

MEMORANDUM

TO: Water Right Permit File 61-7712

FROM: Daniel A. Nelson

DATE: July 29, 2021

SUBJECT: Diversion Rate Review of Pump Curves

The permit holder can use 2 portable pumps to divert the water from the On-Stream pond for the irrigation portion of this permit. The pond at the time of the field exam was almost dry, and there was a concern that the water available would not be adequate to perform an adequate measurement. There was an additional concern that pumping the little amount of water left could harm the fish that are in the on-stream pond. Point of Diversion A (PDA), the point of diversion near the well location, didn't have any water available at that location. Point of Diversion B (PDB), on the northeast side of the pond, did have some water at this location, but there was concerns about the amount of water available for a measurement and harm to the fish in the pond.

Water diverted at PDB is also used to fill the Reserve Pond. The commercial use is from a well that fills a hot tub and then overflows into the On-Stream Pond. The diversion to storage component should only be considered to be the water diverted from the PDA to the Reserve Pond. I will discuss each system separately.

PDA Diversion:

There was no electricity available at the on-stream pond, so fuel powered pumps to divert the water. The pump at PDA uses a diesel powered engine, and the pump at PDB uses a gas powered engine. Determining a theoretical flow rate for these fuel powered engines is extremely difficult. Fuel powered engines rely on gear and belt drive ratios that are not readily apparent by observing the pumping system, and can greatly reduce efficiencies. The Break Horsepower (BHP) for a fuel engine is significantly different than normal electric motors, and the throttle on the motors can be adjusted to operate in what is referred to as a preferred operating range. The preferred operating range is generally 70% to 120%, so it can vary greatly from the standard electric pump. The type of drive on a pump can also affect its efficiency and the BHP.

The pumping system at PDA uses a 42 Hp 3 cylinder Duetz motor and a Model BZ3_M – 3 X 4 X 9 M Berkeley Type B Centrifugal Pump. This system also utilizes a belt drive system. According to the Pump Curve, the maximum RPM's that can be generated using a belt drive system is 2300 RPM's. The total dynamic head (TDH) would be 146 feet of TDH ($[50 \text{ psi} \times 2.31] + 10 \text{ feet lift} + 20 \text{ feet additional pressure} = 145.5 \text{ feet of TDH}$). Based on the pump curve, at 145 feet of head, a belt drive pump at the maximum 2300 RPM's for a belt drive system would produce 520 gpm. There are losses in efficiency we have to consider for most gas

powered pumps, so 520 gpm would be the absolute maximum possible diversion rate this pump could produce.

The permit holder stated that he generally runs 96 sprinklers on this pump system. The standard flow chart for 5/32 sprinklers at 50 psi provides an average flow rate of 5.15 gpm per sprinkler. At 5.15 gpm per sprinkler, the estimated flow rate for this pumping system would be approximately 494 gpm ($5.15 \text{ gpm} \times 96 \text{ sprinklers} = 494.4 \text{ gpm}$). The estimated sprinkler flow of 494 gpm is within 5% of the total maximum possible flow ($[520 - 494] / 520 = 0.05 \times 100 = 5\%$). I am going to recommend 494 gpm or for this portion of the system, since it is within 5% of the maximum capacity this pumping system can supply.

PDB Diversion:

The pumping system at PDB is a Tecumseh 20 Hp pump with a MP Flomax 30 3 X 3 pump. The permit holder stated that the pump was an 18 Hp pump at the time of the field exam, but I couldn't find any 18 Hp Tecumseh pump, and the pump curve only shows 15 Hp and 20 Hp capability. A review of the pump curve suggests that a 15 Hp could not supply the water needed for this type of system. This pump is on the north field, which is approximately 1,560 feet long. The permit holder irrigates this field with a single hand line, so he would have approximately 39 sprinkler pipes ($1560 / 40 \text{ feet per pipe sprinkler} = 39 \text{ sprinklers}$). The standard flow chart for 5/32 sprinklers at 50 psi provides an average flow rate of 5.15 gpm per sprinkler. At 5.15 gpm per sprinkler, the estimated flow rate for the 20 Hp pump would be approximately 201 gpm ($5.15 \text{ gpm} \times 39 \text{ sprinklers} = 200.85 \text{ gpm}$).

The lift from the pond would be approximately 10 feet, and the an additional 20 feet of head would need to be added to 50 psi to maintain this pressure completely through the line. The total dynamic head (TDH) would be 146 feet of TDH ($[50 \text{ psi} \times 2.31] + 10 \text{ feet lift} + 20 \text{ feet additional pressure} = 145.5 \text{ feet of TDH}$). The pump curve shows that a 20 Hp pump can divert at full throttle slightly over 280 gpm at a maximum efficiency of 50%. The actual flow rate needed of 201 gpm would require the pump motor to be throttled back by approximately 39% ($[280 \text{ gpm} - 201 \text{ gpm}] / 280 = 0.282 \times 100 = 28.2\%$). Throttling back the motor to 201 gpm would put this system slightly below the 45% to 56% efficiency range recommended for this pumping system, but this flow rate needed to supply the sprinklers is definitely available from this pumping system. I am recommending 201 gpm or .45 cfs for irrigation from this diversion.

DIVERSION TO STORAGE PDB:

This pumping system is over designed for sprinkler package being use, but this system is also used to divert water On-stream Pond to the Reserve Pond. The open discharge into the Reserve Pond would actually provide additional flow for the Diversion to Storage diversion rate determination. The TDH would change with the due to the change in discharge pressure needed. The sprinkler discharge was estimated at 50 psi, but the open discharge pressure would be closer 10 psi (23.1 feet) -15 psi (30 feet). The lift and additional head would still remain 30 feet (10 feet lift + 20 feet additional head). This would reduce the TDH to 53 feet (23.1 feet + 30 feet = 53.1 feet) to 60 feet (30 feet + 30 feet = 60 feet TDH). According to the pump curve this amount of TDH is way off the chart by means of efficiency, but it does appear a 20 Hp pump could divert to open discharge approximately 540 gpm to 560 gpm.

My concern with this diversion rate is that the efficiency would significantly drop off at this low of TDH. For this reason I am going to recommend the 540 gpm being diverted from PDB for the diversion to storage component to ensure we aren't over estimating the flow rate.

The ground water well also diverts water into the On-Stream Pond, but it only discharges into the pond after it is used to heat the hot tub. Regardless of the flow rate, the diversion from PDB would include any water diverted from the hot water well. The hot tub overflow is basically wastewater, and really shouldn't be considered a diversion to storage. Since the water diverted at PDB includes the water diverted from the well, I recommending that the diversion to storage be limited to 540 gpm or 1.20 cfs.

Recreational Diversion Rate From The Well:

As discussed in the field report, the commercial storage use is being changed to recreation use, because no commercial enterprise was developed. The well has a $\frac{3}{4}$ Hp pump, but it is not used. The well pump requires a generator to be brought in to provide the electricity. The permit holder stated that when the well is pumped, it runs out of water in a short period of time, so he no longer uses the pump. The permit also stated that the well originally diverted over 100 gpm. He also stated that he was required to seal the well with cement, and the diversion rate dropped considerably. The artesian flow was measured at the hot tub using the bucket and stopwatch method. I used a 5 gallon bucket during this test. The following is the information gathered during the test.

Time #1 – 75 sec

Time #2 – 82 sec

Time #3 – 78 sec

Average time to fill the 5 gallon bucket = $(75 + 82 + 78) / 3 = 78.33$ seconds

Flow in gpm = $(5 \text{ gal} / 78.33 \text{ seconds}) \times (60 \text{ seconds} / 1 \text{ minute}) = 3.83 \text{ gpm}$

Flow in cfs = $3.83 / 448.8 = 0.00853 \text{ cfs}$

Since the flow rate is below the minimum allowable diversion rate we can assign to a water use, I am recommending that we round the flow rate up to 0.01 cfs for the commercial use.

TOTALS:**Irrigation Diversion Rate:**

PDA available = 1.10 cfs

PDB available = 0.45 cfs

Total available = 1.55 cfs

Maximum acres limits = 47 acres X 0.02 cfs = 0.94 cfs

Permit limits = 1.60 cfs for irrigation

Irrigation recommendation is limited to 0.94 cfs.

Diversion to Storage:

PDB Available = 1.20 cfs

Permit Limits = 1.60 cfs

Diversion to Storage Recommendation is limited to 1.20 cfs.

Recreation Use:

Well Use available = 0.01 cfs

Recreation use is limited to 0.01 cfs.

PLEASE NOTE: The permit listed commercial storage, but no commercial use developed. The hot tub was developed to remove the heat value of the well water prior to sending it into the On-Stream Pond for storage. Since no commercial enterprise was developed, the water use in the hot tub should be considered a recreational use.

SPRINKLER SYSTEM DISCHARGE

NOZZLE DISCHARGE - GALLONS PER MINUTE							
psi	3/32	1/8	9/64	5/32	11/64	3/16	13/64
20	1.17	2.09	2.65	3.26	3.92	4.69	5.51
25	1.31	2.34	2.96	3.64	4.38	5.25	6.16
30	1.44	2.56	3.26	4.01	4.83	5.75	6.80
35	1.55	2.77	3.50	4.31	5.18	6.21	7.30
40	1.66	2.96	3.74	4.61	5.54	6.64	7.80
45	1.76	3.13	3.99	4.91	5.91	7.03	8.30
50	1.85	3.30	4.18	5.15	6.19	7.41	8.71
55	1.94	3.46	4.37	5.39	6.48	7.77	9.12
60	2.03	3.62	4.50	5.65	6.80	8.12	9.56
65	2.11	3.77	4.76	5.87	7.06	8.45	9.92
70	2.19	3.91	4.96	6.10	7.34	8.78	10.32
75	2.27	4.05	5.12	6.30	7.58	9.08	10.66
80	2.35	4.18	5.29	6.52	7.84	9.39	11.02
85	2.42	4.31	5.45	6.71	8.07	9.67	11.35
90	2.49	4.43	5.61	6.91	8.31	9.95	11.69
95	2.56	4.56	5.76	7.09	8.53	10.20	11.99
100	2.63	4.67	5.91	7.29	8.76	10.50	12.32

AVERAGE APPLICATION RATE - INCHES PER HOUR

Spacing in Feet	Discharge From Each Sprinkler						
	2 gpm	3 gpm	4 gpm	5 gpm	6 gpm	7 gpm	8 gpm
20x20	0.48	0.72	0.96	1.20	1.44	1.70	1.95
20x30	0.32	0.48	0.64	0.80	0.96	1.12	1.28
20x40	0.24	0.36	0.48	0.60	0.72	0.84	0.96
30x30	0.21	0.32	0.43	0.54	0.64	0.75	0.88
30x40	0.16	0.24	0.32	0.40	0.48	0.56	0.64
30x50	0.13	0.19	0.25	0.32	0.38	0.45	0.51
40x40	0.12	0.18	0.24	0.30	0.36	0.42	0.48
40x50	0.1	0.14	0.19	0.24	0.29	0.34	0.38
40x60		0.12	0.12	0.20	0.24	0.28	0.32

AGRICULTURE PUMPS



- Hydraulic Driven
- Engine Driven
- Pedestal Mount



- FLOMAX®
- SERIES
- CHEMFLO®
- FRX



- Applicators/Spraying
- Blending
- Nurse Tanks
- Bulk Transfer

We don't just go with the flow, we create it!™

Our products are designed with our customers needs in mind.

MP Pumps has a complete line of centrifugal products and drive types to meet today's applications in the Agricultural Industry. Whether it is chemical spraying, bulk transfer, mixing or blending, MP Pumps offers its products in Cast Iron, 316 Stainless Steel, Bronze and Aluminum to handle the full range of fluid types. Drive type selections include Hydraulic, Engine and Pedestal mountings. In addition, MP Pumps offers its products in the industry recognized "PumPAK" design allowing for simple pump replacement or coupling to a customer supplied or existing driver.

Section 1: HYDRAULIC DRIVEN

1. Gerotor motors are available in cast iron construction for the smaller platform models. These are offered in the standard hydraulic pedestal or the Hy-Speed Pedestal.
2. Gear Motors are equipped for the larger platform pumps.

Section 2: ENGINE DRIVEN

1. Small Platform Pumps are designed with 3/4" shafts, Larger Platform Pumps are designed with either 1" or 1-1/8" shafts.
2. Engine driven pumps are available mounted on base plates and equipped with carrying handles or lift eyes.

Section 3: PEDESTAL MOUNT

1. Pedestal pumps may be long-coupled where the motor and pump are separated or pulley driven.
2. MP Pumps offers a complete line of base plate assemblies to match the motor and engine size.

SELF-PRIMING

FRX75-SP Series Specifications

- Suction: 3/4" NPT
- Discharge: 3/4" NPT
- Available Materials of Construction: 316 Stainless Steel (Investment Cast)
- Mechanical Seal: Viton (Standard). Optional seals available.
- (1) Hydraulic Motor Displacements: .08 cu. inch



FRX75-SP-HYD, .08 DISPLACEMENT									U.S. UNITS
OIL FLOW	SHUT OFF 0 GPM	5 GPM	10 GPM	15 GPM	20 GPM	25 GPM	30 GPM	35 GPM	MAX. HYD. OIL PRESS.REQ.
1 GPM	7.8 PSI	6.5 PSI	4.8 PSI	2.6 PSI	-	-	-	-	300 PSI
1.5 GPM	10.8 PSI	10.0 PSI	8.2 PSI	6.1 PSI	3.9 PSI	-	-	-	450 PSI
2 GPM	16.0 PSI	14.3 PSI	12.6 PSI	10.4 PSI	7.4 PSI	4.8 PSI	-	-	600 PSI
2.5 GPM	22.5 PSI	20.4 PSI	18.2 PSI	15.6 PSI	12.6 PSI	8.7 PSI	5.2 PSI	-	800 PSI

FRX75-SP-HYD, .08 DISPLACEMENT									METRIC UNITS
OIL FLOW	SHUT OFF 0 LPM	19 LPM	38 LPM	57 LPM	76 LPM	95 LPM	114 LPM	133 LPM	MAX. HYD. OIL PRESS.REQ.
4 LPM	0.5 BAR	0.4 BAR	0.3 BAR	0.2 BAR	-	-	-	-	20.7 BAR
6 LPM	0.7 BAR	0.7 BAR	0.6 BAR	0.4 BAR	0.3 BAR	-	-	-	31.0 BAR
8 LPM	1.1 BAR	1.0 BAR	0.9 BAR	0.7 BAR	0.5 BAR	0.3 BAR	-	-	41.4 BAR
9 LPM	1.6 BAR	1.4 BAR	1.3 BAR	1.1 BAR	0.9 BAR	0.6 BAR	0.4 BAR	-	55.2 BAR



by Gardner Denver

FLOMAX 30

3" x 3" Self Priming Centrifugal Pump

FLOMAX® 30 self-priming centrifugal pumps are capable of creating vacuum sufficient to lift liquids from heights up to 25 feet above the source. Once primed, the pump's built in flapper valve will maintain a full column of liquid in the suction line.

A FLOMAX® 30 PumPAK® is a fully assembled and run tested pump end that can be easily coupled to a number of drivers such as 182TC to 256TC frame motors and gas engines. A bearing pedestal is also available for T-frame motor or belt drive.

Standard features include stainless steel drive sleeve, stainless steel fasteners, renewable wear plate, and a semi-open dynamically balanced impeller.

The FLOMAX® series of pumps are commonly used in Industrial, OEM, Agricultural and Marine applications, such as: Bilge Pumps, Auxiliary Fire Pumps, Ballast Transfer Pumps, Washdown Pumps, Fertilizer and Pesticide Pumps, Applicators & Sprayers, Blending Pumps, Nurse Tanks, Bulk Transfer Pumps and much more.

ABS Type Approval for the Flomax 30 - [Download PDF](#)



Application

- Agricultural
- Industrial
- Marine
- OEM

Features

- Stainless steel drive sleeve
- Stainless steel fasteners
- Up to a 25' suction lift

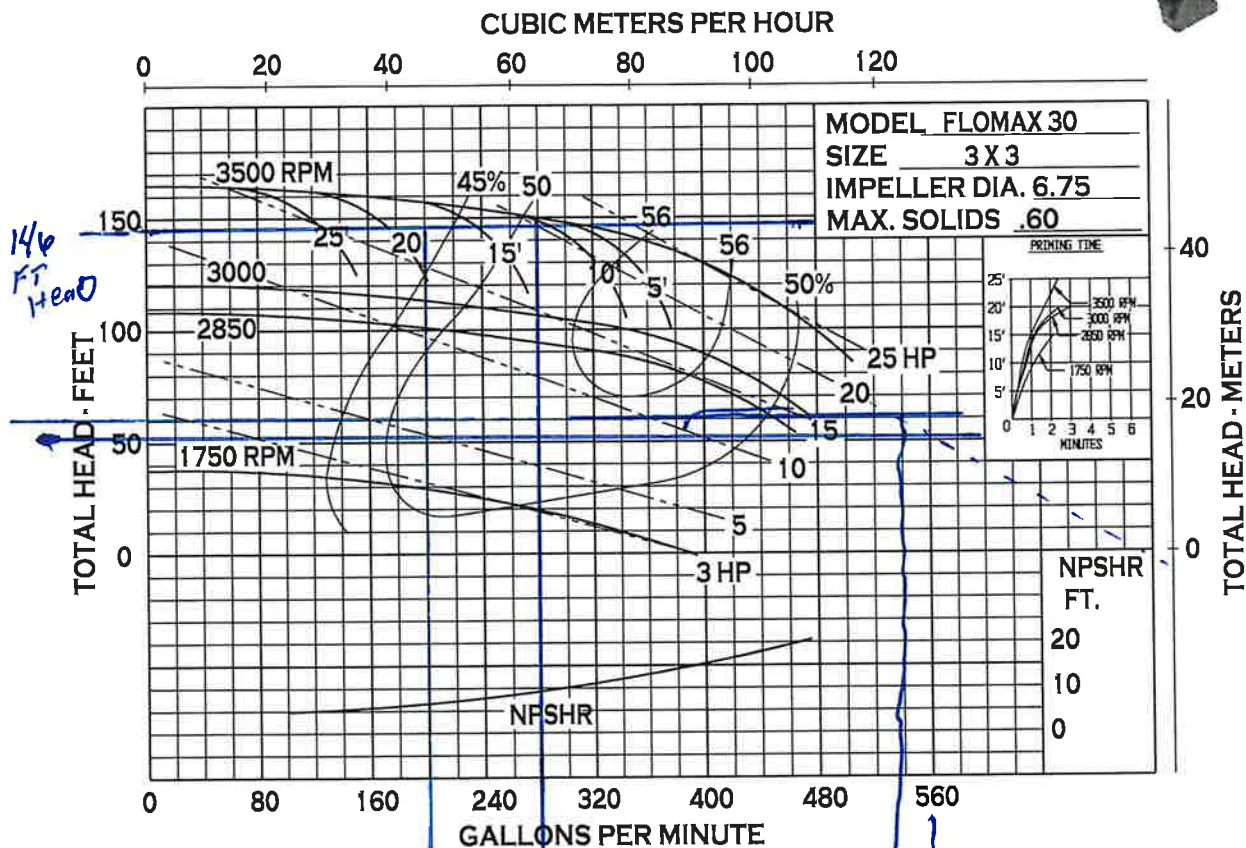
SPECIFICATIONS:

Suction And Discharge	3" x 3" NPT
Materials Of Construction	Bronze, Cast iron
Flow	Up to 500 GPM
Head Feet	Up to 190'
Impeller	6.75" max diameter, 6-vane semi open
Motor	Up to 25 HP
Drive Options	Close coupled 184TC, Close coupled 215TC, Close coupled 256TC, Engine mount 25 HP, Pedestal, PumPAK® (without motor)
Seal	Special seal material combinations available (consult factory), Standard carbon / ceramic / Viton
Max Solid Size	.60"

END SUCTION

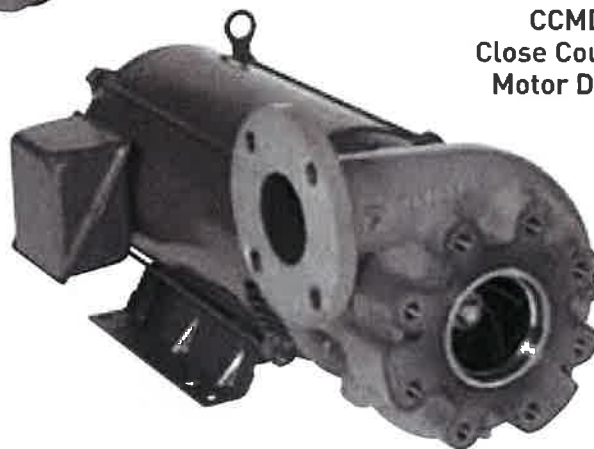
FLOMAX® 30 Specifications

- Suction: 3" NPT (BSP)
- Discharge: 3" NPT (BSP)
- Available Materials of Construction: Cast Iron and Bronze
- Mechanical Seal: Viton (Standard). Optional seals available.
- Shaft: 1" and 1-1/8"
- Engine Horsepower: 25 HP





FM
Frame Mount



CCMD
Close Coupled
Motor Drive



Engine Drive
SAE

BERKELEY® TYPE B CENTRIFUGAL PUMPS PUMP PERFORMANCE

PUMP MODEL NOMENCLATURE

NAME PLATE EXAMPLE:

B 4 G P B H S**B** — TYPE OF CONSTRUCTION
B = "Back Pull-Out" Design**4** — DISCHARGE SIZE (Inches)

NOMINAL IMPELLER DIAMETER (Inches)

G —	3" = A	7" = W	11" = F	15" = EX	18" = EY
	4" = M	8" = Y	12" = G	15.5" = XT	19" = EZ
	5" = X	9" = Z	13" = J	16" = ET	20" = EE
	6" = T	10" = E	14" = N	17" = EW	

TYPE OF DRIVE

P — P = Electric Motor – Pump Attached Directly to Motor Frame
 Q = Engine Drive – Pump Attached Directly to Engine Frame
 R = Frame Mounted Belt or Flexible Coupling Drive
 RM = Special Duty Mounting Frame

B — SPECIAL FEATURES (Optional)
 B = Hydraulically Balanced Impeller Design
 K = Self-Priming

RELATIVE CAPACITY OF IMPELLER

H — LL = Very Low
 L = Low
 M = Medium (Often Omitted)
 H = High
 HH = Very High

2 — NUMBER OF STAGES (Optional)
 (Single stages not indicated)

S — SHAFT SEAL (Optional)
 S = Mechanical Seal (Packed Stuffing Box is not indicated)

10 — HORSEPOWER OF MOTOR OR ENGINE (Optional)
 (Normally indicated on Engine Driven Pumps only)

The model configurations above illustrate the complete range
 of closed coupled product identification numbers.

PUMP SIZE EXAMPLE:

4" x 6" x 13" B H**4"** — DISCHARGE SIZE (Inches)**6"** — SUCTION SIZE (Inches)

NOMINAL IMPELLER DIAMETER (Inches)

13" —	3" = A	7" = W	11" = F	15" = EX	18" = EY
	4" = M	8" = Y	12" = G	15.5" = XT	19" = EZ
	5" = X	9" = Z	13" = J	16" = ET	20" = EE
	6" = T	10" = E	14" = N	17" = EW	

B — SPECIAL FEATURES (Optional)
 B = Hydraulically Balanced Impeller Design

RELATIVE CAPACITY OF IMPELLER

H — LL = Very Low
 L = Low
 M = Medium (Often Omitted)
 H = High
 HH = Very High

Berkeley Type B Hydraulic Performance (by product group)

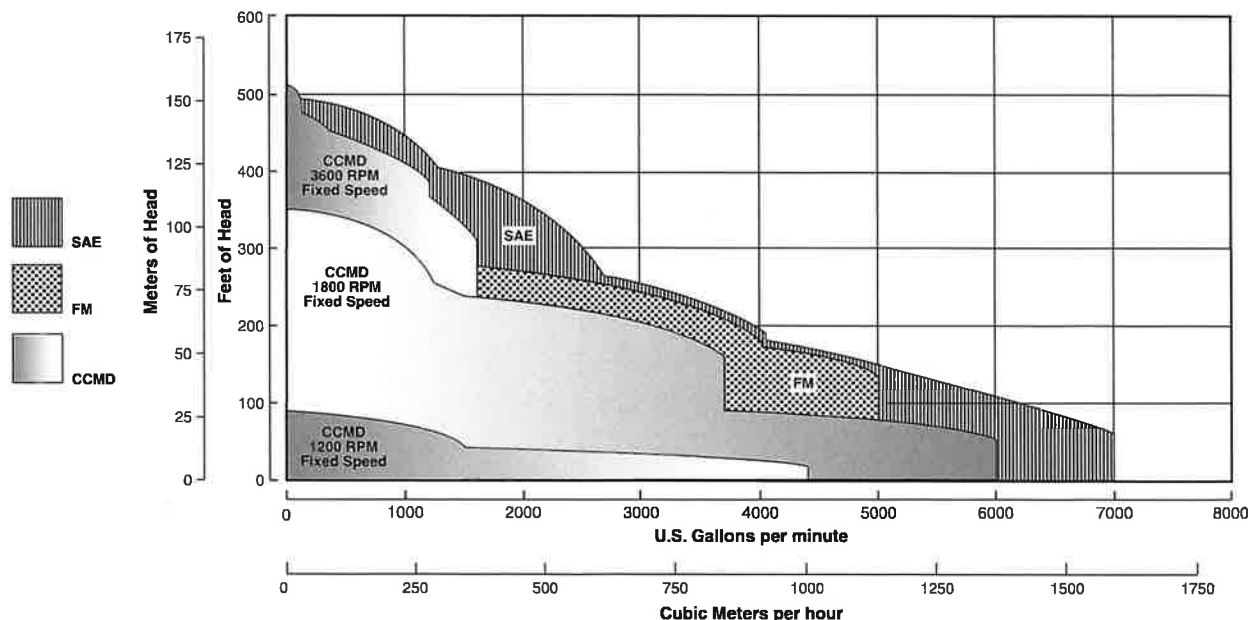


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B1XRMS		1 x 1-1/4 x 4	8
B1-1/2T_L	T	1-1/2 x 2 x 6L	9-10
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B2-1/2T_M		2-1/2 x 3 x 6M	15-17
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Pump Size: 3 x 4 x 9 M

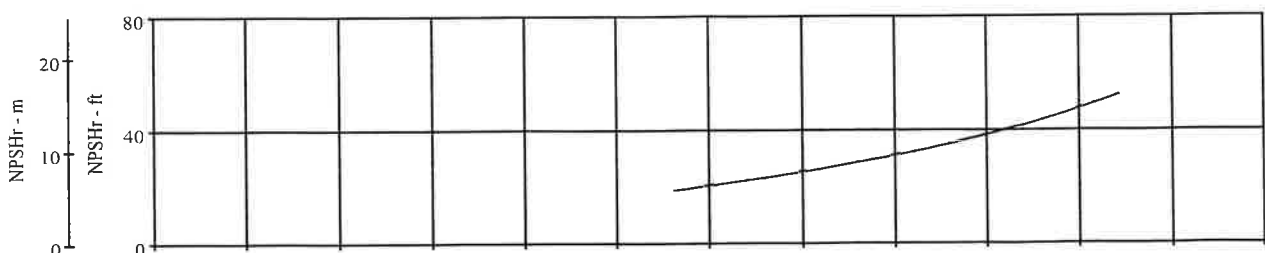
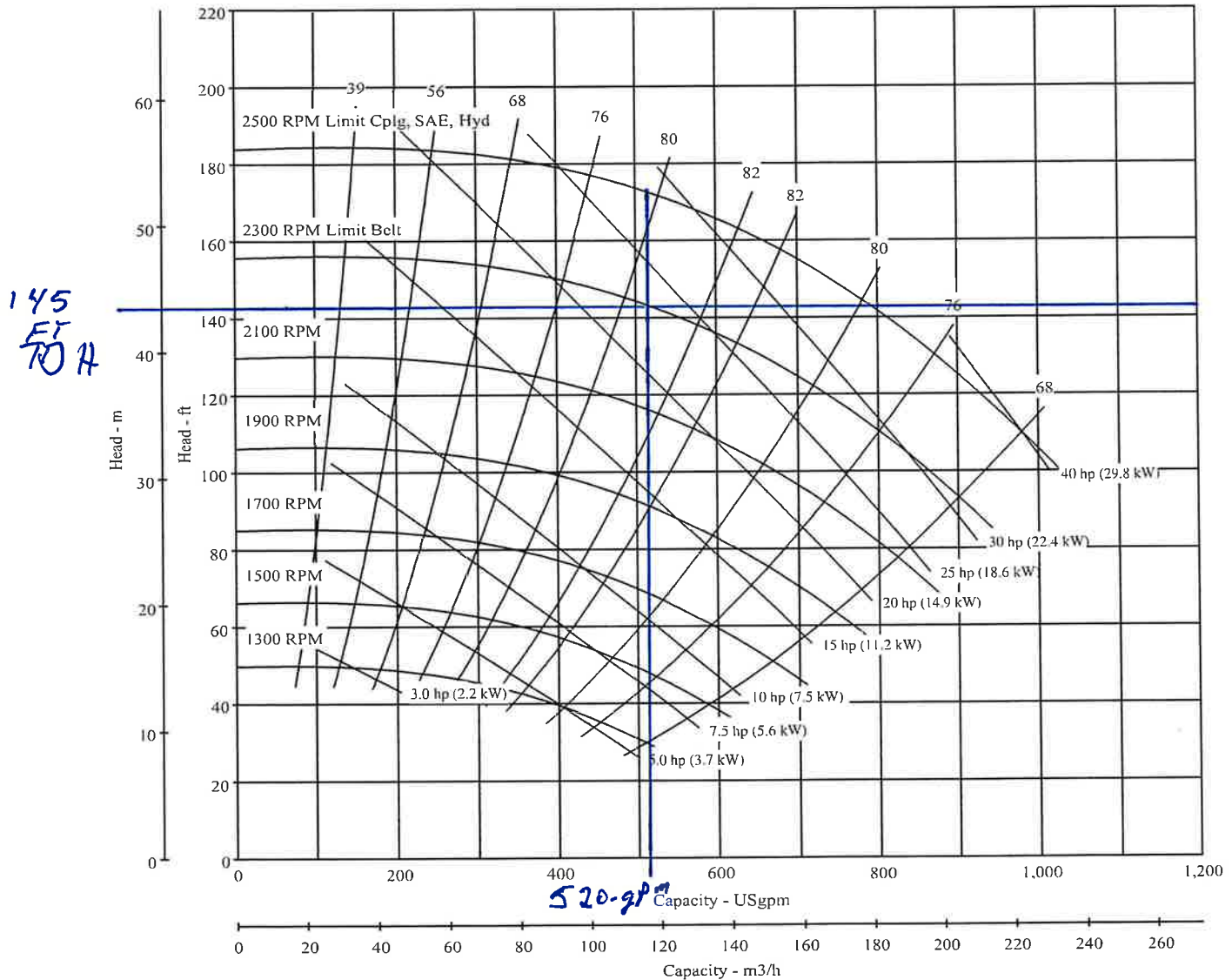
Model: B3Z_M

Curve No. 5021

Type	CCMD	FM CPLG	FM BELT	SAE	Hydraulic	AC Engine
Model	B3ZPM	B3ZRM	B3ZRM	B3ZQM	B3ZRM-HYD	
RPM	1201-1800	1400-2500	1400-2300	1600-2500	1400-2500	

Dia. 9.00"

Nominal RPM: **VARIOUS**
Based on Fresh Water @ 68°F (20°C)
Maximum Working Pressure: 266 PSI (18 BAR)



*NPSH data shown is at maximum speed