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Advancements in ASR Well Design and Operations- City of Phoenix Case Study

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City of Phoenix Service Area

97% Surface
Water - Potable

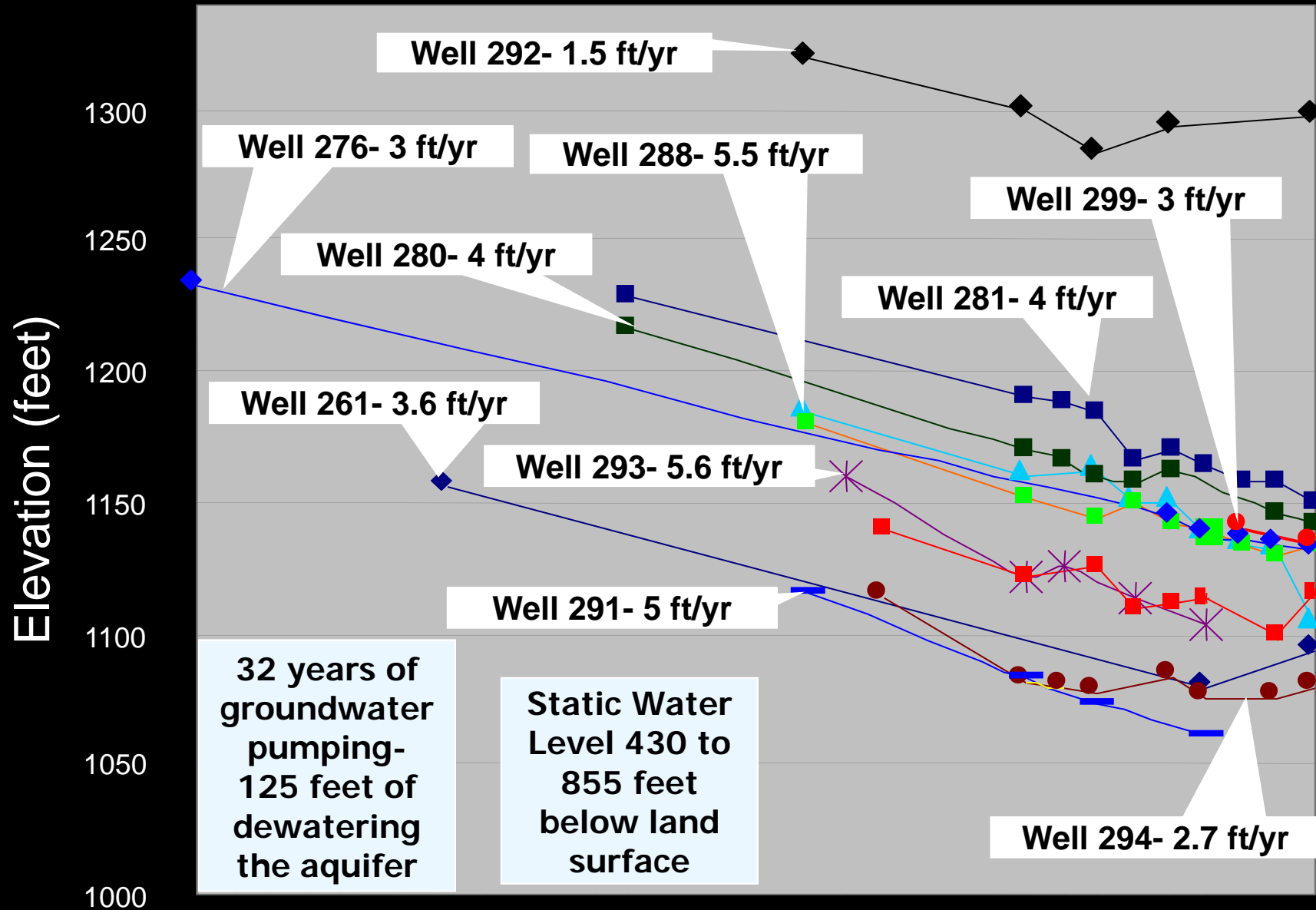
3% Groundwater
Water - Potable

2013 - 1.3
Million
Customers

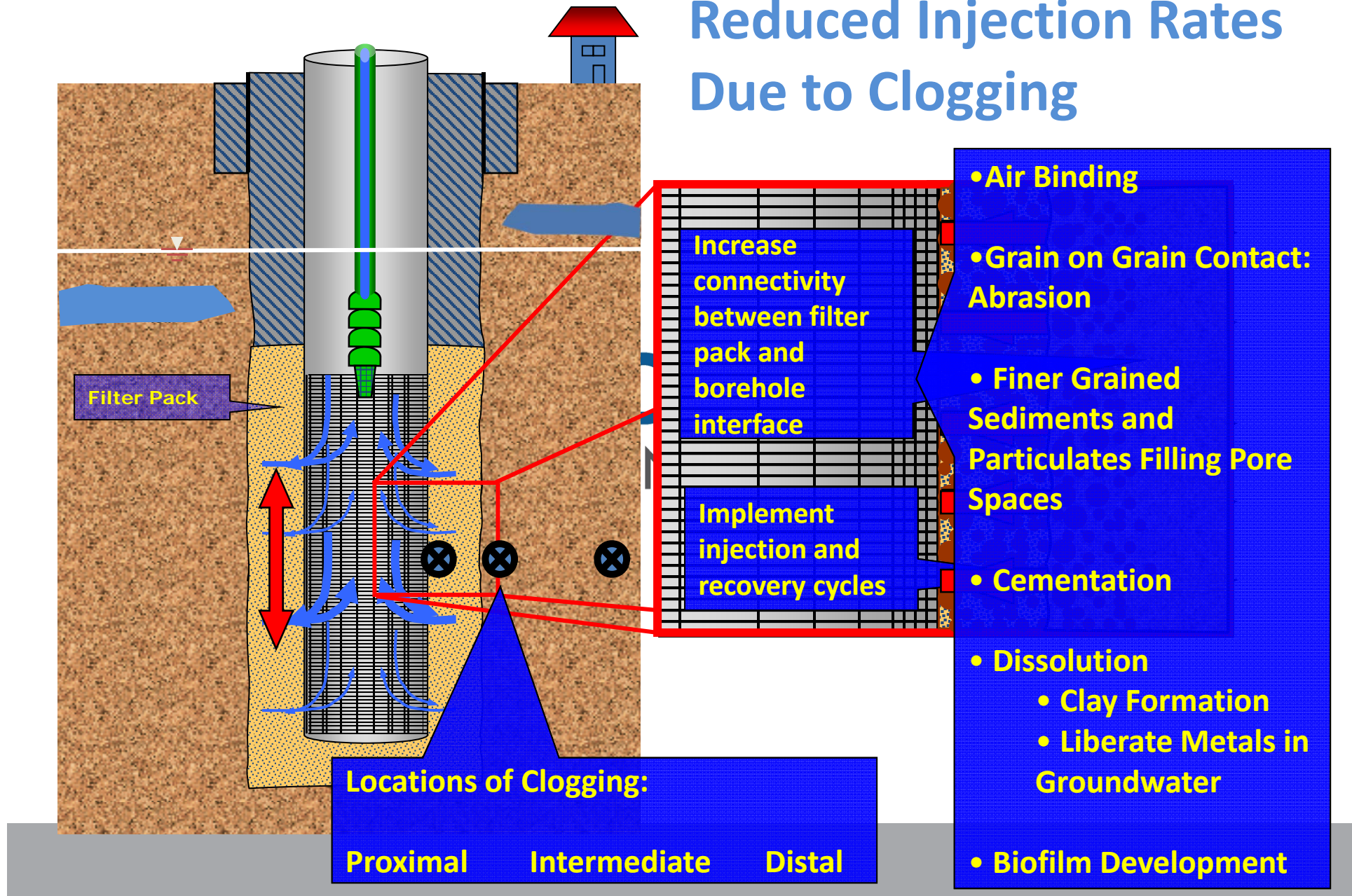
Service Area-
525 square
miles



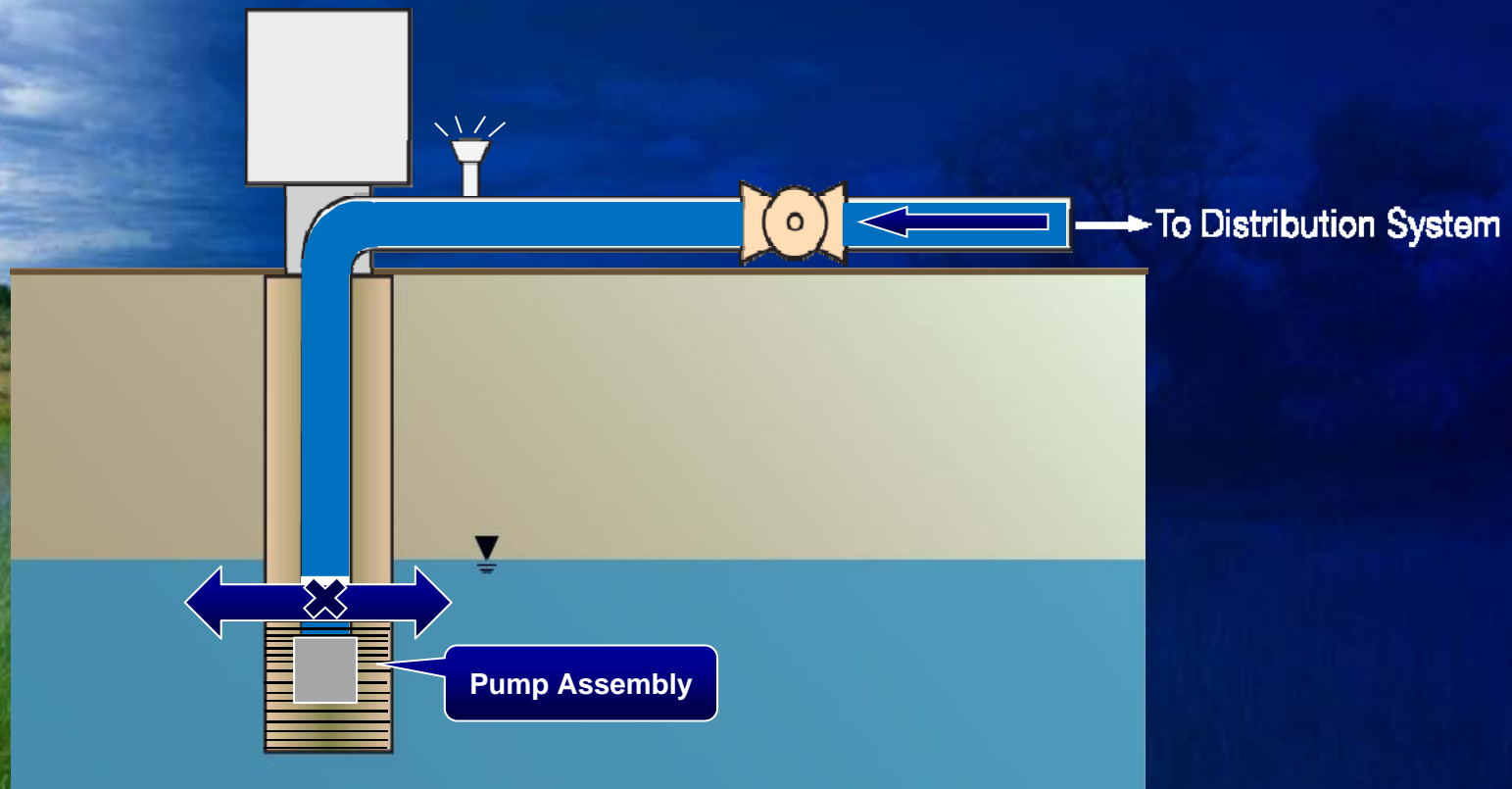
Phoenix Wells: Groundwater Levels



#1 ASR Well Issue: Reduced Injection Rates Due to Clogging



Down-Hole Flow Control Valve Concept



Conventional Methods of Recharge



- Down-Hole Flow Control Valve
 - Eliminate Air Entrainment
 - Regulate Flow- Varied Supplies
- Down-Hole Flow Control Valve Issues
 - Not Operator Friendly
 - Valve Located Down-Well
 - Most Systems Cannot Determine Percent Opening (Position Indicator)
 - Valve has Potential to Leak
 - When Valve Fails- Requires the Valve and Pump to be Pull Out of Well- Extended Down Period.
 - Obtaining Manufacturer Replacement Parts May Require Long-Lead Time

Reverse Siphon Method

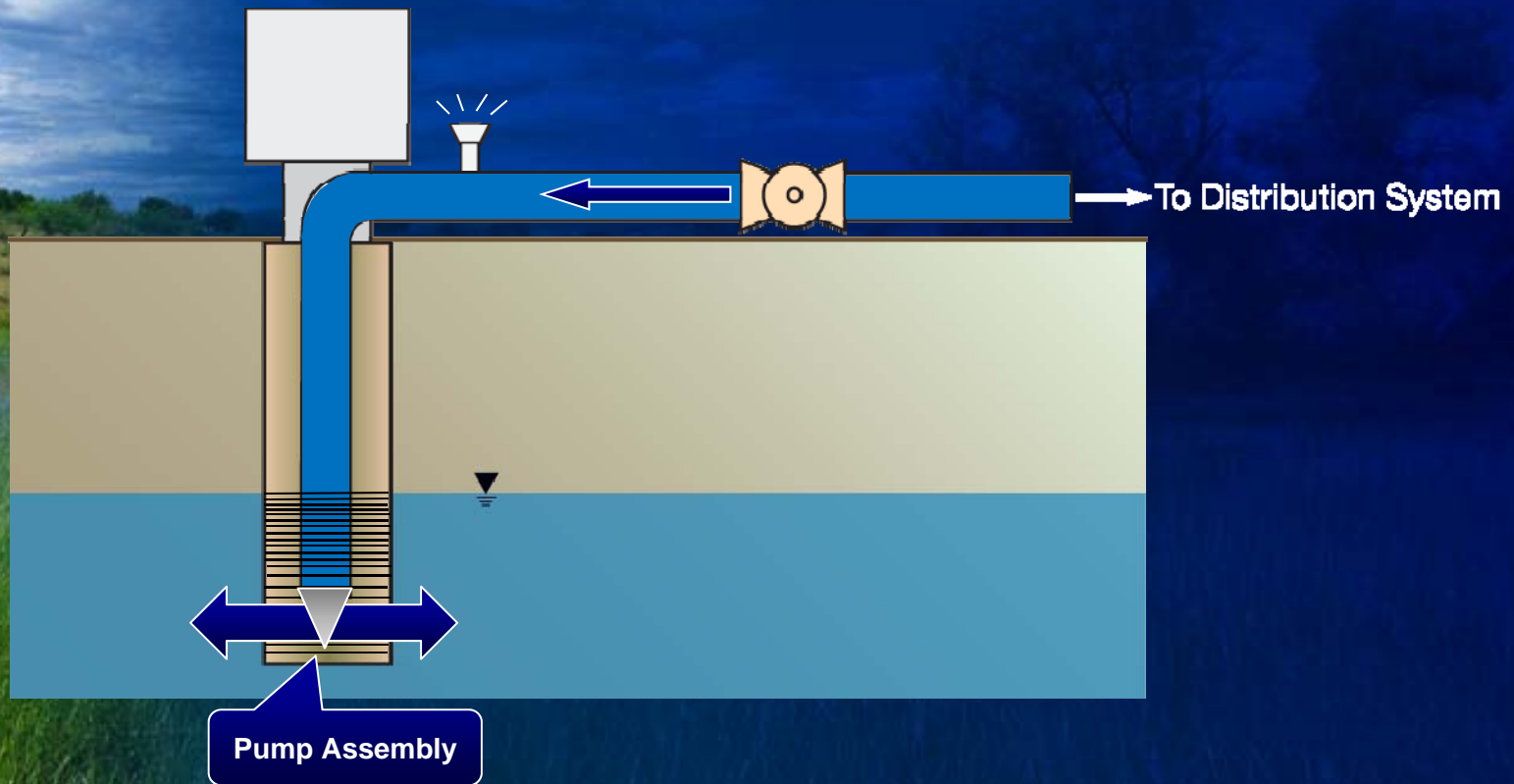
Our Goals & Priorities

- Reduce Air-Entrainment & Agents of Clogging
- All Equipment Serviceable & Not Exotic
- Fewer Mechanical Components = Lower O&M Costs
- Backwash Operations Achieved with Permanent Pump
- Automation-Reduce Labor Force Oversight
- Increase Recharge Utilization

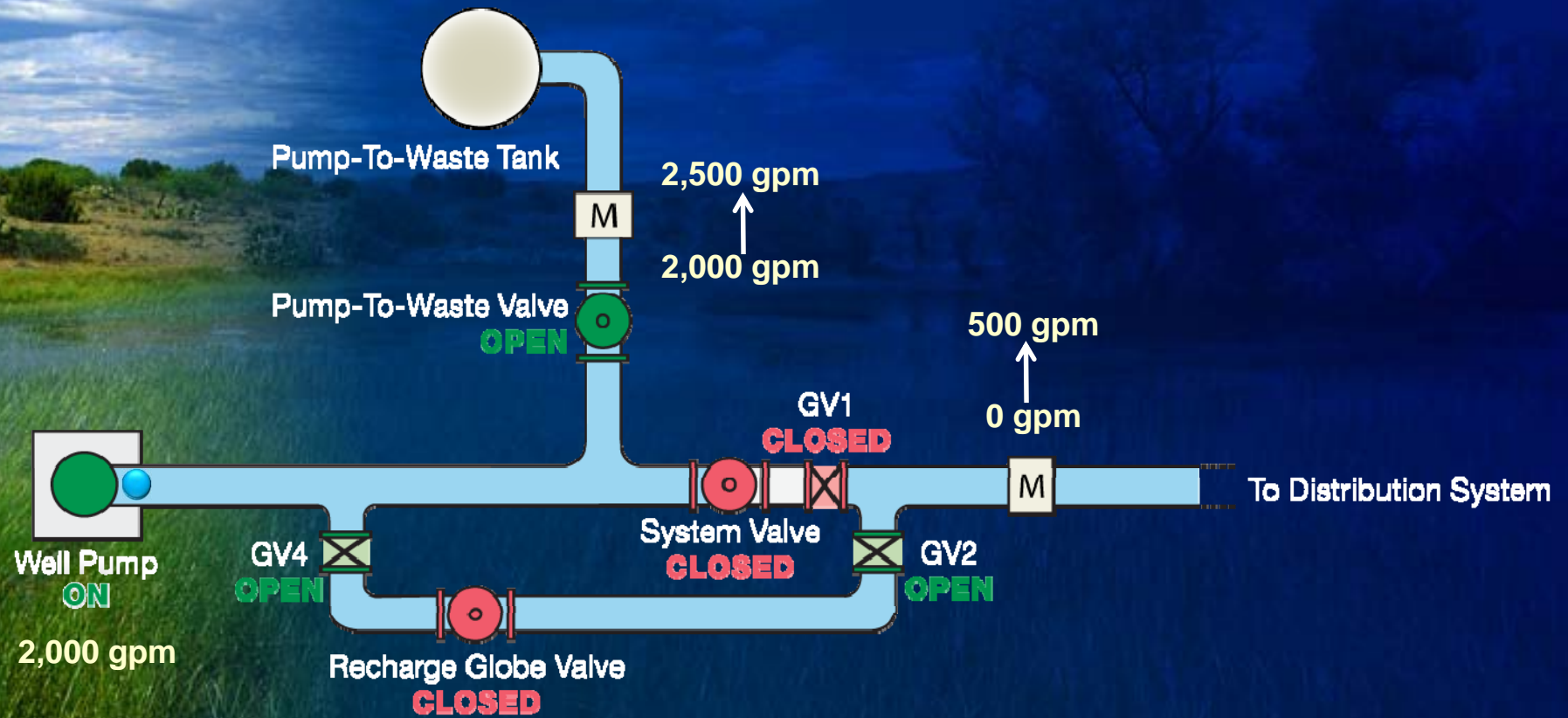


Reverse Siphon Concept

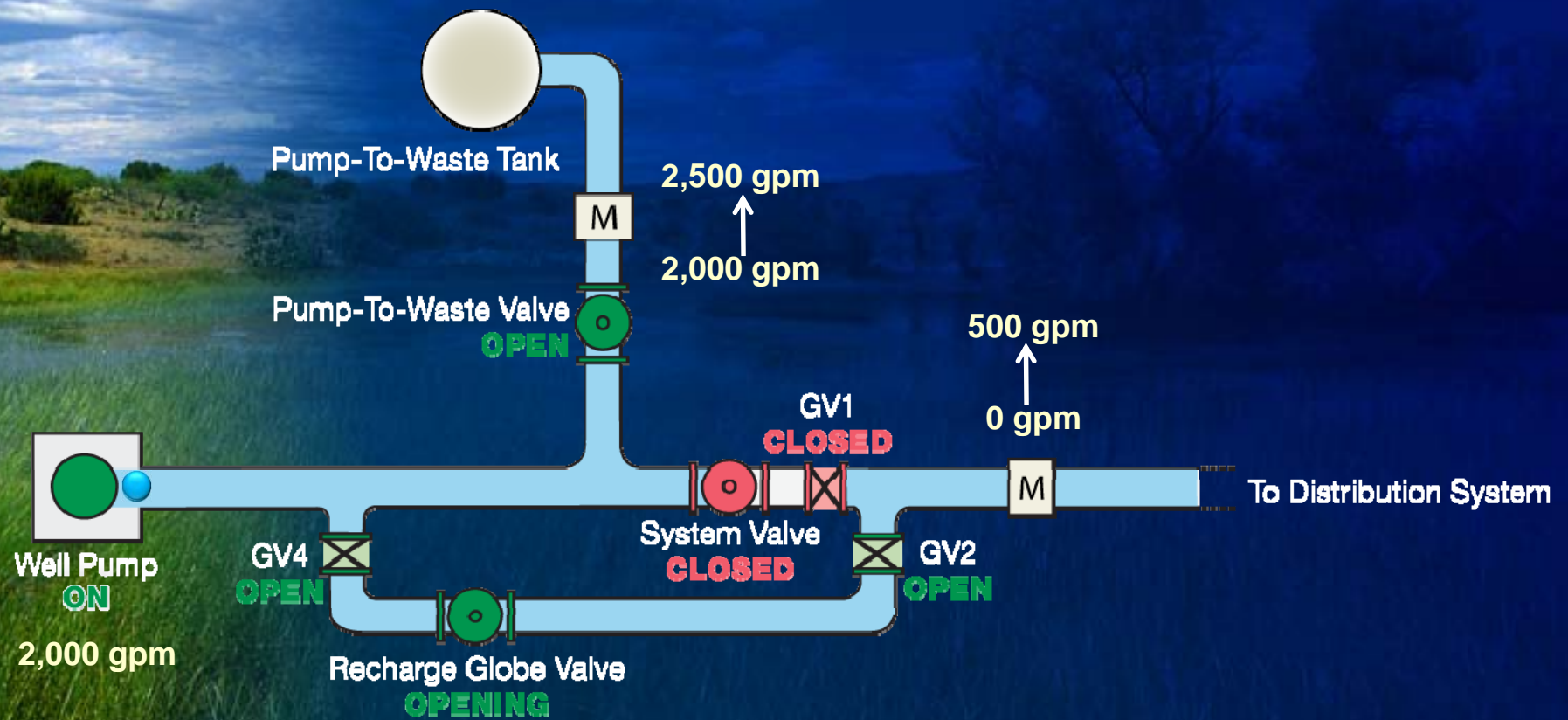
The diagram illustrates a reverse siphon system designed to prevent backflow. It shows a cross-section of the ground with a water table. A vertical pipe, labeled 'Pump Assembly' at its base, extends from the water table up to a storage tank. A horizontal pipe connects the storage tank to a distribution system, with an arrow indicating flow 'To Distribution System'. A check valve is installed on this horizontal pipe to ensure one-way flow. A blue arrow on the horizontal pipe points towards the storage tank, representing the reverse flow path. The background features a landscape with green grass and a blue sky with clouds.



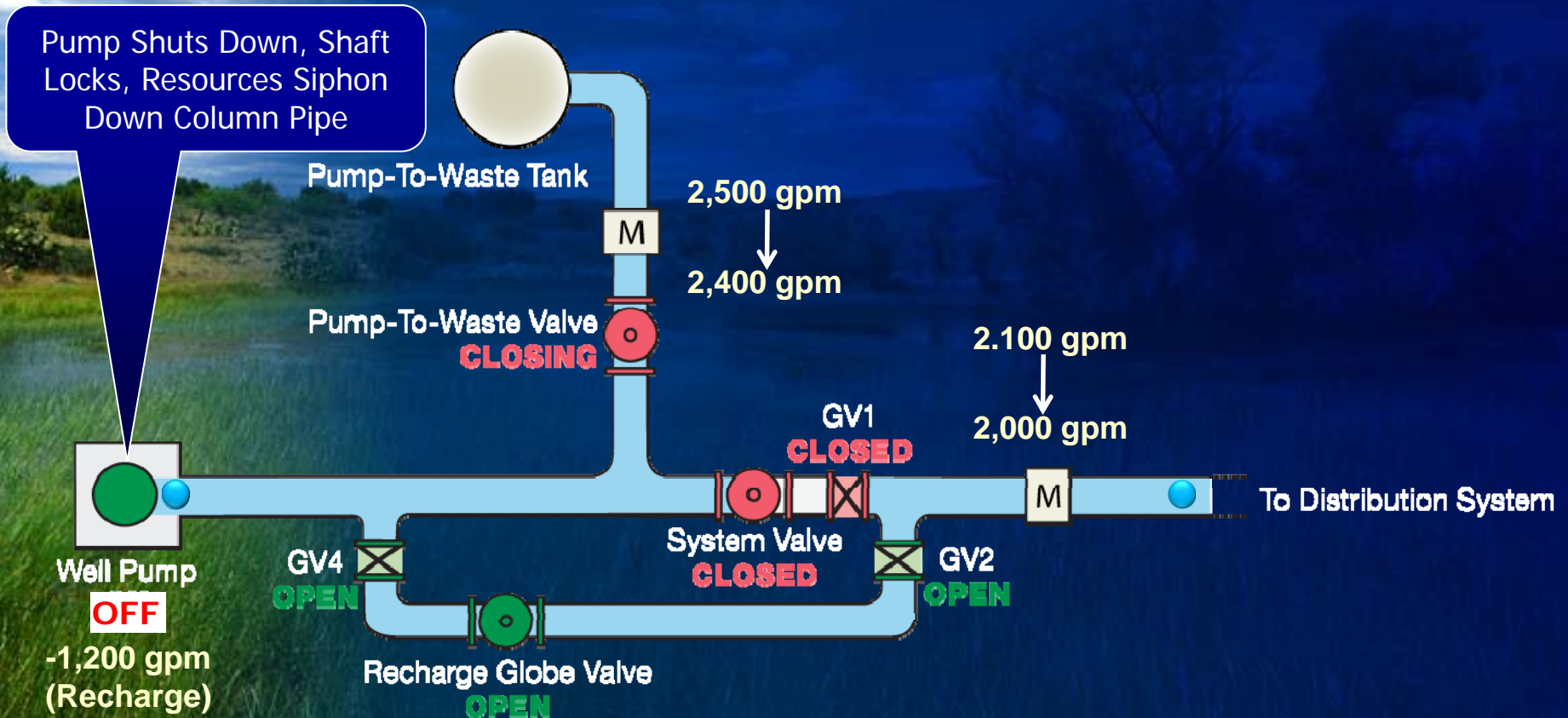
Recharge Start-Up



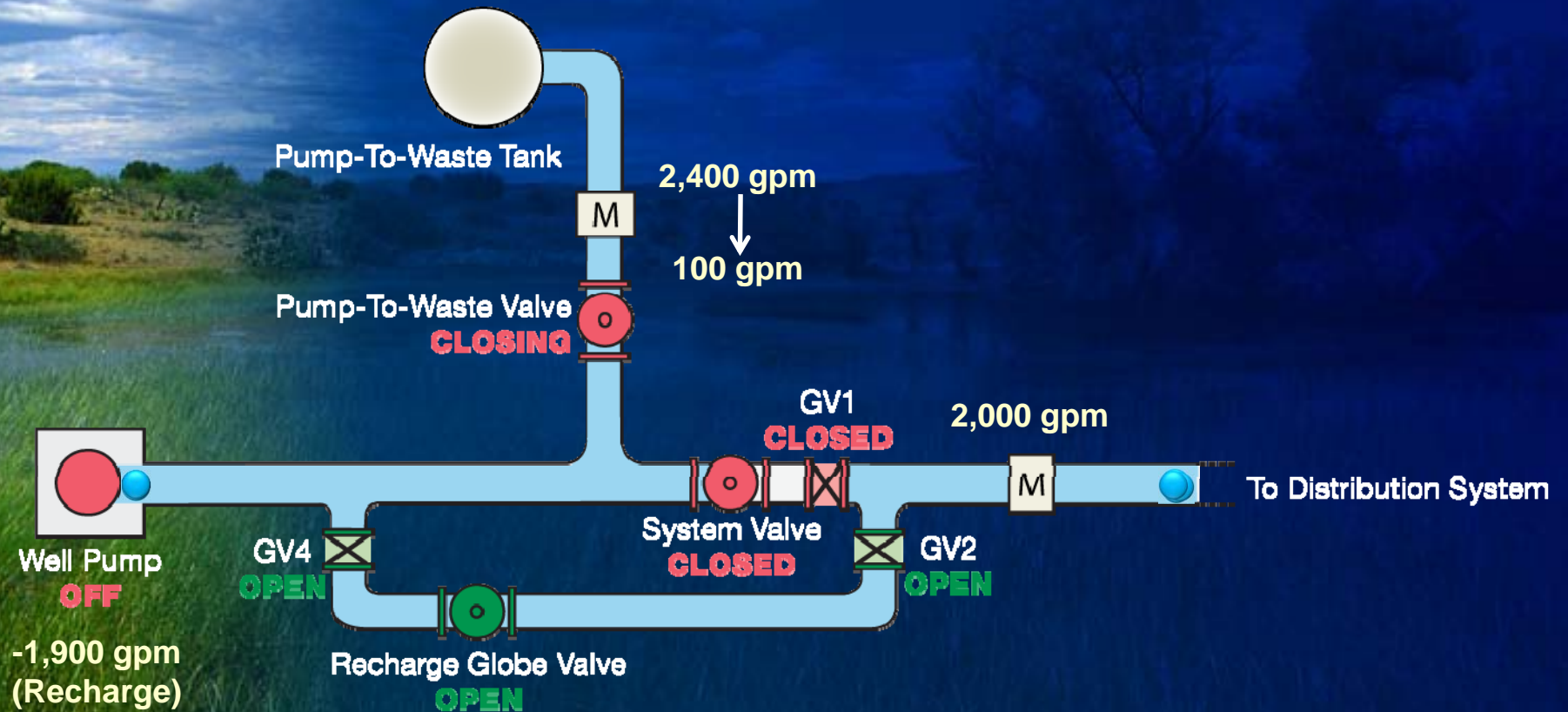
Recharge Start-Up



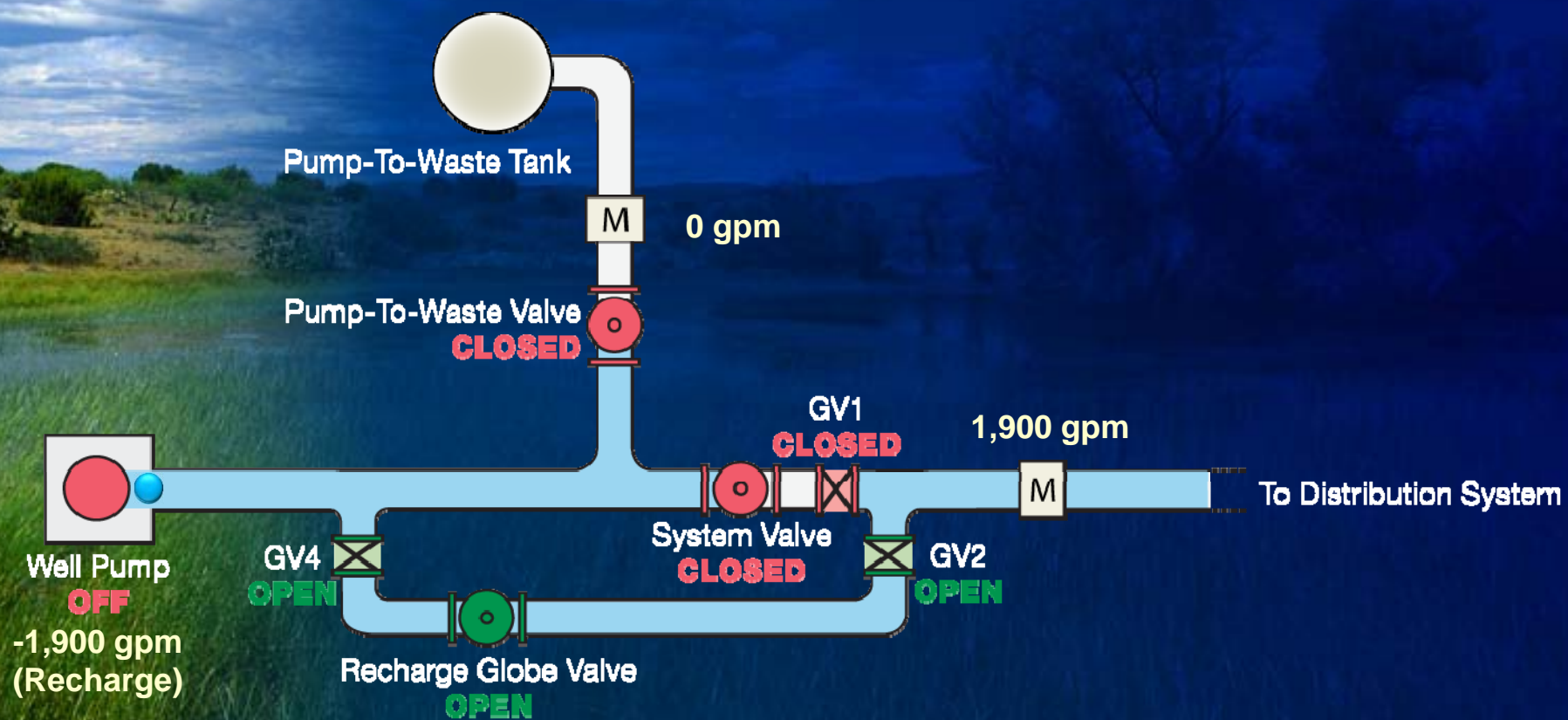
Recharge Start-Up



Recharge Start-Up



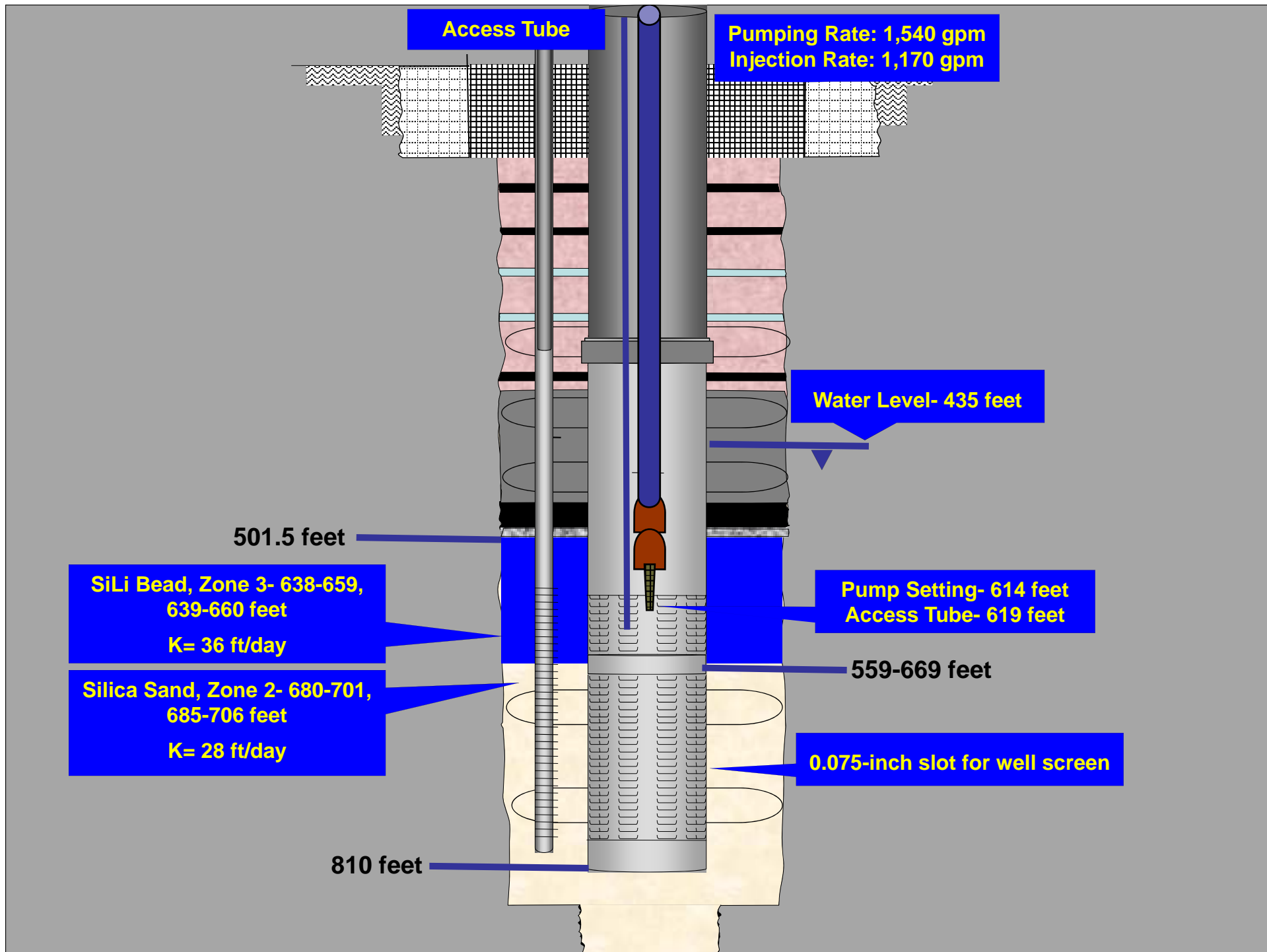
Recharge Start-Up



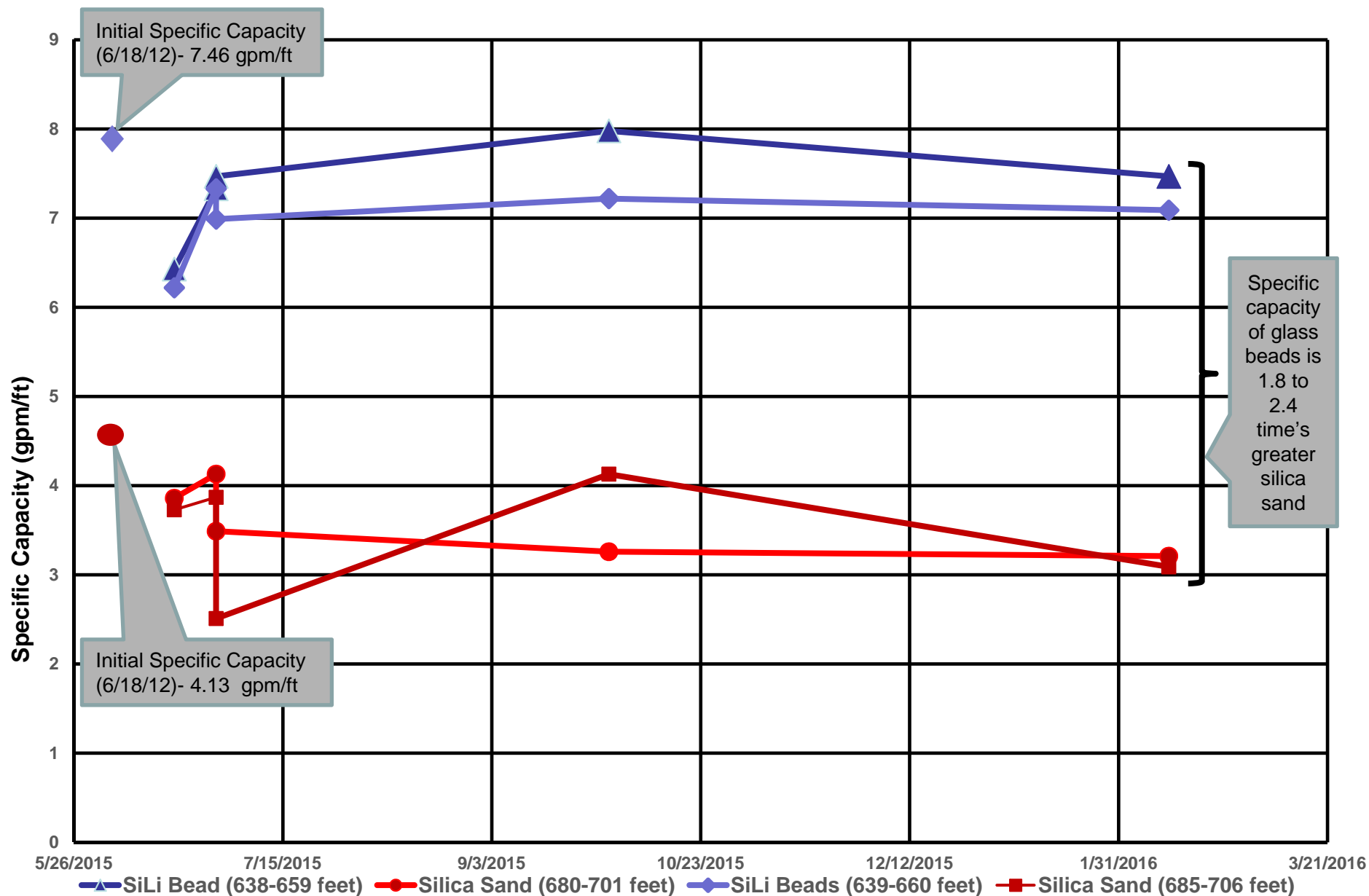
Advancements in ASR Well Design

- Utilize Glass Beads as a Filter Pack Media:
 - Enhance recharge and recovery efficiencies

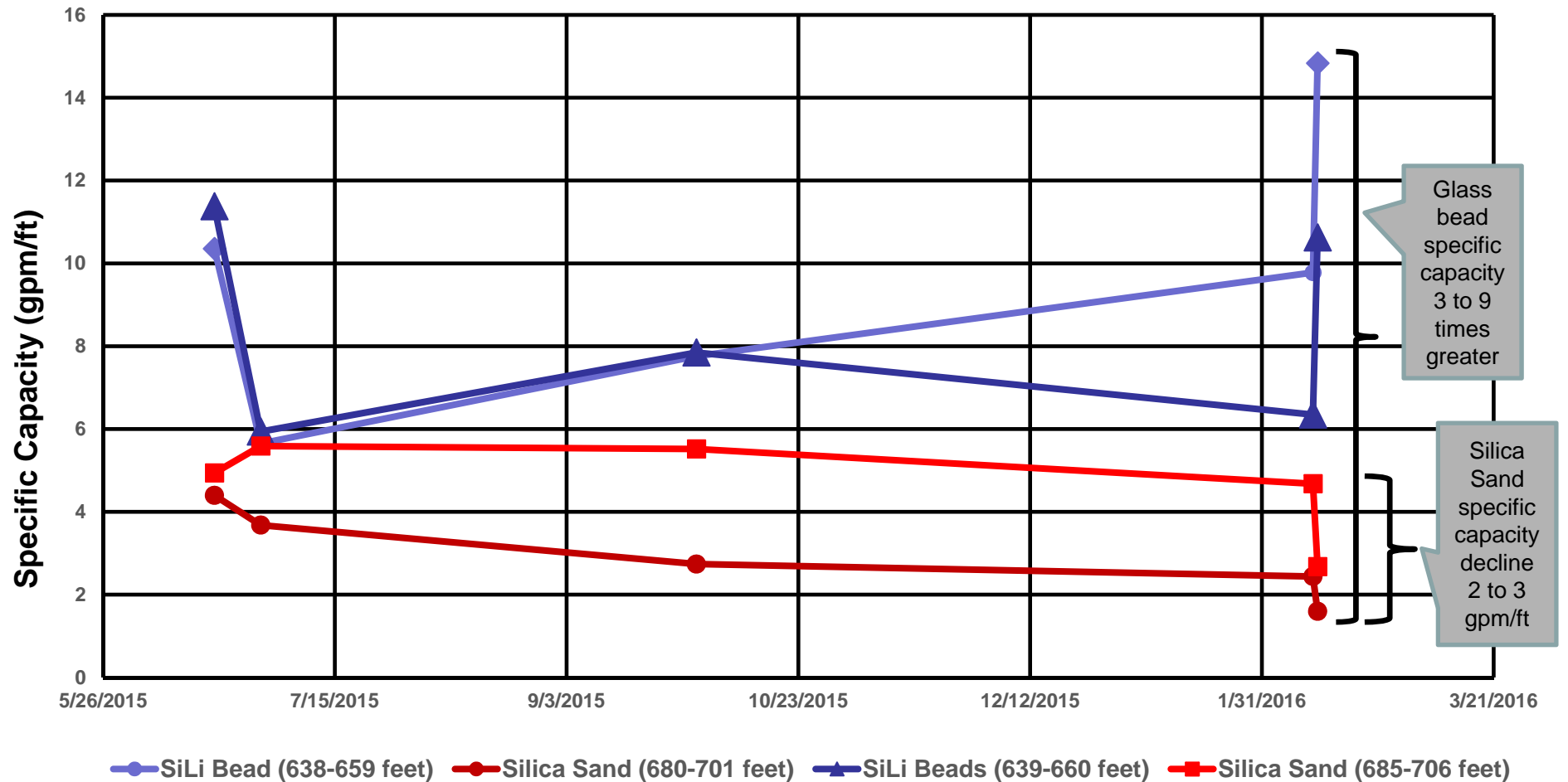




Recovery: Formation Yield: Specific Capacity (gpm/ft): SiLi Beads (638-659, 639-660 ft) vs. Silica Sand (680-701, 685-706 ft)



Recharge: Formation Yield: Specific Capacity (gpm/ft): SiLi Beads
(638-659, 639-660 ft) vs. Silica Sand (680-701, 685-706 ft)



Efficiency of Phoenix's ASR Well?

Standard ASR Well:

- Recharge Rate 50% (770 gpm) of the Production Rate (1,540 gpm)
- Backwash 10.5 hours a week
- Efficiency of Recharge Opportunity 81% (rate)

or

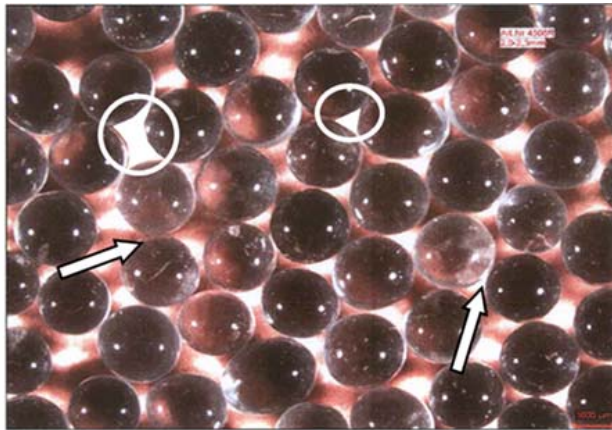
- 6.3 million gallons recharged weekly

City of Phoenix ASR Well:

- Recharge Rate 76% (1,170 gpm) of the Production Rate (1,540 gpm)
- Backwash 7 hours a week
- Efficiency of Recharge Opportunity 90.3% (rate)
or
- 10.7 million gallons recharged weekly!

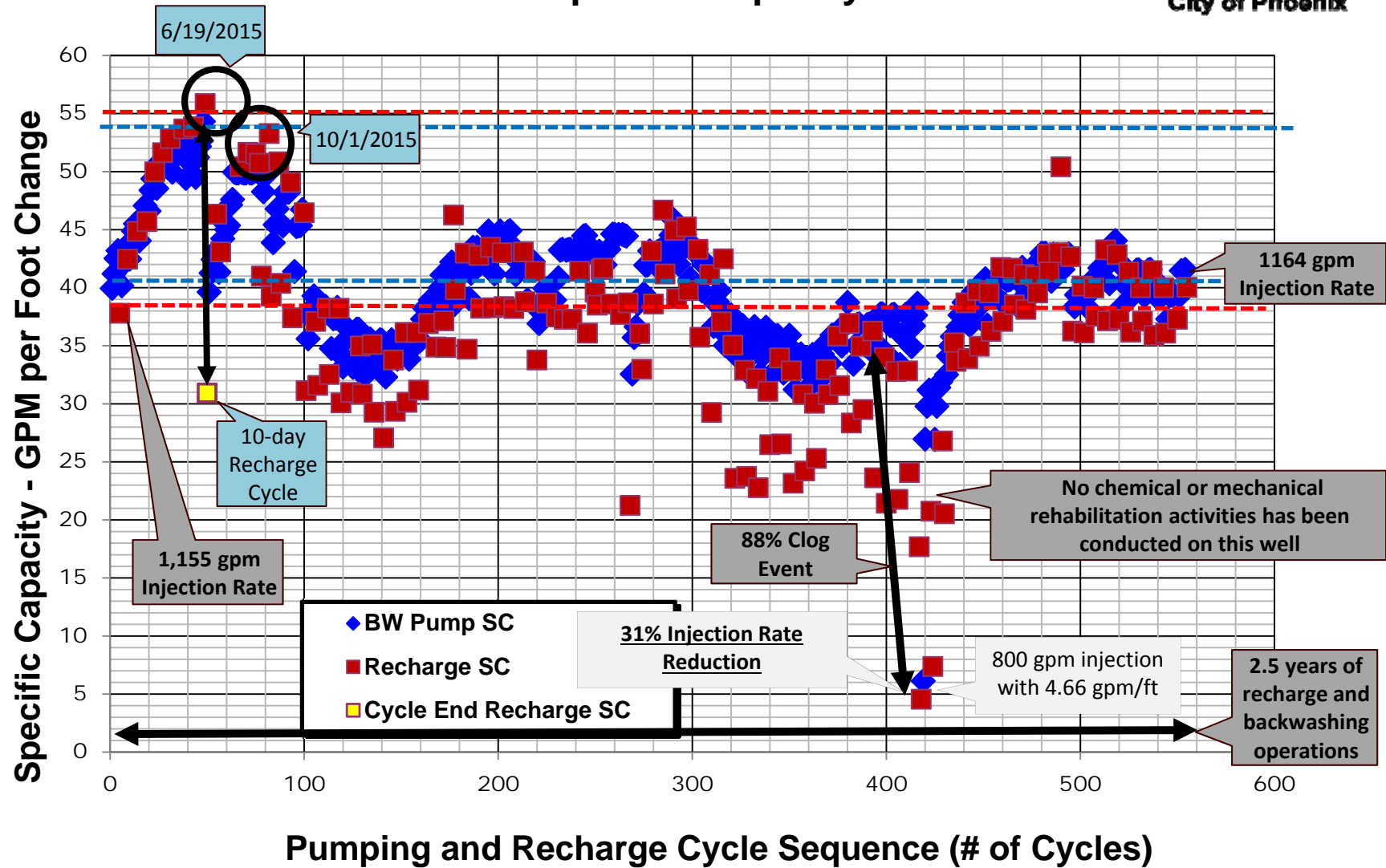


Costs Payback: Glass Beads



- 4,400,000 million gallons per week or 13.5 acre-feet per week (Difference between Phoenix vs. Standard ASR well)
- \$500-\$550/acre-feet (Treatment Costs Recharge Supplies)
- 13.5 acre-feet x \$500-\$550 acre-feet = \$6,750-\$7,425/week
- Glass Beads for an ASR Well:
 - (\$83,400 for 60 MT)
- Cost Payback: **11 to 12 weeks**

Cave Creek Water Reclamation Plant ASR Well-1 Specific Capacity



Conclusions

- City of Phoenix Accomplishments (ASR Well Program)
 - 1st ASR Wells Directly Linked to the Distribution System
 - 1st to Utilize Glass Beads as a Filter Pack Media
 - 1st to Implemented Automated Programming:
 - Operating the ASR Well
 - Streamline Regulatory Reporting
 - Provide Efficiency Plots for Managers and Operators
 - Retaining Sustainable Injection Rates over 8 yrs. of Recharge (minimizing clogging)
 - Water Levels in Aquifer Stable Since 2010
 - Lower O&M Costs
 - Cost Effective (Well Rehabilitation Savings \$110K-\$150K per well per year)
 - Operator Friendly
 - Well Development through the Permanent Pump



Questions

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