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WATER DISTRIBUTION SYSTEM PRESSURE MANAGEMENT

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BENEFITS OF PRESSURE MANAGEMENT

- Reduced leakage rates
- Reduced pump runtimes
- Reduced energy costs
- Improved load-bearing capacity of asbestos cement pipe



FACILITY SET POINTS

- How are pump set points determined?
- How are reservoir fill and draw levels determined?

LEAKAGE RATES

- Water loss through cracked water main
- 1/2 - inch diameter hole in pressurized water main
- Bernoulli's Equation

$$\frac{P_1}{\gamma} + z_1 + \frac{V_1^2}{2g} = \frac{P_2}{\gamma} + z_2 + \frac{V_2^2}{2g}$$

$$Q = c_d A \sqrt{(2g)(H)}$$

LEAKAGE RATES

- $Q = 54$ gpm at 105 psi
- $Q = 52$ gpm at 100 psi
- 2 gpm difference
 - 2,800 gallons per day
 - 1.05 MG per year

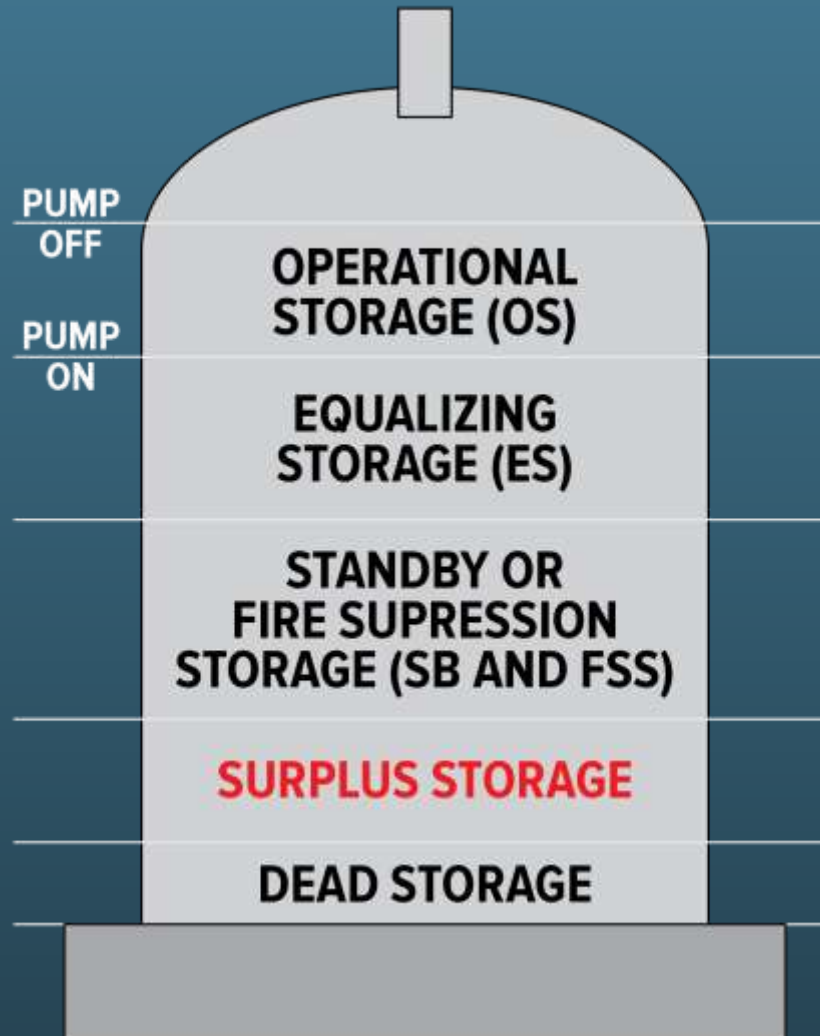


BONNEVILLE POWER ADMINISTRATION STUDY

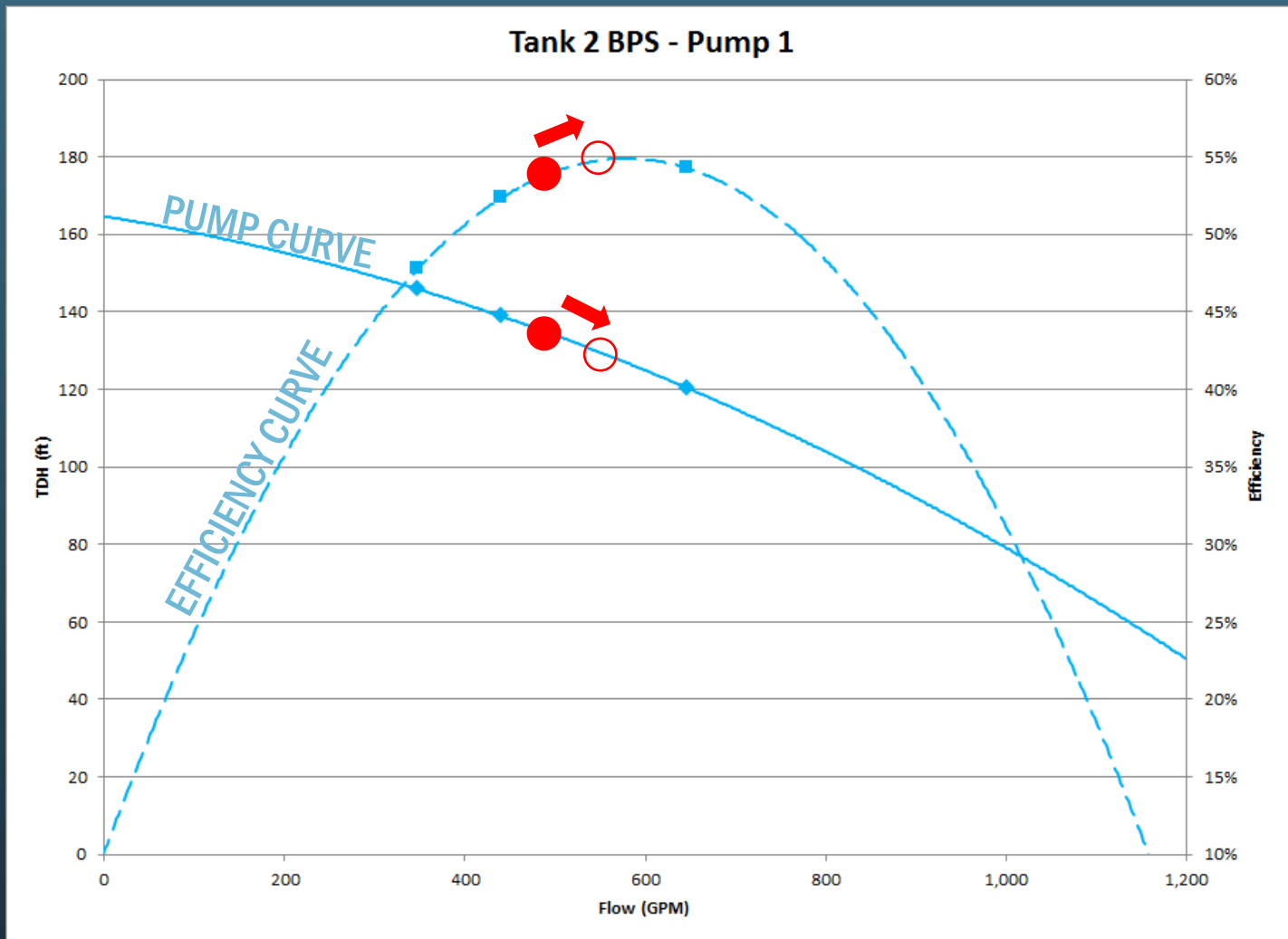
- Grant funding provided by Bonneville Power Administration
- Studied 4 water systems of various sizes
- Visited 87 sites
- Collected data and evaluated 170 different pumps



PRESSURE OPTIMIZATION



PUMP CURVE ANALYSIS



POWER BILL ANALYSIS



SUMMER 2006 AND 2007 BILLING COMPARISON

	Summer 2006		Summer 2007	
Customer Charge		\$ 24.90		\$ 27.20
Energy Charge	20,000 KWHS @ \$.068036 Per KWH	\$ 1,360.72	20,000 KWHS @ \$.074782 Per KWH	\$ 1,495.64
Energy Charge	116,600 KWHS @ \$.054888 Per KWH	\$ 6,399.94	93,760 KWHS @ \$.060754 Per KWH	\$ 5,696.30
Demand Charge	50 KW @ \$.00 Per KW	\$ 0.00	50 KW @ \$.00 Per KW	\$ 0.00
Demand Charge	159.28 KW @ \$5.24 Per KW	\$ 834.63	155.44 KW @ \$5.54 Per KW	\$ 861.14
Reactive Power Charge	66,360 KVRH @ \$.00253 Per KVRH	\$ 167.89	46,400 KVRH @ \$.00265 Per KVRH	\$ 122.96
Electric Conservation Program Charge	136,600 KWHS @ \$.001406 Per KWH	\$ 192.06	136,600 KWHS @ \$.001406 Per KWH	\$ 190.89
Power Cost Adjustment	136,600 KWHS @ \$.008066 Per KWH	\$ 1,101.82	113,760 KWHS @ \$.00 Per KWH	\$ 0.00
Wind Power Production Credit	136,600 KWHS @ \$.000650CR Per KWH	\$ 88.79CR	113,760 KWHS @ \$.001415CR Per KWH	\$ 160.97CR
Current Electricity Charges		\$ 9,993.17		\$ 8,233.16



AC PIPE EVALUATION



RH2 analyzed the existing asbestos cement pipe to determine true condition and load carrying capacity.

CONSTRUCTION EQUIPMENT LOADS

Caterpillar 14M Motor Grader

<http://www.cat.com/cmms/images/C201836.pdf>

Has 6 tires (1 tandem rear axle, 1 front axle)

Max Gross Vehicle Weight

Total 65,998 lbs.

Front Axle 21,912 lbs.

Tandem Rear Axle 44,086 lbs.

Front Axle Single Wheel Load = 10,956 lbs.

Tandem Single Wheel Load = 11,022 lbs.

Tandem Axle Wheelbase 65 in.

Front Tires to Rear Axle Wheelbase 258 in.

Width between Tire Center Lines 93 in.

Caterpillar 385C L Hydraulic Excavator

<http://www.cat.com/cmms/images/C400866.pdf>

Has 2 tracks

Approx. Operating Weight 192,000 lbs.

Ground Track Length 16.83 ft.

Track Width 30 in.

Width between Track Center Lines 9 ft.

Track Load = 5,704 lbs./ft. track length

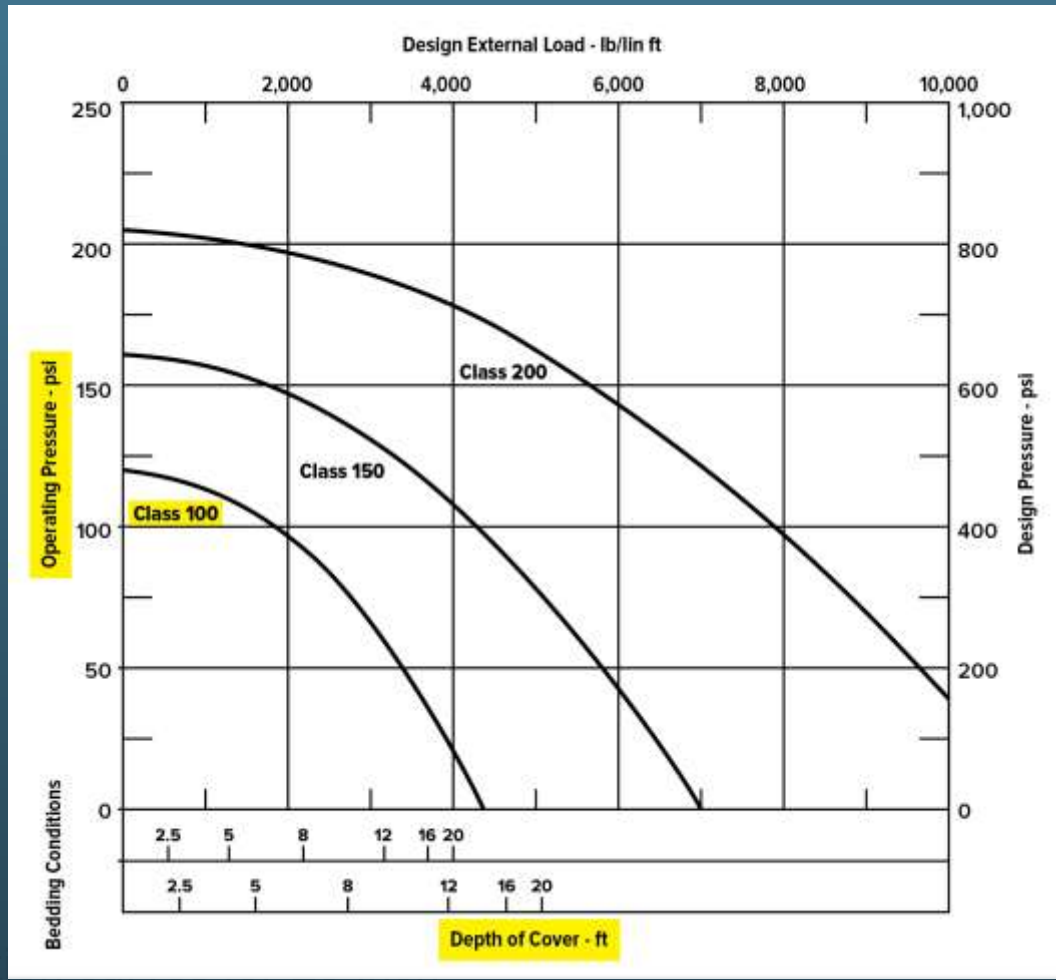
DESIGN EXTERNAL LOAD LIMITS

Pg. 23 AWWA C401-93 - Figure 14B 6" Class 100 AC Pipe			
Operating Water Pressure:		100 psi	
Reduced Water Pressure (1):		60 psi	
Reduced Water Pressure (2):		40 psi	
Design External Load Limits (lbs. per lineal ft. of pipe):			
At operating pressure	At 60 psi pressure	At 40 psi pressure	No water in pipe
1,150	2,600	3,150	4,000

Pg. 24 AWWA C401-93 - Figure 14C 8" Class 100 AC Pipe			
Operating Water Pressure:		100 psi	
Reduced Water Pressure (1):		60 psi	
Reduced Water Pressure (2):		40 psi	
Design External Load Limits (lbs. per lineal ft. of pipe):			
At operating pressure	At 60 psi pressure	At 40 psi pressure	No water in pipe
1,500	2,800	3,200	4,000

Pg. 25 AWWA C401-93 - Figure 14D 10" Class 100 AC Pipe			
Operating Water Pressure:		100 psi	
Reduced Water Pressure (1):		60 psi	
Reduced Water Pressure (2):		40 psi	
Design External Load Limits (lbs. per lineal ft. of pipe):			
At operating pressure	At 60 psi pressure	At 40 psi pressure	No water in pipe
1,900	3,100	3,600	4,400

LOAD BEARING CAPACITY



TECHNIQUES

Initiating pressure management techniques in your system

- Start small – focus on one pressure zone
- Review pressure and fire flow requirements in zone
- Closed zones
 - Perform hydraulic analyses
- Zones with storage
 - Perform storage analysis calculations and hydraulic analyses
- Adjust pump set points in small increments, preferably starting during low demand periods (typically night) to reduce system pressures



SUMMARY

- Small pressure reductions are a cost effective method to reduce water loss
- Pressure management can reduce pumping and treatment costs
- Pressure management can reduce the potential for AC main breaks
- Analytically determine facility setpoints

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QUESTIONS?
