Shannon Municipal Well Maintenance Program Update

(March 2007)

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WELL INITIATIVES

March 20, 2007

PUC Services Inc.
P.O. Box 9000
Sault Ste. Marie, ON P6A 6P2

Attention: **Mr. Mike Lundrigan**
Supervisor, Water Treatment Operations

Re: **Municipal Well Maintenance Program**
Shannon Well and Lorna Well #2 update
File No. VA 03 4762

Dear Mr. Lundrigan,

This letter serves to document the work performed by Well Initiatives Limited (WIL) for PUC Services Inc. as part of the on-going Municipal Well Maintenance Program started in 2004. One of the initial phases of the work program was to conduct downhole video surveys of all of the production wells. As you may recall from our report in early 2005, the video survey of the Shannon Well had not yet been completed, and the video inspection of the Lorna Well #2 revealed corroded casing which was to be rectified by the installation of a liner in the well.

Lorna Well #2 Work Program

Originally, the liner to be installed into Well #2 was a 12" diameter PVC liner. Unfortunately during the grouting process, the PVC liner failed, causing some PVC pieces and a small amount of cement grout to end up in the bottom of the well screen. A submersible pump was installed immediately after the liner failure in an attempt to purge the cement grout from the well. The majority of the grout was successfully removed, however a video inspection revealed the presence of cement grout on portions of the screen and in the bottom of the well. Some of the broken PVC was also visible in the bottom of the well.

In November of 2005, a 12" diameter steel liner was installed into the well and grouted. It should be noted that approximately 15 feet of the 12" PVC liner remained grouted in the well from approximately 160 feet to the top of the lead packer at 185 feet. Therefore, the last 20 feet of the steel liner was reduced to 10" diameter, to

fit inside the 12" PVC. At this time, another video inspection was conducted to assess the screened portion of the well, and determine the amount of plugging which had occurred as a result of the cement grout entering the well. WIL and PUC staff agreed that some attempt should be made to try and clean the cement out of the screen, in order to prevent any loss in capacity in Well #2. This work was completed free of charge to PUC Services Inc.

WIL mobilized back to the site in June 2006. A combination of chemical and physical rehabilitation was used in an attempt to remove the cement from with the well screen. After several days of rehabilitation, another video inspection showed the screen to be much cleaner, with the majority of the cement removed. After the rehabilitation process, the total depth of the well measured 242 feet, where the original well depth was 246 feet. This means approximately 4 feet of the well has been filled in with cement grout. There are also some broken pieces of the PVC liner that could not be removed from the bottom of the well, as they are cemented in place.

Following the rehabilitation process, the well was chlorinated and new submersible pumping equipment was installed into the well on June 8, 2006. This included a 125 hp pump and motor, new 6" column pipe, and a custom fabricated discharge head. The well was operated to waste at rates up to 900 imperial gallons per minute (Igpm), and continues to operate to system with no apparent loss of capacity. We have included the **Pump Installation Record** along with this report.

Shannon Well Work Program

According to PUC files, the Shannon Well pump was due for servicing in 2002. In order to complete a downhole video inspection of the well, WIL staff removed the pumping equipment in November of 2005. Once removed from the well, the pumping equipment was examined to determine its' current condition. Inspection of the pumping equipment revealed three lengths of the column pipe were badly pitted and would require replacement. Additionally, approximately five lengths of column pipe required machining to square the end faces. New bronze bearings were also recommended for all lengths of pipe. WIL suggested upgrading the existing oil-lubricated system to a water-lubricated system. PUC staff agreed, and the parts were ordered. Delays from the Layne supplier meant the pumping equipment was not re-installed during this trip.

The pumping equipment was re-installed into the well on July 8, 2006. The pumping equipment was converted to water-lubrication; which included new couplings, bronze spiders, bearings and shaft sleeves were installed onto the existing column pipe and shafting. A new stuffing box was also installed into the discharge head. On July 11,

2006 the well was operated to waste at rates of 350, 700 and 1,050 Igpm. We have included the **Pump Installation Record** along with this report.

Shannon Well Video Inspection

With the pumping equipment removed, the lubricating oil in the well was pumped and contained, so that the downhole video inspection could be conducted on November 25, 2005. In order to provide a clearer image, the well was pumped at approximately 10 Igpm during the video inspection. The video showed the majority of the steel casing to be in relatively good condition. Corrosion and pitting was noticed in the 12" casing, below 290 feet. Some iron related growth and staining was evident throughout the well. The screened portion of the well was very clean, with only minor plugging evident at the bottom of the well at 331 feet.

Conclusions and Recommendations

The work program as outlined in the 2004 Well Maintenance Program is complete. All of the production wells have had all necessary wellhead upgrades, and the downhole video inspections have been performed.

It is our recommendation that the casing in the Shannon Well be thoroughly cleaned via wire brush, and the well airlifted at the next pump service interval, in approximately 7-10 years. The 2005 video inspection showed some corrosion and pitting of the casing, especially in the 12" casing below 290 feet. After the cleaning and airlifting, another downhole video should be performed. This video will help to identify any further corrosion in the casing, and satisfy the conditions of the Well Inspection and Maintenance program, which requires a downhole video to be performed every 10 years.

At this time, we would like to remind PUC staff of our recommendation made in the 2005 report regarding the Goulais #2 Production Well. The video inspection of this well in 2004 showed corrosion and pitting of the 16" steel casing, as well as turbid water entering around the 10" lead pipe. A steel liner installed into this well would provide a secure casing and would reduce the turbidity and sediment produced by the well, but may slightly reduce the well's capacity. In addition, the pumping equipment in this well is in very poor condition, with significant corrosion on the column pipe and the bowl assembly. The pumping equipment will require replacement of nearly all below ground components in the near future.

If you have any questions or comments, feel free to contact us.

Sincerely

Well Initiatives Limited

Dwayne Graff
President

PUMP INSTALLATION RECORD

TECHNICIAN: R.R., D.S.

DATE: 06.7.8

CLIENT: Sault Ste. Marie PUC
WELL I.D. /LOCATION: Shannon Well

PUMP INFORMATION

MAKE: Layne
BOWL DIA.: 15"
BOWL MAT'L: Cast
MODEL: DLRC
NO. STAGES: 4
IMP. MAT'L: Bronze
SERIAL NUMBER: 73347
DISCHARGE DIA.: 10"
INTAKE B.B.P.: 166'

MOTOR INFORMATION

MAKE: Westinghouse
DATE CODE: 7301
VOLTS: 575
TYPE.: HSB
PHASE: 3
SERIAL NUMBER: 1-1958112
HP: 150
MAX. AMPS.: 135

COLUMN PIPE INFORMATION

PIPE DIA.: 10"
PIPE MAT'L: Steel
THREAD TYPE: Layne
TOTAL PIPE (FT): 150'
WALL THICKNESS: 0.365"
CHECK VALVE: No

Converted to water-lubrication. New couplings, bronze spiders and bearings installed. New shaft sleeves and stuffing box also installed.

WELL INFORMATION

WELL DEPTH: 332'
STATIC W.L.: 68'
WELL DIA.: 24"x12"
CONSTRUCTION: Screened

PERFORMANCE CHECK

PUMPING RATE	WATER LEVEL	PUMP PRESS.	AMPS.
350 igpm	71.85'	170 psi	
700 igpm	73.16'	143 psi	
1050 igpm	74.90'	92 psi	

PUMP INSTALLATION RECORD

TECHNICIAN: R.R., D.S. **DATE:** 06.6.8

CLIENT: Sault Ste. Marie PUC
WELL I.D. /LOCATION: Lorna Well #2

PUMP INFORMATION

MAKE: Grundfos	**MODEL:**1100S1250-3	**SERIAL NUMBER:**P10421US350
BOWL DIA.: 10"	**NO. STAGES:**3	**DISCHARGE DIA.:**6"
BOWL MAT'L: Stainless	**IMP. MAT'L:**Stainless	**INTAKE B.B.P.:** 131'

MOTOR INFORMATION

MAKE: Franklin	**MODEL NO.:** 2366276025	**SERIAL NUMBER:**03G19160010
DATE CODE:03G	**MOTOR DIA.:** 8"	**HP:** 125
VOLTS: 575	**PHASE:** 3	**MAX. AMPS.:** 151
S.F.: 1.15	**KVA CODE:** K	**BASE OF MOTOR B.B.P:**137'10

COLUMN PIPE INFORMATION

PIPE DIA.: 6"	**THREAD TYPE:** 8V	**WALL THICKNESS:** 0.280"
PIPE MAT'L: Steel	**TOTAL PIPE (FT):** 126'4"	**CHECK VALVE:** In pump

WIRE INFORMATION

WIRE SIZE: 2 AWG	**WIRE TYPE:** RWU	**TOTAL LENGTH:** 135'

WELL INFORMATION

WELL DEPTH: 242'	**WELL DIA.:** 12", 10"	**CONSTRUCTION:** Screened
STATIC W.L.: 35'		

PERFORMANCE CHECK

PUMPING RATE	WATER LEVEL	PUMP PRESS.	AMPS.
900 igpm	61'	136 psi	R134 Y137 B136

SHUT-IN PRESS.: **WATER LEVEL:**

NOTES: 12" steel liner installed to 183' and cemented (bottom 20' is 10")
1" PVC water level tube total length 130'