening", is positioned below the company name.

Luke Schoening, P.Eng.
Project Engineer

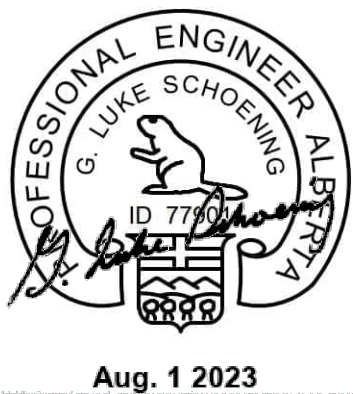
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Enclosure


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Should any questions arise regarding the content of this report, please contact the undersigned.

MPE ENGINEERING LTD.



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Signature	
APEGA ID	107563
Date	08/01/2023
PERMIT NUMBER: P 3680	
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)	

EXECUTIVE SUMMARY

A lack of long-term water security is a major challenge that has plagued the Town of Nanton for many years. This challenge has been highlighted through recent study and was even more evident in spring 2022 when water levels in the raw water storage reservoir were at extreme lows, mere days away from the Town running out completely. The Willow Creek Region Shared Water Distribution Study (MPE, 2020) recommended that a regional potable water supply be obtained from the Town of High River or additional raw water storage be constructed to maximize diversion from Mosquito Creek during appropriate times of the year. The regional potable water supply option was identified as the most prudent as the reliability and timing of flow as well as challenging water quality from Mosquito Creek has led to operational challenges at the Nanton WTP. Funding was obtained through the Alberta Community Partnership program to further evaluate the feasibility and complete preliminary engineering of a regional potable water connection from High River to Nanton. The intent was to more clearly identify the project scope and costs to assist in exploring funding availability for this project. Based on the completed study, MPE has the following conclusions and recommendations:

- Based on initial indications of High River’s WTP filtration capacity, sufficient capacity exists to serve existing customers and the Town of Nanton through 2042.
 - MPE recommends the Town of High River begin stress testing the treatment system to verify the capacity of the WTP and filtration system under a wide range of demands and raw water scenarios.
- Hydrogeological review indicates that the aquifer utilized for the High River Well field can support additional allocation as required for the Town of Nanton.
- Preliminary Design is complete with capital costs for a complete system estimated at up to \$14,951,00 including up to 30% contingency.
- The Town of Nanton should apply on behalf of Nanton, High River, Foothills County, and the MD of Willow Creek (Partners) for provincial funding for the Regional Water System under the Water for Life (W4L) Strategy.
 - This application would benefit from an Intermunicipal Memorandum of Understanding between the Partners involving the support for a treated water line between High River and Nanton.
- Upon receipt of funding approval, complete detailed design according to the preliminary design concepts introduced by this report including:
 - Completion of two additional wells in the High River aquifer.
 - Additional hydrogeological evaluation of the proposed wells to facilitate the transfer of license capacity from the Oldman River Basin to the required location.

- Upgrades at the High River water treatment plant including distribution expansion and backwash improvements.
 - A potable water transmission main connecting to the existing potable water distribution system in SW High River aligned largely along the existing rail right of way where available and paralleling municipal roadways in private land.
 - A booster and metering Station at the boundary of High River.
 - Connection to the Town of Nanton treated water storage and distribution system at the existing Nanton water treatment facility.
- Upon receipt of funding approval:
 - Continue intermunicipal discussion for development of formal water sharing agreements.
 - Begin detailed land negotiations along the proposed route including with CP rail and private landowners.
 - Submit application for transfer of license allocation to the proposed wells, and
 - Obtain additional potable water license allocation as required.

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1 INTRODUCTION & PROJECT UNDERSTANDING

1.1 OVERVIEW

A lack of long-term water security is a major challenge that has plagued the Town of Nanton for many years. This challenge has been highlighted through recent study and was even more evident last spring when water levels in the raw water storage reservoir were at extreme lows, mere days away from the Town running out completely. The Willow Creek Region Shared Water Distribution Study (MPE, 2020) recommended a regional potable water supply be obtained from the Town of High River or additional raw water storage be constructed to maximize diversion from Mosquito Creek during appropriate times of the year. The regional potable water supply option was identified as the most prudent as the reliability and timing of flow as well as challenging water quality from Mosquito Creek has led to operational challenges at the Nanton WTP.

Funding is in place through the Alberta Community Partnership program to complete the study and preliminary engineering of a regional potable water connection from High River to Nanton to more clearly identify the project scope and costs to assist in exploring funding availability for this project.

1.2 STUDY SCOPE

The focus of this study is to further the understanding of the feasibility of a regional water system supplying water from the Town of High River to the Town of Nanton as well as undertake preliminary design of the proposed system.

The major tasks included in this project were as follows:

- Review of historical data and updating of previous water demand projections for the Town of Nanton and an overview of historical water demands and projection of water Demands for the High River water supply and treatment system.
- Review of previous work to assess all available Nanton water sources and water supply options.
- Assessment of High River Water System Infrastructure to determine the availability of capacity for a regional system.
- Review options for regional water systems governance models
- Preliminary design of the regional potable water supply system from High River to Nanton.

1.3 OBJECTIVE

The objective of this project is to increase understanding of the challenges to be met in proceeding with a regional water system for the Town of Nanton from the Town of High River and provide a basis for proceeding with detailed design of such a system.

2 DATA COLLECTION & ANALYSIS

Water usage data was collected from the Town of Nanton and the Town of High River to update current water usage and project water usage to the 20-year design horizon. Additional System and operational data were collected from the Town of High River to understand the Town’s existing supply, treatment, and distribution infrastructure and evaluate the requirements of the system for supply to the Town of Nanton.

Reviewed documents include (but are not limited to):

- Sub-Regional Raw Water Supply – Nanton and Cargill Servicing Feasibility Phase 1 – Draft Memorandum (Urban Systems, 2021)
- Willow Creek Region Shared Water Distribution Study (MPE, 2020)
- High River Utility Master Plan (ISL, 2017)
- High River Water Treatment Plant Capacity Analysis (Stantec, 2015)
- Regional Water and Wastewater Servicing Masterplan (Calgary Regional Partnership - 2014)
- Filter Inspection Report (AWI, 2013)
- High River Infrastructure Master Plan (ISL, 2011)
- Town of High River Sustainable Water Resources Management Plan and multiple supporting technical studies (Worley Parsons, 2011-2013)
- Filtration Process Development (AWI, 2007)

2.1 WATER USAGE

2.1.1 Population Projections

Historical population figures were obtained from Statistics Canada census data. The most recent census data available is from 2021. For the Town of Nanton growth has been experienced as periods of significant growth with intermittent periods of flat or slightly reducing population. As such it was determined that utilizing a long-term growth rate over 20 years moving forward would provide a conservative estimate of positive growth going forward (0.82%). Based on discussion with the Town of High River more recent years growth rates (2016-2021, 1.05%) have been applied to estimate population growth. The most recent five-year growth rate has also been projected forward for Cayley as the other urban community being provided potable water from High River via an existing regional connection.

Table 2.1.1: Population Projections

	Growth Rate Projection	Historical Data						Projected Population					
		%/yr	1996	2001	2006	2011	2016	2021	2022	2027	2032	2037	2042
Nanton	0.82%	1,665	1,841	2,055	2,132	2,130	2,167	2,185	2,276	2,370	2,469	2,572	2,679
High River	1.05%	7,359	9,376	10,716	12,498	13,594	14,324	14,474	15,250	16,068	16,930	17,837	18,794
Cayley	1.87%	n/a	n/a	325	265	377	414	422	463	508	557	611	670

Notes: Historical Data Obtained from Statistics Canada Census Information
 Growth Rate for Nanton based on Historical 20-Year Growth, Growth Rate for High River / Cayley based on Historical 5-Year Growth

2.1.2 Historical Water Usage

Historical water usage data was provided by the Town of Nanton and Town of High River to update the understanding of water demand for each community and their customers. Summary tables of four (4) years (2018-21) for the Town of High River and its customers and for 10 years (2012-21) for the Town of Nanton are included in Appendix B.

It is worth noting that water usage in the Town of Nanton has undergone a significant increase in usage during all seasons over the course of the reviewed records. During that time average daily per capita usage has gone from 340 lpcd in 2012 to 565 lpcd in 2021. This is an increase of approximately 66%. It has been speculated that this increase may be partially attributable to leakage within the distribution system. As such the Town of Nanton has undergone a number of measures to try and identify and eliminate leakage points within their distribution system and reduce the trend of increasing water demand.

2.1.3 Water Demand Projections

The historical water usage data and the projected populations for the municipalities were used to calculate the future (2042) water demands.

Per capita consumption for future demands was assumed to remain at a recent historical average rate for the urban communities to be serviced by the proposed regional system. Based on data availability a 4-year average per capita consumption rate was utilized for the communities currently serviced by the High River Water Treatment plant while a 5-year average per capita consumption rate was used for the Town of Nanton.

The Town of High River currently supplies potable water to an industrial meat packing facility operated by Cargill within Foothills County. For the purpose of water demand projections, it has been assumed that the historical average day demand and maximum daily demand would be utilized as the future demand for this facility with no anticipated growth from the High River system.

The current and projected water demands for each water user are provided in Table 2.1.3. Similar to other regional studies, a 20% allocation is recommended to be included in the projections for future rural demands for any regional options considered. It is understood that in this case there is no immediate expectation for additional rural connection to the proposed regional system.

Figure 2.1.3: Current and Projected Water Demands

	Current Water Demand (Year 2021)					Projected Water Demand (Year 2042)		
	Population	Average Day (m3/day)	Per Capita Use (l/day/capita)	Max Day (m3/day)	Max Day to Avg Day (ratio)	Population	Average Day (m3/day)	Max Day (m3/day)
Village								
High River	14,324	6,931	491	12,239	1.77	17,837	8,764	15,476
Cayley	414	82	184	166	2.03	611	112	229
Cargill	-	6,118	-	8,202	1.34	-	6,118	8,202
High River Total	-	13,131	-	20,607	-	-	14,994	23,907
Nanton	2,167	1,054	486	1,833	1.63	2,572	1,241	2,158
Rural Upsize	-	-	-	-	-	-	-	432
Regional Total	-	14,185	-	22,440	-	-	16,235	26,496

Notes: For simplicity of tabulation, the per capita usage for the Town of High River includes all other regional distribution customers (including Aldersyde and County Users) that are not included in Cayley or Cargill figures.

2.2 REGIONAL SYSTEM CAPACITY

Based on the historical water usage of the Town of Nanton, The Town of High River, and the additional combined customers of the Town of High River the projected demand for the regional system is approximately 26,496 m³/day (26.5 MLD) in 20 years time. Capacity of the High River Water Treatment is understood to be limited by the filtration capacity to a maximum of 4,200 igpm (approximately 27.5 MLD) however this capacity has not been verified through recent operational testing. Initial indications are that the High River Water Treatment Plant has sufficient existing capacity to service existing customers as well as the Town of Nanton through 2042. Further discussion of the High River Water Treatment Plant capacity and ability to meet regulatory requirements will be discussed further throughout this report.

3 WATER SUPPLY OVERVIEW

3.1 EXISTING NANTON WATER SUPPLY

3.1.1 Overview

The Town of Nanton obtains raw water from two sources. The primary source of raw water is Mosquito Creek. Raw water is drawn through an infiltration gallery connected to a wet well with submersible pumps. Water is conveyed through a 200mm pipeline to a 204,000 m³ raw water storage reservoir. Mosquito Creek is a seasonal waterway with highly variable seasonal flow. The low flow period can vary year to year but is generally from October 1st to April 30th. The large variation of seasonal flow is due to the limited catchment area of Mosquito Creek and drought-precipitation cycles that could be exacerbated by climate change. During the high flow period the flow in Mosquito creek is heavily reliant on diversion of water into the creek from the Highwood River through the works of Alberta Environment and Parks (AEPA) via Women’s Coulee. The Town is entirely reliant on raw water storage during periods of low background flow and when the AEPA diversion is not operating.

The secondary source of raw water is a spring located approximately 12 km southwest of Nanton. The licensed diversion quantity and practical capacity of the spring do not provide sufficient flow to be used as the primary source. Spring water is conveyed to Nanton through a 100mm pipeline. A project was completed in 2020 to extend the spring waterline to the raw water reservoir to supplement the during periods of low flow. The intent was also that diversion of the spring source into the raw water reservoir would alleviate water quality issues caused by inconsistent blending of the two sources. After the extension project was completed, it was discovered that there was a cross connection between the potable water distribution system and the spring waterline. The cross-connection was eliminated and the flow into the reservoir from the spring waterline was reduced to a trickle. It is worth noting that the spring and associated transmission line are utilized by additional licensed water users, and it is not well understood how much water is diverted between the source and the Town of Nanton. It has been shown however that the spring waterline is not a sufficiently reliable secondary source to significantly supplement levels in the raw water reservoir.

The Town currently operates a Water Treatment Plant with a water treatment process including dissolved air flotation (DAF) clarification, rapid gravity sand filtration and chlorine gas disinfection. The Town was recently awarded a grant under the Alberta Municipal Water/Wastewater Partnership for a project aimed at improved the aesthetic quality of water by implementation of reservoir aeration and a Powder Activated Carbon (PAC) feed system. The project is in design with construction expected later in 2023.

3.1.2 Recent Nanton Water Supply Challenges

Insufficient Storage Volume in the existing Nanton Raw Water Reservoir has become increasingly evident in recent years and has pushed the Town’s water supply challenges to the forefront. According to historical water use records the Town of Nanton used an average of 953 m³/day during the winter (Oct-Apr) months however that usage appears to be increasing further with an average winter usage of 1122

m³/day in 2021. At the 5-year rate of usage the 204,000 m³ of available storage in the raw water storage reservoir would last approximately 214 days, at the 2021 rate of usage the available storage would last approximately 181 days. The October through April period where the Women's Coulee transfer is inactive can vary year to year but numbers in the area of 212 days. As such, it is clear that the Town of Nanton is at high risk of running short of raw water at the 5-year usage rate and in very clear risk of running short well before the transfer begins if the current trend of increased usage is not reversed.

There are a number of measures that have been discussed and utilized to mitigate the risk of raw water shortage moving forward including:

- Efforts to reduce potable water use and search out and eliminate system losses.
- Lobbying AEPA to increase in the diversion period from the Highwood/Women's Coulee
 - AEPA has accommodated this somewhat however their ability to extend the period is limited by fall and spring weather as well as available upstream flow/storage.
- Initiating Raw Water Pumping from Mosquito Creek during periods of higher flow, outside of the AEPA diversion window
 - Highly dependent on weather
 - Reduced ability to manage raw water quality by limiting pumping to period of best water quality in Mosquito Creek
- Temporary expansion of raw water reservoir storage capacity
 - Limited by reservoir structure and accessibility of alternative storage areas

It is clear that even with all available mitigation measures taken a permanent solution will be required in the near future.

4 WATER SUPPLY UPGRADE ALTERNATIVES

4.1 PREVIOUSLY REVIEWED WATER SUPPLY ALTERNATIVES

The Shared Water Distribution Study reviewed additional sources of raw and treated water for the Town of Nanton including increased pumping and storage of water from Mosquito Creek, Raw and Treated water supplies from Pine Coulee Reservoir, other local and regional groundwater sources, treated water supply from the Town of Claresholm and treated water supply from High River. Supply of raw water from the Bow River was reviewed for the Okotoks/Foothills County Sub-Regional Water Supply (Urban Systems, 2021). These alternatives are briefly summarized in the following sections.

4.1.1 Nanton Raw Water Storage Expansion

As part of the Shared Water Distribution Study, it was determined that the existing raw water storage reservoir does not meet the current version of AEPA Standards and Guidelines for Municipal Waterworks (Standards). To meet current standards, raw water reservoirs should be constructed with a minimum of two cells to provide redundancy, with each sized to provide 75% of the annual raw water needs. The Town currently has a single cell with capacity for 51% of the current annual raw water needs and 35% of the projected 2044 annual raw water needs. To meet current AEPA guidelines, an additional 640,000 m³ of raw water storage would be required. This volume is more than three times the storage capacity of the existing raw water storage reservoir. The Shared Water Distribution Study identified a minimum storage shortfall of approximately 90,000 m³ based on projected winter low-flow period (Oct-Apr) demands.

The Shared Water Distribution Study identified an interim solution to “buy some time” for further study and obtain funding for an appropriate long-term solution. This interim project was the spring line extension to the raw water reservoir discussed previously and completed in 2020. At some point following this work a connection was between the supply piping and distribution system was detected and eliminated, and it has now been discovered that the spring water source provides only a trickle of flow. The Town has ceased utilizing any flow from this line. Unless there is an unexpected increase in spring water flow or the Town is able to determine that flow is somehow being diverted from the spring line, the spring source is not a significant current benefit to the Town of Nanton.

4.1.2 Pine Coulee Raw Water Supply

This alternative explored a change of the primary raw water source from Mosquito Creek to Pine Coulee Reservoir. Pine Coulee reservoir is located approximately 17 km south of the Town of Nanton. A new or transferred water licence would be required to change sources, and a licence from Pine Coulee would have a reservoir elevation restriction. It is understood that potential WTP upgrades would also be required to treat a new source. The risk of utilizing Pine Coulee Reservoir and the relative high cost of a pipeline precluded this alternative from further consideration. Since completion of this review, all available water from Pine Coulee Reservoir has been allocated.

4.1.3 Claresholm Regional Water Supply

The Claresholm WTP, located approximately 38km south of Nanton was determined to have adequate treatment capacity to support the Town of Nanton projected potable water demands. This option would involve construction of a potable water pipeline from the Town of Claresholm north to the Town of Nanton. For the purposes of the 2020 study, it was assumed that no upgrades within the Town of Claresholm potable water distribution system would be required. As with the Pine Coulee Raw Water Supply alternative, a new licence for the Town of Nanton would be required and would be subject to the reservoir elevation restrictions.

The risks of Pine Coulee Reservoir as a raw water source combined with the relatively high cost of a pipeline from Claresholm to Nanton precluded this option from further consideration.

4.1.4 Pine Coulee Regional Water Supply

This alternative reviewed construction of an all-new regional WTP near Pine Coulee Reservoir. The new WTP would receive water from Pine Coulee Reservoir and service the Towns of Claresholm, Granum, Stavely, Nanton, and rural water users located along various pipeline alignments. Existing local potable water storage and pumping facilities would be maintained and upgraded as necessary in each municipality. The existing raw water supply pipeline to the Claresholm WTP would have been repurposed as a potable water pipeline.

The risk of utilizing Pine Coulee Reservoir as a raw water source for new licences (Stavely, Nanton, and rural users), the high cost of an all-new WTP and regional pipelines and the need to decommission existing facilities with several years of remaining useful life left precluded this alternative from further consideration.

4.1.5 Sub-Regional Raw Water Servicing from the Bow River (Urban Systems, 2021)

After the Shared Water Distribution Study (MPE, 2020) was completed, the Town of Nanton was notified that the Town of Okotoks and Foothills County are collaborating on a sub-regional water servicing concept for the area surrounding Okotoks and a portion of Foothills County. As part of the concept, raw water servicing for Cargill and Nanton was considered. High River was not considered for reasons not relevant to this report.

The concept described in the Sub-Regional Servicing Memo involves construction of approximately 47 km of raw water pipeline and two pump stations, as well as upsizing of upstream infrastructure. The pipeline would deliver raw water to the Town of Nanton's raw water storage reservoir for treatment in the existing WTP. The cost of the pipeline and associated infrastructure was estimated at \$40,451,000, allowing for a 40% contingency and 15% engineering.

The extremely high cost of this option relative to all other options reviewed and the fact that Nanton would have to maintain and potentially upgrade the ageing Nanton WTP precludes this alternative from further consideration.

4.1.6 High River Regional Water Supply

The Shared Water Distribution Study (MPE, 2020) reviewed the option for a potable water supply from High River on a high level. Preliminary findings indicated that is a favorable and preferred option. The intent of this Regional Water Study is to further vet this option.

4.2 NANTON – HIGH RIVER REGIONAL WATER SUPPLY

4.2.1 Water Supply and Treatment System Summary

The Town of High River operates a water supply, treatment, and distribution system to meet the potable water needs of the residents of the Town of High River, as well as supplying water via regional connection to the Cargill Industrial Facility, Hamlet of Cayley, and other Foothills County residents.

The current water supply and treatment system consists of:

- Raw Water Supply including
 - 15 Raw Water Wells
 - Production intervals at 5-16 m depth.
 - GWUDI water source from aquifer directly connected to the Highwood River.
 - Wells completed with pitless adapters, submersible pumps, and local flow monitoring.
 - Maximum well pumping rates vary from 23 – 48 l/s.
 - Located at varied locations within Town boundaries.
 - Raw water pipeline supply network to water treatment plant
 - Wells are grouped together by location with several common pipelines into the WTP.
- Water Treatment Plant including
 - Pre-Treatment Coagulant Addition
 - Rapid Gravity Filters (from AWI, 2013)
 - 3 Filters
 - Each Filter - 6.1 m (20 ft) diameter, 29.2 m² (314.2 ft²) area (AWI, 2013)
 - Total Filtration Area - 87.6 m²
 - Design Loading Rate (filter) – 1400 igpm (106 l/s, 13.1 m/hr)
 - Total Design Loading Rate – 4,200 igpm (318 l/s 27,500 m³/day, 318 l/s)
 - Design Backwash Rate (each filter) – 15 USgpm/ft² (36.7 m/hr, 4713 USgpm, 297 l/s)

- Air Scour Capability
- UV Disinfection
 - 4 x 300 mm (24”) Gravity driven UV reactors in parallel operation.
- Clearwell (s)
 - Reservoir No. 1 – 9092 m³ (2,000,000 Imp. Gal)
 - Reservoir No. 2 – 4546 m³ (1,000,000 Imp. Gal)
 - Series Operation
- Residuals Management
 - Backwash Storage Reservoir
 - Direct Discharge to River during normal operation.
 - Pumped to River during high river conditions.
- Distribution Pump System
 - 4 Vertical Turbine Pumps
 - 2 x 100 HP – 76 l/s each
 - 2 x 250 HP – 189 l/s each
 - Firm Capacity - 341 l/s
 - Total Capacity - 530 l/s
 - All duty points at 53.3m (76 psi)

4.2.2 Review of Site Assessments

A site review of the High River Water Treatment Plant and select raw water wells was completed on July 15, 2022. A summary of observations related to the ability of the Town of High River to supply potable water to the Town of Nanton are included below:

- The gravity filtration system is of a type know as a declining rate or self backwashing.
 - This design utilizes contained design where raw water is distributed to all filters from a raised distribution box with a set weir height to provide consistent driving head for filtration through the media bed. Filtered water travels from the filter underdrain to an open topped backwash reservoir located above the enclosed filter bed.
 - The filtered water conduit from the underdrain below the filter to the backwash reservoir is entirely enclosed within the filter vessel and not subject to any valving.
 - Filtered water decants from the backwash reservoir(s) of each filter into common filtered water collector piping and through parallel UV reactors and into the clearwell.

- The backwash reservoirs of three filters have been interconnected. Effectively tripling the available backwash volume for each filter and reducing the rate of decline of available backwash head.
- The building is “roughed-in” for an additional filter of the same size and construction.
- Some mounding of media is visible through filter portholes. This may be attributable to uneven raw water distribution.
- No backwash was available to observed during the site visit.
- Backwash flow is not measured at the High River WTP.
- Raw water wells have been updated following flooding over the last decade to reduce the likelihood of surface contamination and infiltration during flooding conditions.
 - Level monitoring within some wells has been reported to be unreliable, as a result operations has the capability for manual level measurement.
- The distribution pumping header has been “roughed-in” for an additional vertical turbine pump.
 - Distribution pumping electrical and MCC’s appear to be at capacity.

4.2.3 Review of Operational Discussions

- Overall, the plant is well maintained and carefully operated.
- Filter Air Scours are not operated.
- During Backwash two filters are operated at maximum capacity while a third is backwashed
 - This results in a maximum production rate during backwash of 212 l/s.
 - At the design backwash rate the backwash storage will decline by the difference between the backwash rate and the maximum production rate during backwash (297 l/s – 212 l/s = 85 l/s).
 - The backwash outlet valves can be modulated via the backwash waste valve on each filter.
 - Because the backwash flow is not measured it has not been verified what the current backwash flow rate is.
 - Prior recommendations from a filter audit (AWI 2013) indicated that the backwash flow rate was well below the design flow and below the rate likely required for sustainable operation and use of the filter air scour. That report further recommended draw down testing of each filter while increasing the backwash waste valve setpoint.

4.2.4 Review of High River System Capacity

4.2.4.1 RAW WATER SUPPLY SYSTEM - SUMMARY

- Operations information indicates that all wells running together can provide a flow of 4750 igpm (31,095 m³/day, 360 l/s).
- Cumulative allowable license diversion rates can provide a flow of 4727 igpm (30,945 m³/day, 358 l/s).
- Overall capacity of infrastructure is sufficient to support the proposed needs of the existing Town of High River system as well as the addition of a regional water supply to the town of Nanton.

4.2.4.2 RAW WATER SUPPLY SYSTEM – HYDROGEOLOGICAL INVESTIGATION

A review has been completed of previous hydrogeological studies to evaluate if there is capacity in the shallow groundwater aquifer that is currently utilized by the Town of High River to support the additional demand of the Town of Nanton above and beyond the currently licensed capacity that is attached to the system to provide water to the Town of High River, Foothills County, and the Cargill facilities within Foothills County.

The following is a summary of the hydrogeological investigations. A copy of the Town of High River Water Supply Evaluation by Waterline Resources Inc. is attached in full in Appendix C.

The following are understood to be relevant conclusions in support of the feasibility of a regional water supply from the Town of High River to the Town of Nanton:

- The High River Aquifer appears to have the capacity to meet the expanded demand of Nanton both within, and in addition to the existing license allocations and listed points of diversion.
- It is probable that Nanton's water demand can be met by long-term sustained diversion from source wells WW17 and WW18.
- Source Wells WW17 and WW18 are located in the Oldman River Watershed and therefore utilization of these wells should not require an inter-basin transfer.

The following points of expanded detail have also been identified by the hydrogeological review:

- The Town of High River Wells are in a highly transmissive surficial aquifer.
- There are 15 licensed wells in the well field.
- The well field straddles the Bow River and Oldman River Watersheds.
- Source wells WW17 and WW 18 are located withing the Oldman River watershed.

- Baseline testing suggests that these wells can sustain production beyond their tested rates.
- These wells are not currently commissioned for license operation.
- In 2013 Worley Parsons undertook an assessment that included development of a regional groundwater model. The assessment includes simulations of variable pumping schedules to optimize groundwater extraction and pumping scenarios.
- The current High River diversion is sustained below the total licensed allocation and one license specifically located within the Oldman watershed is underdeveloped.
 - The underdeveloped license within the Oldman watershed could be further amended to include commissioning of WW17 and WW18.
 - The Town of Nanton is within the Oldman Watershed and therefore licensing the Town of Nanton from these wells may include different considerations than those wells within the Bow River Basin. This will be discussed in further detail within the regulatory review.
- A transfer of some High River license allocation to Nanton is likely to be accepted by AEPA as supported by historical assessments.
- If Nanton can get access to an existing license allocation available for transfer within the Oldman River watershed, or transfer their existing allocation expanded studies would be required to support additional development of the High River Aquifer.
- There is some uncertainty regarding the overall cumulative impact of diversions from the High River well field however the main conclusions are that:
 - The aquifer appears to have capacity to meet the demand of the Town of Nanton
 - The aquifer appears able to meet this demand in addition to the existing license allocations and listed points of diversion if managed appropriately.
 - Currently undeveloped wells WW17 and WW18 appear to have capacity to meet and exceed the additional water supply needs of the Town of Nanton.
 - Because Wells WW17 and WW18 are located within the Oldman River Watershed allocation should be transferable to these wells without an inter-basin transfer.

4.2.4.3 WATER TREATMENT PLANT CAPACITY

Lower end estimates of plant production capacity come from prior reviews of the water system and have been based on a reference estimate of the filtration capacity based on regulatory guidelines for standard filtration rates of dual media gravity filters.

These estimates of approximately 18 MLD can be roughly calculated as follows:

- Each filter has an approximate diameter of 6.1 m and a corresponding surface area of 29.2 m².
- Total available filter surface area is 87.6 m².
- Alberta Environment Standards and Guidelines (AEPA 2012) indicates that in general gravity filters should be designed to be operated with a loading rate in the range of 2m/hr to 9 m/hr.
- A filtration rate of 9 m/hr for three filters translates to a total filtration capacity of 219 l/s or 18.9 MLD.
- Based on an estimated 95% hydraulic efficiency daily production would be 18 MLD.

Upper end estimates of plant production capacity are based on figures from a report detailed filter inspection/audit of the existing gravity filters completed by filter optimization professionals (AWI, 2013)

- At this time, the filter design loading rate was indicated at 4200 igpm (318 l/s) or 27.5 MLD.
 - This translates to a filter loading rate of approximately 13 m/hr.
- Based on an estimated 95% hydraulic efficiency daily production could be as high as 26.1 MLD.
- The filter inspection indicated that actual filter loading rate at the time of the audit was 3300 igpm (250 l/s) or 21.6 MLD.
 - This translates to a filter loading rate of approximately 10.3 m/hr.

It has been demonstrated over years of plant production that practical capacity can exceed the lower-level estimate of 18 MLD. Actual historical maximum day demand has reached approximately 21 MLD. Furthermore, although AEPA standards indicate typical filter loading in the range of 2 m/hr – 9 m/hr there is allowance for filtration rate of up to 15 m/hr within the standards depending on filter design and where that filtration rate has been substantiated by a filter column study. In the case of an operating filter, it could be expected that operational history would provide validation of a higher filtration rate. In this case, you under normal operating conditions the plant has been shown to capable of a filter loading rate of up to 10.3 m/hr or greater that 21 MLD.

The upper-level filtration capacity of 13 m/hr or 27.5 MLD is indicated as the design capacity of the filters however there is no available record of operational data or filter column study that indicates that this rate of filtration is achievable over long term operation and under reasonable expected water conditions. As such it is recommended that for ongoing acceptance of this upper-level estimate of plant capacity the Town of High River should undergo stress testing of the facility. This stress test would include periodic attempts to operate the water treatment facility at the theoretical maximum capacity during all conditions. During that stress test the plant would be operated at its maximum rate but would only run for the time required to satisfy the daily demand.

Proposed Stress Test Procedure:

- Average Daily Plant Production – 13,131 m³/day or 152 l/s
- Est. Op. time at maximum filtration rate of 318 l/s – 11.5 hrs of filter run time over a 24-hr period.
 - Operational time will vary based on seasonal lower (winter) or higher (summer) flow.
- Stress test duration would be based on required time to complete at least one complete filter run (beginning and ending with a filter backwash).
- During the stress test operations to note:
 - Incoming filter turbidity - at start and end of test.
 - Outgoing filter turbidity - at start and end of test.
 - Filter Run times – Time between backwashes at max filtration rate.
 - For calculation of unit filter run volumes (UFRV).
- Stress testing could be completed over the course of a couple of standard working days monthly or quarterly.
- Ideally stress testing would be scheduled to include best-case and worst-case incoming water quality scenarios for validation of plant capacity over the range of inlet water conditions.

Ultimately the stress testing may provide long term validation of the reasonable filtration capacity of the High River Water Treatment Plant. If initial results indicate that the maximum filtration rate cannot be achieved over all conditions the stress testing could be adjusted to accommodate a maximum filtration rate exceeding the current maximum rate (21 MLD) and less than the theoretical design capacity (27.5 MLD). The stress testing procedure would be a useful demonstration of capacity for the Town of High River regardless of evaluation of its' capacity for supplying water beyond it's limits. The limitations of the stress testing may indicate that the Town of High River needs to consider planning of upgrades to the water treatment capacity even without the added demand imposed by a regional connection to the Town of Nanton.

4.2.4.4 DISTRIBUTION SYSTEM

Currently the Town of High River Water Treatment Plant is equipped with a total of four distribution pumps with a total installed capacity of 530 l/s currently that capacity is delivered by:

- 2 x 250 HP Vertical Turbine Pumps
 - Each capable of supplying 189 l/s at 53.3 m of head (76 psi pressure).
- 2x 100 HP Vertical Turbine Pumps
 - Each capable of supplying 76 l/s at 53.3 m of head (76 psi pressure).

Firm capacity of the system is represented by the available pumping capacity of the system when the largest single pump is unavailable. With one 250 HP pump unavailable capacity is reduced to 341 l/s.

Firm capacity of the system should equal or exceed the greater of maximum daily demand plus fire flow or peak hour flow. Town of High River standards for fire flow are specified as 225 L/s (ISL 2011). When this is added to the current maximum daily demand for the Town of High River (239 l/s) and the proposed maximum daily demand of the regional system (27 l/s) The required firm flow should exceed 491 l/s. As such it has been proposed that the distribution capacity be increased by the addition of an additional 250 HP vertical turbine pump with a corresponding increase in firm capacity to 530 l/s.

5 PRELIMINARY DESIGN

5.1 CONCEPTUAL DESIGN

The High River Regional Water Supply project is proposed to consist of local upgrades to the Town of High River Raw Water Supply, Treatment and Distribution System to facilitate potable water supply to the Town of Nanton, a connection to the Town of High River Distribution System, a Booster Pumping and flow metering facility at the Town of High River limit, an approximately 30km Regional Transmission Pipeline south to the Town of Nanton and a connection to the existing potable water storage and distribution pumping system at the Town of Nanton. The specific details of each proposed element of the system will be discussed in detail in the following sections. Preliminary design drawings are included in Appendix A.

5.1.1 High River Upgrade Requirements

The Town of High River potable water supply and treatment system is understood to have been designed for supply of between 18,000 – 27,700 m³/day of potable water. Currently the system successfully produces up to approximately 21,000 m³/day of potable water and consistently meets regulatory standards. With production of up to 27,700 m³/day the system would have sufficient capacity to supply the Town of High River, current municipal and industrial customers, and the Town of Nanton. A projection of current municipal growth 20 years in the future results in an estimated 20-year maximum daily design flow of approximately 26,500 m³/day.

Addition of raw water wells to optimize raw water quality as well as facilitating proper backwash is expected to assist in reaching full plant capacity. It is also recommended that immediate and periodic stress testing of the water supply system be undertaken to provide proof of capability under all conditions as well as operational insights into treatment at maximum capacity.

Local upgrades at the Town of High River are proposed to include the following:

- Upgrades to the raw water supply system including:
 - Completion of two (2) additional raw water wells,
 - Capacity increase to provide sufficient raw water to satisfy additional Nanton demands. Exact capacity increase will be determined by hydrogeological assessment.
 - Will provide additional operational flexibility at the High River Water Treatment plant to optimize raw water quality while maintaining necessary raw water flow during high flow periods.
 - Will utilize existing drilled and uncompleted wells (WW17, WW18).
 - Completion with pitless adaptors, submersible pumps, flow measurement, level measurement and telemetry.

- Connection to the existing raw water supply pipeline network to the WTP.
- Upgrades to the potable water distribution pumping system:
 - Addition of an additional High Lift Distribution Pump.
 - Expected increase of firm capacity from 341 l/s to exceed 483 l/s.
 - Provision of additional pumping capacity will ensure firm capacity of High River distribution pumping system continues to exceed requirements for Maximum Daily Demand and local Fire Flow after addition of Nanton Demand.
 - Utilize “spare” location in High River Distribution Header.
 - Connection to the existing raw water supply pipeline network.
 - Requires additional electrical and controls upgrades.
- Upgrades to the Town of High River potable water treatment system.
 - Connection of distribution pump header potable water supply to gravity backwash reservoirs.
 - Additional firm capacity of distribution pumping system will enable distribution pumps to supplement backwash supply to optimize backwash rate.
 - Current backwash rate is insufficient for bed fluidization and cleaning under stress situations (AWI, 2013).
 - Regional connection is expected to increase likelihood of periods of stress on WTP.

5.1.2 Connection at High River

Connection is expected to be made to the existing distribution system near the intersection of 12th Avenue and Center Street, extending south along the old CP Rail property to the Town boundary. Preliminary estimated costs for this work are carried under the Transmission Pipeline to Nanton.

The Viability of this point of connection has been evaluated by ISL Engineering based on a previously created model of the Towns Distribution System. The following comments are adapted from correspondence and figures from ISL Engineering

The available pressure in the water system was evaluated based on the addition of a point use/turnout added at the proposed connection location drawing flow at the proposed regional pipeline maximum design capacity of 27 l/s.

- The evaluation found that during a period of peak hourly demand (PHD) in the Town of High River, the available distribution pressure at all locations throughout the Town of High River should

remain comfortably above the minimum pressure of 275 kPa (40 psi) required in water distribution systems under PHD.

- Available Pressure in the model node closest to the point of diversion specifically dropped by only 6 kPa (<1 psi). This was the location of the highest drop. Other locations of existing heavy use were also spot checked and indicated a minor drop.

In summary the addition of the regional flow is not anticipated to adversely affect available pressure in the Town of High River distribution system even during periods of highest flow. The impact on available pressure throughout the Town of High River in this scenario is depicted in Appendix D - Figures 1, 3 and 5.

The available fire flow throughout the distribution system was also evaluated based on a point use of 27 l/s coming from the proposed point of connection.

- The evaluation found that with the addition of the regional flow the available fire flow at the point of connection fell by a corresponding 27 l/s (458 l/s dropping to 431 l/s).
- Fire flows dropped by the most along Centre Street and in the southeast areas of the town however any area with a drop of more than 5 l/s in available fire flow still maintained an available fire flow above 277 l/s.
- The evaluation identified no immediate concerns in fire flow availability from the regional demand with generalized reduction in fire flow with the largest drops near the point of connection. Areas near the point of connection still indicates some of the highest available fire flows in the Town.

The impact on available fire flow throughout the Town of High River in the scenario is depicted in Appendix D – Figures 2, 4 and 6.

5.1.3 Booster Pump and Metering Facility

The pressure from the High River potable water distribution system is not sufficient to convey potable water the entire distance to the Town of Nanton, as such booster pumping is required to provide additional lift to overcome distance and topography. The facility will provide for in-line pumps and no storage will be provided at the facility. Two potential locations were reviewed including at the Town of High River boundary in the same location as the meter vault and PSV, and at TWP RD 18-4. Both locations appear to be suitable for access and proximity to necessary utilities.

The Booster Pump and Metering Facility is proposed to include the following:

- New Building
- Two (2) booster pumps:

- Firm capacity 2,300 m³/day.
- Sodium hypochlorite feed system for boosting chlorine residual.
- Pressure Sustaining Valve
 - Will maintain upstream pressure in High River Distribution System.
 - Protection in event of fire or catastrophic pipeline failure.
 - Remote drip-tight emergency actuation by the Town of High River.
- Flow measurement prior to any regional demand.

The station has been preliminarily sited along the existing railway right-of-way as near to the Town of High River boundary as possible. This ensures that:

- The proposed site is currently owned by the Town of High River as a proposed partner in the project.
- The Town of High River distribution system can be protected by the pressure sustaining function of the booster station.
- Any future connections between the planned point of connection to the Town of High River distribution system and the Booster Station will be within the Town of High River and serviced by existing pressure from the Town of High River distribution pumping system.
- Any future connections downstream of the Booster station will be metered as part of the regional transmission system.
- The booster station can be sited to be protected from future flood risk by the existing Dike.
- Access can be made available from existing paved roads.
- Utility servicing is readily available.

5.1.4 Treated Water Transmission to Nanton

A transmission pipeline will convey potable water from the Town of High River boundary to the existing Town of Nanton treated water storage. The pipeline is anticipated to follow along the abandoned CP Rail right of way for most of the alignment.

The following is a summary of the proposed pipeline:

- Regional potable water transmission line from High River to Nanton,
 - Capacity 2,300 m³/day
 - Total length near 30 km
 - 250 mm (10 in) HDPE

- Following Abandoned Rail Alignment (up to 75%).
- Additional Alignment through private land (estimated 25%).
- Minor capacity available for rural use at discretion of project partners.

5.1.4.1 ROUTE SELECTION AND LAND AVAILABILITY

The preliminary design concept plans to follow the existing rail alignment for the majority of its length. At the time of this report creation the majority of this land remains under the control of CP Rail with the second largest portion owned by the Province (Alberta Transportation) and with lesser portions owned by the Town of High River and private landowners. Where there is not abandoned rail right of way the assumption is made that the alignment will parallel municipal roadways in Foothills County and the MD of Willow Creek. No approach has been made to private landowners however preliminary conversations have been had with CP Rail and Alberta Transportation.

Alberta Transportation has demonstrated a willingness to discuss usage of the land for a potable water pipeline while maintaining ownership. CP Rail has indicated an interest in sale of the abandoned rights-of-way without indicating any preference to selling for the potable water pipeline purpose. It is understood that sale of unspecified portions of the right-of-way under control by CP may be in progress as this report is prepared.

5.1.4.2 LAND COSTS AND ACQUISITION CONSIDERATION FOR PROPOSED PIPELINE ROUTE

In support of this feasibility review a Land Agent (Bridge Land Services) was engaged to assist in estimating costs including the relative costs of irrigated, cultivated and grassland quarters. As part of that evaluation the Land Agent has also provided a preliminary work plan estimate to undertake the necessary land acquisitions. Estimated cost for both land acquisition and land agent services have been incorporated into preliminary cost estimates. It is understood that based on the course of land negotiations the alignment of the pipeline could vary somewhat from the preliminary concept. The pipeline preliminary design has been developed with this in mind such that the basic elements of the technical design can be maintained with significant variations in the final alignment.

5.1.4.3 ENVIRONMENTAL CONSIDERATION FOR PROPOSED PIPELINE ROUTE

Based on the preliminary pipeline routing Beartracks Environmental Services was engaged to complete a desktop environmental assessment to better understand the potential environmental constraints and sensitivities for the proposed area. It should be noted that the environmental screening was completed based on the preliminary alignment however the review and conclusions are based on an area within up to 1000 m of the proposed route the conclusions can be expected to be consistent with some variation in the exact pipeline routing.

The complete desktop assessment by Beartracks Environmental Services is included in Appendix E. This includes listing of areas of potential and actual environmental and biophysical concern with respect to:

- Disturbance of Native vegetation and sensitive habitats.
- Disturbance of wetlands and watercourse crossings from construction activities including erosion, habitat loss and unplanned discharges; and
- Disturbance of wildlife habitat and features including nests, dens, and breeding ponds.

Recommendations from the desktop review include:

- For areas where there will be disturbance to native vegetation and potential sensitive habitats, a vegetation assessment should be completed prior to construction activities allowing for the following:
 - Identification of noxious weeds that are to be eradicated.
 - Avoidance of tracked watched vegetation.
- Where possible soil disturbances should be completed on previously disturbed land.
- Good management practices should be in place for reclamation, erosion control and weed management.
- Notifications will be required for watercourse crossings.
- Sediment and erosion controls and a spill response plan will be required for watercourse crossings.
- Some sensitive wildlife breeding areas overlap the project including migratory birds.
 - The restricted activity period (RAP) for the wildlife in the area would occur between March 15 and August 15.
 - A migratory bird sweep is recommended prior to any work during the RAP.
 - To cover the length of the pipeline multiple sweeps will likely be required as work progresses.
 - Identified wildlife may have a recommended setback and timing restriction to minimize disturbance with the RAP.

Overall, the desktop assessment did not identify any unexpected areas of environmental concern however it has identified that prior to construction additional vegetation and wildlife sweeps will be required and because pipeline construction is likely to be completed in the restricted activity period multiple wildlife sweeps will be required. These items have been incorporated into the probable costs.

5.1.4.4 HISTORICAL RESOURCES CONSIDERATION FOR PROPOSED PIPELINE ROUTE

Arrow Archeology Limited was engaged to complete a desktop review of the potential historical resources along the pipeline route to determine the likelihood of encountering sites that would result in subsequent

requirements for a detailed historic resources impact assessment. The overview was completed based on the preliminary pipeline alignment however as part of the overview the closest recorder historical resources were also identified. The following were the general conclusions:

- There are no recorded historical resources located in the project footprint.
- Women’s Buffalo Jump is a significant and important site and is located approximately 2.5 km West of the proposed alignment, NW of Cayley.
- Other nearest sites are:
 - Along Mosquito Creek approximately 4 km NW of the proposed crossing.
 - An historic building in Cayley that will not be impacted.
- The lack of historical resources is likely due to a combination of extensive cultivation and level terrain unfavorable for habitation by Precontact Era cultures.
- The most likely area for unrecorded historical resources is watercourse crossing at Mosquito Creek near Nanton and at the Little Bow tributary near High River however the conclusion was that these are of limited potential for historical resources.

Based on the above conclusions Arrow Archeology has provided their findings in a format that can be utilized as application for Historical Resources Approval to the Historical Resources Branch of Alberta Culture and Community Services. That document is included in full in Appendix F and includes a recommendation that based on the preliminary alignment a limited area Historical Resources Impact Assessment be completed at the Mosquito Creek crossing only. It was also noted that based on the low likelihood of encountering a historical resource the submission may result in an outright approval with no need for additional HRIA, however a limited HRIA at the Mosquito Creek crossing is most likely and will be included in the opinion of probable cost.

5.1.5 Connection at Nanton

A connection from the transmission pipeline to the existing treated water storage is required. The existing potable water distribution pumps will be maintained. The existing raw water reservoirs will be decommissioned or re-purposed and WTP equipment will be decommissioned by the Town of Nanton.

The following is a summary of local upgrades at the Town of Nanton

- Process piping and building modifications to accommodate
 - Incoming flow measurement and control,
 - Re-configuration of Sodium hypochlorite feed system for chlorine residual boosting,
 - Connection to the existing treated water storage reservoir.
 - Retain existing distribution pumping system.

6 COST ESTIMATES

6.1 CAPITAL COSTS

Order of magnitude capital cost estimates for the proposed regional water supply have been prepared. A summary table is tabulated in table 6.1. Full details of the estimates are available in Appendix F. Cost estimates have been prepared according to AACE (Association for Advancement of Cost Engineering) Class III guidelines.

Figure 6.1 Opinion of Probable Cost Summary

LOCAL UPGRADES - TOWN OF HIGH RIVER		\$	970,000.00
TRANSMISSION MAIN - HIGH RIVER TO NANTON		\$	7,900,000.00
BOOSTER STATION AND METER VAULT - NEAR HIGH RIVER		\$	730,000.00
LOCAL UPGRADES - TOWN OF NANTON		\$	258,000.00
		GRAND SUBTOTAL	\$ 9,858,000.00
		-20% Contingency	+30% Contingency
Contingencies		\$ (1,972,000.00)	\$ 2,957,000.00
Geotechnical/Materials Testing		\$	75,000.00
Regulatory Approvals		\$	50,000.00
Environmental Assessment, Historical Resources and FNC		\$	50,000.00
Hydrogeological Allowance		\$	35,000.00
Engineering (15%)		\$ 1,218,000.00	\$ 1,926,000.00
		GRAND TOTAL	\$ 9,314,000 \$ 14,951,000

Cost estimates have been divided into four subsections including the local upgrades required at the Town of High River, the transmission main from the point of connection on the High River distribution system to the Nanton WTP, the booster station at the High River town boundary and the local upgrades at the existing Town of Nanton WTP as required to connect the regional pipeline to the existing treated water storage and distribution system.

These capital costs are an opinion of capital costs based on recent pricing and as such are presented in a range according to AACE guidelines.

It is important to note that capital cost estimates do not include allowances for the purchase of additional water license allocation. The estimate for the potable water transmission pipeline does include estimated costs for land agent engagement and land purchase based on preliminary review of land use and current ranges of land values in the proposed pipeline area.

6.2 FINANCING CAPITAL INFRASTRUCTURE

There are different methods of funding large capital cost projects required by a municipality. These methods range from full cost recovery through base utility billing in which the charge to the customer includes the full cost of delivery (i.e., capital cost debentures, operation, and maintenance, overhead, and administration) to special levies on a utility bill that cover the cost of improvements.

6.2.1.1 REGIONAL SYSTEMS INITIATIVE - WATER FOR LIFE STRATEGY

In 2006, as part of the “Water for Life Strategy” the Province of Alberta began the Regional Systems Initiative. Under this program the Province would fund 90% of the capital costs of constructing regional municipal water or wastewater pipelines. The Province would provide 100% funding to the “hub” suppliers to make the necessary expansions and improvements to service the regional customers.

For the proposed project, the Town of High River would be the hub community and upgrades to the Raw Water Supply, WTP and distribution pumping system required to accommodate the regional supply would be fundable at up to 100%. The remainder of the capital costs including the booster station, transmission pipeline and connection to Nanton would be considered part of the regional pipeline and would be fundable at up to 90%. If the full estimated cost (including 30% contingency) is funded at the above rates the overall blended funding rate for the project would be approximately 91%. With a total project cost of up to \$14,951,000 the potential provincial contribution would be \$13,643,000 and the local contribution would be \$1,347,000.

The actual blended funding rate and funding totals may vary from these estimates based on evaluation interpretation of the eligibility of specific portions of the proposed project under the Water for Life Program.

6.3 OPERATIONAL COSTS

Operation and maintenance cost for the potable water transmission system have been estimated. This estimate has been prepared based on a buy/sell model according to the existing framework that The Town of High River uses for existing customers. Also included are estimated operations and maintenance costs that would apply beyond the purchase of water for the booster station, transmission pipeline, storage, and distribution in the Town of Nanton. More specifically the operations and maintenance estimates include:

- Potable water purchase from the Town of High River (starting at current rate \$1.39/ m³).
- A recurring potable water connection fee charged by the Town of High River (\$2500, every 2 months).
- Estimated labour costs for Town of Nanton water operators and vehicles utilized part time for regional water operations.
- Disinfection Chemical Costs.
- Electrical and pumping costs for pumping equipment and building loads at the proposed booster station.
- A general maintenance allowance.

All costs have been projected forward including growth according to the previously discussed population estimates and a projected average inflation of 4% for the projected lifespan of the infrastructure.

Operations and maintenance costs begin at \$1.77/m³ based on immediate connection and have been projected to increase to \$4.63/m³ in 25 years. Details of the operations and maintenance cost estimates are included in Appendix F.

6.4 PRESENT WORTH ANALYSIS

A present worth analysis was undertaken to account for both the capital costs and the major O&M costs associated with the proposed project over its projected life cycle. The present worth analysis assumes that the local share will be debentured over a 25-year period based on current interest rates from the Alberta Capital Finance Authority. Based on the net present value calculation the cost of water for the regional supply will be approximately \$2.02/m³ based on immediate connection and projected to \$4.83/m³ in 25 years. Details of the net present value analysis are included in Appendix F.

7 REGULATORY REVIEW

7.1 DIVERSION LICENSES

For the Town of Nanton to receive potable water from the Town of High River, water licence at the point of diversion from the Town of High River water wells is required. This licence can be in the form of a transfer of the currently held licence from Mosquito Creek, or through acquisition and transfer of allocation from another existing licence.

7.1.1 Existing Nanton Diversion License

Preliminary conversations with AEPA staff indicate that up to 42% of Nanton’s licence from Mosquito Creek would be transferrable to the point of High River’s diversion off the Highwood River. The transferrable portion of the license is understood to be based on the quantity of flow currently originating in the Highwood River and diverted by provincial water operations through Women’s Coulee to Mosquito Creek and subsequently utilized by the Town of Nanton. The “background flow” from the Mosquito Creek local catchment may not be eligible for transfer. Based on this evaluation the transferable portion of the existing Nanton license would be up to 259,031 m³/ year. Compared with a projected annual raw water demand to service Nanton of nearly 430,000 m³/year the available volume eligible for transfer will be insufficient to satisfy the immediate and longer term demands of the Town of Nanton

Additional discussion with AEPA staff has focused on additional considerations for transfer of a larger portion of this. One point of discussion is that evaluation of eligible quantity for transfer should account for the seasonality of flow in Mosquito Creek and the possibility that during the current period where Nanton draws water from Mosquito Creek (May-Oct) a relatively larger percentage of flow may be coming from the Women’s coulee diversion. It has been indicated on a preliminary basis but not confirmed that depending on a detailed analysis from AEPA hydrologists a slightly larger portion of the license may be eligible for transfer. The adjustment is not expected to be sufficient on its own to satisfy the immediate demands of the Town of Nanton if transferred to the High River diversion.

Further discussion with AEPA staff has focused on the finding of the hydrogeological investigation indicating that the proposed wells to be developed (WW17 and WW18) are located in the Oldman River basin rather than the Bow River Basin. It is possible that transfer of license to this location may be reevaluated based on this understanding however no indication of additional eligibility for transfer has been confirmed at this time. It is understood that the final decision regarding eligibility for transfer will be made after an application for transfer is submitted.

7.1.2 Additional Diversion License

Based on the above understanding, the volume of transferrable water is not adequate to meet the Town of Nanton’s current or future water demands. Additional licence allocation must be obtained to receive water from High River. It is understood that because the entire South Saskatchewan River Basin is closed to new allocation the only way to acquire additional allocation is through transfer of eligible licenses within the basin. It has previously been communicated by AEPA staff that those licenses downstream of

the confluence with the Bow River and Highwood River are the least technically challenging transfers within the Bow River Basin sub-basin.

Upon review of the hydrogeological investigation, it appears that the most viable option for development of the raw water system is through completion of existing raw water wells WW17 and WW18. The Town of High River well field appears to straddle a divide between the Bow River and Oldman River sub-basins of the South Saskatchewan River and these wells are located within the Oldman sub-basin. As such the most viable options for license transfer should be from licenses downstream within the Oldman River sub-basin.

The transfer of licenses is facilitated by AEPA, but the acquisition of transferable quantity is based on availability of eligible licenses that can be found and purchased by the Town.

7.1.2.1 POSSIBILITY OF LICENSE SHARING

It is also possible that available allocation within the Town of High River license(s) could be utilized by the Town of Nanton as part of a service agreement or governance structure agreed to by both parties. This may also be a consideration for an interim measure to facilitate the completion of the regional system. Currently the Town of High River has ample capacity within their existing licenses however it is understood that through long-term planning the Town of Nanton may intend to utilize the balance of that licensed capacity for their own municipal development. It is possible that a regional servicing agreement could include provision for the Town of Nanton to utilize the excess capacity of the Town of Nanton in the period immediately following completion of a regional potable water transmission pipeline, with agreement that the Town of Nanton would purchase/or acquire additional license allocation as required in the future as the communities grow to offset the allocation that the Town of Nanton has and will utilize. These Further discussions between administration and elected officials of all partner communities would be required to determine the desired path forward.

7.2 EPEA OPERATING APPROVALS AND REGISTRATION

The Towns of High River and Nanton WTP's currently operate under *Environmental Protection and Enhancement Act* (EPEA) approvals. All Environmental Protection and Enhancement Act approvals and Codes of Practice contain conditions and requirements pertaining to:

- construction,
- management and operation,
- system classification and operator requirements,
- limits,
- monitoring and reporting.

Prior to implementation of the proposed upgrades, it is recommended that applications be made to AEPA for amendment of the Town of High River waterworks approval for the modifications described herein.

The implementation of a regional waterworks system would allow for the eventual decommissioning and cancellation of the Town of Nanton waterworks approval and a registration under the *Code of Practice for a Waterworks System Consisting Solely of a Water Distribution System* furthermore, according to MPE Engineering’s interpretation of the classification point system, based on the population served by the waterworks system, the Town of Nanton operation requirement would be reduced to a minimum of one operator with a Level II Water Distribution Systems Certificate.

8 GOVERNANCE MODELS REVIEW

There are various methods to govern the construction, operation, and maintenance of a regional water system. The governance method chosen may influence the portion of the total costs of construction and the water rate for which a member community may be responsible. The governance model chosen by the regional member communities does not influence the amount of funding received from Alberta Transportation. The formulas for determining the available grants remain the same. The difference is how the member communities decided to allot the funds among the various portions of the project (i.e., plant upgrades, pipelines, etc.) and the governing organization that is created to operate and maintain the regional system. Three models are used to illustrate the costs associated with the various regional alternatives; Buy/Sell, Regional Commission, and Municipal Controlled For-Profit Corporation.

8.1.1 Buy/Sell (Intermunicipal Agreements)

Under the buy/sell governance model the Seller would be the Town of High River and the customer would be the Town of Nanton. The Town of Nanton could also choose now or in the future to form a commission or municipal corporation with other partners and that organization would then be the customer.

Under the Buy/Sell governance model, the available funding has been applied to the construction costs according to the AMWWP funding formulas. The remaining costs are borne by the member communities based on the individual flow rates of each community to the overall capacity of the system. For this feasibility review it has been assumed that Nanton would secure a 25-year debenture for their portion of the construction costs. The operation and maintenance of the regional water treatment plant would be the responsibility of the hub community as they would retain ownership of the infrastructure. The hub community would sell water to the regional customers at a rate equal to the cost of producing water plus a government regulated profit margin (~5-10%). Generally, a long-term agreement is executed between the various municipalities that would define the means and methods for determining the cost of water to be charged to the water users.

The Town of High River has indicated a preference towards participation in the project as the Seller in a Buy-Sell model. It is understood that this is consistent with their participation in additional regional systems including the existing system that provides water to the Village of Cayley and to users within Foothills County including Cargill. As such a pricing model is already in place based on a fixed rate connection fee charged bimonthly (every 2-months) and a unit cost price of treated water.

A detailed discussion will be required between the Town of Nanton and the Town of High River exactly where the cost sharing, and system ownership boundaries will be implemented. Of note are the following considerations. Under the water for life funding program and a buy/sell model it is understood that those costs that require a 10% municipal contribution may be largely borne by Nanton as the customer community. However, because there are significant benefits to the operation of the raw water supply and distribution pumping system for the Town of High River because of the upgrades required to those systems there may be some reasonable discussion for some cost sharing of the municipal portion. Also, the location of the gate or point of sale for the buy sell system will need to be determined. Under this

structure it may be logical for the Town of High River to take on ownership and operation of the Booster Pump Station since this station is proposed to be located on Town of High River Land, within Town of High River boundaries and is intended to serve the function of measuring flow leaving the Town of High River and protecting the Town of High River distribution system from loss of pressure.

8.1.2 Regional Services Commission

Under the Regional Services Commission governance model, the available funding would be applied to the construction costs at a blended rate for the entire cost of the project. The remaining costs would be borne by a Commission made up of members of each community. The Commission would secure a single 25-year debenture for all the remaining construction costs and would recoup the costs by selling water at a base rate to each of the member communities. Therefore, each member community would pay for the construction costs based on the individual flow rates of each community to the overall capacity of the system but would pay it through the water rate structure of the Commission. The operation and maintenance of the regional water treatment system would be the responsibility of the Commission, as the Commission would now own the infrastructure, rather than the hub community. The operation and maintenance costs would be reflected in the base water rate charged to each community.

8.1.3 Municipal Controlled Corporation

Municipal controlled corporations are for-profit corporations that are controlled by a municipality or group of municipalities for the purposes of providing a regional municipal service or facility. Approval from the Minister of Municipal Affairs must be obtained by the municipalities that wish to establish a municipal controlled corporation prior to the establishment of the corporation.

8.1.4 Governance Model Selection

Ultimately the selection of a governance model is a determination of the political and financial goals of the communities involved however it is useful to review the potential advantages and disadvantages of a buy/sell system compared to a commission or corporation that includes both the hub and customer facilities.

For a buy/sell model the advantages include the following:

- Customer is no longer responsible for most practical aspects of water quality and treatment.
- Seller Regulatory requirements for water treatment and quality change little.
- There are few additional seller regulatory requirements, although the seller does take on some regulatory and practical obligation for water quality supply to the customer.
- Customer regulatory requirements become significantly simpler.
- May free up more customer municipal operational resources for sanitary collection and treatment and potable water distribution.
- The seller maintains autonomy over their system.

For this model, the corresponding disadvantages include the following:

- The customer has little control of the water supply and treatment system upstream of the purchase location.
- There may be less opportunity for the buyer to share responsibility for operation and maintenance of regional infrastructure.

This can be compared to a regional commission or corporation model where the contrasting advantages can be described as follows:

- The supplied communities are able to retain some ownership and influence in the operation of all phases of the supply and treatment system through the structure of the commission or corporation.
- Staffing for maintenance and operation of the pump station and pipeline becomes shared responsibility with other partners through the structure of the commission or corporation.
- Cost for future capital planning may be more easily shared between partners.

For this model, the corresponding disadvantages include the following:

- Members of the commission or corporation may become responsible for a portion of unseen costs related to operations or infrastructure that are brought into the organization by other members.
- Legal and organizational structure can be difficult to organize or modify in the future.

9 DISCUSSION

The Town of Nanton does not have access to a year-round and long-term reliable supply of water. The problem has recently reached a level of severity such that the Town has come overly close to being unable to treat and supply sufficient volumes of potable water to its residents. Several alternatives for varied supply of raw or potable water have been reviewed over the course of multiple studies and a regional supply from the Town of High River has emerged as the best alternative. This regional study is an attempt to further evaluate the feasibility and develop a preliminary design for that alternative.

9.1 SUMMARY DISCUSSION

9.1.1 Available and Projected Capacity of High River to Supply the Town of Nanton

Preliminary indications are that the Town of High River would be capable of supplying the Town of Nanton with the completion of some upgrades to the Raw Water System, Water Treatment Plant and Distribution Pumping System.

Based on review of previous hydrogeological investigations the shallow groundwater aquifer in use by the Town of High River for the well field appears to have the capacity to meet the expanded demand of a system including the Town of Nanton over and above the existing license allocations in the aquifer. Existing tested but undeveloped wells owned by the Town of High River are located in the portion of the aquifer that is within the Oldman basin and these wells have been identified as a reasonable prospect for development to provide additional water accommodating Nanton's demand. Additional hydrogeological testing would be required during development to verify the well capacity for licensure.

The area of most concern with High River Capacity to supply Nanton is within the water treatment plant itself and specifically with the gravity filtration system. The theoretical maximum treatment capacity of the gravity filtration system is based on an unproven filtration rate of the filters that has not been operationally verified under a full range of conditions and should be verified by stress testing. Recommended upgrades to the raw water supply system and water treatment plant are expected to provide some additional assistance in optimizing the WTP capacity. The addition of raw water wells will also give High River operations staff greater operational flexibility to ensure that the best quality of raw water can be directed to the filtration system at any given time. Modification to the backwash supply through connection to the expanded distribution pumping system will also provide opportunity for improved constant rate backwash of the gravity filters.

9.1.2 Preliminary Design of Potable Water Transmission System

The preliminary design includes a connection to the existing distribution system in the southwest portion of the Town of High River, A proposed 250mm transmission main following along the existing railway right-of-way and private land, a pressure boosting and metering station at the Town of High River boundary and a connection to the existing Town of Nanton storage and distribution system in the existing Nanton water treatment plant.

9.1.3 Capital and Operational Cost Estimates

A capital cost estimate has been developed based on the preliminary design of the system. Capital costs have been estimated at up to \$14,951,000 including all phases of the proposed project. Operational cost has been estimated on a per unit of potable water supplied at \$1.77 /m³ based on immediate costs after connection including cost of water purchase and fees from the Town of High River under a buy/sell model.

9.1.4 Raw Water License Requirements

Based on discussion with AEPA the current raw water allocation held by the Town of Nanton may be partially eligible for transfer to the Town of High River raw water aquifer source. The exact quantity available for transfer will be determined by AEPA at the time of transfer application but appears to be insufficient to satisfy the current demand of the Town of Nanton. As such a shortfall of approximately 171,000 m³ (139 acre-ft) would need to be made up through license acquisition or sharing.

9.1.5 Feasibility of Alternatives

One other alternative was discussed for further review by the previously completed Nanton and Willow Creek Shared Water Distribution Study. This alternative involved an increase in Raw Water Storage and continuing and upgrading treatment at the existing Nanton Water Treatment Facility with the extension of the spring water line into the Nanton WTP to partial mitigate raw water shortages during the winter season.

After completion of the previous study a project was undertaken to extend the spring water line into the water treatment plant. During execution of this project, it was revealed that the water flow in the spring line may have been affected by a connection to the distribution system and the available flow was virtually nil.

Currently a project is underway to improve the treatment in the existing Nanton WTP and mitigate some persistent water quality issues experienced by the Town. This project included addition of full-scale raw water reservoir aeration within the existing storage cell to reduce the inlet raw water manganese and formation of organic taste and odor causing compound as well as the addition of a Powdered Activated Carbon (PAC) feed system to mitigate these issues in the treatment process itself. These measures are expected to provide improvement to the quality of treated water in the Town of Nanton.

Expansion of storage has previously been identified as less desirable than a regional supply due to concerns with the viability of Mosquito Creek as the only available source of Raw Water. It is expected that due to concerns with the upstream diversion and climate the source itself may lack some reliability and although the treatment improvements are expected to improve the potable water quality it will not completely eliminate the ongoing taste and odor concerns that have been experienced by the Town of Nanton. Furthermore, it is understood that the Town of Nanton WTP is well into its service life and there will be a continued need for upgrade and replacement of building systems and process equipment and even system replacement as the plant extends beyond its typical usable service life.

9.2 ADDITIONAL DISCUSSION

9.2.1 *Cargill Canada*

Cargill operates the High River Protein Processing Plant in Foothills County near the Town of High River. This beef processing facility includes slaughter, fabrication, rendering and hide operations and is a customer obtaining potable water from the Town of High River through an agreement between the Town of High River and Foothills County. It is understood that there is some possibility that in the intermediate to long term there may be other opportunities for Foothills County and Cargill Canada to obtain potable water from other sources serviced from the Bow River.

For the purposes of this review all evaluation of the feasibility of the Town of High River as a supplier of potable water to the Town of Nanton have assumed that the demands of the Town of High River will continue to include usage by the Cargill facility at current and historical levels. If the situation materializes that Cargill were no longer a customer of the Town of High River, the uncertainty over the existing and future capacity of the Town of High River to supply the Town of Nanton would be eliminated entirely as the current and future usage of the Town of Nanton is approximately one quarter of what has been identified for use by Cargill.

9.2.2 *Additional Communities*

The ultimate driving force of a regional project from the Town of High River to the Town of Nanton is the scarcity of available raw water and the subsequent treatment challenges of the Town of Nanton and the indication that a supply of treated water from the Town of High River is the most acceptable option for mitigation of these concerns. As such the Town of Nanton and the Town of High River will be the main partners in the regional system. Any connection between these two communities will by necessity also need to pass through both Foothills County and the MD of Willow Creek. As such these communities have been consulted with for an understanding of their level of support for the proposed project.

Foothills County has not been proposed as a user of the pipeline however has been approached at an administrative level by the Town of Nanton with indication of general support for a project to satisfy the needs of the Town of Nanton. It is recommended that prior to proceeding with land acquisition a formal request be made by the partners (Nanton, High River) to Foothills County for a council resolution in support of the project. It is recommended that a similar request be made to the MD of Willow Creek.

The MD of Willow Creek has been approached at an administrative level and has indicated general support for the project with no indication of current interest in participation as a water user.

An intermunicipal memorandum of understanding between Nanton, High River, Foothills County and possibly, the MD of Willow Creek would provide a solid basis for moving forward with funding applications and more detailed agreements on the exact structure of water supply from the Town of High River to the Town of Nanton as well as the level of participation or lack or lack of participation of additional municipalities.

10 CONCLUSION & RECOMMENDATIONS

A regional potable water supply from the Town of High River continues to be a feasible option for the secure long-term supply of potable water to the residents of the Town of Nanton. The following upcoming steps are recommended:

Detailed review of the Regional Water Study with the municipal partners from the Town of High River and Town of Nanton. Upon completion of the review MPE will adjust and finalize this report as necessary.

Provide a copy of the Regional Water Study to additional parties for review including the department of Environment (AEPA) and the department of Municipal Affairs (MA)

Begin the process to try and obtain, through facilitated discussion, an Intermunicipal Memorandum of Understanding between Nanton, High River, Foothills County, and the MD of Willow Creek on the question of support for a treated water line between High River and Nanton.

Town of High River operations should begin stress testing of the High River Water Supply and Treatment System to verify the capacity of the Water Treatment Plant and gravity filtration system specifically under a wide range of demand and raw water scenarios.

The Town of Nanton should apply on behalf of the Partners for provincial funding for the Regional Water System under the Water for Life (W4L) Strategy.

- This report along with the previous Shared Water Distribution Study will be required as support for the application.
- The application would include the intermunicipal Memorandum of Understanding and/or resolution/motions from council indicating general support in concept for the project with specifics of an agreement to be determined later.

Upon receipt of funding approval complete detailed design according to the preliminary design concept detailed in this report including:

- Detailed design of raw water system upgrades
 - Will include detailed hydrogeological evaluation of the proposed wells for completion.
 - Detailed hydrogeological evaluation will be required for completion of a transfer of license capacity to this location.
- Detailed design of upgrades at the water treatment plant upgrades including distribution system expansion and backwash improvements.
- Detailed design of the Potable Water Transmission Main.

- Upon receipt of funding engage a land agent to begin land negotiations along the proposed pipeline route. Land acquisition can be expected to be a critical path item and will require engagement at the earliest possible time.
- Detailed design of the Booster Station at the boundary of the Town of High River.
- Detailed design of the connection to the Town of Nanton treated water storage and distribution at the existing water treatment facility.

Continue discussion with AEPA on the viability of transfer of the maximum possible quantity of raw water license capacity currently held by the Town of Nanton to the proposed raw water wells within the expanded High River Well Field.

- Begin process to seek additional license allocation as required for transfer to the High River Well field.