Technical Memorandum

Regional District of Okanagan-Similkameen

Faulder Water Supply Capacity Review

April 2008

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TECHNICAL MEMORANDUM

Regional District of Okanagan-Similkameen
Faulder Water Supply
Interim Supply Options

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1 Objective

The objective of this technical memorandum is to identify short term solutions to provide water to the community of Faulder due to concerns about rapidly declining levels in the aquifer being used as the community's sole source of water supply.

2 Background

The existing Faulder well was developed in about 1993 and has been operating since that time. It draws water from the Meadow Valley Aquifer at a depth of approximately 58 metres below ground surface. Bedrock was encountered at a depth of 67.4 metres. The well is apparently shallow relative to the depth and thickness of the aquifer. Since its development, the Faulder well has operated relatively problem free. An assessment was undertaken by Unit Electrical Engineering in 2003 at the request of the RDOS due to concerns about power fluctuations/brownouts and system operational efficiency. There was no mention in their report regarding groundwater levels.

Over the past couple of years from July 2006 to early 2008 the operating staff have observed a decline in both static and dynamic water levels as well as a slight decline (4%) in well pump flow. Due to concerns about potential plugging of the well screen, the RDOS arranged through Golder Associates to rehabilitate the well using air burst technology. Despite the rehabilitative efforts, it is our understanding that both static or dynamic water levels have continued to decline while pump output declined by approximately 32%.

The RDOS is concerned that the combination of declining water levels and declining pump output could compromise the community water supply and therefore requested a review of the causes of the problems as well as interim and long term solutions to addressing them. This technical memorandum addresses potential short term solutions. The root cause of the declining water levels and potential long term solutions will be the subject of a separate report.

3 Existing System Description

The existing Faulder distribution system was constructed in 1993 and supplies domestic and irrigation water requirements to 51 residential connections from the Faulder well.

The well pump is a Byron Jackson Model 6MQL 10-stage pump driven by a 40 hp Franklin Electric motor equipped with a manually adjustable variable frequency drive (VFD). The pump assembly was installed with the pump inlet set at an approximate depth of 58.25 metres in a 200 mm diameter well casing. Power supply to the well pumphouse is provided by BC Hydro at 120/240 volts single phase which is subsequently stepped up to 480 volts using a 50-kVA transformer. It is our understanding that the VFD is presently set at 57 hz due to concerns about electrical systems reliability when operating at higher speeds and electrical loads. According to information shown on the record drawings, the top of the existing well screen is set at a depth of 59.8 metres and the screen length is 4.6 metres. At the time that the well was installed the measured water level was 46.9 metres below ground surface.

The well supplies water into a distribution system consisting of primarily 150 mm diameter distribution mains and a 200 mm fill-draw main to a treated water reservoir with a top water level 108 metres above the well pumphouse floor elevation. The treated water reservoir has a capacity of 130,000 litres (34,500 usgal). Well pump operation is controlled by reservoir level.

4 Existing System Issues

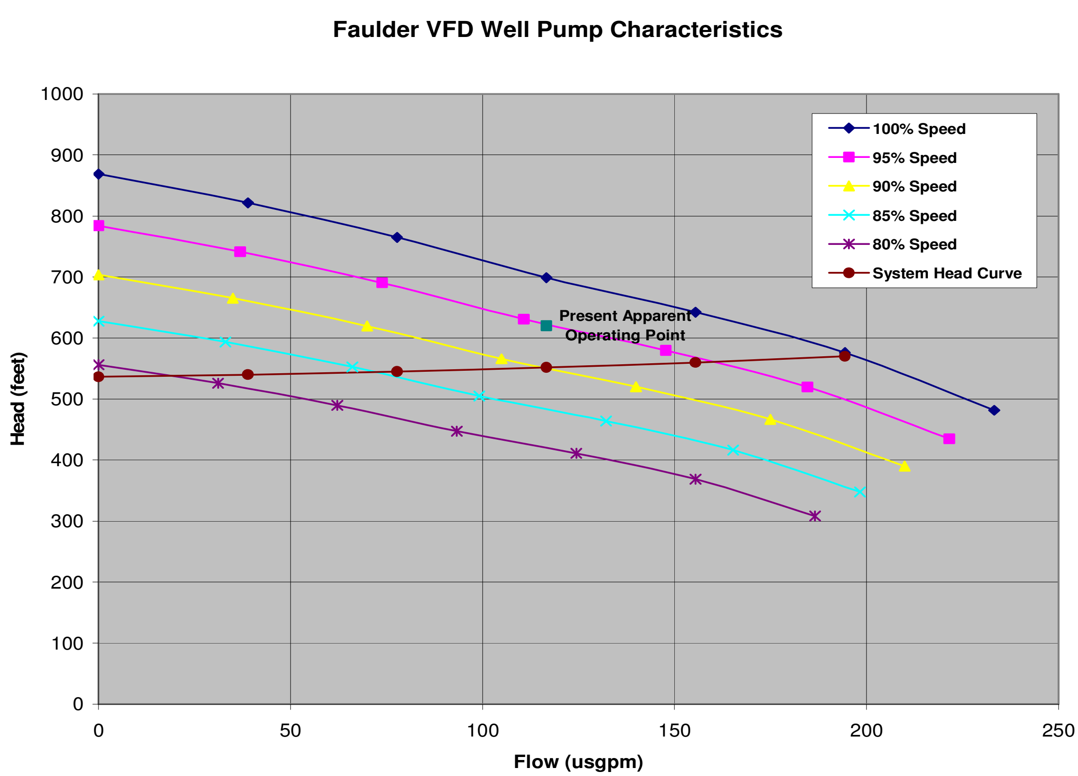
As noted in Section 2, despite undertaking the rehabilitation work, both static and dynamic levels appear to be continuing to drop. The most recent measurements (April 8, 2008) infer a static water level of 53.5 metres and a dynamic water level of 56.25 metres below ground surface (assuming ground surface is 0.9 metres below wellhead). Data provided by the RDOS and Golder Associates shows the following static and dynamic water levels in the well over the past couple of years:

Date	Static Level Below Ground*	Dynamic Level Below Ground*	Data Source
1993	46.9 m	Not Available	Well Drilling Report
February 2006	51.5 m	Not Available	Level transducer
May 2006	52.4 m	56.0 m	Level transducer
July 2006	48.9 m	52.9 m	Level transducer
January 2007	51.8 m	55.7 m	Level transducer
May 2007	53.6 m	57.3 m	Level transducer
May 2007	51.7 m	55.5 m	Manual water tape
January 2008	52.9 m	56.6 m	Manual water tape
March 2008	53.9 m	56.7 m	Manual water tape

**All levels adjusted from “depth below previous wellhead” to “depth below ground surface” by subtracting 0.3 m.*

The different data sources seem to produce different information – see different sets of readings for May 2007 showing a difference of 1.9 m. Within the initial “level transducer” data set levels rose quite dramatically from May 2006 to July 2006 and then showed a continuous steady decline to May 2007. Within the second “manual water tape” data set, levels have shown a continuous decline from May 2007 to March 2008. Discussion with the operators indicates that the level transducer instrument was removed in June 2007 and calibration checked. It was found to be out of calibration by a factor of 9%. It is quite possible that this calibration error existed for all readings from this instrument, however, this can't be confirmed. It is probably reasonable to use the data produced from this instrument to understand water level trending while it was being used (i.e. Increasing or decreasing water levels) however, it is difficult to utilize this data as a basis for drawing conclusions about actual water levels during this period in the absence of other comparable data.

The pump output (as measured at the flow meter) has been reduced from 10 l/s (158 usgpm) before rehabilitation to 7.4 l/s (117 usgpm) subsequent to rehabilitation. The flow rates have been confirmed by both by using a second digital flow meter and volumetric flow testing. The following chart shows pump characteristics compared to the system head curve as well as the current apparent operating point.



Based on our review of the dynamic and static water levels we have concluded that the reduced pump flow rates are more likely due to a mechanical or hydraulics issue with the well pump and piping system than reduced inflow to the well. We have consulted with the operators as well as Aqua Tech Services, the contractor who performed the pump removal and replacement. Neither can explain the reason for the reduced flow rates. The dynamic water levels are higher than the required NPSH and submergence for the pump. The pump inlet and bowl assembly were inspected twice and showed no evidence of cavitation or unusual wear. The check valves were inspected for operability. The casing vent was checked to ensure that a vacuum condition wasn't occurring in the casing. The VFD was checked to ensure speed readings were correct. The pump was also run off a generator to ensure that it was not a power related issue. The only other possible cause for the reduced flow would be a restriction in the piping between the well pump and the pumphouse pressure gauge. The RDOS staff are continuing to search for possible causes of the pump flow reduction including hydrostatically testing the buried portion of the pipe between the pitless adaptor and the well pumphouse. The reason for the flow reduction needs to be determined.

Based on our review of the pump characteristics and setting in the well casing we believe that it is safe to continue operating the pump as long as the dynamic water level remains less than 57.6 metres. This should provide adequate NPSH as well as pump submergence while still providing some factor of safety for both. This information has also been confirmed by the pump supplier, Smith Cameron.

5 Short Term Options

The following short term options have been identified to address the potential continued decline in static and dynamic water levels on an interim basis:

1. Gibbs Well – Utilize the nearby privately owned Gibbs well by temporarily installing a well pump and constructing an overland supply line between it and the existing Faulder Well Pumphouse.

2. Existing Well – Utilize the existing well by providing a shroud on the well pump to allow the pump to be lowered deeper into the well screen.

3. Trout Creek – Install a temporary intake on Trout Creek in order to utilize it on an emergency basis.

Each of the above options are described and evaluated in the following sections.

5.1 Gibbs Well

Concept:
The Gibbs well is located on the West ½ District Lot 1072 on the south side of Trout Creek. It is approximately 90 metres away from the existing Faulder well. Information provided by the RDOS shows this well to have similar water quality characteristics as the existing Faulder well. It is

inferred that the Gibbs well extends deeper into the aquifer which would mean that the well pump would have improved submergence and therefore additional capacity to deliver water during low water level periods. In order to utilize this well a well pump and piping assembly would have to be obtained and installed into the existing well. Power supply would have to be extended from the existing Faulder well pumphouse to a temporary weatherproof panel adjacent to the Gibbs well.

Well Modifications:
The Gibbs well consists of a 150 mm diameter casing installed to a depth of 83.5 metres below ground surface. The well screen is set at a depth of approximately 79.7 metres. It has therefore been assumed that either the existing Faulder well pump or the existing spare pump could be installed in the smaller diameter Gibbs well casing complete with an adequate length of threaded 75 mm or 100mm diameter steel riser piping. It may be possible to use the existing riser piping from the existing well, however additional length(s) of piping would be required due to the increased depth of the Gibbs well and the available clearance of the couplings from the existing casing would have to be confirmed to ensure that the power supply cable would fit.

Electrical Modifications:
Power supply to the new Gibbs well site would require modifications to the present power supply system. This should include adding power harmonic mitigation equipment as the present system already has harmonic issues and with the increased distance of power supply to the new location, this harmonic issue would worsen. There is insufficient space within the existing Faulder pumphouse to accommodate the harmonic mitigation equipment, therefore a building extension (or an equipment shed) would need to be added to the pumphouse. Also the equipment layout within the building is likely contributing to the overheating of the VFD, as the VFD is mounted above the step up transformer. We would recommend relocating the transformer into the new extension (or shed) with the new harmonic mitigation equipment. If this harmonics issue is not addressed there is a high probability the new pump would not operate properly and the power system would have increased harmonics issues with the increased distance.

In order to provide power to the Gibbs well site and improve the electrical system the following upgrades would be required:

- Construct a new building extension (or equipment shed) on the existing concrete pad beside the entry door to locate new harmonic mitigation equipment and relocated transformer.

- Provide a new single phase harmonic filter (Mirus Lineator # 1T1) in an EEMAC1 enclosure located in new building extension, which would be wired between the existing (relocated transformer) and the line side of the existing VFD.

- Provide a new dv/dt filter in an EEMAC 1 enclosure (MTE # DVAGB0055) located above the harmonic filter, which would be wired between the load side of the VFD and the new motor disconnect switch.

- Provide a new 3c # 2 Teck cable from the dv/dt filter to the new motor motor disconnect switch. This cable (size based on well being 120 metres away and well 80 metres deep) would be supported within building extension, then routed through a conduit sleeve to underground, then recommend direct buried to new well head location.

- Provide a new 100 Amp disconnect switch mounted in a lockable weatherproof metal kiosk or junction box at the new well head location.

- The new Teck cable would be terminated to the line side of disconnect switch and cable supplied with well pump motor would be terminated to the load side of the disconnect switch.

To maintain the existing well pump and to minimize down time during the change over to the new Gibbs well pump, the following issues need to be considered;

- Cores between the new and existing building should be completed and the conduit and wiring installed as soon as possible.

- If reusing the existing Faulder pump and motor, consideration needs to be given to the existing motor cable and it's length and size for voltage drop and deeper well (i.e. Is existing supplied cable long enough to reach the new disconnect switch at grade?).

- If relocating the existing transformer becomes a timing issue, it may be possible to leave it under the VFD however, the heat generation will continue to create operational issues.

- If new building extension (or shed) is of combustible construction, space and heat issues will need to be resolved with the new and relocated equipment (all of this equipment is expected to run hot).

Pipe Connection:
In order to connect the Gibbs well to the existing distribution system a 150 mm diameter pipeline would be installed overland from the Gibbs well to connect to the existing distribution piping either inside the well pumphouse or the buried portion immediately east of the pumphouse. The pipeline would probably be hung from the existing bridge at the Trout Creek crossing or possibly simply secured to one side of the bridge. The estimated length of this pipe has been assumed to be 120 lineal metres. All piping would have to be either fixed joint or restrained joint. Pipe material could be either PVC, ductile iron, HDPE, or welded steel. For the purpose of estimating costs we have assumed ductile iron pipe complete with restrained joints. We have confirmed with a local supplier that this pipe complete with joint restrainers is available in Vancouver for immediate delivery.

Estimated Cost:
The following provides an estimate of the capital cost:

Direct Buried Electrical Cable	$5,000
Excavation, Trenching, and Backfill	$6,000
Faulder Well Pumphouse Electrical Mods & New equip.	$12,000
Faulder Well Pumphouse Building Extension	$25,000
Gibbs Well Electrical (Disc Sw. Box & connections)	$3,000
Remove, Modify Discharge Pipe Assembly, and Install Well Pump	$5,000
Supply and Install Overland DI Pipeline	$17,000
Tie-in Pipeline to Existing Distribution System	$5,000
Engineering & Contingencies @ 30%	$23,000
TOTAL ESTIMATED COST	**$101,000**

The incremental cost to make the connection permanent would be approximately $6,000 which is the added cost of burying the pipeline.

Potential Issues:

- The Gibbs well is privately owned and permission would have to be obtained from the landowner to be able to use the well for the Faulder water supply system.
- A building extension would be required at the Well Pumphouse for the new electrical equipment and a temporary kiosk or junction box would have to be constructed to house the electrical disconnect switch.
- The Gibbs well casing is 150 mm diameter (ie. 50 mm smaller than the Faulder community well casing). Confirmation will be required that either the existing well pump or the spare pump will fit into the smaller diameter casing.
- Water quality at the Gibbs well is very similar to water quality in the existing Faulder well and has similar uranium levels exceeding the GCDWQ guidelines.
- Utilization of the temporary well and the overland water supply pipeline would require approvals from IHA and the Ministry of Environment.

Advantages:

- The Gibbs well is inferred to be approximately 20 metres deeper than the existing Faulder well and should therefore provide improved water supply security during the period when the aquifer levels are low.
- The Gibbs well is located in relatively close proximity to the Faulder community well thus reducing the amount of infrastructure required to make the temporary connection.

5.2 Existing Faulder Community Well

Concept:
A smaller diameter well pump would be obtained and provided with a perimeter shroud which would allow it to be place deeper in the existing well casing. The shroud would essentially provide a barrier between the pump inlet and the well screen to allow the pump to be set with its inlet at the same elevation as the well screen. The existing well pump is a 150 mm diameter pump assembly connected to a 100 mm diameter riser pipe. To facilitate attaching the shroud to the well pump a 100 mm diameter well pump and an extension to the 100 mm riser pipe would have to be obtained and installed in the existing well casing. Based on information provided by the RDOS it would appear that this would allow the well pump to be lowered approximately 1500 mm deeper into the existing well casing depending on actual pump assembly dimensions.

Well Modifications:
Modifications would include installation of a new well pump complete with a 150 mm steel shroud. The existing riser assembly would have to be fitted with an extension to allow it to be connected to the new smaller diameter well pump. We contacted Smith Cameron, the suppliers of the original well pump to obtain information regarding 4-inch well pump characteristics and availability. They provided a series of pump curves that could meet the discharge head requirements. They also confirmed that the maximum flow output available using a 100mm diameter pump would be in the order of 2.5 l/s (40 usgpm) which is less than one quarter of the existing pump capacity. Because of the limited capacity, we would not recommend proceeding with this option unless the system is limited to providing domestic water supply only.

Estimated Cost:
The following provides an estimate of the cost of Option 2:

Remove Existing Well Pump and Piping	$1,000
Supply of New 4-inch Well Pump	$10,000
Refit Pump With Shroud	$4,000
Electrical Modifications	$10,000
Engineering & Contingencies @ 30%	$8,000
TOTAL ESTIMATED COST	**$33,000**

Potential Issues:
- Pumping capacity utilizing this option is extremely limited and would only be adequate for supplying domestic demands.
- The delivery time for the new pump is a concern due to the present state of the Faulder community water supply.
- The required electrical modifications are significant considering that this would only be a temporary change.

- Because of the deeper well pump setting there is a high likelihood that the well would require rehabilitation within a very short time.

Advantages:

- This option requires fewer modifications to the existing system compared to the other options thereby reducing impacts on the existing water supply and overall costs.

- This option does not require any regulatory approvals other than confirming the proposed modifications with IHA.

5.3 Intake on Trout Creek

Concept:
An intake would be placed in Trout Creek to allow water to be withdrawn from Trout Creek for the Faulder community water supply. This would necessitate providing a new distribution pump adjacent to the well pumphouse and a piped connection to the existing distribution system. It would also necessitate provision of a chlorination system due to the fact that Trout creek is a surface water supply. It should be noted that Trout Creek is the water supply for the District of Summerland. A temporary water licence would have to be obtained from the Ministry of Environment to withdraw water from Trout Creek. Approval would be required from IHA prior to proceeding with this option due to the fact that it is a different source than presently being used and that it is a surface water source.

Intake:
The new intake would either be designed as a submerged intake within the creek bed or as a buried infiltration type located on the bank of the creek. For the purpose of this analysis we have assumed that it would be designed as a conventional submerged intake due to the fact that this is a more reliable design with fewer potential operational issues than the infiltration type. The intake would therefore consist of a pre-manufactured cylindrical wedge wire screen placed on the creek bed longitudinal to the direction of flow. The screen would have to be designed in conformance with DFO and MOE requirements. The inlet piping would consist of a 150 mm diameter header to the pump inlet.

Pumping System:
The pumping system would consist of either a shallow submersible well pump installed in a 200 mm diameter casing or alternatively a canned vertical turbine unit could be utilized. For the purpose of this evaluation we will assume that either a submersible or well pump would be used. Because of the elevation of the pump and the raw water inlet the discharge head requirements for the pump would be considerably lower than the existing well pump therefore power requirements would be significantly lower. It might even be possible to utilize the existing spare well pump for the purpose of the Trout Creek supply by removing 3 stages from the existing bowl assembly in order to make it suit the reduced head requirements. The pump would operate at a constant speed and would start

and stop based on treated water reservoir level similar to control of the existing well pump. We are awaiting a quotation regarding the cost and delivery availability for the pump.

Water Treatment:
Under IHA's current filtration protocol, the Trout creek water supply would normally require treatment consisting of coagulation, flocculation, clarification, filtration, and chlorine disinfection. However, because of the fact that this is considered an emergency situation, IHA may allow the temporary system to proceed on the basis of chlorination only. Associated Engineering contacted IHA in order to obtain clarification regarding the treatment requirements. The initial response was that IHA would probably allow water withdrawn from Trout Creek to be used under the following conditions:

- It was being used under an emergency condition on a temporary basis until a permanent solution is determined.
- The water would have to be chlorinated.
- The community would be put on a Boil Water Advisory during the period that water was obtained from Trout Creek.
- Advanced formal approval of the final design concept would have to be obtained from IHA.

For the purpose of this report, we have assumed that treatment would consist of chlorination utilizing sodium hypochlorite. The system would consist of a PVC tank, chlorine feed pump and associated piping and controls all located inside the existing well pumphouse. The feed pump would be designed to feed at a constant rate with the ability to manually adjust speed and stroke. The sodium hypochlorite solution would be fed into the distribution piping downstream of the distribution pump. The provision of the water treatment system and the electrical modifications for the new pump would necessitate constructing an extension to the existing well pumphouse.

Estimated Cost:
The following confirms the estimated cost for Option 3:

Supply and Installation of Intake Pipe and Screen Assembly	$10,000
Supply and Installation of Shallow Well or Sump	$30,000
Supply and Installation of Submersible Pump (subject to supplier conf.)	$20,000
Supply and Installation of Discharge Pipe	$5,000
Electrical Allowance	$10,000
Well Pumphouse Building Extension	$25,000
Chlorination System	$6,000
Engineering & Contingencies @ 30%	$32,000
TOTAL ESTIMATED COST	**$138,000**

Potential Issues:

- This option has more rigorous regulatory approval requirements than the other options under consideration. Approvals would be required from IHA, Ministry of Environment and DFO.

- Because this option involves use of a surface water source, water quality is a concern especially if the water is unfiltered.

- The District of Summerland will have to be consulted due to the fact that Trout Creek is the District's primary source of supply.

- Delivery requirements for the new submersible pump could potentially delay implementation.

- This option has the highest capital cost of all options under consideration.

Advantages:

- If regulatory approval can be obtained for this option, it may be possible to retain it as a long term backup emergency supply for the community.

6 Conclusions And Recommendations

6.1 Conclusions

We have drawn the following conclusions from the analysis:

1. Static water levels in the Faulder community well have dropped a significant amount since it was originally developed, although there is evidence that the static water levels can fluctuate significantly over short periods of time as evidenced during the period between May 2006 and July 2006 when the levels apparently rose 3.5 metres.

2. Well pump flow rates showed a significant decline when the pump was reinstalled after the well rehabilitation work was completed. The reason for this performance decline is more likely due to a hydraulic or mechanical issue rather than the well itself.

3. Our calculations indicate that the well pump can continue to be operated as long as dynamic water levels remain above 57.6 metres below ground surface (0.6 metres above the well inlet). This has also been confirmed by the pump supplier.

4. Of the three options were investigated for addressing water supply to the community should water levels continue to drop, the best cost benefit would be achieved utilizing Option 1 – Gibbs Well assuming that the owners are willing to allow the community to use the well on an interim basis.

5. Option 2 – Modification Existing Well Pump System would result in an approximate 80% reduction in water supply capacity and is therefore considered to be the least viable option.

6. Option 3 – Trout Creek has the highest capital cost, would involve the most rigorous regulatory approval process, and requires the longest implementation time. IHA have indicated that this approach would only be considered as a short term emergency solution.

6.2 Recommendations

We make the following recommendations:

1. Continue to investigate the declining aquifer levels in order to determine the causes and potential long term solutions.

2. Obtain approval from the owners of the Gibbs well for the community to use it as an emergency water supply.

3. If water levels show a continued declining trend over the next two weeks, proceed with implementing Option 1 – Gibbs well if landowner approval can be obtained.

4. Continue to monitor the performance of the well pump to determine the reason for the sudden drop in discharge flow.

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