

Lorna Well 1 and 2 Assessment and Repair Report
(February 2012)



INTERNATIONAL WATER SUPPLY LTD

Groundwater Development – Drilling Services
Pumps – Water Treatment – Service & Maintenance

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February 29, 2012

Sault Ste. Marie PUC Services Inc.
40 Kresin Engineering Corporation
536 Fourth Line East
Sault Ste. Marie, ON
P6A 5K8

ATTENTION: Orlan Euale, P.Eng.

Reference: Sault Ste. Marie Well Assessment and Repair
Lorna Ave. Wells No. 1 and No. 2

As authorized we have completed inspection and assessment of the wells and pumping equipment of the Lorna Ave. Wells No. 1 and No. 2. The following is a report of our findings and recommendations.

Background

Lorna Ave Wells No. 1 and 2 were constructed by International Water Supply Ltd. in 1977 and 1982 respectively. Both wells are similarly constructed in overburden soils using the Rotary Reverse Circulation drilling technique. The wells are 24 x 16 inch double cased, fully cement grouted to a depth of 172 ft. bgl, with silica gravel packed 10 inch stainless steel screen over the interval 186 to 248 ft. Both wells were developed, tested and subsequently rated 1050 IGM (79.5 L/S). Well construction drawings are attached for reference.

In 1978 and 1982 the wells were equipped with Layne vertical turbine pumps, model 12 TLC-6 stage bowl assemblies for a design condition of 1260 USGM at 326 ft. TDH. The bowls were set on 125 ft of 10 inch x 2 ½ x 1 ½ oil lubricated style column assemblies and driven by 150 Hp vertical hollow shaft USEM electric motors.

The pump at Lorna Well 1 was serviced in 1991 and again in 2001. Lorna Well 1 has a history of performance deterioration. Biofouling is suspected. The well was successfully rehabilitated in 1980 and again in 2001.

The pump at Lorna Well 2 was serviced in 1991. Lorna Well 2 was recommended for rehabilitation in 2001 however this work was not authorized and the well was left out of service.

In 2005, the Lorna Well 2 was inspected by others as part of a Municipal Well Maintenance Program started in 2004. The 16 inch inner well casing was reportedly corroded and others installed a 12 inch steel liner to a depth of 160 ft. (a failed 12 inch PVC liner extends to 185 ft.) the steel liner is reduced to 10 inch over the interval 160 to 186 ft. The bottom 5 ft. of screen has been reportedly left filled with cement grout in error. Others attempted to correct the error and rehabilitate the well screen to remove cement from the screen. This was partially successful however no well performance testing following the modifications to the well has been provided.

The 12 inch liner reduced the diameter of the well such that the 12 inch vertical turbine line shaft bowl and 10 inch column assembly could not be reinstalled. In June of 2006 a 10 inch model Grundfos 1100S125-3 stage submersible pump and 125Hp motor were installed on 126 ft of 6 inch steel drop pipe. It was reportedly operated to waste at 900 IGM.

Lorna Well No 1.

Lorna Well No. 1 has reportedly not been operated for a long time. A well and pump performance test was conducted on December 1, 2011.

Due to high operating pressures at lower rates, the well was pumped to waste at two rates of flow; 67 and 84 L/s (890, 1108 IGM) measured by a circular orifice weir with free discharge. Water levels were measured using the installed airline gauge. Discharge head pressures were measured using a calibrated test gauge. Motor amperages were also recorded. Red coloured water was initially produced, then turned to a dark greenish colour.

The results of the well performance test are plotted on the attached Drawdown vs Capacity graph. For comparison, the results of previous testing; after construction in 1977, and tests following the 1980 and 2001 rehabilitation treatments are also shown. The results indicate that well performance has only slightly deteriorated since last testing in 2001.

Pump performance was observed to be near to, and slightly high when compared to the factory curve.

The pump was removed from the well on December 2, 2011 and laid out for inspection. The bowl was disassembled. The residual oil from the static water level was removed for disposal by PUC services.

The following was observed:

- The bowl assembly was found to be in generally good condition. Some wear is evident on the impeller shaft, bowl bushings and bearings. These should be replaced as part of a standard overhaul.
- The oil lubricated column pipe assembly requires significant cleaning and the replacement of most bronze enclosing tube box bushings, tension bearing and the top special enclosing tube.
- Several pieces of the 10 inch column pipe require machining to the end of butt faces to provide a proper seal.
- The column pipe requires a wire brush cleaning and recoating with an NSF protective enamel on the interior and exterior surfaces.
- VHS motor operating amperages were good. A moderate vibration was noted but was not considered a concern. The upper bearing appears to be noisy. PUC services took the motor to a local service shop for further inspection.
- The pump base should have the grout around the pump base ring removed and the pump leveled, aligned and re-grouted.

A video inspection of the Lorna Well No. 1 was completed on December 5, 2011. A DVD copy of the inspection has been provided. The following observations were made:

- All measurements are recorded in feet, with the top of the pump base as the reference measuring point.
- The static water level was observed at 28 ft (8.5 m). The well was pumped at a rate of 0.8 L/s overnight in order to improve water clarity. Due to turbid water caused by iron, visibility was somewhat impaired.
- The 16 inch casing appears in satisfactory condition. The upper 60 feet has only minor mineral build-up. At depths of 100 and 143 ft heavier mineral deposits were observed. Close inspection shows no apparent issues with the casing structure.
- The visible welded joints appeared to be in good condition.

- The top of the screen was observed at 190 ft. The screen is in good condition with only minor mineral deposits in some sections.
- The bottom plate was not observed since it was covered with approximately 1 to 2 ft of soft debris. Two steel bar weights used with dropped in airline were found at the bottom. These are not an issue however a fishing magnet could be used to attempt to retrieve them.

Lorna Well No. 2

A Well and Pump performance test was conducted on December 1, 2011. Due to high operating pressures the well was pumped to waste at two rates of flow; 57 and 75 L/s (758, 1000 IGM) measured by a circular orifice weir with free discharge. Water levels were measured with a probe meter and discharge head pressures were measured using a calibrated test gauge. Motor amperages were also recorded. Red coloured water was initially produced, then cleared with a slight greenish tinge after 15 minutes.

The results of the well performance test are plotted on the attached Drawdown vs Capacity graph. For comparison, the results of previous testing; after construction in 1982 and in 2001 are also shown. These results indicate that performance appears to be improved compared to original. Although approximately 5 ft of screen has been filled with cement grout, rehabilitation efforts by others to remove cement from the well appear to have improved overall well performance.

Pump performance was observed to be near to, and slightly low, when compared to the factory curve.

The pump was first attempted to be removed from the Well on December 3, 2011. It was found that the thread and coupled joints on the 6 inch diameter drop pipe had been tack welded. The pump was re-installed in order to decide if it should be completely pulled as originally planned.

On December 5, 2011 the pump was then pulled. The following was observed:

- Each joint required careful grinding of the welds to save the pipe from damage.
- The steel drop pipe was found coated with iron deposits. It requires wire brush cleaning and re-coating with NSF protective enamel on the exterior.

- The submersible motor was checked for winding and insulation resistances. It checks out good.
- The wet end bowl assembly was subsequently disassembled and appears in generally good condition. The impeller shaft bushings and impeller skirt wear rings are worn and require replacement.

A video inspection of Lorna Well No. 2 was completed on December 6, 2011. A DVD copy of the inspection has been provided. The following observations were made:

- Well measurements are recorded in feet with the top of the pump base as the reference measuring unit.
- The static water level was observed at 27 feet (8.2 m). The well was pumped at a rate of 0.7 L/s overnight in order to attempt to improve water clarity. Some fogging of the camera lens occurred due to temperature changes.
- The 12 inch steel liner installed by others in 2005 extends to a depth of 160 ft where it is reduced to 10 inch steel and extends to 186 ft. Reportedly, there is a piece of 12 inch PVC from 160 to 186 ft from a failed attempt to line the well casing.
- The 12 inch/10 inch steel liner appears to be in good condition. The welded joints appear good. There is a minor iron mineral coating on the liner. Below the pump setting of near 130 ft coating changes colour from brown to black/grey indicating a change from oxidized to reduced conditions.
- The top of the screen was observed at approximately 183 ft. It appears in good condition with very little mineral coating in the top section. At 194 ft and below, minor deposits are noted. Below 230 ft the screen becomes cloudy with poor visibility.
- The bottom 5 ft of the well is reportedly filled with cement grout. This was not visible since it was covered with approximately 2 to 3 ft of soft debris.



Discussions and Recommendations

Lorna Well No. 1

1. Current Well performance at Lorna Well No. 1 is considered satisfactory compared to previous testing. No well maintenance rehabilitation work is required. The accumulated soft debris and two pieces of steel bar at the bottom of the well could be removed at this service interval.
2. Regular recordings of production, water levels and above ground level should be maintained in order to monitor any changes in well or pump performance. A Well and Pump performance test should be conducted every 5 years.
3. Pump performance follows near to the factory curve. On disassembly and inspection the bowl was found to be in generally good condition. It requires replacement of standard wearing parts.

The 34 year old oil lubricated column assembly was found to be in fair condition. It requires a significant amount of repair and replacement parts in order to return it to service.

4. There are two options available for the Lorna Well No. 1 pumping equipment.

Option 1 would be to overhaul the pump as it is presently equipped for oil lubrication. The column assembly requires significant cleaning, machine work and replacement of enclosing tube box bearings.

Option 2 would be to modify the existing bowl assembly for water lubrication. A new column assembly with stainless steel shafting and sleeves would be installed. In order to provide adequate lubrication to the shaft bearings above the 30 ft (9m) static water level on start up, we would recommend that a pre-lube injection of potable water through the new stuffing box in the existing discharge head be installed. This could be controlled by a solenoid valve and timer relay installed in the motor controls.

The conversion to a new water lubricated style of column assembly is recommended since the static water level is within its application range. Water lubrication style column assembly eliminates the use of oil lubrication and the costs of removal and disposal every 5 years. Maintenance costs for cleaning and servicing the water lubricated style column assembly is generally less compared to that of oil lubrication style.

If capital cost is the governing factor in this decision then servicing the existing pump as presently equipped is the least expensive.

5. When the pump is re-installed the base should be leveled, aligned and re-grouted.

Lorna Well No. 2

1. Current Well performance at Lorna Well No. 2 is considered good compared to the historic reported testing. Well performance appears to be near to and slightly improved compared to performance tests following construction in 1982. No well maintenance rehabilitation work is required at this time. The accumulated soft debris with the bottom of the well could be removed at this service interval.
2. Regular recording of production, water levels, and above ground head should be maintained in order to monitor any changes in well or pump performance.

A well and pump performance test should be conducted every 5 years.

3. Pump performance follows near to, but slightly lower when compared to the factory performance curve.

The pump bowl and motor submersible are in good condition but the bowl requires the replacement of worn impeller shaft bushings and skirt wear rings.

The 6 inch drop pipe should be wire brush cleaned and coated on the exterior with NSF protective enamel.

Should you have any questions, please do not hesitate to contact us.

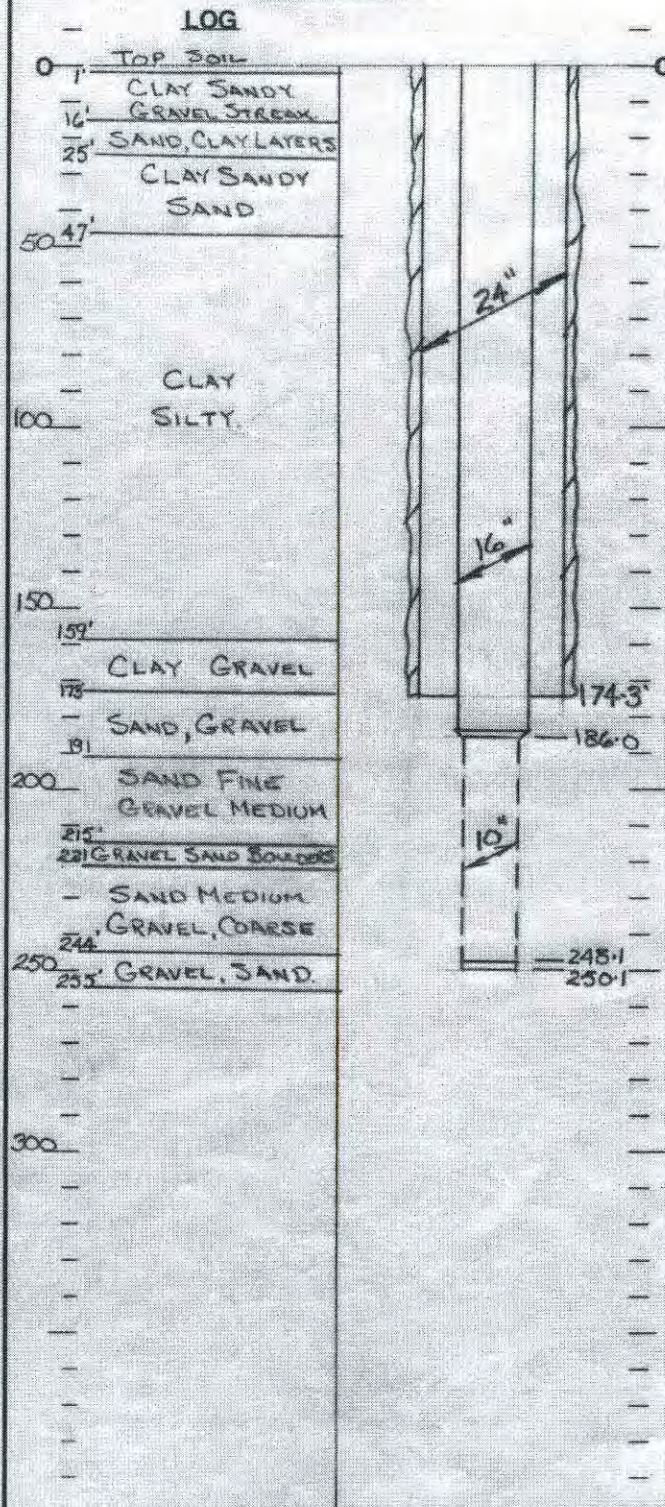
Regards,



John A. Harris, P.Eng.

JAH/ww

WELL DIAGRAM



WELL MATERIAL

Outer Casing: 24 " dia., 0.375" Wall Thk. Matl.: Stl
 Cemented from 0.0 " to 174.3 "
 Inner Casing: 16 " dia., 0.375" Wall Thk. Matl.: Stl
 Screen: Make COOK 10" dia., Opening & Matl.: 20Slot-5.5
 Plug: Type PLATE Matl. Stl Other: _____
 Gravel: Type SILICA Size 0.8mm Quantity 16 +
 (to 135')

WELL TEST DATA

Preliminary Test Date: SEPT 12/77 by J. GRAY
 Static Level: 33.19' " below M.P. +2.0'
 Pumping Rate IGM: 1200IGM
 Pumping Duration: 24 hrs. _____ min.
 Pumping Level at Test End: 62.24' "
 Performance Plots: dd-t Dwg. A77413
 dd-r Dwg. A77414
 step-test A78007

Final Test: Date _____ by _____
 Rated Well Capacity IGM 1050
 Pumping Rate IGM _____ Static level 33.13 1/8"
 Pumping level _____ " at _____ hrs. _____ min.
 Pump pressure: _____ psi: Main pressure _____ psi
 Shut off: AGH _____ psi: W.L. _____ "
 Clear Well Depth from B.P. 253.9" Air Line 125"
 PLASTIC

PUMP & MOTOR DATA

Pump Make L+B Rating 1050IGM @ 326 TH
 Head: Type TF1010 S.N. 86584
 Column: 125 X 10" X 2 1/2" : Shaft Mt: 1 1/2" CS
 Bowl: 12TLC Stage 6 : Curve: 15040
 Suction: 10" dia. 5.0" Long
 Special: Zinc Sleeves _____ : Taped Oil Line Yes
 Other _____
 Motor Make: US Frame: 444TP SN: CD1040154
150 HP, 3 ph, 60 hz, 1770 rpm 575"
 Bearing No. Upper 7322-M
 Lower 6215-J

Special Equipment _____

WELL REVISIONS AND REHABILITATION

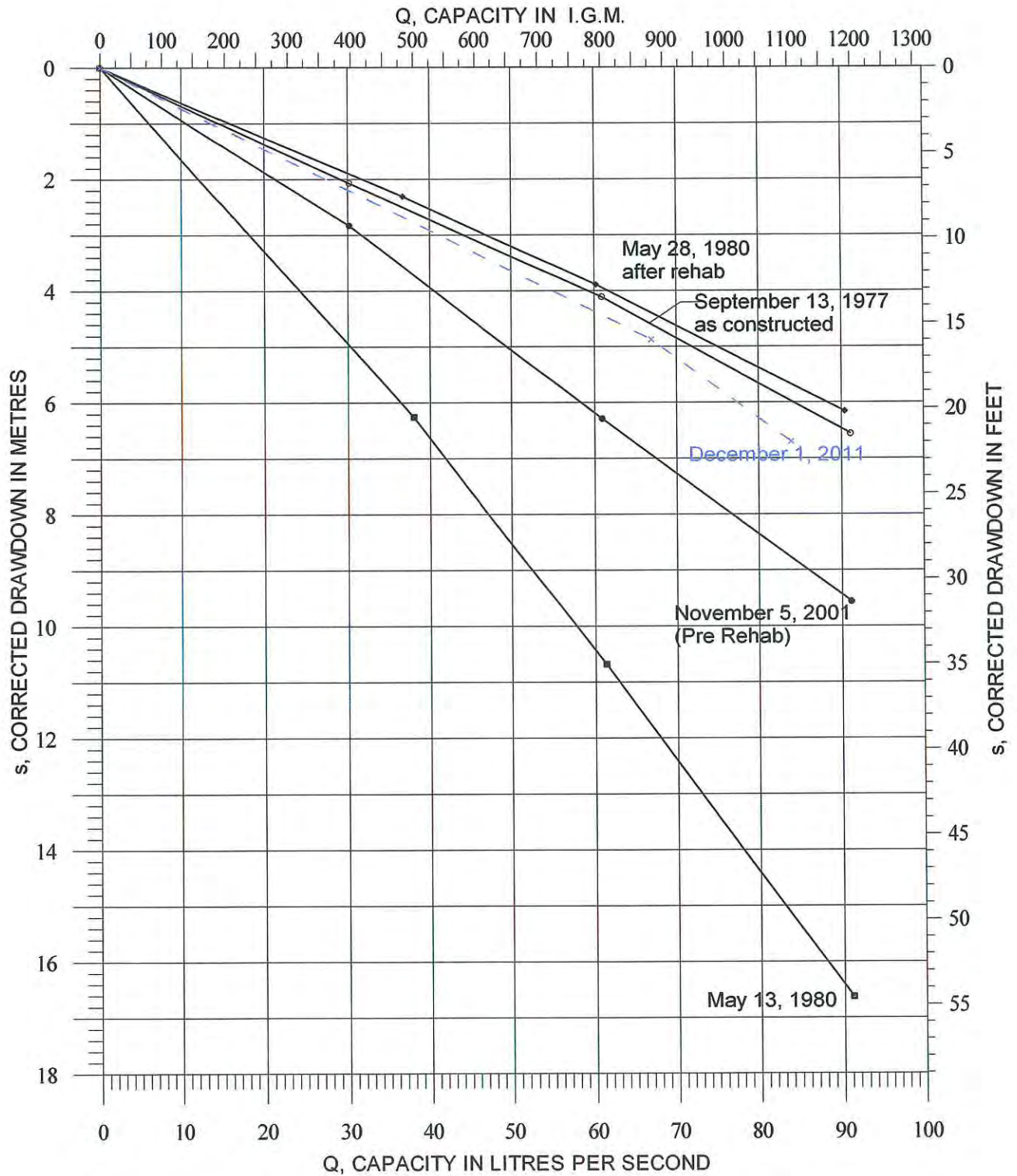
DATE	WORK DONE	BY

International Water Supply Limited
 SASKATOON - BARRIE - MONTREAL

CLIENT: SAULT STE MARIE P.U.C
 WELL NO: 3 - QUEEN ST.
LORNA 1
 DRILLED BY: J. GRAY DATE: SEPT 177 DRAWN: LP
 INSTALLED BY: _____ DATE: _____ DATE: JAN 18/78



International Water Supply Ltd.



**SAULT STE. MARIE P U C
WELL PERFORMANCE
LORNA WELL 1**

Dwg. No. L12033

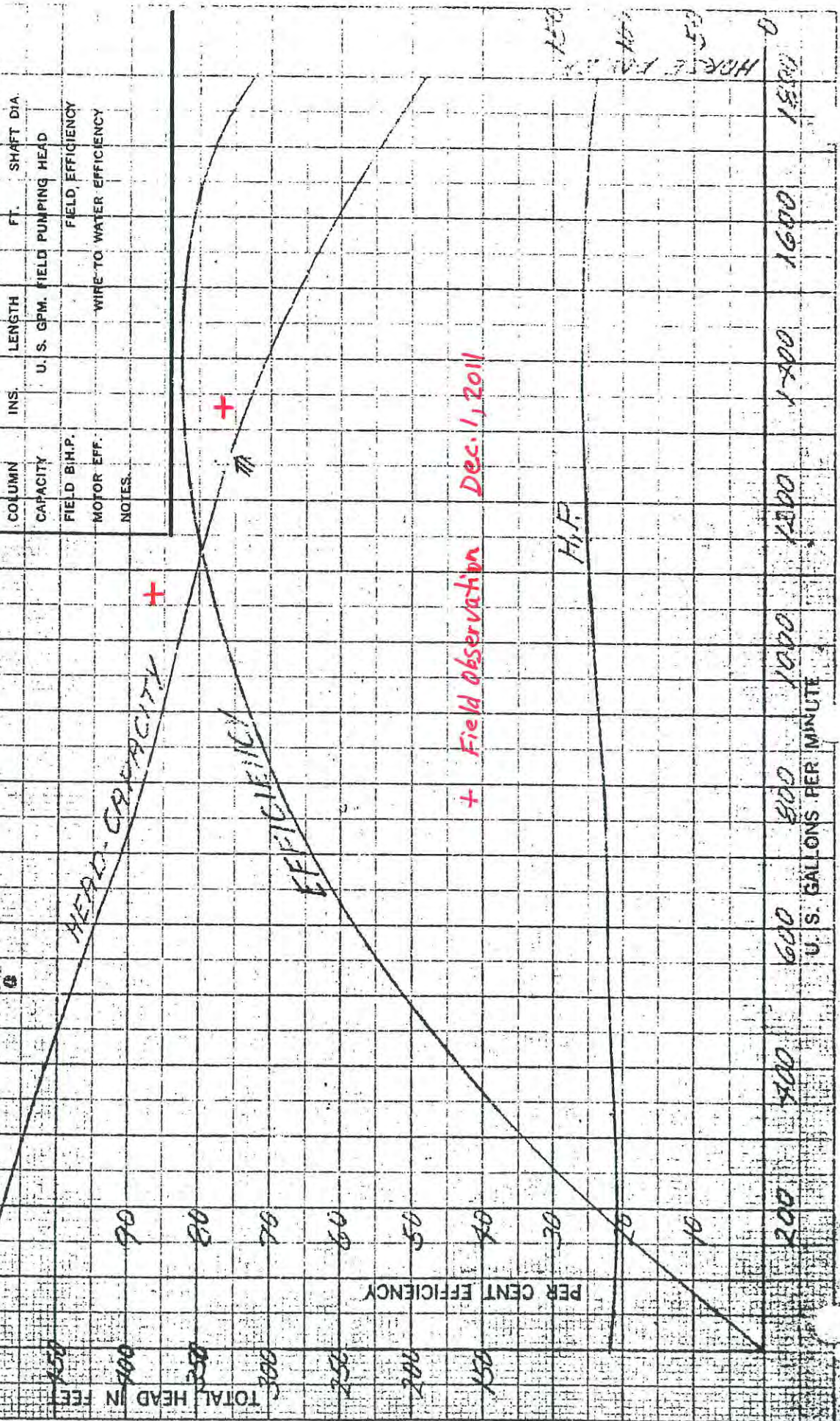
DEEP WELL TURBINE PUMP PERFORMANCE CHART

CURVE SHEET NO. 500026
DATE

THESE CURVES SHOW THE GENERAL SHAPE OF THE PUMP BOWL CHARACTERISTICS UNDER SHOWN TESTS AT THE CONSTANT SPEED INDICATED. A TOLERANCE OF PLUS OR MINUS 2% MUST BE ALLOWED IN THE GUARANTEED CAPACITY, HEAD AND EFFICIENCY AT THE RATED POINT WHEN PUMPING NON-CASEOUS WATER FREE FROM DETRITUS AT A TEMPERATURE NOT OVER 85° FAH. AND WITH THE LOWEST IMPELLER SUBMERGED.

FOR **SM-ADANA 1**
ADDRESS
TYPE OF PUMP FIG. **72C** R.P.M. **1770**
SIZE OF PUMP **12** - INS. STAGES **6** IMPELLER
FIELD PERFORMANCE

THE FIELD PERFORMANCE AS SHOWN BELOW MAKES ALLOWANCE FOR ALL THE HYDRAULIC AND MECHANICAL LOSSES IN THE COLUMN AND SHAFT OF THE INSTALLATION ACCORDING TO THE STANDARDS OF THE HYDRAULIC INSTITUTE. THE FIELD PUMPING HEAD IS THE LIFT FROM THE WELL PLUS THE DISCHARGE HEAD MEASURED AT THE DISCHARGE CONNECTION AT THE SURFACE.



COLUMN CAPACITY	INS. LENGTH	FT. SHAFT DIA.

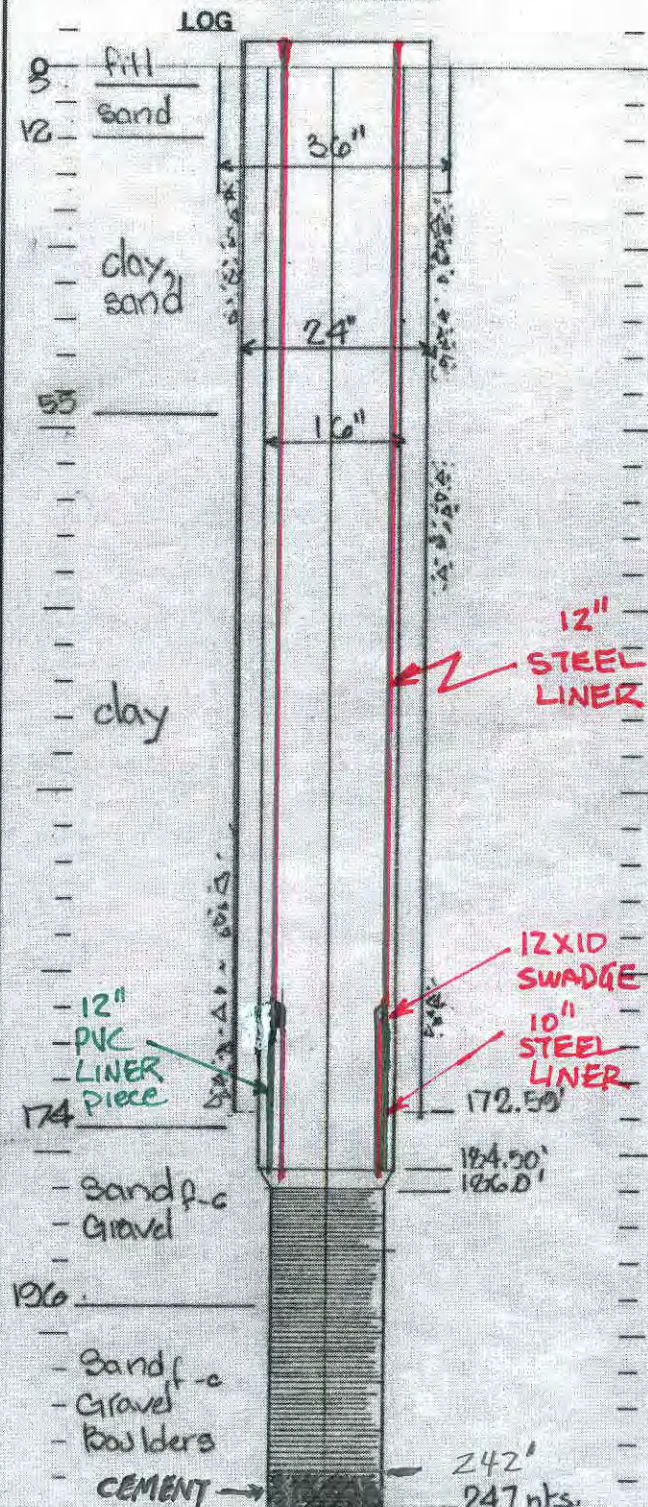
FIELD B.H.P.	U. S. GPM	FIELD PUMPING HEAD

MOTOR EFF.	WIRE TO WATER EFFICIENCY

NOTES

FIELD PERFORMANCE

WELL DIAGRAM



WELL MATERIAL

Outer Casing: 24 " dia., 375 " Wall Thk. Matl.: steel
 Cemented from 0 " to 572 "
 Inner Casing: _____ " dia., _____ " Wall Thk. Matl.: _____
 Screen: Make Smith 10 " dia., Opening & Matl.: 20 stainst.
 Plug: Type plate Matl: stain. steel Other: _____
 Gravel: Type silica , Size 0.8 , Quantity 20 ton

WELL TEST DATA

Preliminary Test Date: March 8, 1982 by J. Gray
 Static Level: 40.42 " below M.P.
 Pumping Rate IGM: 1200
 Pumping Duration: 24 hrs. _____ min.
 Pumping Level at Test End: 80.84 "
 Performance Plots: dd-t Dwg. _____
 dd-r Dwg. _____

Final Test: Date _____ by _____
 Rated Well Capacity IGM _____
 Pumping Rate IGM _____ Static level _____ "
 Pumping level _____ " at _____ hrs. _____ min.
 Pump pressure: _____ psi; Main pressure _____ psi
 Shut off: AGH _____ psi; W.L. _____ "
 Clear Well Depth from B.P. _____ " Air Line _____ "

PUMP & MOTOR DATA

Pump Make Layne Rating 1260 IGM @ 327 TH
 Head: Type TF 1018 S.N. 99303
 Column: 124 " X 2 1/2 " X 1/2 " : Shaft Matl: steel
 Bowl: 12 TLC Stage 6 : Curve: _____
 Suction: 10 " dia. 5 " Long
 Special: Zinc Sleeves _____ : Taped Oil Line Yes
 Other _____
 Motor Make: U.S. Frame: 444 TP SN: 9203219
100 HP, 3 ph, 60 hz, 575 rpm
 Bearing No. Upper: 7322 M
 Lower: 6215 J

Special Equipment

200' Gauge
200' Gauge
125' - 3/8 plastic air line

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY
<u>NOV/05</u>	<u>LINER BY OTHERS</u>	

International Water Supply Limited

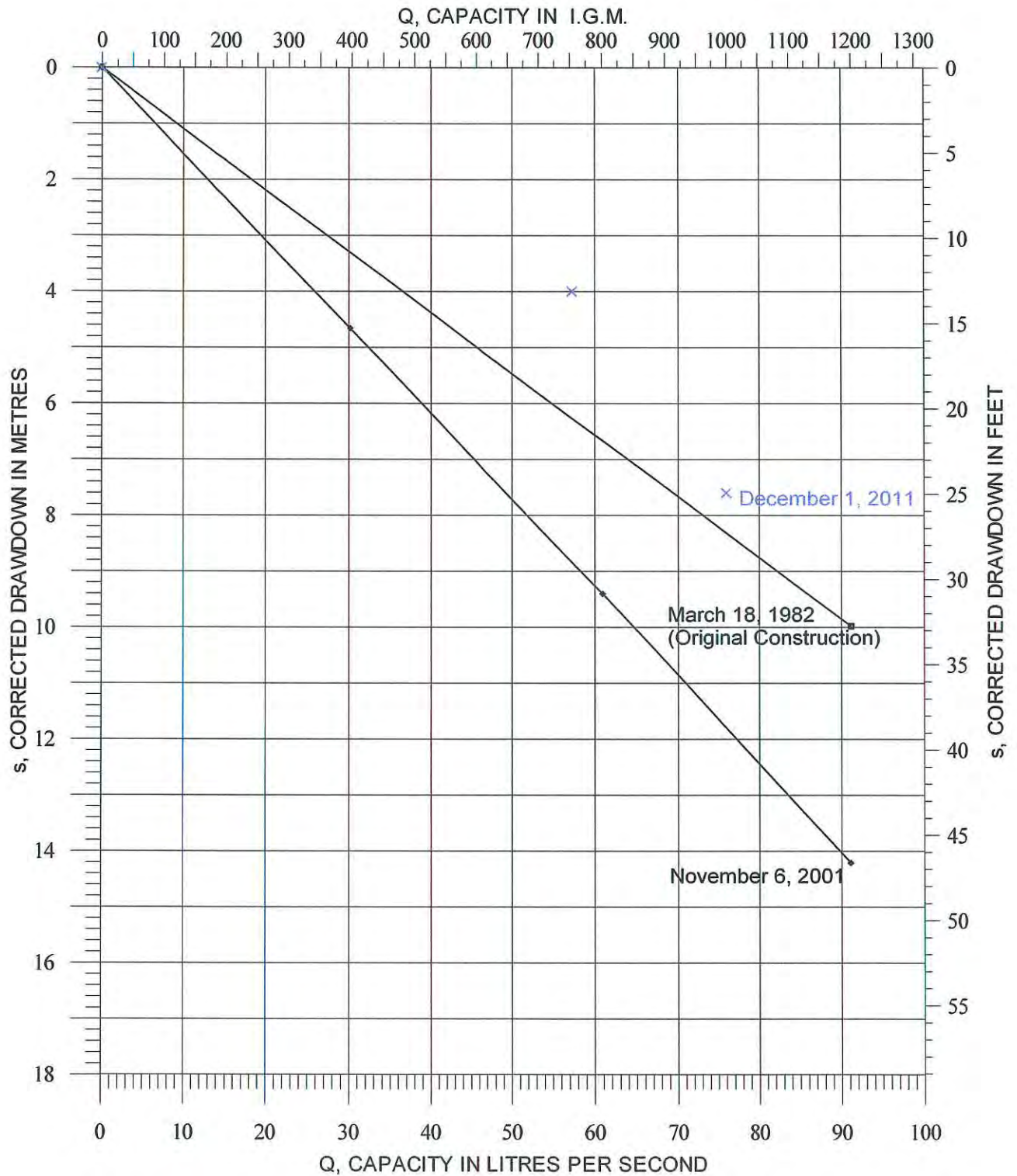
SASKATOON - BARRIE - MONTREAL

CLIENT: Sault St. Marie
 WELL NO: Lorna Drive No 4

LORNA 2
 DRILLED BY: J. Wall DATE: 3/82 DRAWN: J. Wall
 INSTALLED BY: _____ DATE: _____ DATE: 2/83



International Water Supply Ltd.



**SAULT STE. MARIE P U C
WELL PERFORMANCE
LORNA WELL 1**

Dwg. No. L12033

Performance Curves

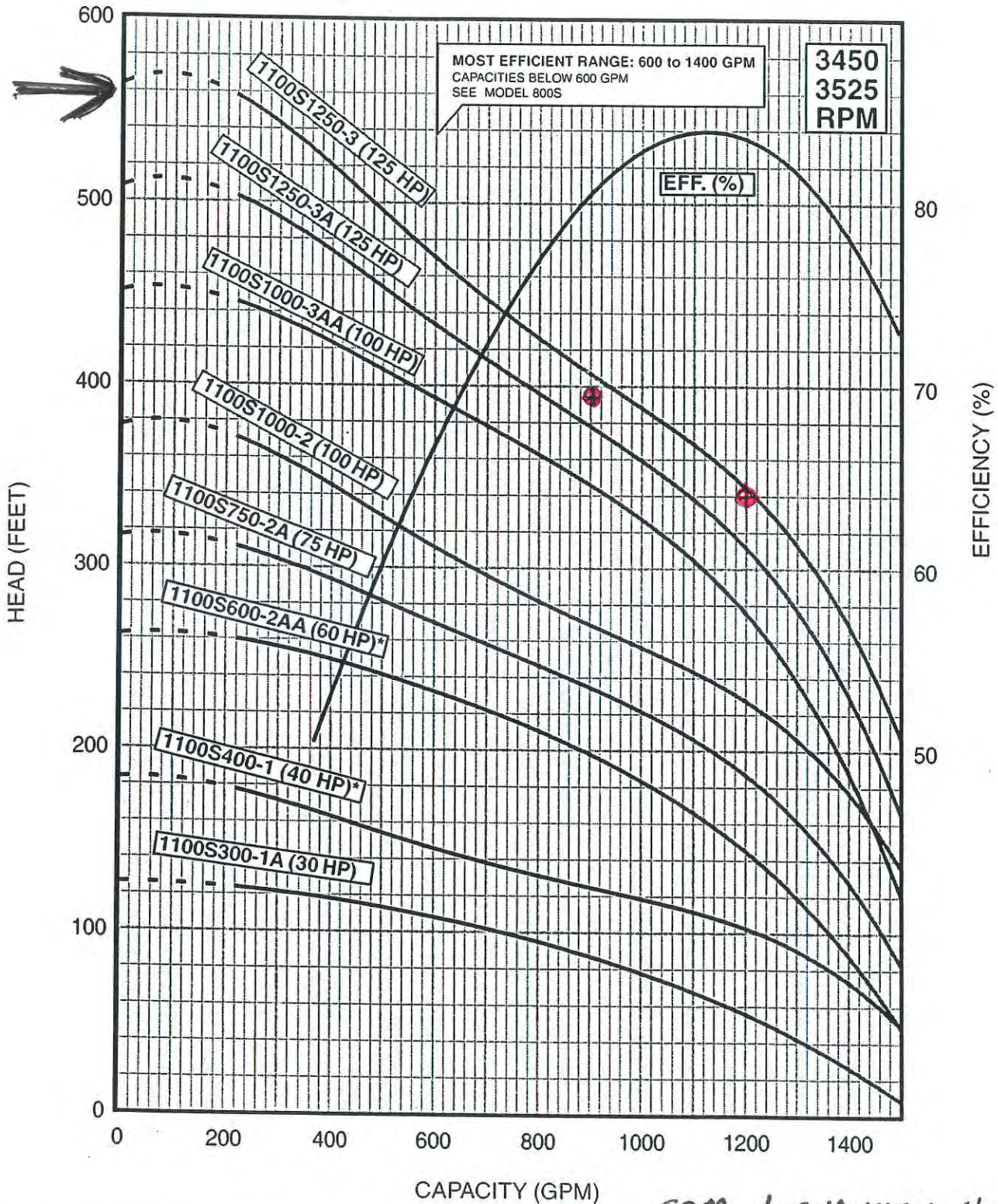
1100 GPM

Model 1100S

FLOW RANGE: 220 -1400 GPM

OUTLET SIZE: 6 " NPT

NOMINAL DIA. 10"



PERFORMANCE SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
6" MOTOR STANDARD, 30-60 HP/3450 RPM.
8" MOTOR STANDARD, 75-200 HP/3525 RPM.
10" MOTOR STANDARD, 250 HP/3500 RPM.
* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.

⊕ Field observed Dec 1, 2011

Lorna Well 1 and 2 Assessment and Repair Report
(June 2012)



INTERNATIONAL WATER SUPPLY LTD

Groundwater Development – Drilling Services
Pumps – Water Treatment – Service & Maintenance

342 Bayview Drive, P. O. Box 310
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June 22, 2012

COPY

Sault Ste. Marie PUC Services Inc.
C/O Kresin Engineering Corporation
536 Fourth Line East
Sault Ste. Marie, ON
P6A 5K8

Attention: Orlan Euale, P. Eng.

Reference: Sault Ste Marie Well Assessment and Repair
Lorna Well No. 1 and No. 2

As authorized we have completed inspection and assessment of the well and pumping equipment of the Lorna Wells No. 1 and No. 2 site. The following is a supplemental report to our initial report of Feb 29, 2012.

Lorna Well No. 1

As recommended and subsequently authorized, the existing pumping equipment installed at Lorna Well No. 1 was converted to water lubrication style.

The bowl was serviced with replacement bronze bushings, wearing and a stainless steel impeller shaft. The discharge case was modified for water lubrication. A new water lubricated column assembly with stainless steel shafting was also supplied and a stuffing box installed in the discharge head. The pump was installed on April 27, 2012. Copies of the pump curve and installation plan have been provided.

Prior to the pump installation the well was disinfected with a 1250 gal volume of 125 mg/l chlorine solution. The pumping equipment was also sprayed with a 200 mg/l solution of sodium hypochlorite. The well was subsequently flushed to waste on start up and any residual disinfectant neutralized with sodium thiosulphate dechlor. The pump was found to operate well with a slight motor vibration.

On May 10, 2012 an attempt was made to try to improve the motor vibration. This was somewhat successful. There was an improvement in the plane perpendicular to the discharge piping but little change in the plane parallel. The VHS motor clutch was found not to be original to the motor and had to be factory balanced with the original motor

from Lorna 2. It is not likely that further field balancing can improve this. Current vibration levels are considered acceptable.

Lorna Well No. 2

As recommended and subsequently authorized, the existing Grunfos submersible pump was serviced with the replacement bowl bushings and wear rings, and a replacement stainless steel spring for the integral check valve. The pump riser pipe was cleaned and painted and the pump reinstalled on April 27, 2012. Since the existing 6 inch drop pipe (supplied by others) threading did not tighten satisfactorily it was installed with steel straps welded over the coupling joints to prevent any unthreading. Copies of the pump curve and installation plan have been provided.

Prior to the pump installation the well was disinfected with an 800 gal volume of 100 mg/l chlorine solution. The pumping equipment was also spray disinfected with a 200 mg/l solution of sodium hypochlorite. The well was subsequently flushed to waste on start up and any residual disinfectant neutralized with sodium thiosulphate dechlor. The pump operated well.

Conclusions and Recommendations

1. Well performance at both Lorna Well No. 1 and No. 2 is considered good compared to previous reported testing. A performance test should be conducted on the wells every 4 to 5 years.
2. Regular recording of production, water levels, and above ground head should be maintained in order to monitor any changes in well or pump performance.
3. The pumps should be pulled for inspection and servicing of wearing parts in 5 years.
4. When the pumps are removed for servicing a well video inspection should be completed.

If you have further questions, please don't hesitate to contact us.

Regards,



John A. Harris, P.Eng.

JAH/ww



INTERNATIONAL WATER SUPPLY LTD.



Company: International Water Supply
 Name:
 Date: 12/21/2011
 Selection: 20111221SSMLorna1

SSM Lorna Well 1

Pentair Water

Pump:

Size: 12TLC (6 stage)
 Type: Vertical Turbine
 Synch speed: 1800 rpm
 Curve:
 Specific Speeds:
 Dimensions:
 Vertical Turbine:
 Speed: 1760 rpm
 Dia: 9.75 in
 Impeller:
 Ns: ---
 Nss: ---
 Suction: 10 in
 Discharge: --- in
 Bowl size: 11.75 in
 Max lateral: --- in
 Thrust K factor: 8.5 lb/ft

Search Criteria:

Flow: 1260 US gpm Head: 326 ft

Fluid:

Water
 Density: 62.25 lb/ft³
 Viscosity: 1.105 cP
 NPSHa: --- ft
 Temperature: 60 °F
 Vapor pressure: 0.2563 psi a
 Atm pressure: 14.7 psi a

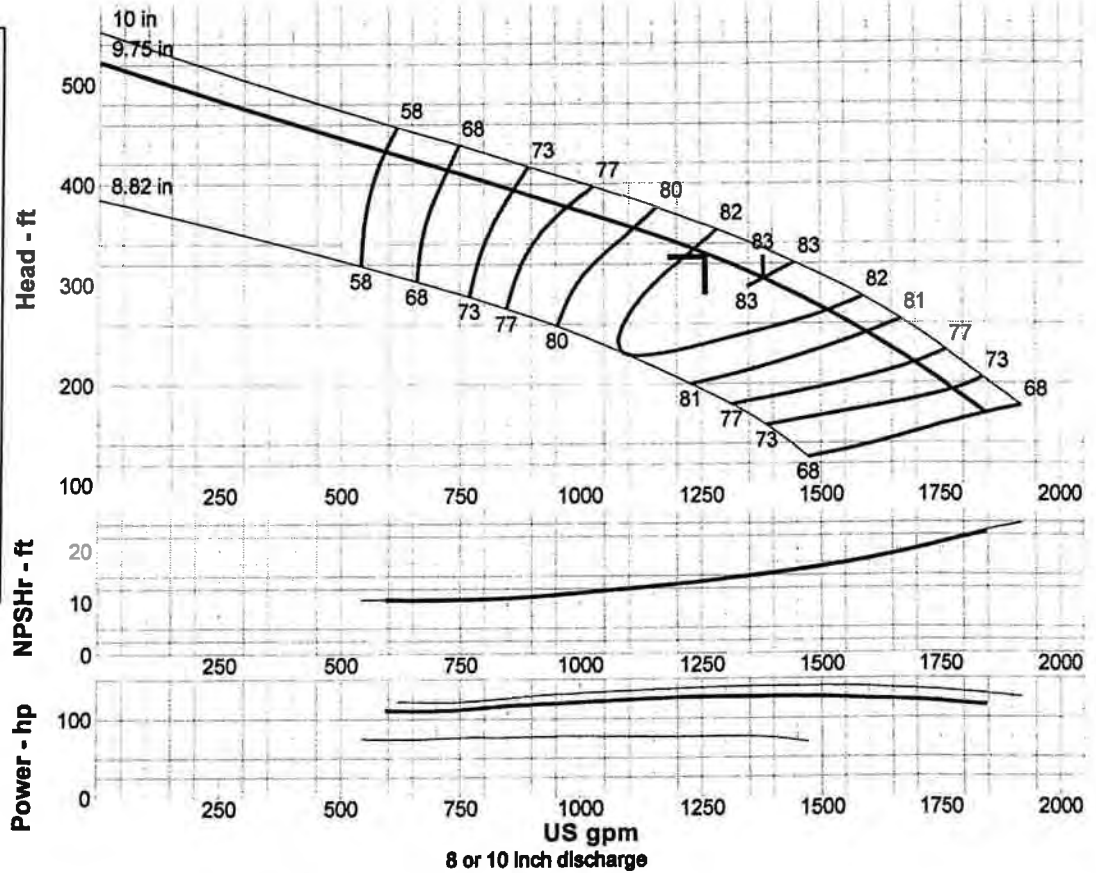
Motor:

Standard: NEMA
 Enclosure: ODP
 Sizing criteria: Max Power on Design Curve
 Size: 150 hp
 Speed: 1800
 Frame: 444T

Pump Limits:

Temperature: 150 °F
 Pressure: 410 psi g
 Sphere size: 1.12 in
 Power: --- hp
 Eye area: 28.3 in²

Data Point	
Flow:	1260 US gpm
Head:	330 ft
Eff:	82.2%
Power:	128 hp
NPSHr:	14 ft
Design Curve	
Shutoff head:	523 ft
Shutoff dP:	226 psi
Min flow:	--- US gpm
BEP:	83% @ 1380 US gpm
NOL power:	128 hp @ 1380 US gpm
Max Curve	
Max power:	141 hp @ 1446 US gpm



Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
1512	1760	274	82	127	16.8
1260	1760	330	82.2	128	14
1008	1760	372	77.7	122	11.9
756	1760	410	69.2	113	10.6
504	1760	446	51.4	112	10.5

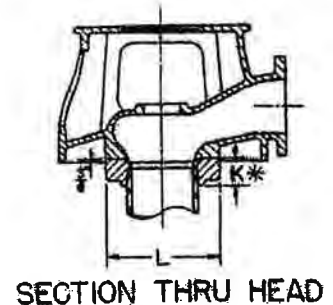
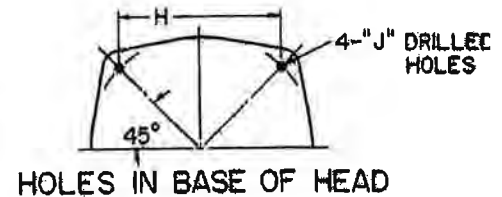
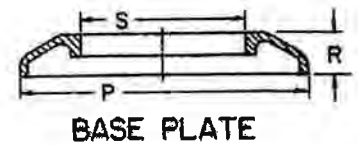
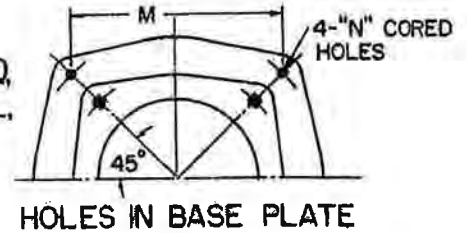
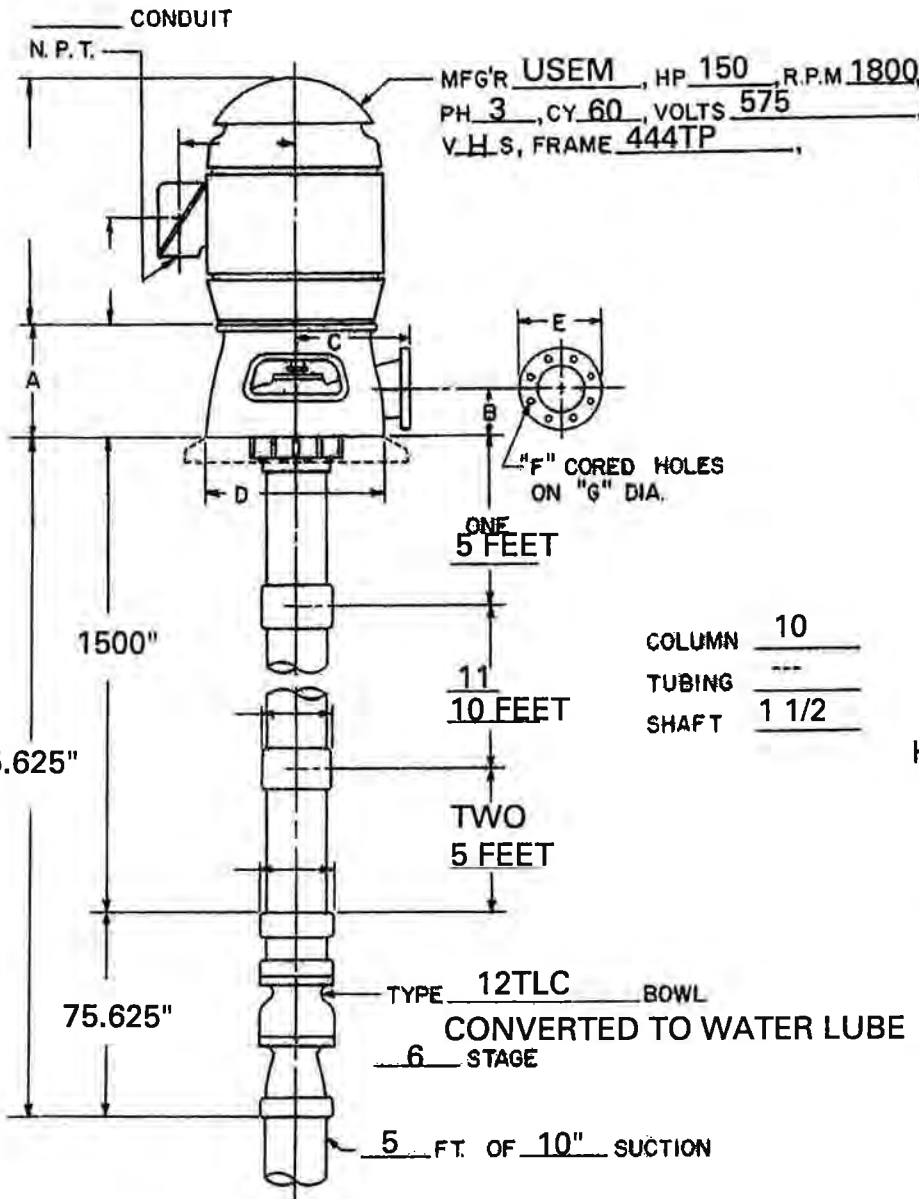
INSTALLATION PLAN

TYPE TF1018 DISCHARGE HEAD

LAYNE & BOWLER INC. MEMPHIS, TENN.



USE THESE DIMENSIONS ONLY
WHEN CERTIFIED BY FACTORY



* FOR COLUMN SETTINGS OF 200' OR GREATER, "K"=11

CUSTOMER: SAULT STE. MARIE PUC	YOUR NO: _____	G.P.M. 1260 US
LOCATION: LORNA AVE. WELL No. 1	OUR NO: _____	T.D.H. 330 FT.
FOR APPROVAL: _____	PUMP NO: 66584	R.P.M. 1800
CERTIFIED: _____	DATE: APRIL 27, 2012	B.H.P. 128

HEAD	A	B	C	D	E	F	G	H	J	K*	L	M	N	P	R	S
TF413	13	6	11	18	9	8 3/8	7 1/2	14 1/8	11	2 1/8	10	16 1/8	7 1/8	21	2	17
TF613	14	6	11	18	11	8 7/8	9 1/2	14 1/8	11	2 7/8	11	16 1/8	7 1/8	21	2	17
TF418	13	6	14 1/2	23	9	8 3/8	7 1/2	17 1/8	11	2 1/8	10	20 1/8	7 1/8	26 1/2	2 3/4	21 1/2
TF618	15	6	14 1/2	23	11	8 7/8	9 1/2	17 1/8	11	2 7/8	12 1/2	20 1/8	7 1/8	26 1/2	2 3/4	21 1/2
TF018	10	7 3/8	11 1/2	23	13	8 7/8	11 1/2	17 1/8	13	3 1/8	13	20 1/8	7 1/8	26 1/2	2 3/4	21 1/2
TF1018	18	8 1/2	14 1/2	23	16	12-1 1/4	17 1/8	18	3 1/8	16	20 1/8	7 1/8	26 1/2	2 3/4	21 1/2	
TF1218	20	9 3/8	16 1/2	26	19	12-1 1/4	17 1/8	19 1/8	3 1/8	19	23 1/8	7 1/8	32	3 1/2	24	

HEAD	A	B	C	D	E	F	G	H	J	K*	L	M	N	P	R	S
TF625	15	8 1/2	18 1/2	31	11	8 3/8	9 1/2	23 1/8	11	2 1/8	12 1/2	29 1/8	1	38	3 1/2	12
TF825	20	8 1/2	18 1/2	31	13	8 3/8	11 1/2	23 1/8	11	3 1/8	16	29 1/8	1	38	3 1/2	12
TF1025	20	8 1/2	18 1/2	31	16	12-1 1/4	17 1/8	23 1/8	11	3 1/8	19	29 1/8	1	38	3 1/2	12
TF1225	21	9 3/8	18 1/2	31	19	12-1 1/4	17 1/8	23 1/8	11	3 1/8	19	29 1/8	1	38	3 1/2	12
TF1225I	21	9 3/8	18 1/2	31	19	12-1 1/4	17 1/8	23 1/8	11	4 1/8	19	29 1/8	1	38	3 1/2	12
TF1425	21	10 1/8	18 1/2	31	21	12-1 1/4	18 1/8	23 1/8	11	4 1/8	21	29 1/8	1	38	3 1/2	12
TF1227	24	9 3/8	21	36	19	12-1 1/4	17 1/8	27 1/8	11	3 1/8	19	33 1/8	1	43	4 1/2	14

Performance Curves

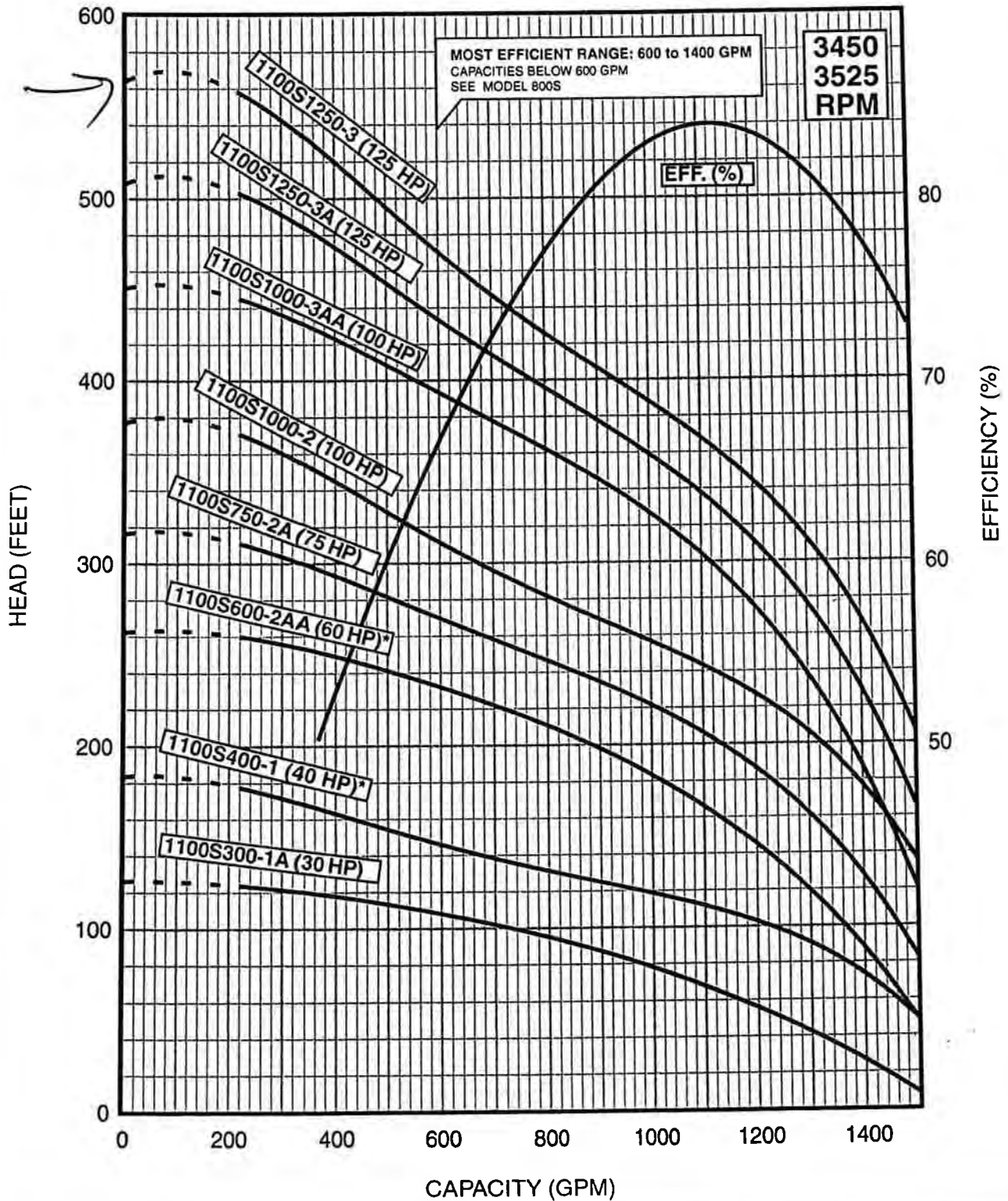
1100 GPM

Model 1100S

FLOW RANGE: 220 - 1400 GPM

OUTLET SIZE: 6 " NPT

NOMINAL DIA. 10"



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

6" MOTOR STANDARD, 30-60 HP/3450 RPM.

8" MOTOR STANDARD, 75-200 HP/3525 RPM.

10" MOTOR STANDARD, 250 HP/3500 RPM.

* Alternate motor sizes available.

Performance conforms to ISO 9906 Annex A
@ 10 ft. min. submergence.