Memorandum

Date: December 12, 2014

To: Trevor Lashua, Town of Hinesburg
Rocky Martin, Town of Hinesburg

From: Joe Duncan, PE, A+E

RE: Town of Hinesburg Wells 4 & 5
Recommended Plan

BACKGROUND

Aldrich + Elliott, PC (A+E) was retained by the Town of Hinesburg to conduct source permitting and preliminary engineering for a new groundwater supply and treatment at Wells 4 and 5 located off Shelburne Falls Road. The existing Wells 1 and 3 located off Charlotte Road are experiencing diminishing capacities as well as water quality issues related to hardness, iron, manganese, and MTBE. The Town passed a bond vote on November 4, 2014 for the new groundwater supply on Shelburne Falls Road. The new wells have high hardness, low iron, non-detect manganese, and non-detect MTBE. As part of the project and associated bond vote the Town is planning to provide treatment for the high hardness and medium iron, which have been nuisances to the system users.

The Town requested that A+E review treatment alternatives and develop a recommended plan for the new groundwater supply and associated treatment. This memo summarizes the recommended plan.

SOURCE SUMMARY

Wells 4 and 5 are to be permitted with the following capacities:

Source	Capacity (gpm)
Well 4	240
Well 5	90
Allowable Combined Yield	280

The Allowable Combined Yield is the highest amount of flow that can be withdrawn from both of the wells simultaneously without negatively impacting the aquifer. This means that Well 5 can only be pumped at 40 gpm when Well 4 is running. Ultimately, the water system's new source capacity would be 280 gpm (subject to State approval). In order to be permitted for the above capacities the Town will need to connect the Bertrand, Fortin, and two Lyman properties to the Town's water system.

Once Wells 4 and 5 are in service, the plan is to no longer utilize Wells 1 and 3 but to maintain them as back-ups in case of emergency. It is anticipated that the new Wells 4 and 5 will provide the required additional capacity to address the immediate and short-term capacity needs. Assuming the short-term build out occurs as projected there will still be a need for additional source capacity in the future (10 to

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20 year horizon). Therefore, it is recommended that the Town pursue an additional source(s) to address the long-term capacity needs. The initial focus should be the Shelburne Falls Road area so as to tie the future well source(s) into new control building for Wells 4 and 5.

TREATMENT ALTERNATIVES

There are several methods to remove hardness from water. The most common method is to use a salt-based ion-exchange process. This process however adds sodium to the water, which has been indicated as not desirable during the bond vote hearings. An alternate method is to use a membrane filtration method, which preferentially removes hardness while leaving other minerals behind. This process is possible by using a "loose" membrane that strongly rejects calcium and magnesium. The benefit of this process is that no additional chemicals are added to the drinking water. A loose membrane is called nanofiltration, which is similar to reverse osmosis but wastes less water and uses less power.

The "con" in using a membrane system is that part of the inlet flow is rejected as a side stream concentrate. This concentrate stream contains the rejected hardness (calcium and magnesium), and would be directed to the sanitary sewer. This would be a constant flow as long as the membrane system is online. An ion exchange process using softening is typically a batch process, whereby after a particular duration, the resin must be regenerated. This process expels a high concentration of calcium chloride into the sanitary sewer. The net total of calcium rejection is the same for both systems, but it is a constant lower level hardness concentration for the nanofiltration system versus a much higher concentration intermittently for the ion exchange system.

For both systems, the treatment process removes all hardness leaving the water extremely soft. This is not desirable because it not only impacts taste but generates corrosive water. The solution for both systems is to bypass a portion of the raw well water around the treatment system and blend it with the treated water to generate a target hardness of 100 to 125 mg/l.

Costs for the two treatment options systems were developed based upon pricing received from national equipment manufacturers. There is a local membrane treatment system manufacturer, Industrial Services Inc. (ISI), located in St. George, VT. We have worked with ISI to identify a recommended nanofiltration system that can be manufactured at their St. George facility and locally installed by them at the new well site. Based upon information received from ISI, the cost for nanofiltration utilizing their system is the lowest cost alternative.

Item	**Ion Exchange**	**Nanofiltration (National Mfg)**	**Nanofiltration (ISI)**
Water Treatment System	$195,000	$270,000	$155,000
Wastewater Pump Station	$30,000	$30,000	$30,000
Emergency Generator	$80,000	$100,000	$100,000
Process Piping	$30,000	$40,000	$40,000
Treatment Building	$160,000	$150,000	$150,000
Heating/Ventilation	$45,000	$40,000	$40,000
Electrical	$60,000	$70,000	$70,000
Total	**$600,000**	**$700,000**	**$585,000**

The annual operation and maintenance (O&M) costs for both systems are estimated as follows:

- Ion Exchange $23,800 per year
- Nanofiltration $20,000 per year

Pros and cons of each system are summarized below:

Nanofiltration

Pros

- Constant process and provides for consistent hardness removal
- No sodium added to the water supply
- Minimal operator time required

Cons

- Higher power consumption
- Loss of inlet flow, which produces concentrated waste for treatment at the WWTF
- Iron fouling can occur if iron becomes oxidized
- Membranes require routine acid wash cleaning
- High service pumps and clear well required to bring effluent back up to system pressure

Ion Exchange

Pros

- Low power consumption
- Minimal process flow loss except during regeneration
- Can be run at system pressure with no additional booster pumping or clear well required

Cons

- Sodium added to water
- Batch process
- If iron and manganese become present at high levels, pretreatment may be required
- Requires a brine making system and storage tanks with routine salt deliveries
- Slow reduction in efficiency during batch process provides for potential uneven hardness removal
- Significant operator time required
- Regeneration required

RECOMMENDED PLAN

It is recommended that the Town pursue nanofiltration as it provides a good softening system, the best overall treatment, the best improvement in taste, and can better address future compliance issues. It is further recommended that the Town consider utilizing local funding sources (i.e. the MTBE settlement funds) to direct purchase the nanofiltration system from ISI. ISI's local presence provides competitive pricing relative to the national manufacturers, local service, and the ability to tailor the system with the Town's preferred equipment (i.e. system controls, pumps, etc.). A State DWSRF loan is proposed to fund the overall project and the procurement policies of their funding do not allow for sole source direct purchases. In talking with the State, the Town can utilize their own local funding to direct purchase the nanofiltration system without compromising the DWSRF loan funding for the remaining project elements.

It is further recommended that the Town begin exploratory drilling this winter to identify an additional source(s) to satisfy the estimated long-term capacity needs of the water system. The initial focus should be the Shelburne Falls Road area so as to tie the future well source(s) into new control building for Wells 4 and 5.