

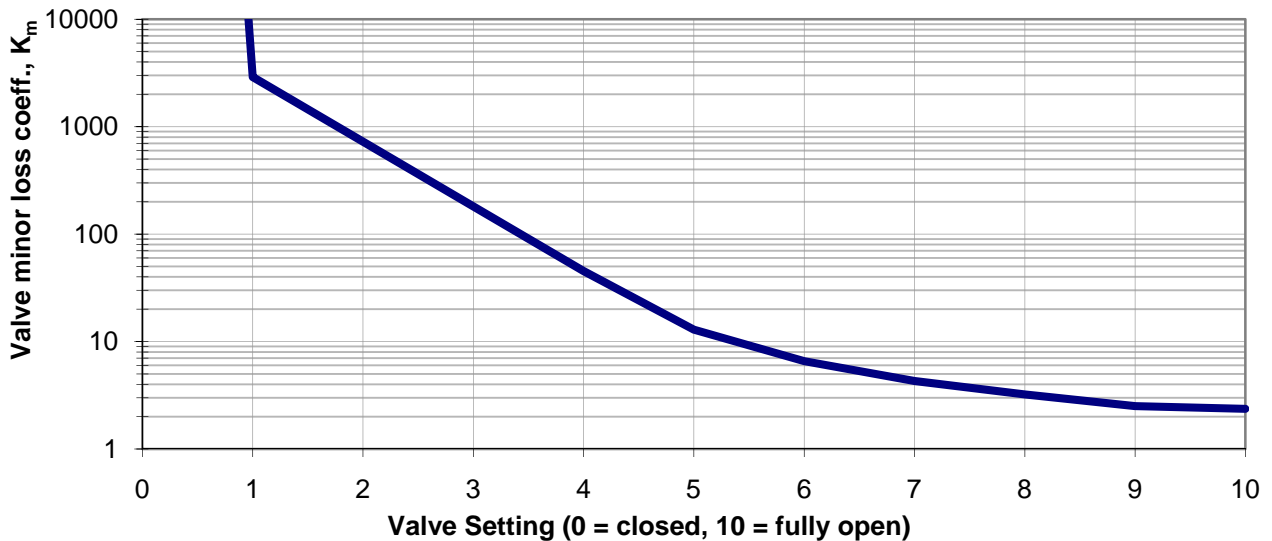
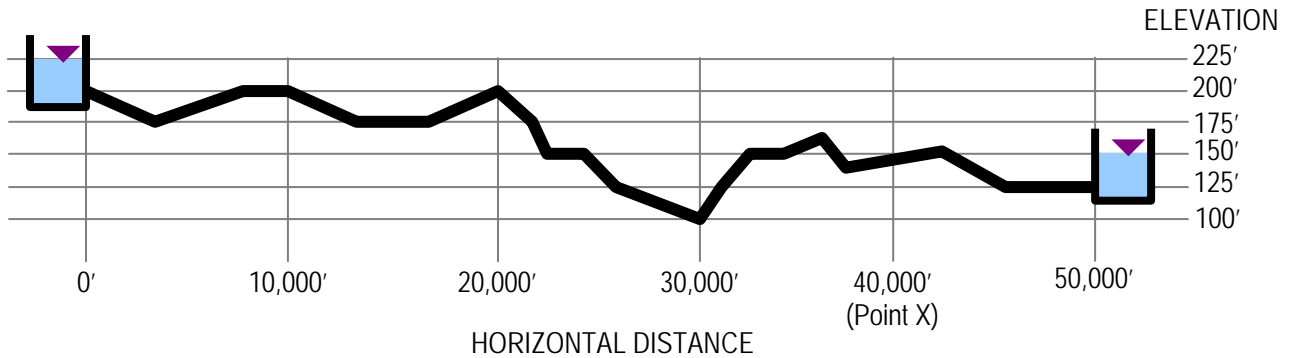
Name: _____

CVEN 458 – Hydraulic Engineering of WDS
 Spring Semester 2010
 Dr. Kelly Brumbelow, Texas A&M University

Exam #2

Open-book, Open-notes (6 pages, 2 questions); Time allowed: 75 minutes

1. A planned water transmission pipeline is diagrammed below with centerline elevation as indicated. It is designed as a steel pipe 48 inches in diameter with a butterfly valve installed at point X. The valve manufacturer publishes the graph of valve minor loss coefficient versus setting shown below the system sketch. A separate analysis has rated the maximum design pressure (including pressure due to water hammer) for the pipe at 175 psi. You have been tasked with determining an appropriate valve closure procedure for the valve at point X for the case of an initially fully open valve and steady flow in the pipeline.



Continued on next page

In this problem you should determine the maximum allowable closure of the valve in the first characteristic time of the pipeline. You should express your final answer in the following manner: “The valve may be closed from setting 10 to setting ____ in ____ seconds.” (40 points)

Pipeline characteristics

Total Length = 50,000 ft Actual inner diameter = 47.000 in Wall thickness = 0.500 in

Modulus of elasticity = 30×10^6 psi Assume $f = 0.013$

Sum of minor loss coefficients (except valve at Point X) = 25.3

You do not need to include safety factors in your calculations. These have already been included in the original calculation of maximum design pressure.

2. A wastewater lift station is under design. The wet well is to be a cylinder 30 feet in depth, and two pumps will be installed:

- Aurora 610 Non-clog sewage, 6x6x12, 12 in impellor, 875 rpm (“small” pump)
- Aurora 610 Non-clog sewage, 6x8x15, 15 in impellor, 875 rpm (“large” pump)

Technical data for the pumps is attached. The lift station pumps are installed in parallel and discharge to a force main of length 200 ft, diameter 8 in, friction factor $f = 0.012$, and negligible minor losses. The force main ends at a reservoir whose water surface elevation is constant at 10 ft above the top of the lift station wet well.

You are determining operational parameters for the 2 pumps in the lift station, i.e., under what conditions of inflow and wet well level should each pump be turned on or off. Your desired guidelines are that:

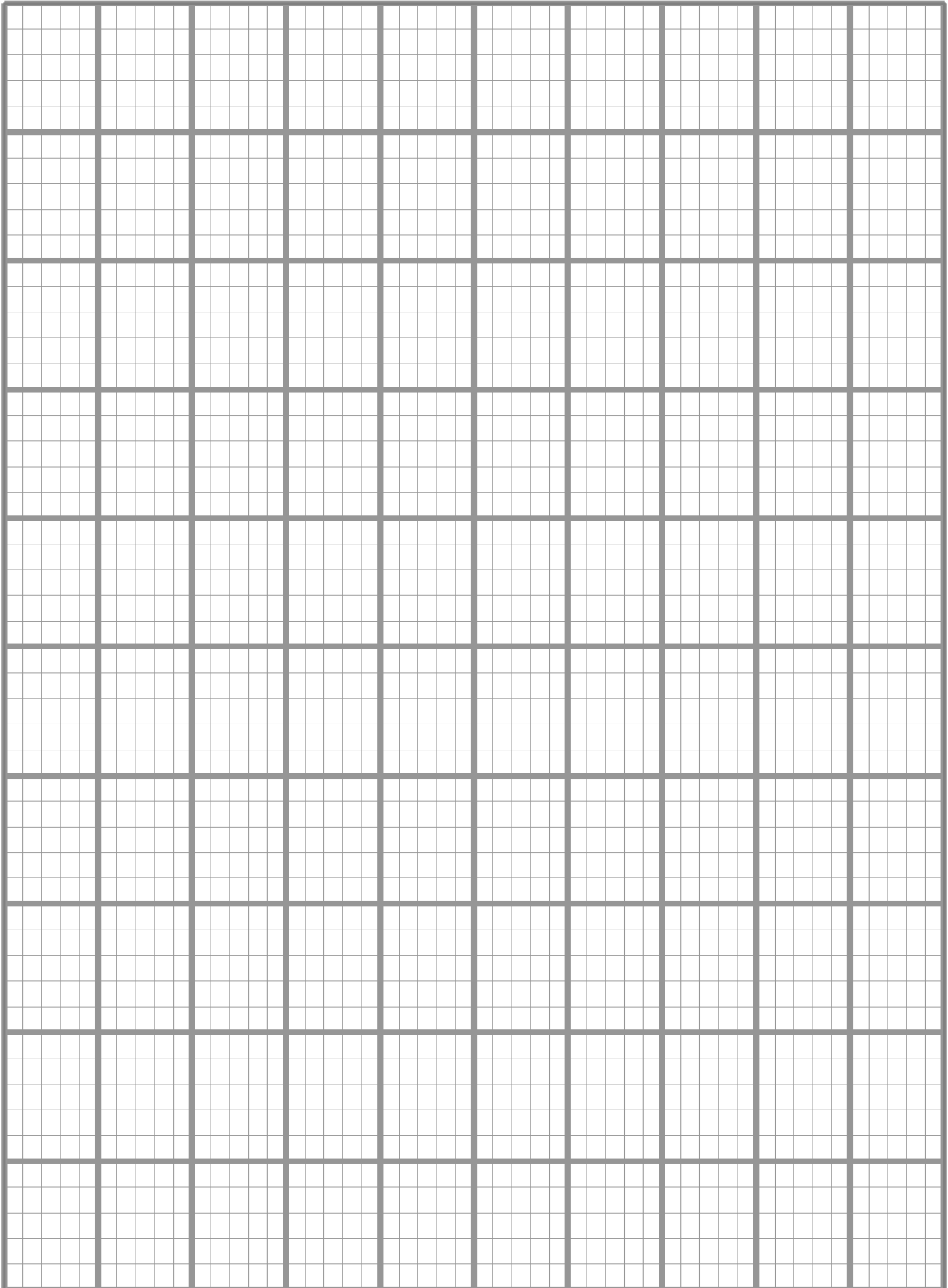
- Pumped flow should equal or exceed inflow when any pump(s) is/are running;
- Power consumption should be minimized by running only the minimum pumping configuration needed;
- The small pump should not be operated below 400 gpm, and the large pump should not be operated below 600 gpm.

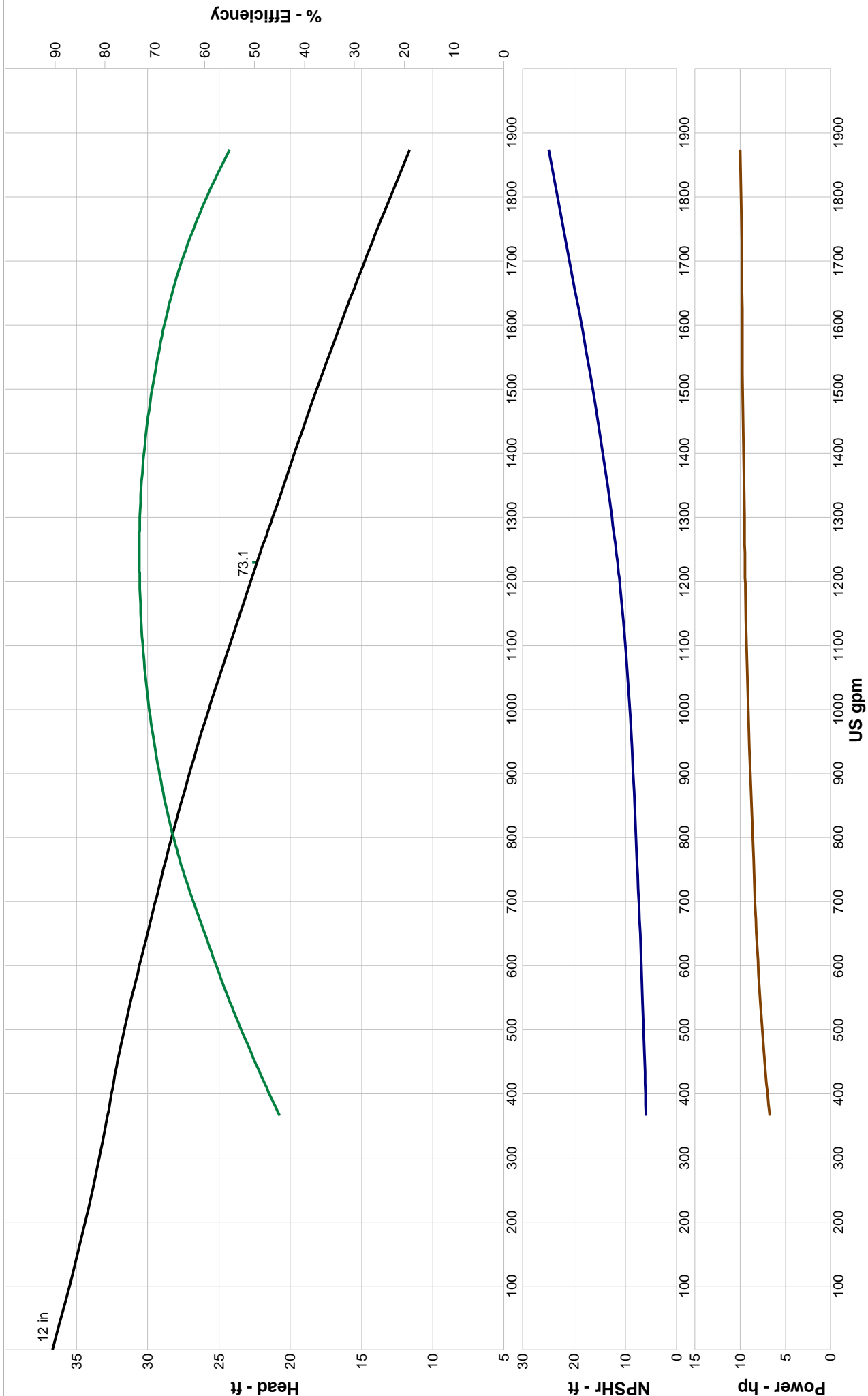
The portion of the operations matrix detailing when both pumps should operate is given below. **For each given wet well level, state whether or not both pumps should ever operate simultaneously by writing YES or NO, and (if YES) the minimum inflow for this condition (i.e., if inflow drops below the minimum, one of the pumps should be turned off).** (60 points)

Depth of Water in Wet Well (ft)	Both pumps operating? (YES or NO)	Minimum Inflow for Both Pumps to Remain On (gpm)
0		
10		
20		
30		

A sheet of blank graph paper is attached that you may use for graphical solutions.

1 cfs = 448.83 gpm





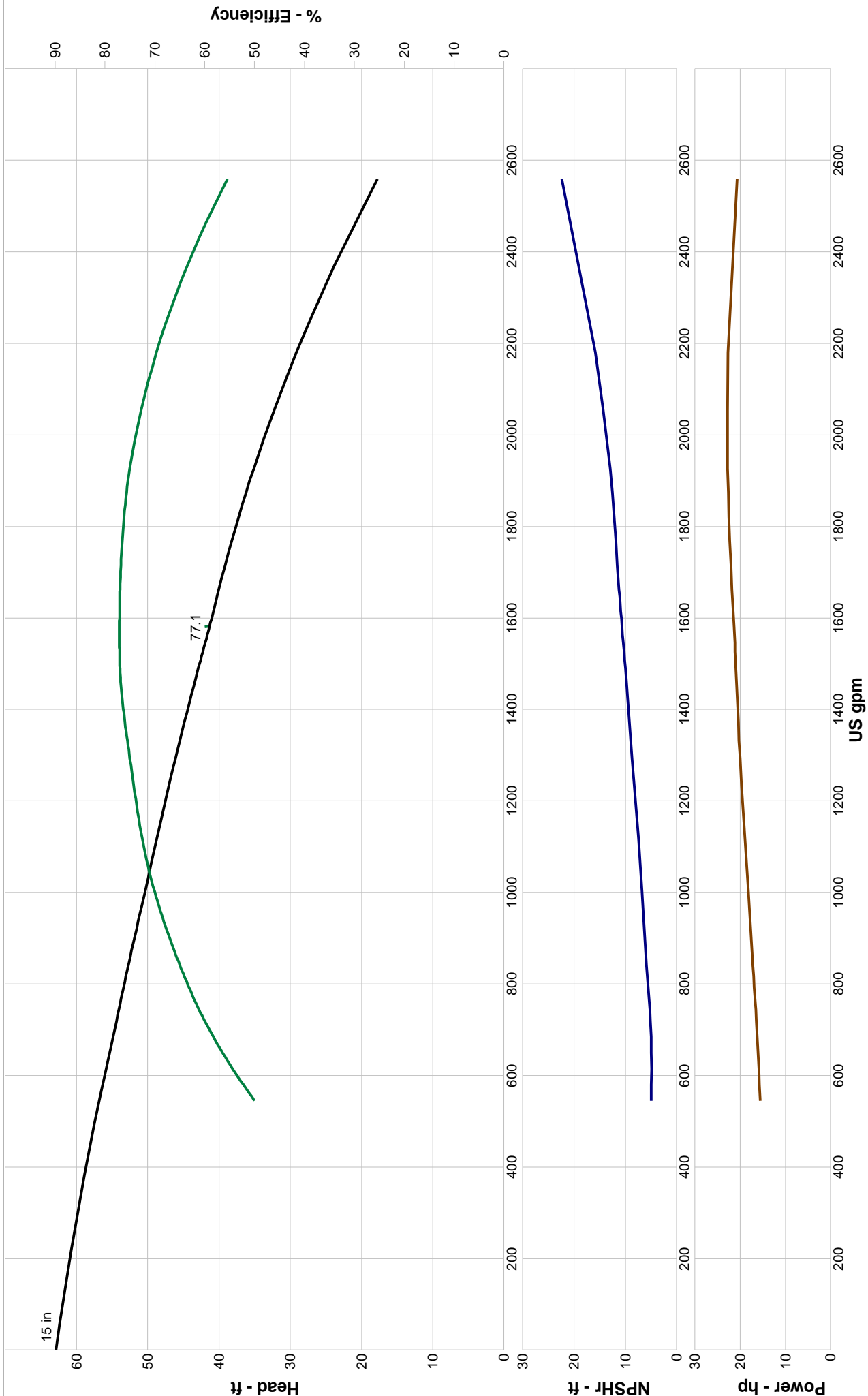
Impellers Are Cut on an Angle. Diameter Shown Is Average of the Shroud Diameter. Curve efficiencies are typical. For guaranteed values, contact Aurora Pump or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Aurora Pump o a su distribuidor local.

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AURORA PUMPS
 Catalog: Aurora Pumps:60, Vers 3.8
 610 NON CLOG SEWAGE - 900

Size: 6x6x12
 Speed: 875 rpm
 Dia: 12 in
 Curve: PC115573N





Impellers Are Cut on an Angle. Diameter Shown Is Average of the Shroud Diameter. Curve efficiencies are typical. For guaranteed values, contact Aurora Pump or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Aurora Pump o a su distribuidor local.

Company: CVEN 458
 Name: Brumbelow
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AURORA PUMPS
 Catalog: Aurora Pumps:60, Vers 3.8
 610 NON CLOG SEWAGE - 900

Size: 6x8x15
 Speed: 875 rpm
 Dia: 15 in
 Curve: PC115577N

