

**Water Well Service-Rehabilitation
And
Asset Management Program (AMP)**

Ray Reece – Utility Service Group (USG)



Well Problems/Effects

- A. Well Clogging – Reduce Production-Increase Sand Production**
- B. Loss of Efficiency - More Expensive Water**
- C. Deterioration of Water Quality**
- D. Total Loss of Capital Investment**



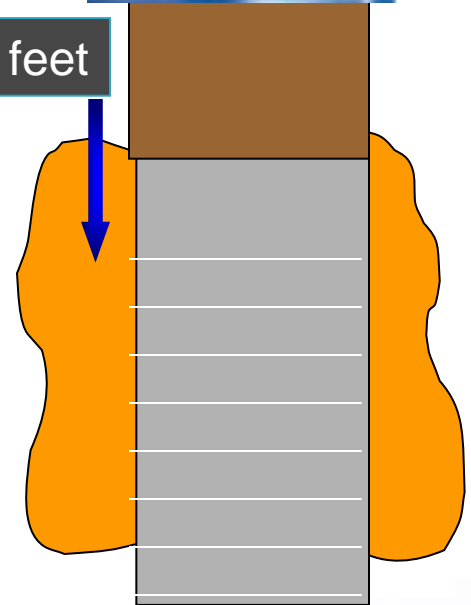


Water Well Plugging: Common Causes

- a. Biofouling-Mineral Encrustation (As Shown in Pictures)
- b. Mechanical-Formation Fines (Silt and Clay)
- c. Chemical- Precipitation of Minerals



Maximum 2 feet



Steps for Effective Rehabilitation

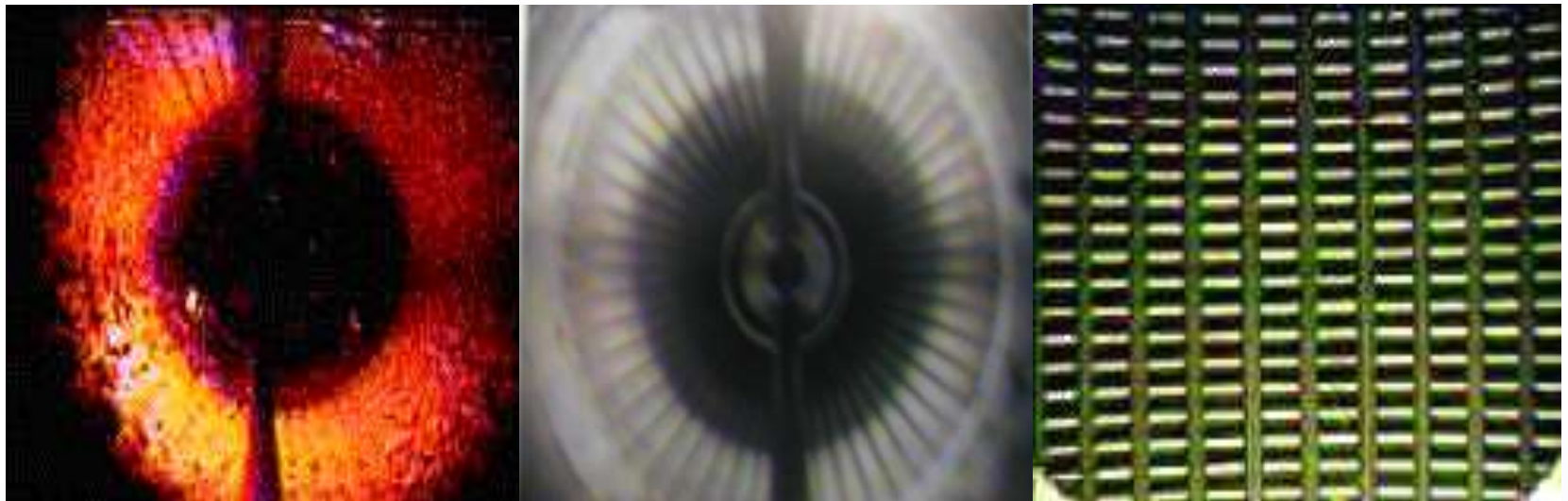
1. Pre-Rehabilitation Pump Test
2. Pull pumping equipment
3. Video inspection
4. Mechanical Cleaning/Wire Brush
5. Chemical or AquaFreed™ Application
6. Post Re-Development
7. Video Inspection
8. Re-Install Pumping Equipment
9. Install AquaGard™
10. Post Rehabilitation Pump Test





AquaFreed®

- ▶ Most Effective Rehabilitation Technology
- ▶ Environmentally Safe
- ▶ Excellent Penetration of Energy
- ▶ Broad Based Application
- ▶ Excellent at Removal of Bacterial and Mineral Deposits



How AQUA FREED[®] Works:

Energy released during Phase Changes:

Liquid to Gas (570 Times Volume Expansion)

Liquid to Solid

Solid to gas (Sublimation)

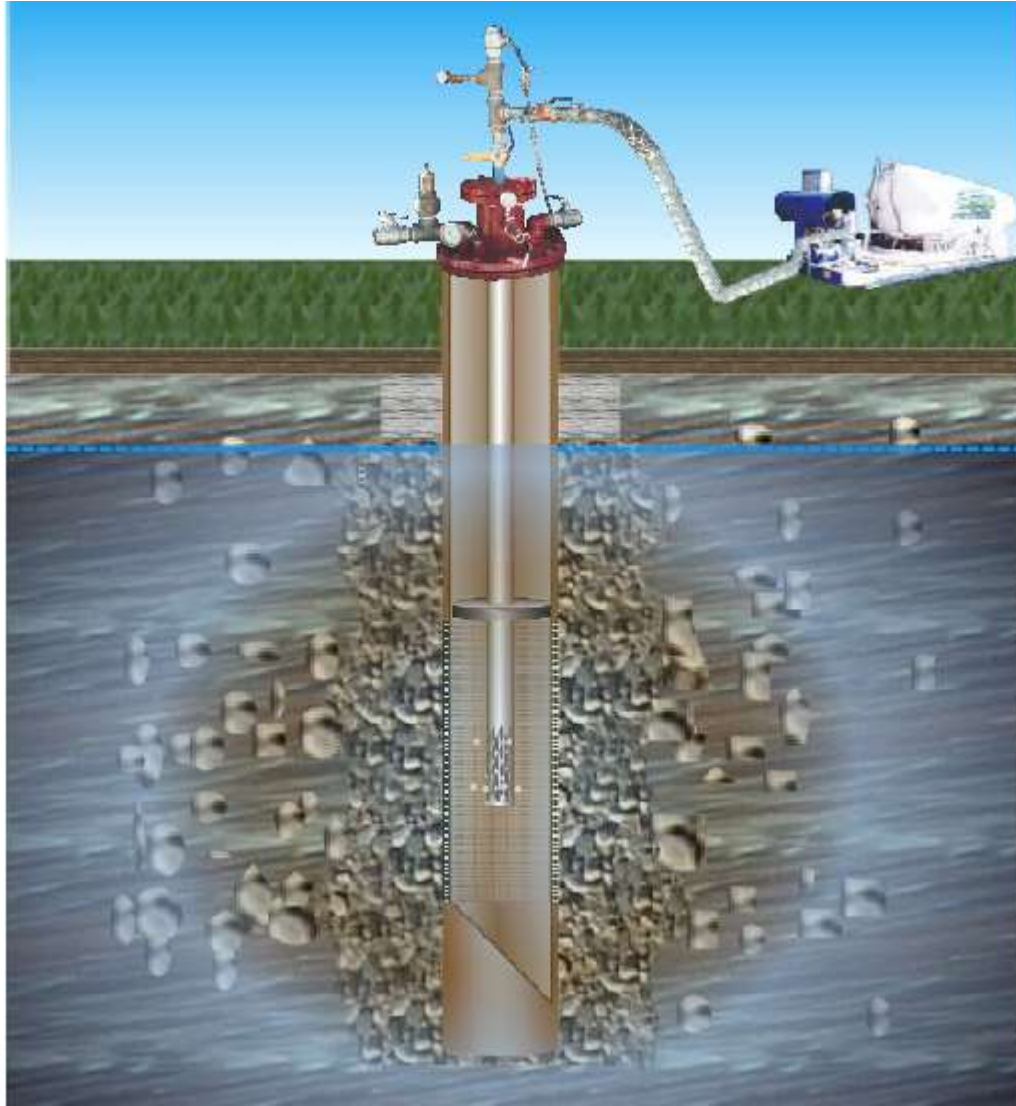
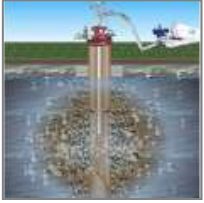
Carbon Dioxide has surfactant properties that helps to penetrate the aquifer as well as scale & biofilm

Formation of Carbonic Acid (H_2CO_3) a mild acid (Approx. pH=5) allowing some dissolution of scale

Pore Water Freezing allowing scale and biofouling to be dispersed

FIRST STAGE:

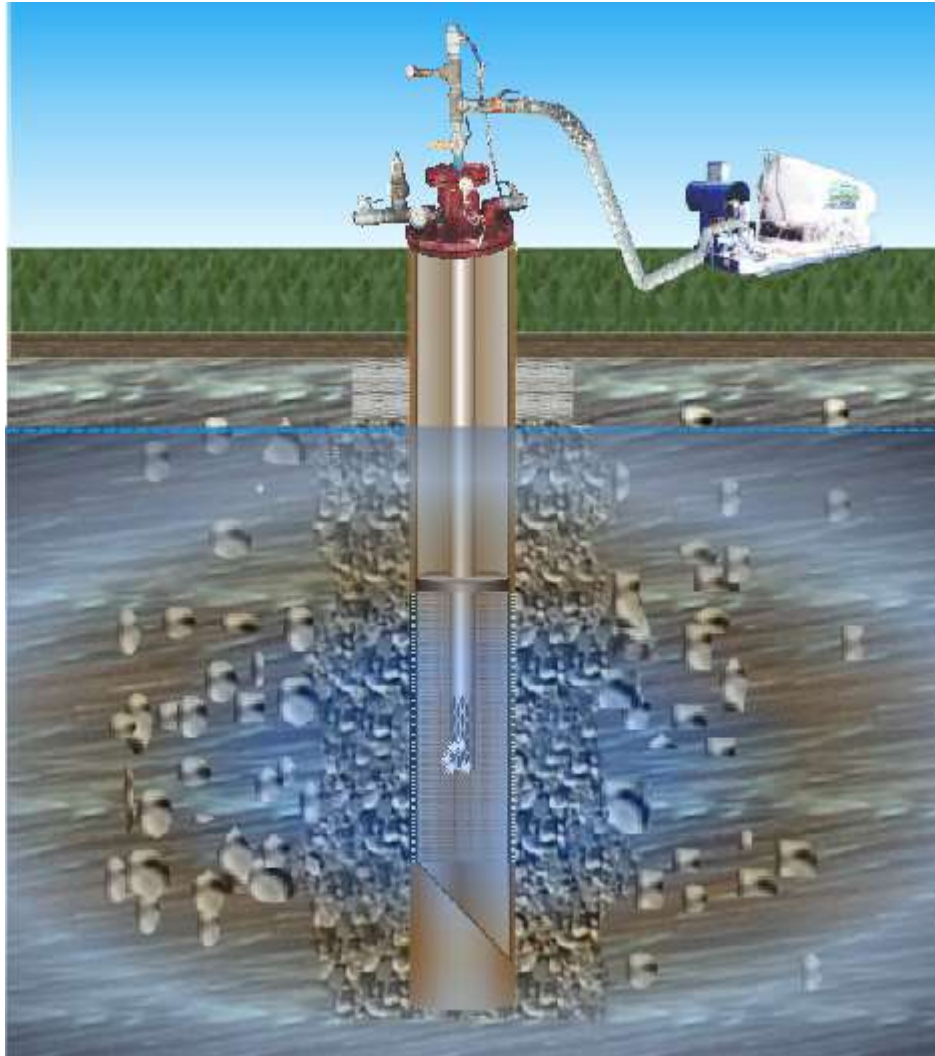
Seal off the well and inject CO₂ in the gaseous state.





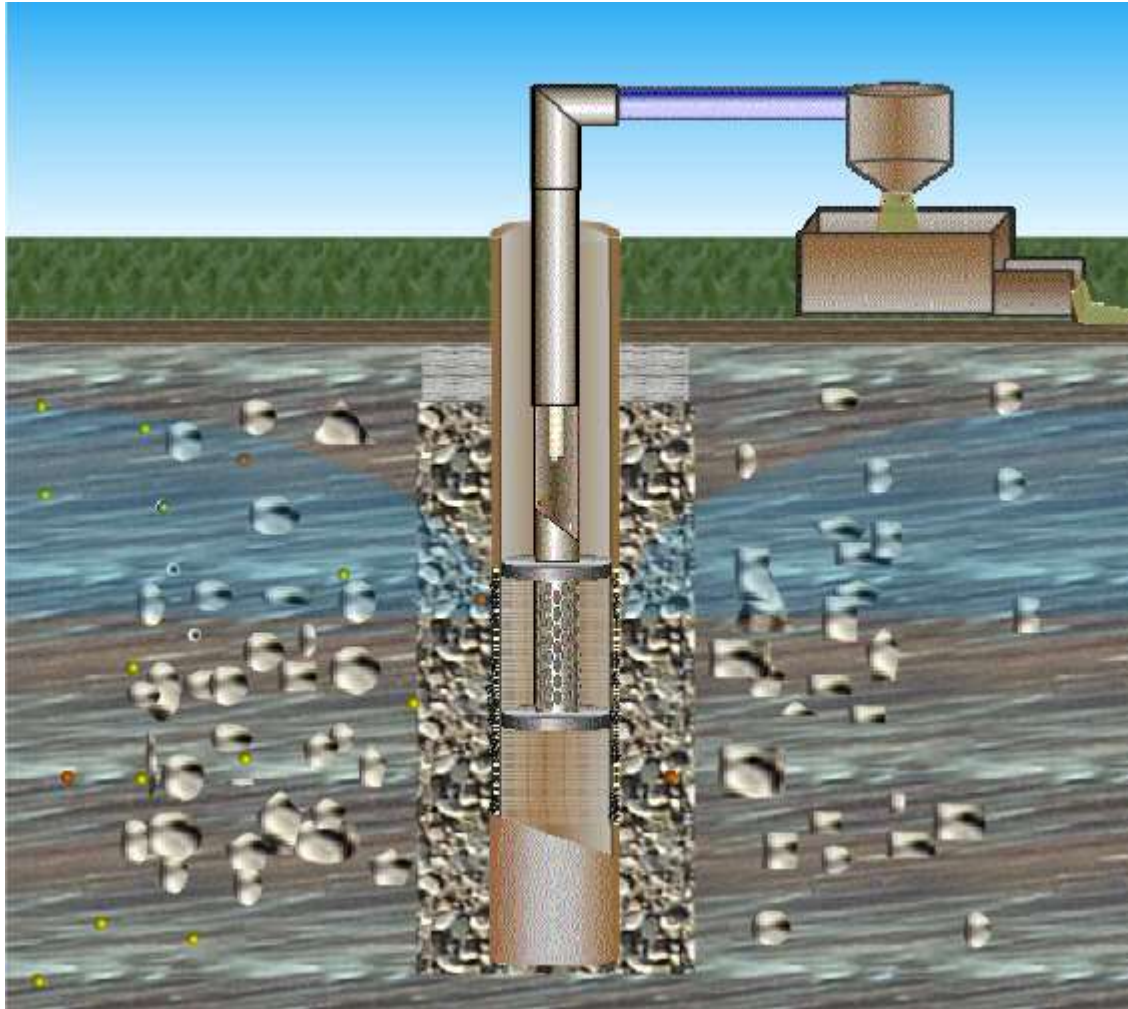
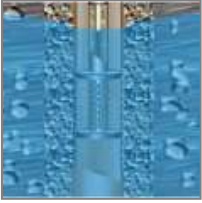
SECOND STAGE:

CO₂ injection in liquid state at controlled pressures.

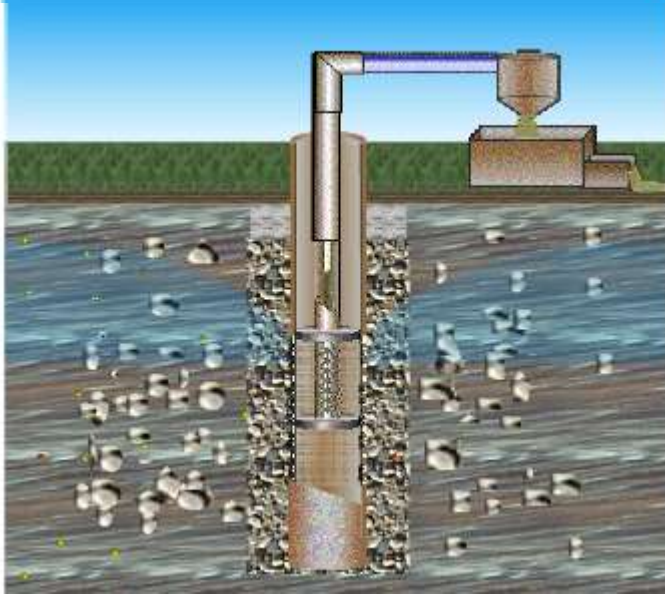


THIRD STAGE:

Development with double surge block and airlift.



The Most Effective Method of Development – Removing the detached Material



Zone by Zone Flow Rate Before and After Rehabilitation

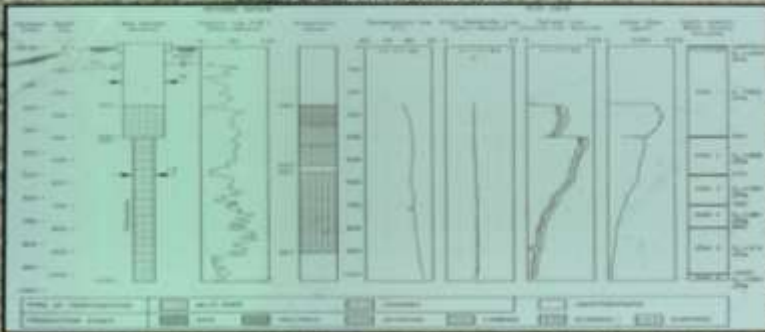
Total Flow 3000 gpm Before Rehabilitation

Zone 1:	600 gpm
Zone 2:	568 gpm
Zone 3:	793 gpm
Zone 4:	481 gpm
Zone 5:	314 gpm
Zone 6:	244 gpm

Total Flow 3000 gpm After Rehabilitation

Zone 1:	1,074 (+79%)
Zone 2:	1,002 (+76%)
Zone 3:	267 (-64%)
Zone 4:	150 (-69%)
Zone 5:	194 (-38%)
Zone 6:	313 (+28%)

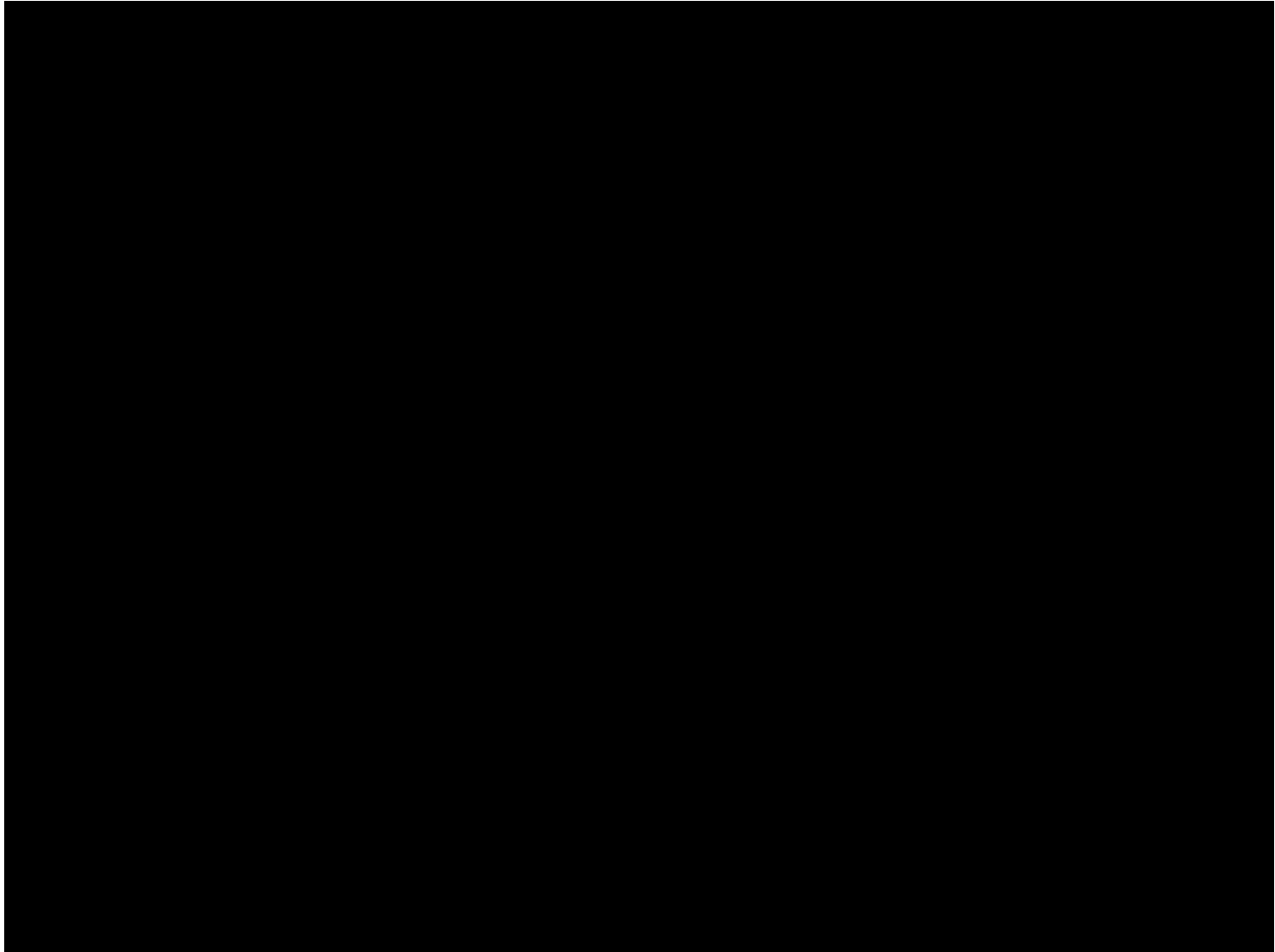
Well Logging And Depth Specific Water Quality Sampling Data Summary
Pre - Rehabilitation



Well Logging And Depth Specific Water Quality Sampling Data Summary
Post - Rehabilitation



Desoto, Kansas



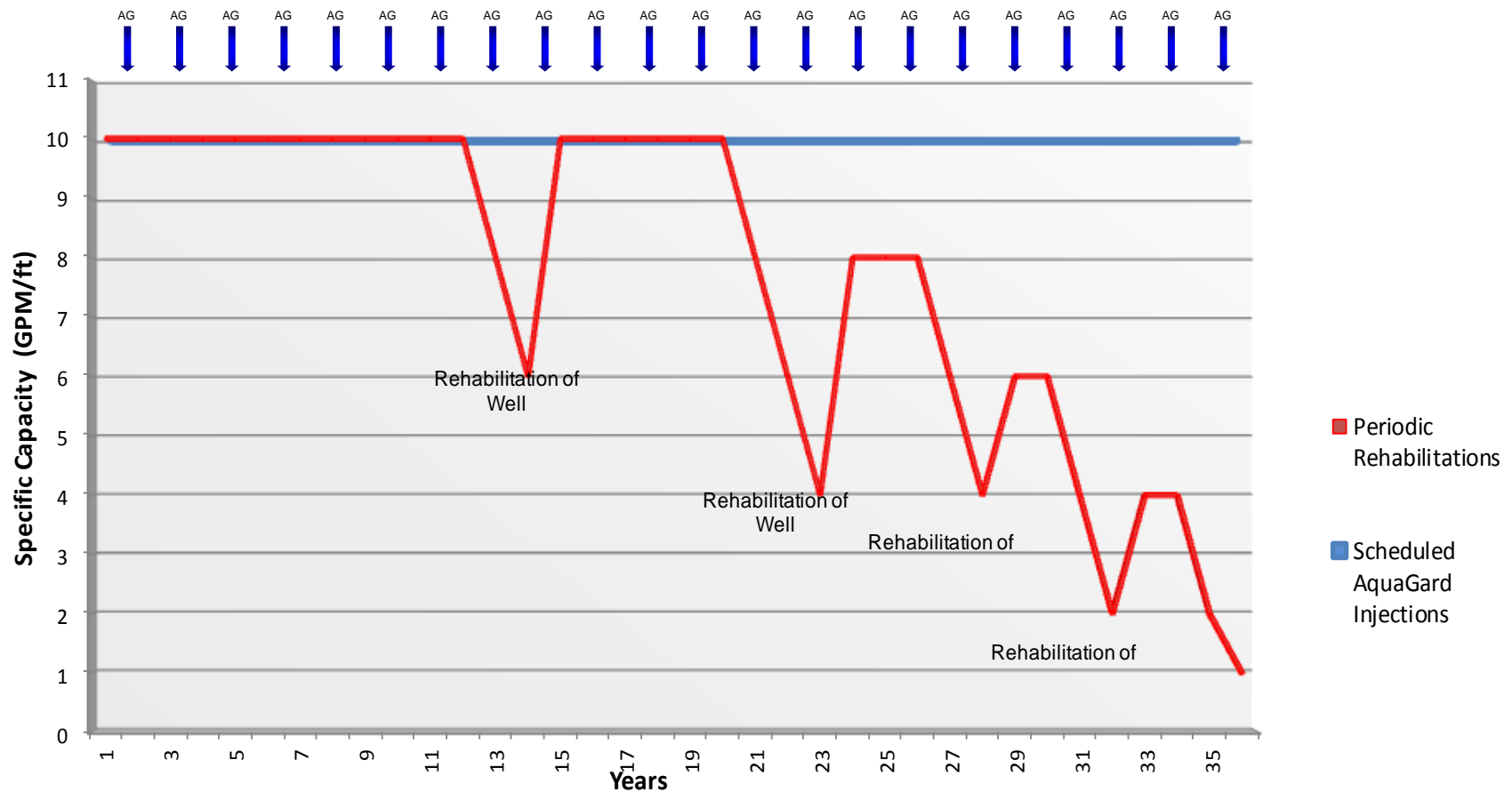
**What Happens
When We Wait
Too Long to
Rehab?**

**Extensive and
Hardened
Mineralization!**





Operate to Failure compared to AquaGard Maintenance of Wells





Aqua Gard™

Water Well Asset Management Program

- a. **Aqua Gard Well Asset Management is permanently installed in each well**
 - a. In well preventative maintenance device used for scheduled service
- b. **Very cost effective**
 - a. Allows wells to be effectively maintained without pulling the pump
 - b. Reduced down time during maintenance service (usually less than 24 hours)
- c. **Equipment allows effective energy to be delivered into a well for cleaning**
 - a. Scheduled service compared to reactive rehabilitation
- d. **Fixed budget pricing and potential to spread initial cost**





Asset Management Program (AMP)

Sustainable Best Practice For Maintaining Water Well Production, Water Quality, Equipment and Distribution (Source to Tap)

Value of the USCI AMP

- a. Extend Asset Life Cycle Indefinitely
- b. Improve and Maintain Well Performance
- c. Predictable Cost (Flat and Fixed Annual Fee)
- d. Reduce Operational Cost (Specific Capacity and Efficiency)
- e. Maintain Consistent Water Quality
- f. Transfer Risks
- g. Single Source Responsibility
- h. Improved Knowledge of Well and System Condition
- i. Enables Proactive Maintenance Management of Wells or Entire System
 - a. Time Based Maintenance Program to keep well clean
- j. Spread Initial Investment of Rehabilitation or Other Investment Costs

