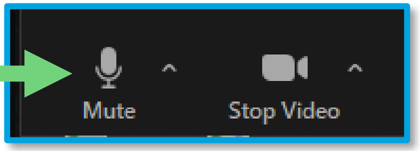
Using Zoom!

Mute yourself!

Have a question?
Use the chat feature or unmute.

Controls accessed at the bottom



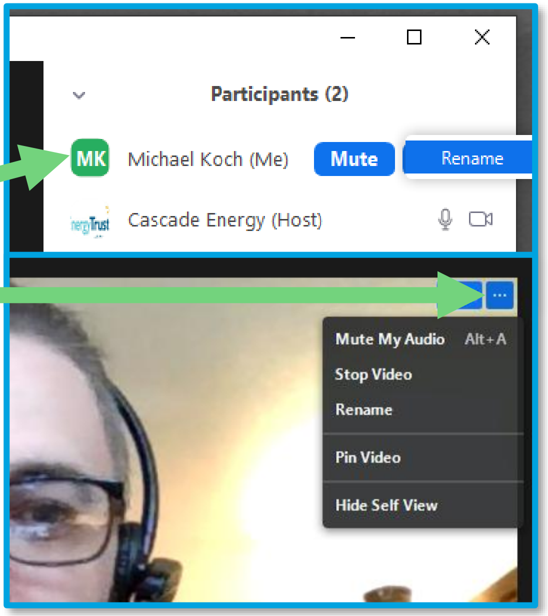
Rename yourself

“Name (Company)”

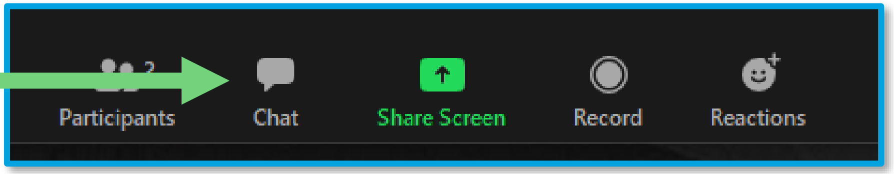
Right click on your picture or 3 dots

OR

Controls accessed at the right after clicking ‘Participants’ at bottom.



Access Chat at the bottom



Recording

This meeting is being recorded (both audio and video)

If you do not consent to being recorded, please let the meeting moderator know ASAP and we will facilitate your participation in another way or adjust our procedure.

WATER VIRTUAL IN-PLANT (VINPLT) TRAINING

Session 6

Thank You!

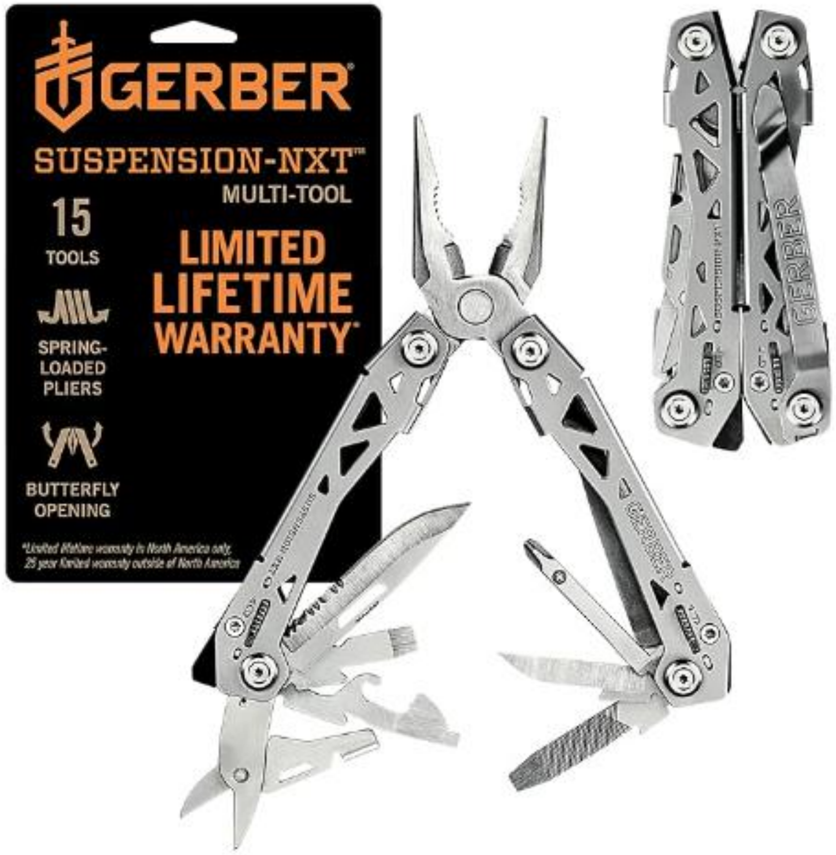
Sponsor:

Better Plants
U.S. DEPARTMENT OF ENERGY

Week 6: Hydraulic Modeling, Energy Efficient Design and Capital Projects

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Final Kahoot Prizes!



Training Schedule Overview

Week	Date and Time	Content
Week 1	Oct 2, 2025 10:00 AM ET	Introduction, Energy Basics, & Power Company Relationships
Week 2	Oct 9, 2025 10:00 AM ET	Water Source Selection, KPIs, and Energy Teams
Week 3	Oct 16, 2025 10:00 AM ET	Water Treatment Energy Opportunities, the 5 L’s
Week 4	Oct 23, 2025 10:00 AM ET	The 5L’s (cont’d), Treasure Hunts
Week 5	Oct 30, 2025 10:00 AM ET	Pumps
Week 6	Nov 6, 2025 10:00 AM ET	Hydraulic Modeling, Energy-Efficient Design and Capital Projects
Week 7	Nov 13, 2025 10:00 AM ET	Persistence Strategies
Week 8	Nov 20, 2025 10:00 AM ET	Closeout

HOMEWORK RECAP

POLL

WEEK 8 PRESENTATIONS

Drinking Water Systems VINPLT: Close-out Presentation

Company Name:
Facility Name:
Participant Name(s):

Savings Opportunities in Water Treatment

Savings Opportunities in Source Selection

Savings Opportunities in “Leaping”

Savings Opportunities in “Looping”

Savings Opportunities in “Leaking”

Savings Opportunities in “Losing”

Savings Opportunities in “Loading”

Savings Opportunities in Pumps

Savings Opportunities from Hydraulic Model

Tips Learned from this Training

Next Steps or Action Items after the VINPLT

- What are your next steps to implement opportunities?
- What are you planning to do after the VINPLT?
- Lessons learned?

Questions and Answers

HYDRAULIC MODELING

Hydraulic Model Demos...

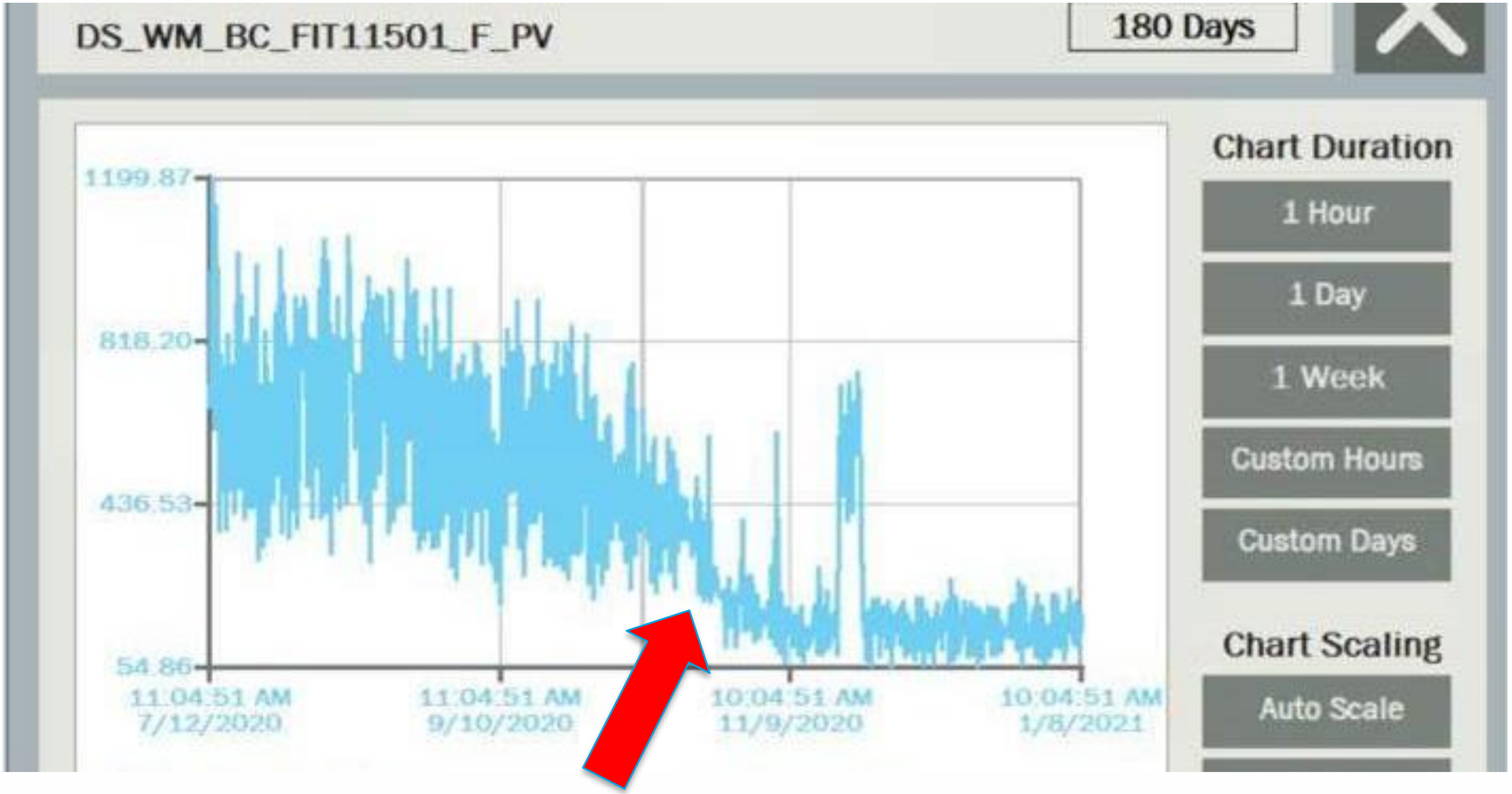
- High Pressure Areas
- Low Pressure Areas
- Broken PRV
- Pump Power
- WTP Trace
- Tank Levels

Broken PRV: How much does it cost?

- 642 gpm
- 4858 ft upstream – 4706 ft downstream = 152 ft
- Assume 75% efficiency for upstream pump

Power = (642)(152)/(3960*0.75) = 32.9 HP

(32.9 HP)(0.746 kW/HP)(24 h/d)(30 d/mo)($0.085/kWh) = **$1,502/mo**


DS_WM_BC_FIT11501_F_PV
180 Days
Chart Duration
1 Hour
1 Day
1 Week
Custom Hours
Custom Days
Chart Scaling
Auto Scale
1199.87
818.20
436.53
54.86
11:04:51 AM 7/12/2020
11:04:51 AM 9/10/2020
10:04:51 AM 11/9/2020
10:04:51 AM 1/8/2021

BREAK

ENERGY-EFFICIENT DESIGN

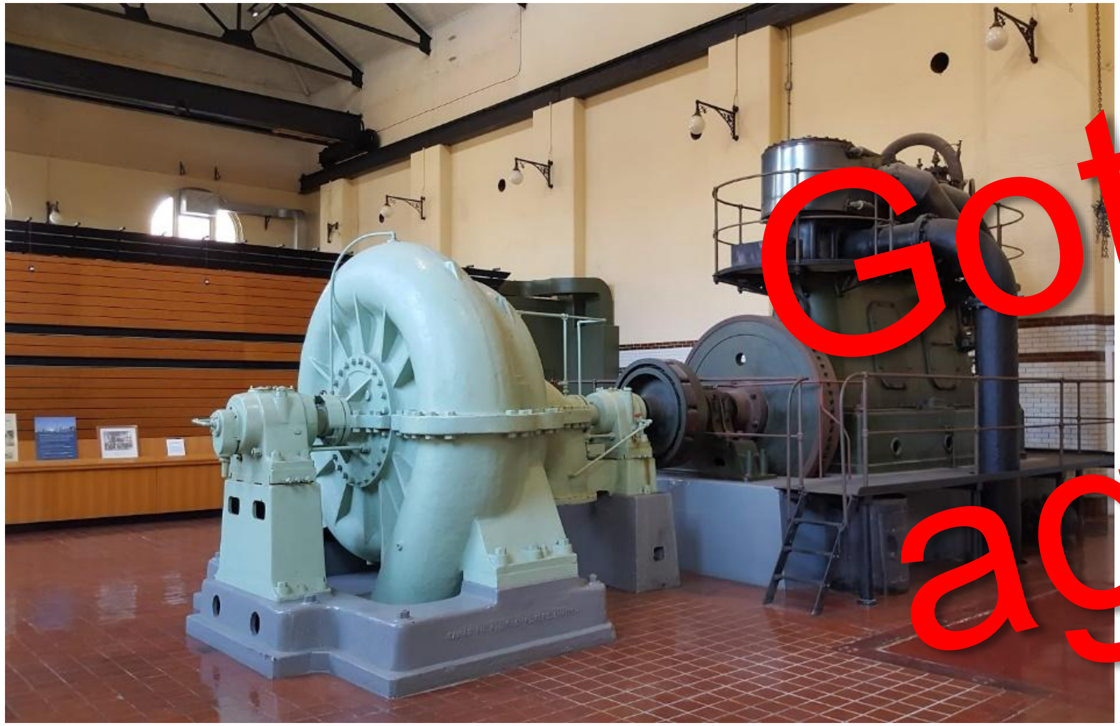
Which pump station is more efficient?

Gotcha!

A

B

Which pump station is more efficient?

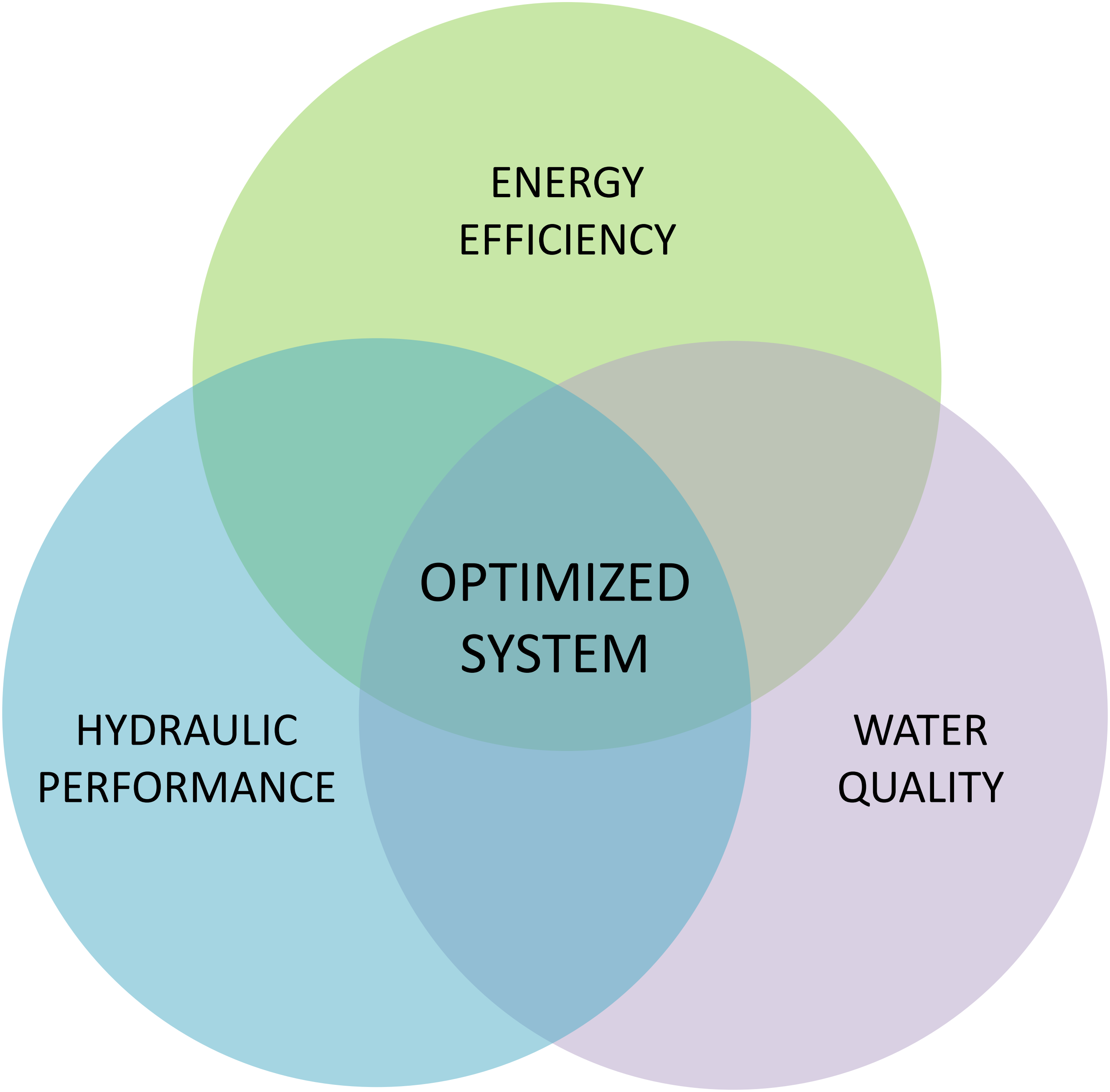


Gotcha again!

A B

You can't always SEE energy efficiency

- Much occurs before construction
- Much depends on how the facility is used, not what's in it
- Facility is just a piece of the system puzzle
- Conditions (e.g., hydraulics, climate) vary



Jones and Sowby, "Water System Optimization" (*Journal AWWA*, June 2014)

Overview

Planning

Energy analysis

Layout

Equipment

Monitoring

Planning

- Evaluate master planned projects
  - Typically developed with historic system function
  - Not developed with energy efficiency in mind
  - May modify or eliminate master planned projects
- Is this the right project?

Planning

- What's the range of operating conditions?
  - Existing, future
  - Peak day, winter
- Consider energy efficiency
  - Does an alternative minimize energy cost?
  - Or reduce/eliminate other capital projects?
- Extended-period simulation (EPS) hydraulic model

Case Study: Logan City, Utah

LOGAN
CITY UNITED IN SERVICE

Logan City Water System

- Population 50,000
- Utah State University
- >10,000 metered connections
- 190 miles of mainline
- 1 spring and 4 deep wells

Problems

- Deteriorating infrastructure
- Many mainline breaks: over 300 per year
- High pressures: over 220 psi
- Water shortage in summer
- High pumping costs
- Reactionary, rather than proactive, operations

Specific System Performance Goals

- Minimize pressure fluctuations
- Maximize storage use
- Eliminate unnecessary pumping
- Eliminate unnecessary PRV flow
- Improve water quality
- Minimize pumping costs

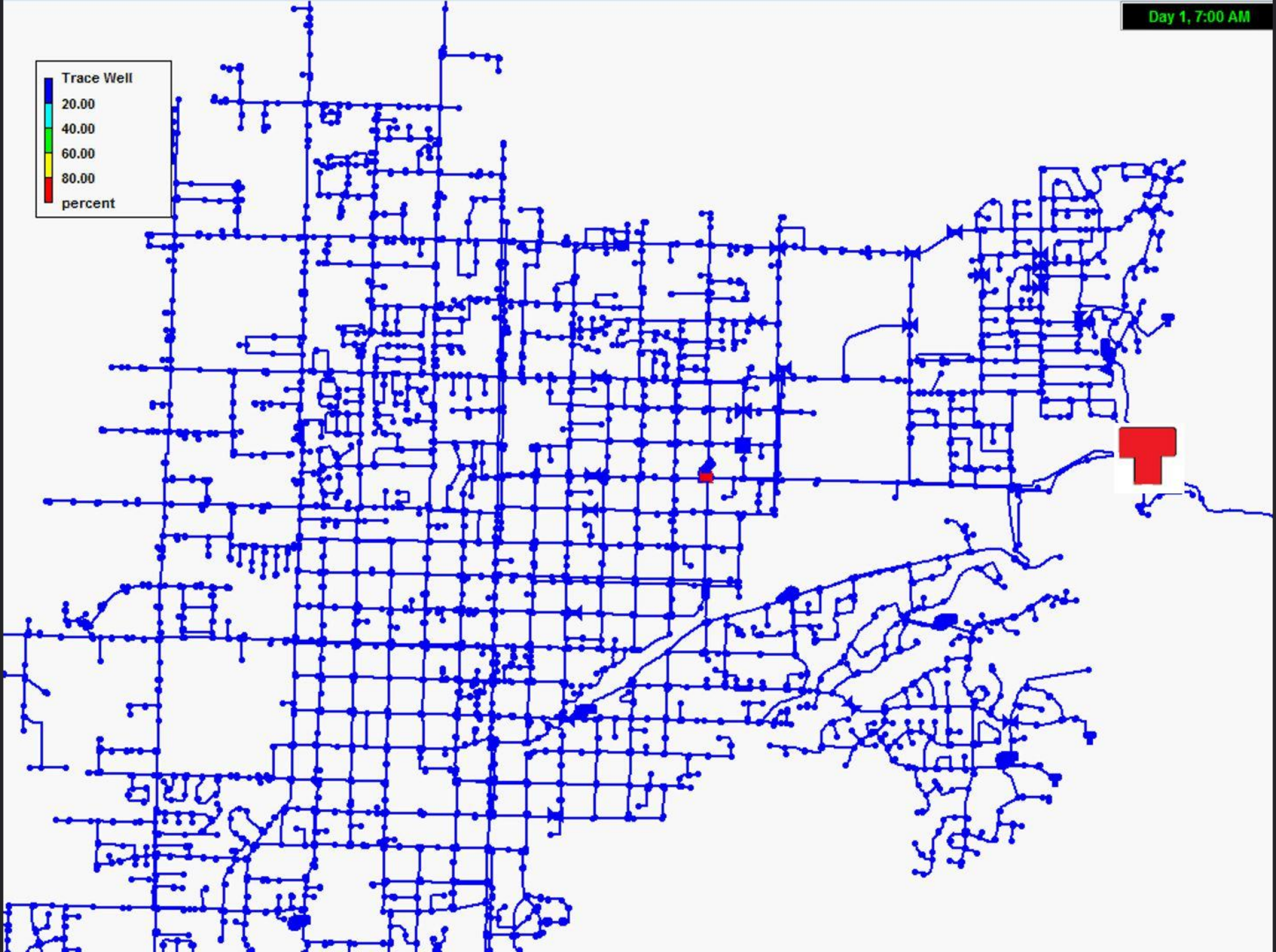
Initial Scope (RFQ)

Well

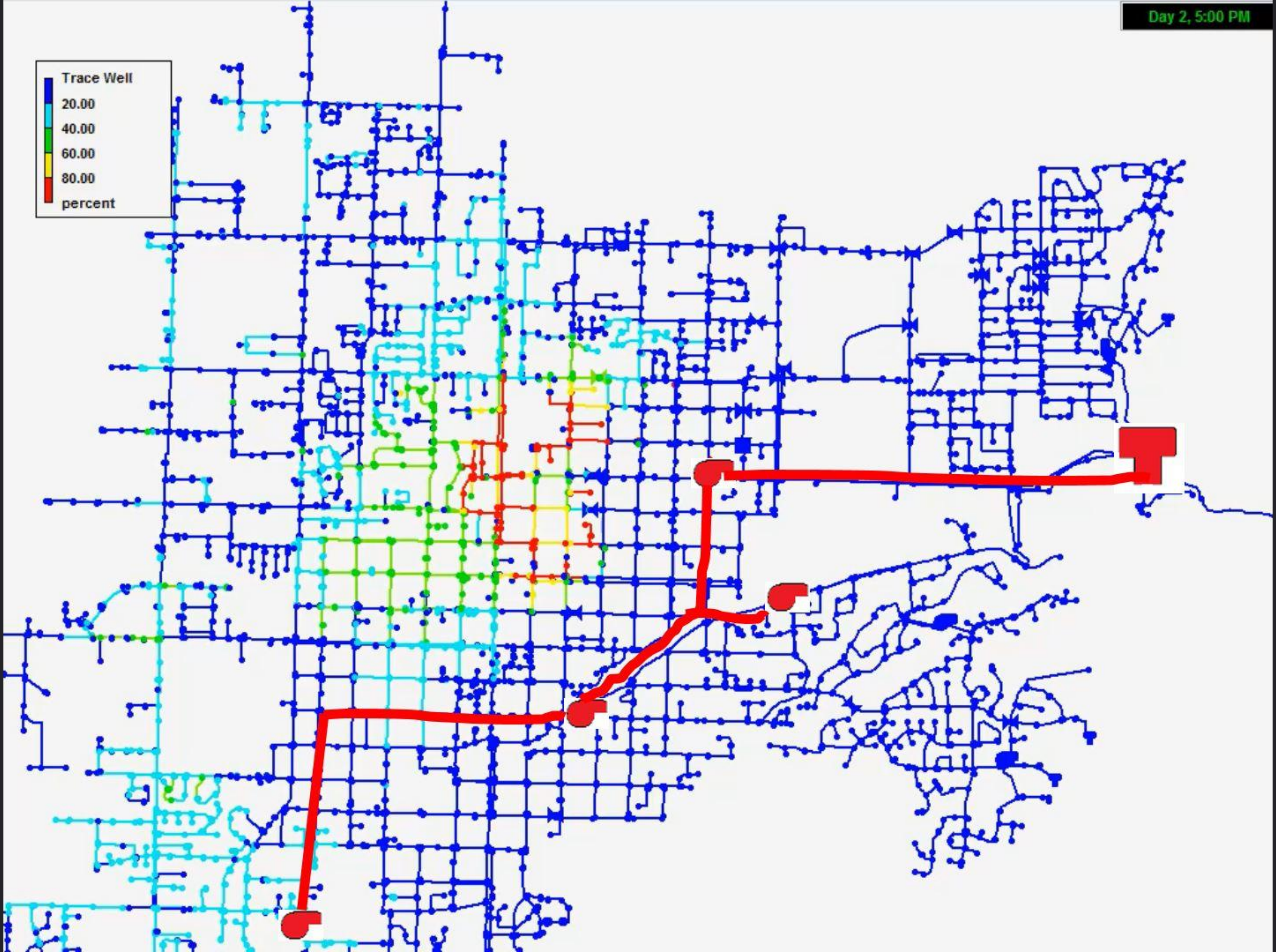
Transmission line

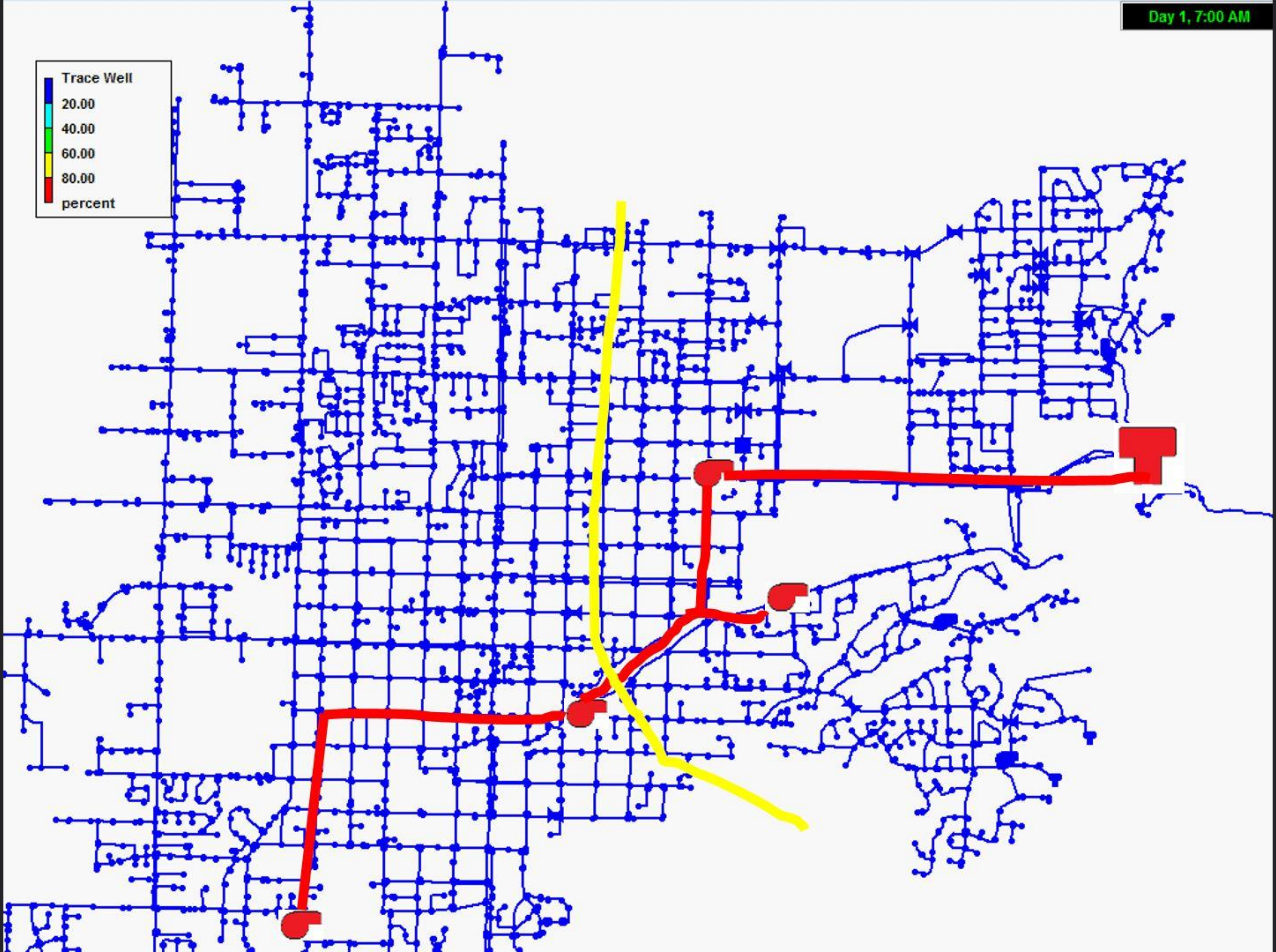
Actual Scope

- ~~Well~~
- ~~Transmission line~~
- Hydraulic modeling
- Audit of water & energy use
- New pressure zone
- Well pump station retrofits
- Minor transmission upsizing
- Efficient operation

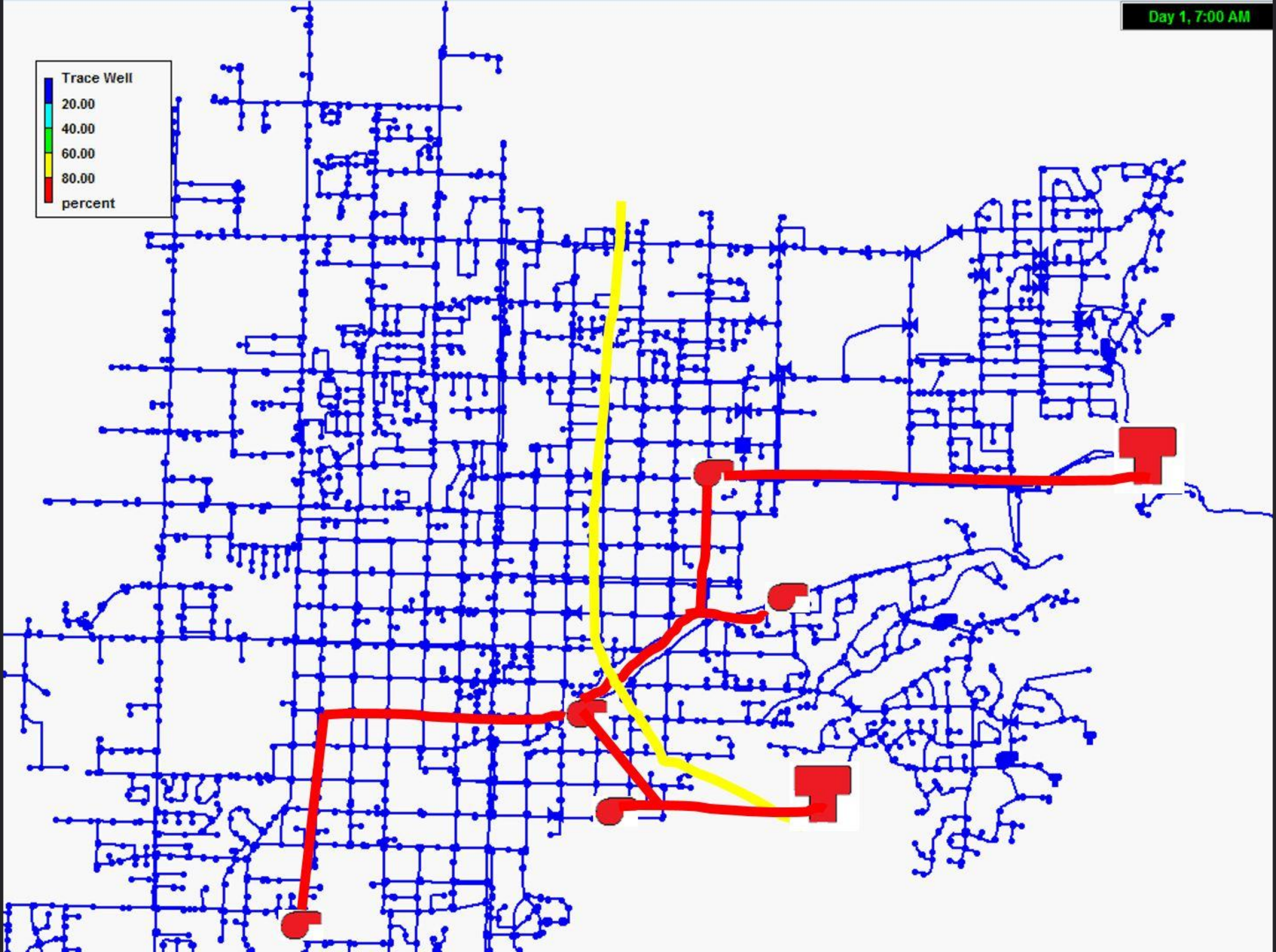


Day 1, 7:00 AM
Trace Well
20.00
40.00
60.00
80.00
percent

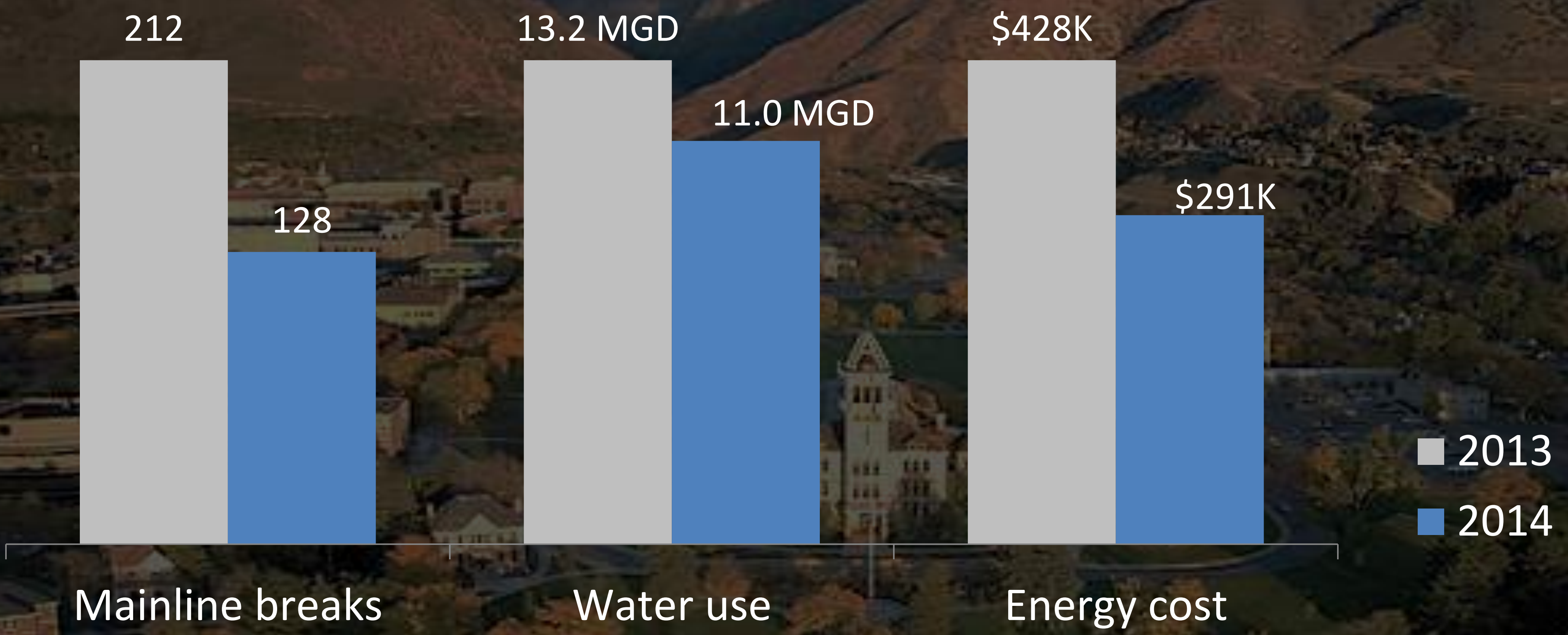

Day 2, 5:00 PM
Trace Well
20.00
40.00
60.00
80.00
percent



Day 1, 7:00 AM
Trace Well
20.00
40.00
60.00
80.00
percent


Day 1, 7:00 AM
Trace Well
20.00
40.00
60.00
80.00
percent

Project Results



↓ 40%

↓ 17%

↓ 32%

City-Identified Benefits

- Less water wasted = Less energy and money wasted
- Fewer pressure complaints
- Preventive maintenance occurring
- Crew attitudes improved
- Safer working environment – lower pressures
- Eliminated the need for a $3 million transmission project
- Postponed construction of new water source

Paul Lindhardt, W/WW Manager

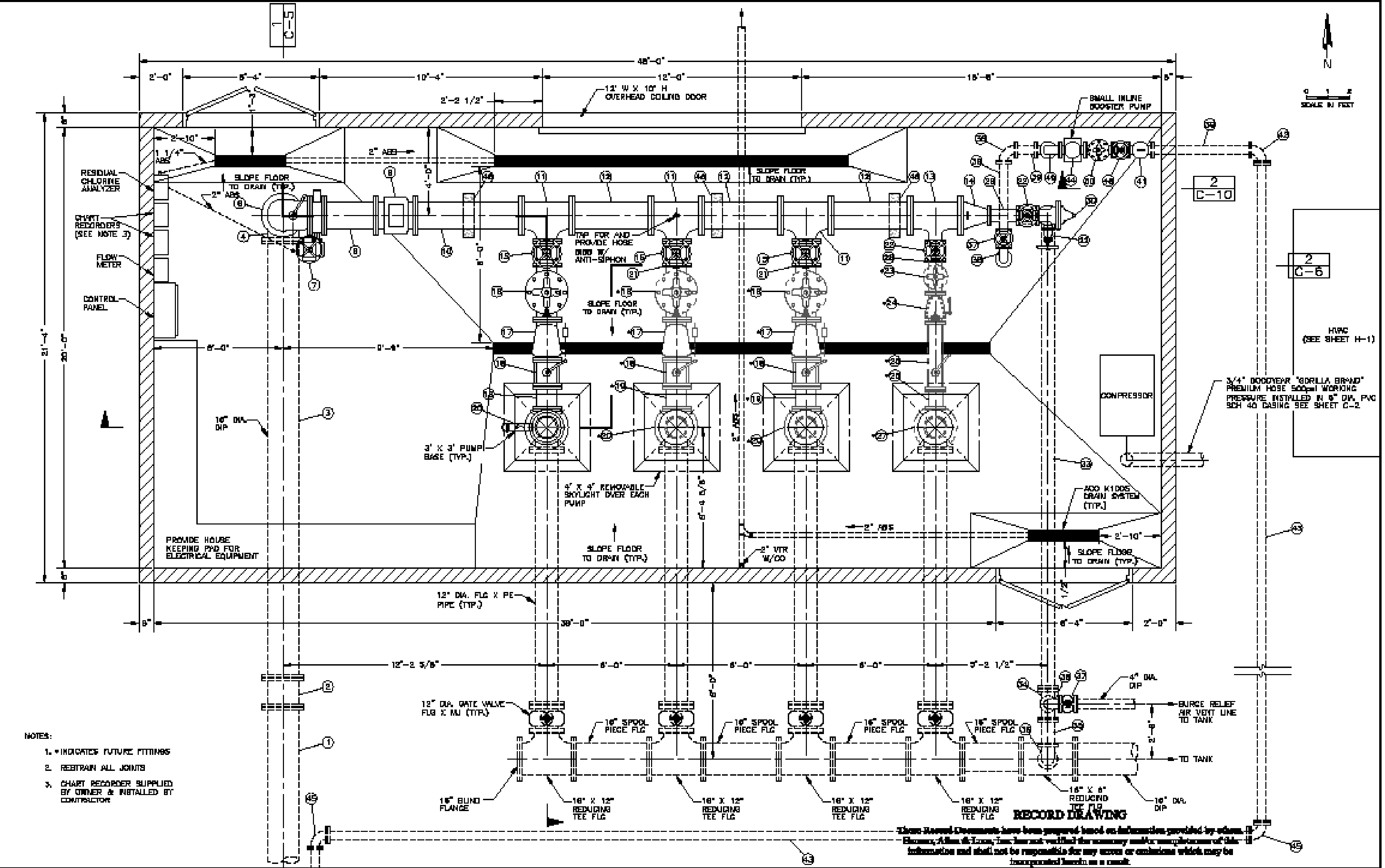
The savings and operational efficiency have continued each year since 2013. … The payback period for this project will be shorter than projected.

Energy Analysis

- Include energy analysis in engineer's scope!
  - Otherwise it won't happen
  - How much will it cost to operate?
  - Look beyond capital costs
- Pumping components
- Building components

Layout

- Pump array of different sizes
  - Efficiently handle range of water demands
  - Jockey pump—small, efficient, constant
- Bays for future pumps
- Space for VFD and other controls



NOTES:

1. * INDICATES FUTURE FITTINGS
2. RESTRAIN ALL JOINTS
3. CHART RECORDER SUPPLIED BY OWNER & INSTALLED BY CONTRACTOR

RECORD DRAWING

These Record Documents have been prepared based on information provided by others. Hansen, Allen & Luce, Inc. has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

DESIGNED VGC	3			
DRAFTED SDN	2			
CHECKED MEA	1	04/2008	RECORD DRAWING	SDN VGC
DATE SEPTEMBER 2006	NO.	DATE	REVISIONS	BY APPR.

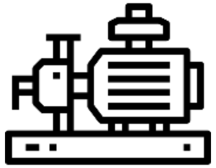
PROJECT ENGINEER

SCALE: AS SHOWN

ANDRA BOOSTER PUMP STATION
CIVIL
FLOOR PLAN

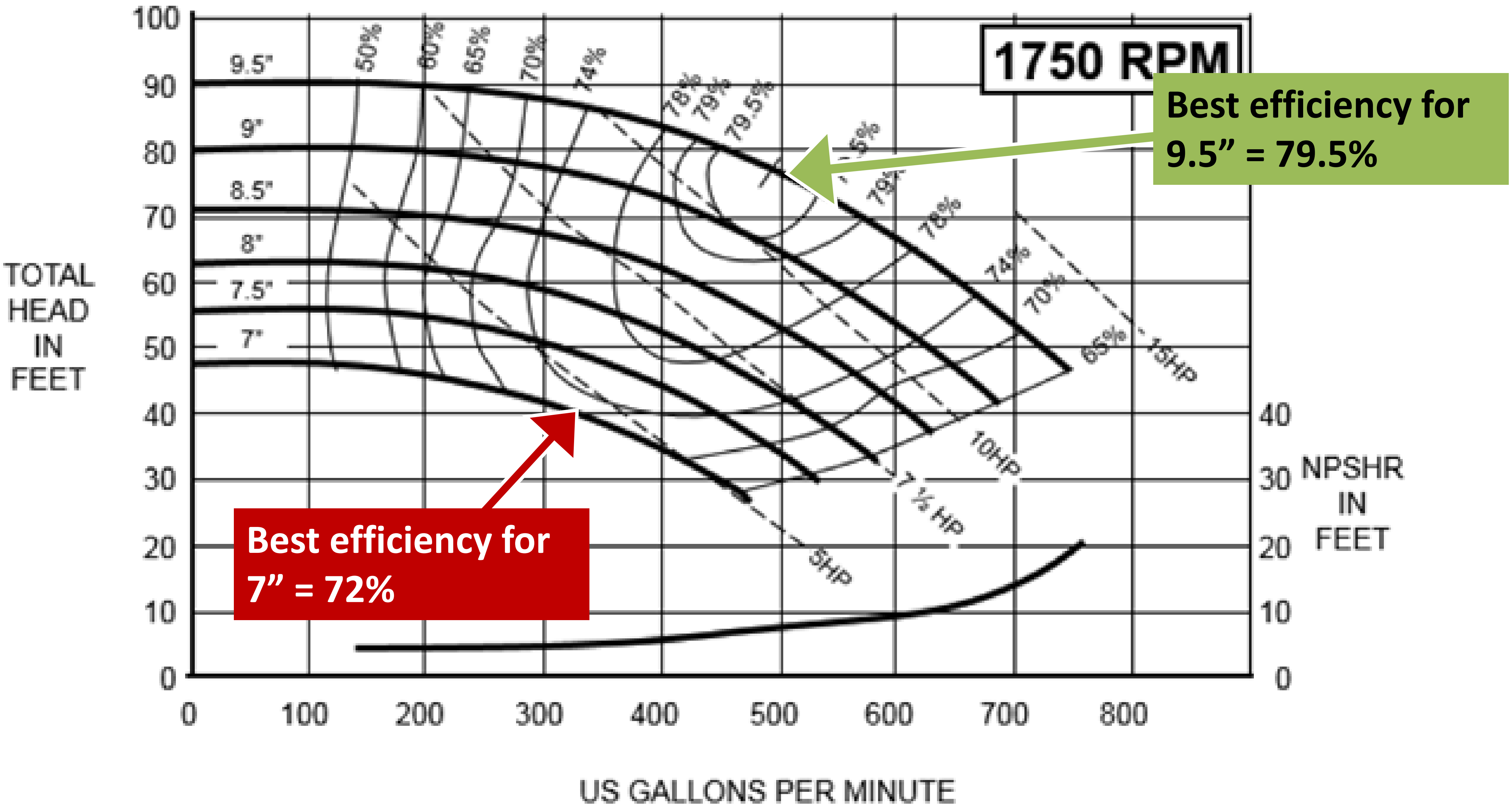
SHEET C-4

019.33.200

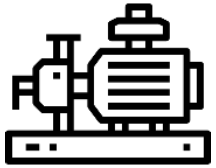


Equipment

- Premium high-efficiency motors
- Avoid oversizing pumps and motors
  - Worst-case condition?
  - Safety factor applied at every step?
- Largest impeller for given pump casing
  - Smaller gap between casing and impeller
  - More power applied to fluid
  - Higher efficiency

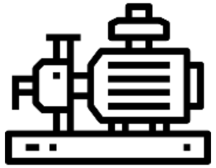


1750 RPM
Best efficiency for 9.5" = 79.5%
Best efficiency for 7" = 72%
TOTAL HEAD IN FEET
NPSHR IN FEET
US GALLONS PER MINUTE
9.5"
9"
8.5"
8"
7.5"
7"
50%
60%
65%
70%
74%
78%
79%
79.5%
5HP
7 ½ HP
10HP
15HP
0
100
200
300
400
500
600
700
800
10
20
30
40
50
60
70
80
90



Equipment

- Variable Frequency Drive (VFD)
  - Control flow rate
  - Respond to varying water demands
  - Maintain high efficiency
  - Bypass at full speed
  - Also for mixers and other treatment equipment

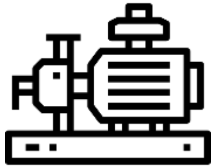


Equipment

- Flow meter
  – Please!
- Suction and discharge pressure gages
  – Total dynamic head when pump is running
- Power submeter for major components
  – E.g., well + booster


SIEMENS
SITRANS F
3163
2718
4122.71
3492.32
VALVE-2
VALVE-1
OPEN
STOP
CLOSE
SIEMENS

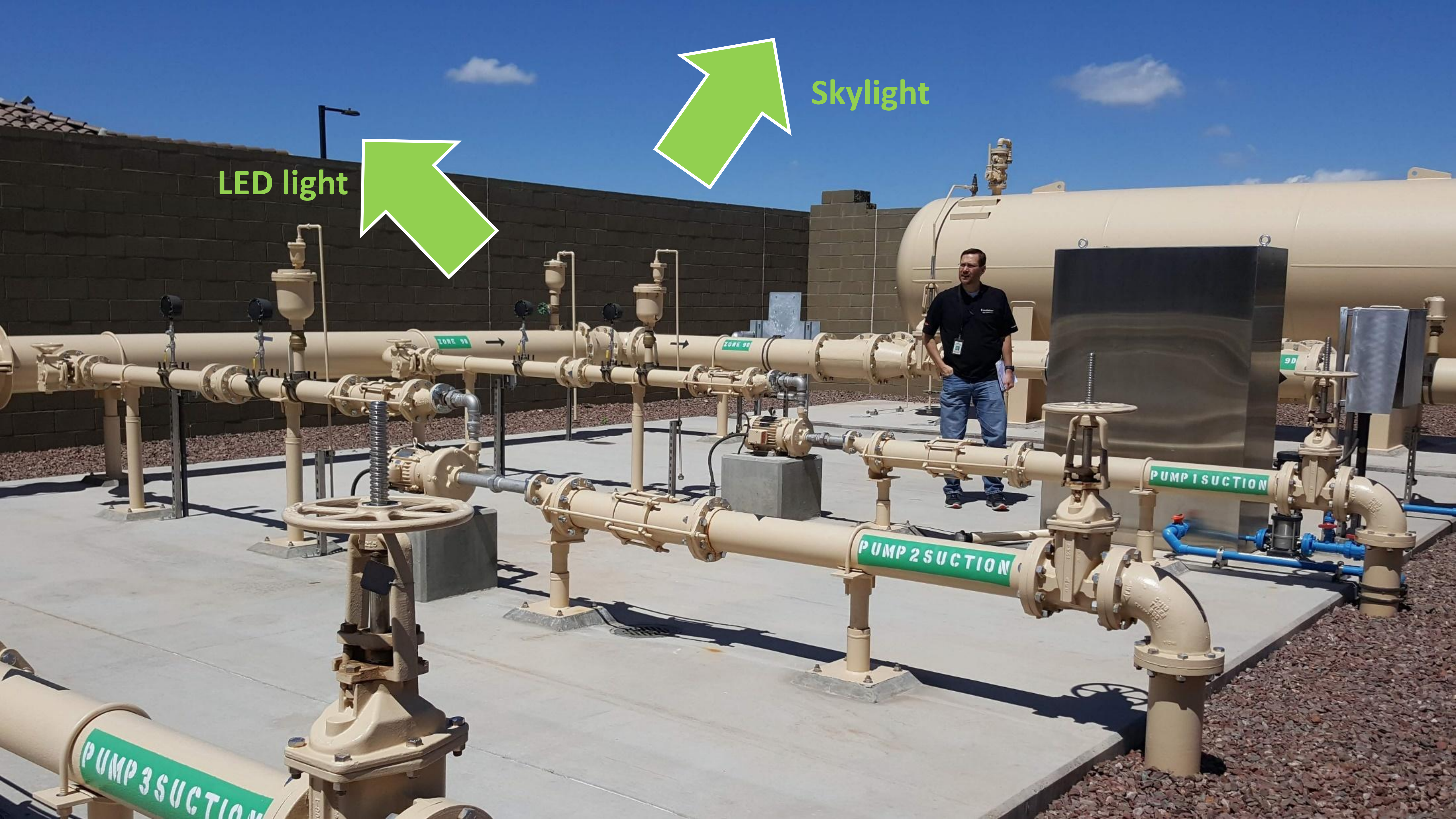
kV2c
Multifunction Meter
PACIFICORP
55 317 094
DANGER
Do NOT Remove Meter –
Current Transformers in Circu
CAUTION
480



Equipment

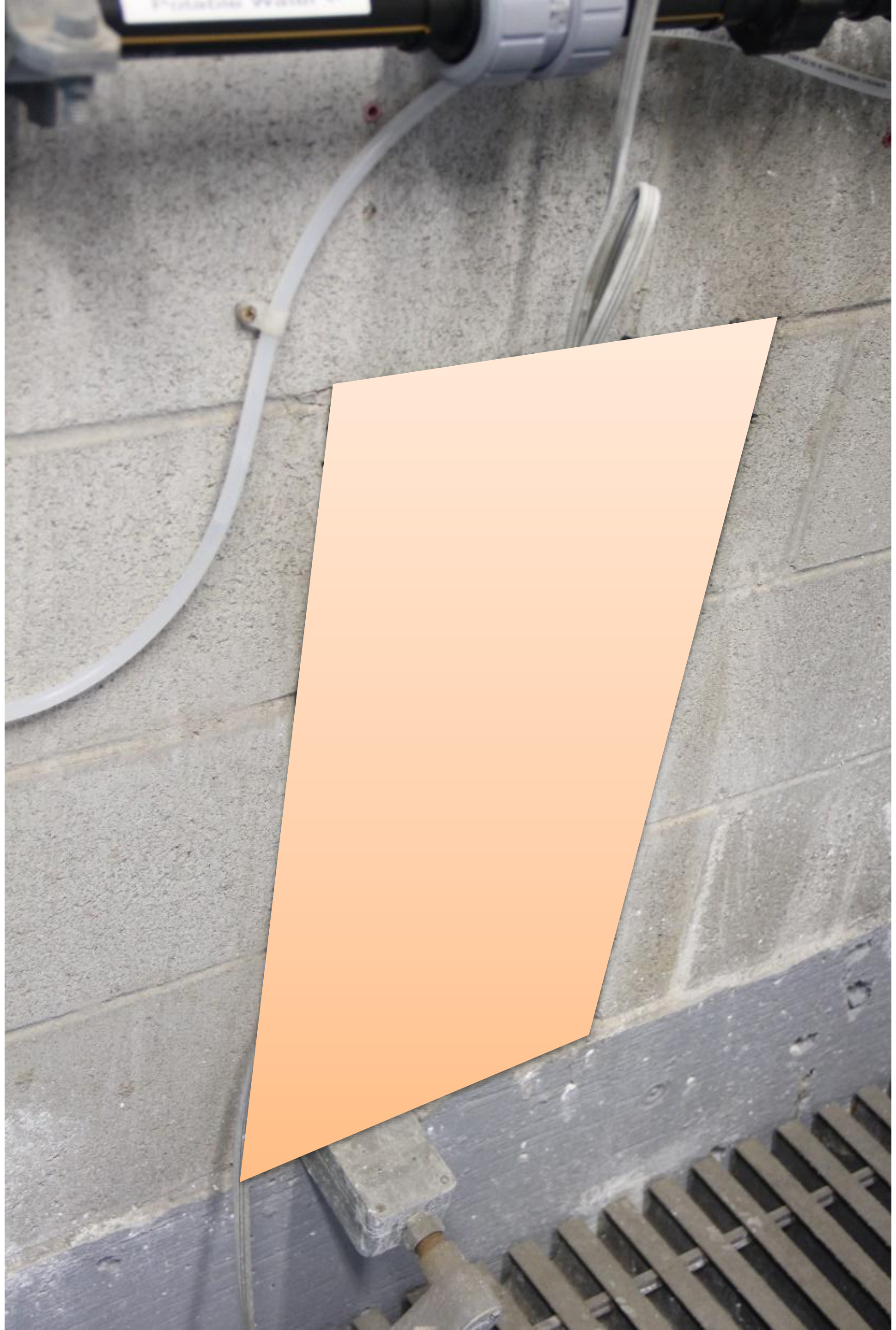
- Other
  - Skylights
  - LED lights
  - Occupancy sensors or timers
  - Programmable HVAC
  - Fans (high volume, low speed)
  - Insulation over vents and hatches when winterized


Creepy old light
← with spider webs


Skylight
LED light
PUMP 1 SUCTION
PUMP 2 SUCTION
PUMP 3 SUCTION

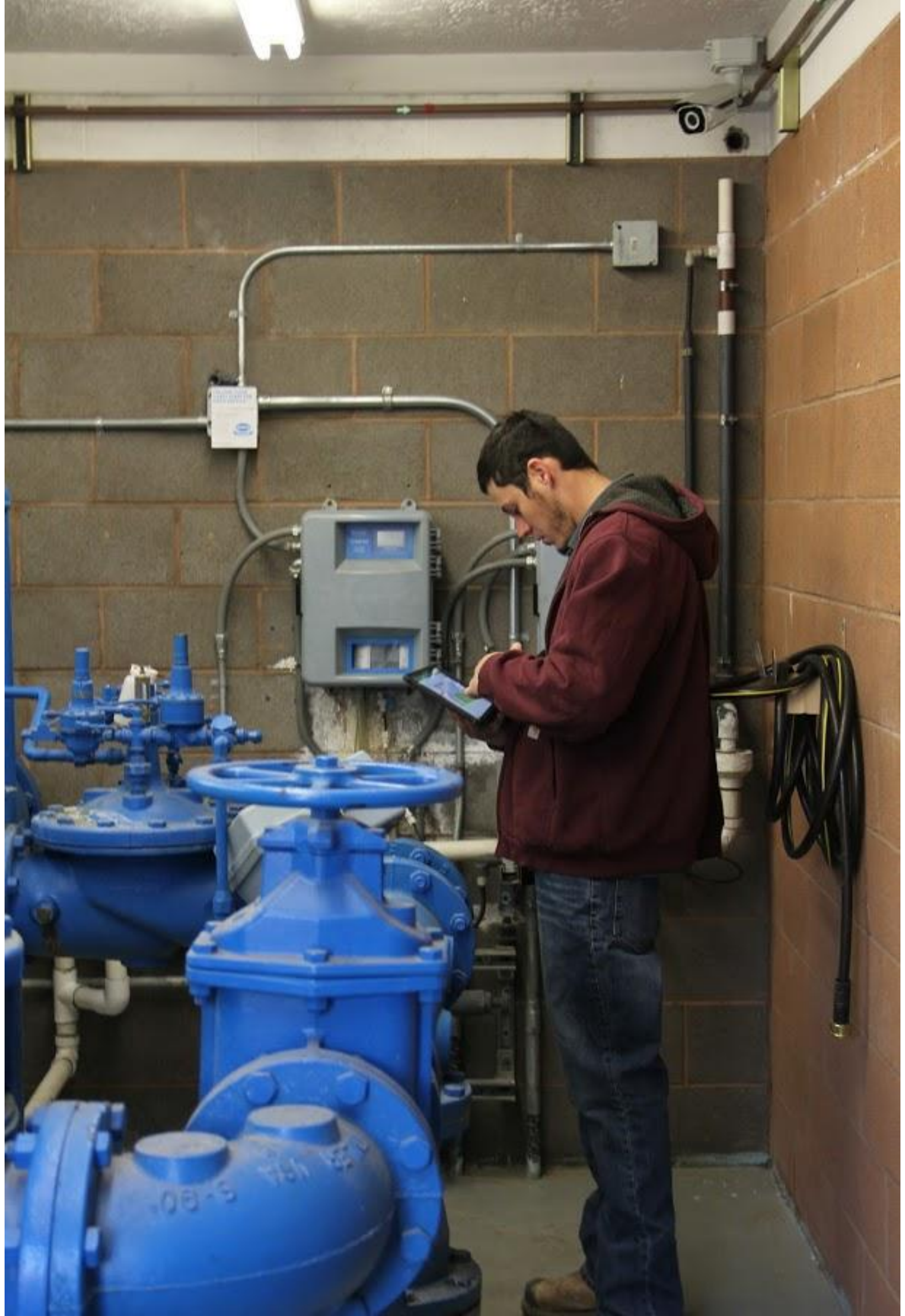

LO


TRANE
FAN
AUTO
74
6:30
76
DONE
LEAVE
RETURN
SLEEP
CANCEL



Monitoring

- Pump curves (or at least make and model)
  - Pump and motor inventory
- Power meter number/account
  - Match to facility
  - Facilitate customer service and engineering



Monitoring

- Annual performance review
  - "How do you know if your pumps are stealing from you?"
  - Use flow, pressure, and energy data to evaluate performance
  - Does it match design?
  - Informs action

Monitoring: Efficiency vs. Intensity

- Energy Efficiency
  - Equipment
  - 0%–100%
  - High value good
- Energy Intensity
  - Facility or system
  - kWh/MG
  - Low value good

Example: Performing as Expected?

Favorite Greek letter

$$\eta = \frac{Qh}{3960P}$$

- Design: 79% wire-to-water efficiency
  - 84% pump efficiency
  - 94% motor efficiency
- Actual:
  - 1,000 gpm
  - 210 ft TDH
  - 75 kW = 100 HP

$$\eta = \frac{(1000)(210)}{3960(100)}$$

$$\boldsymbol{\eta = 53\%}$$

Which water well will want what watts when working?

Well 1
750,000 kWh
300 MG

Well 2
345,000 kWh
230 MG

Well 3
252,000 kWh
120 MG

CAPITAL PROJECT INCENTIVES

Capital Projects

What Are Capital Projects?

•Long-term investments in major equipment, systems, or infrastructure improvements

•Typically involve **significant upfront costs** and **long useful lifespans**

•Aim to **improve performance, reliability, efficiency, or capacity** of a facility

•Examples include:

- Equipment replacements (e.g., blowers, pumps, mixers, compressors, drives)
- Process upgrades or automation improvements
- Major building system overhauls (HVAC, lighting, or control systems)

•Usually require **engineering design, and capital budgeting approval**

•Can qualify for **utility incentives or rebates** that help offset upfront costs and improve project payback

Capital Projects Economics

	Energy kWh/year	Savings kWh/year	Peak Demand kW	Project Cost	Incentives	Bill Savings $/year	ROI years
Baseline	4,197,797	-	-	-	-	-	-
Upgrade	3,098,332	1,099,465	126	$ 705,339	$ 62,755	$ 92,042	7.0

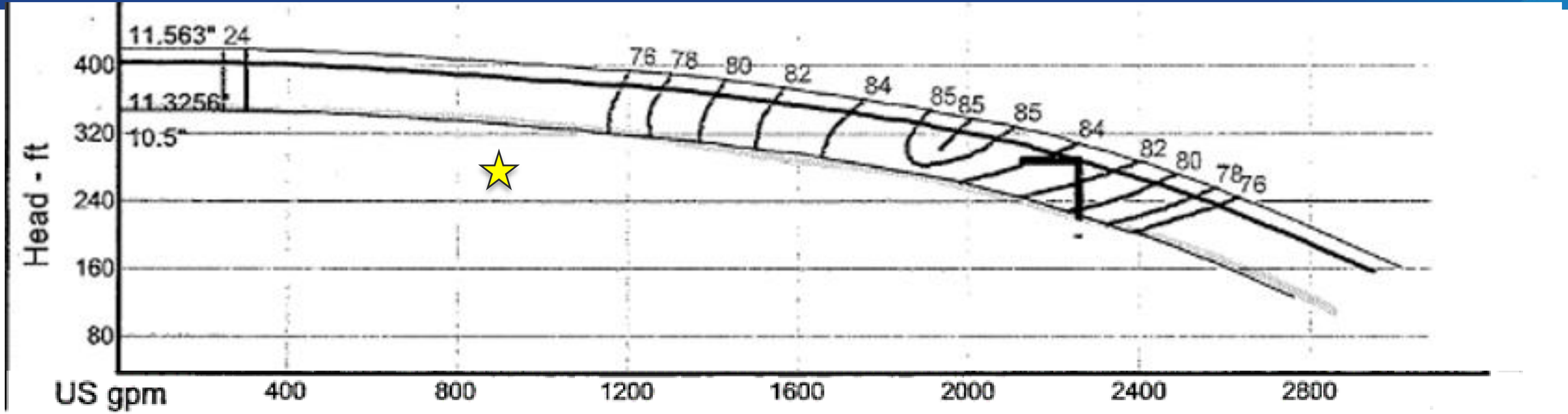
$$\text{ROI} = \frac{Project\ Cost - Incentive}{Bill\ Savings}\ \text{(Years)}$$

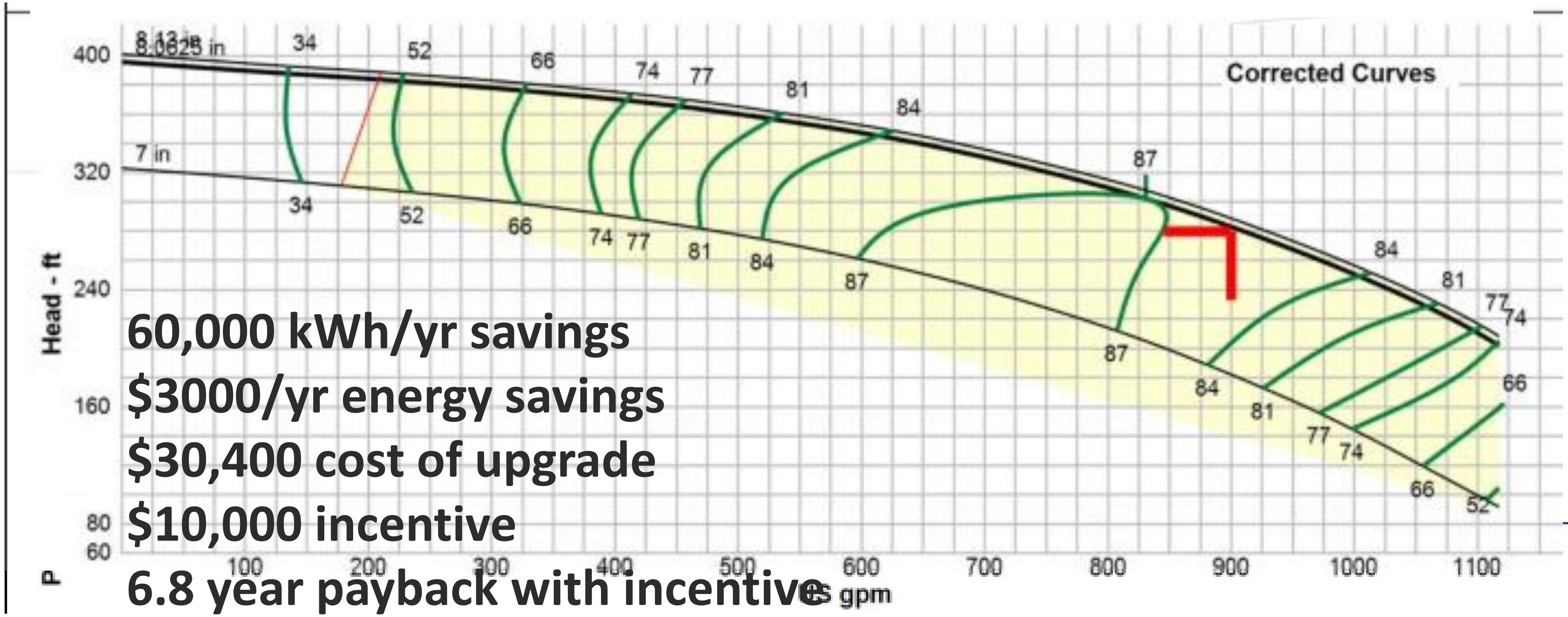
Incentives can be based on:

- $ per kWh saved
- $ per peak kW saved
- Capped at x % of total project cost

Check with your utility!

Well Pump Retrofit





60,000 kWh/yr savings

$3000/yr energy savings

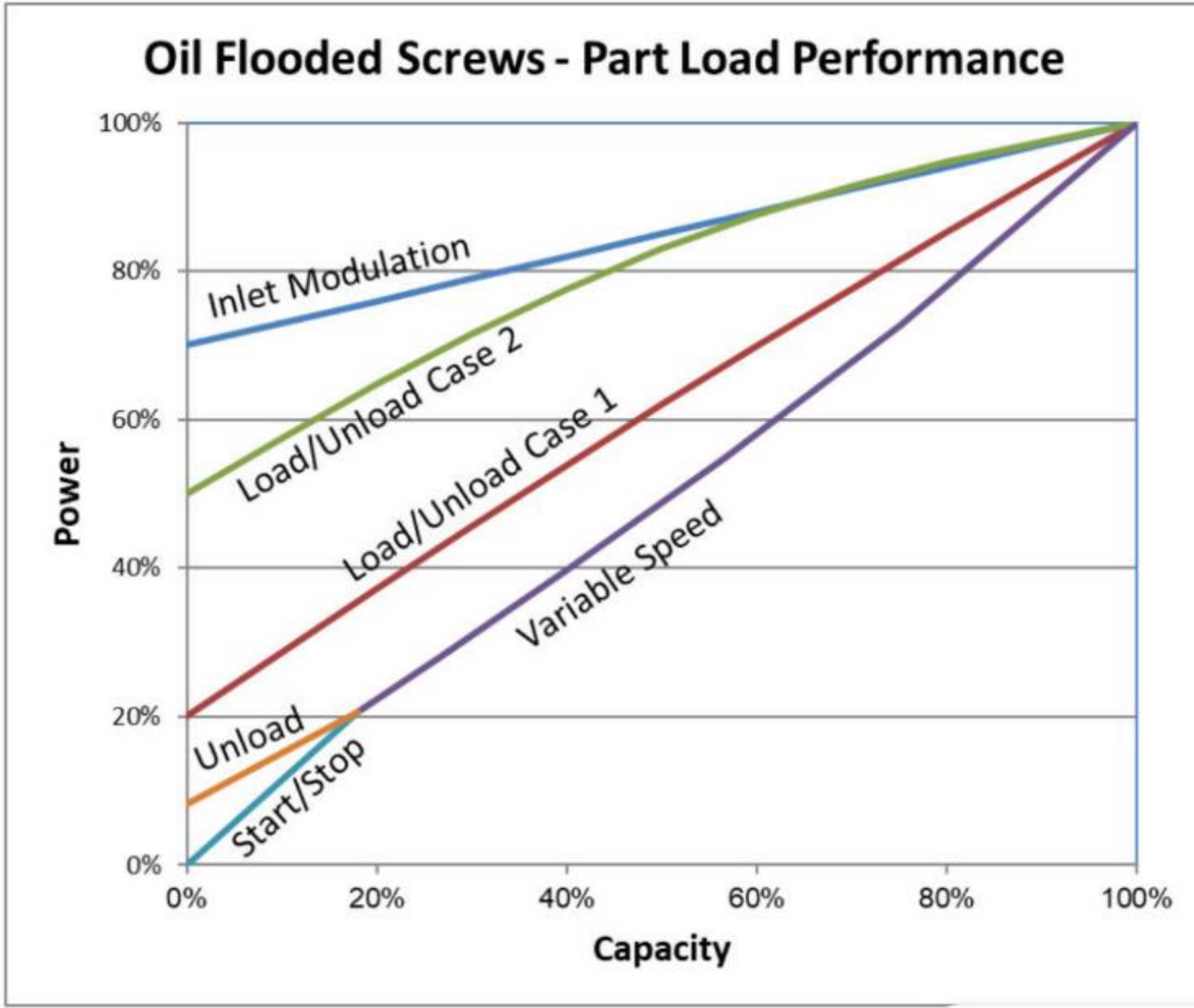
$30,400 cost of upgrade

$10,000 incentive

6.8 year payback with incentive

Water Treatment Plant Compressor Upgrade

- Baseline – Existing
  - 40 hp screw compressor with inlet modulation and non-cycling dryer
- Energy Efficient Upgrade
  - 30 hp screw air compressor with VFD with cycling dryer
    - 98,000 kWh savings
    - $17,000 incentive
    - Payback without incentive 5.6 years
    - Payback with incentive 2 years



New UV system

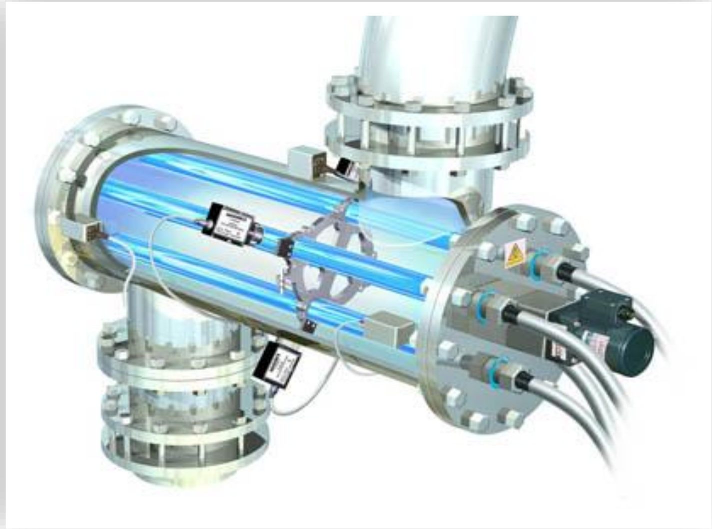
Theoretical Baseline

The baseline used for this project is the new TrojanUVsigna system without **UV transmittance and flow** controller and sensor. For this reason, the baseline system is not able to modulate power depending on UV transmittance.

Upgrade

TrojanUVsigna with UV transmittance sensors: **Banks are turned on/off based on UV demand and flow**. The advanced Solo Lamp Driver enables lamp dimming from 100 to 30% power and has built-in diagnostic capabilities for easy troubleshooting.

	Energy kWh/year	Savings kWh	Peak Demand kW	Project Cost	Incentives	Bill Savings $/year	ROI years
Baseline	630,720	-	-	-	-	-	-
Upgrade	214,856	415,864	18	$ 28,217	$ 8,877	$ 18,500	1.05



On your smart phone
Go to: https://kahoot.it/
Game PIN:

KAHOOT!

Takeaways

- If you have a hydraulic model – use it
- Design and plan for upgrades/replacements with energy efficiency in mind
- Reach out to your power provider about incentives when you are considering new equipment

Closing

Questions
Comments
Discussion

Email Giulia, Katie or Mike
giulia.pollastri@cascadeenergy.com
katie@halengineers.com
mike.lewis@cascadeenergy.com

SEE YOU THURSDAY!

aquafficiency
Saving energy, one gallon at a time

Q&A Session

Questions?