Well Maintenance Techniques

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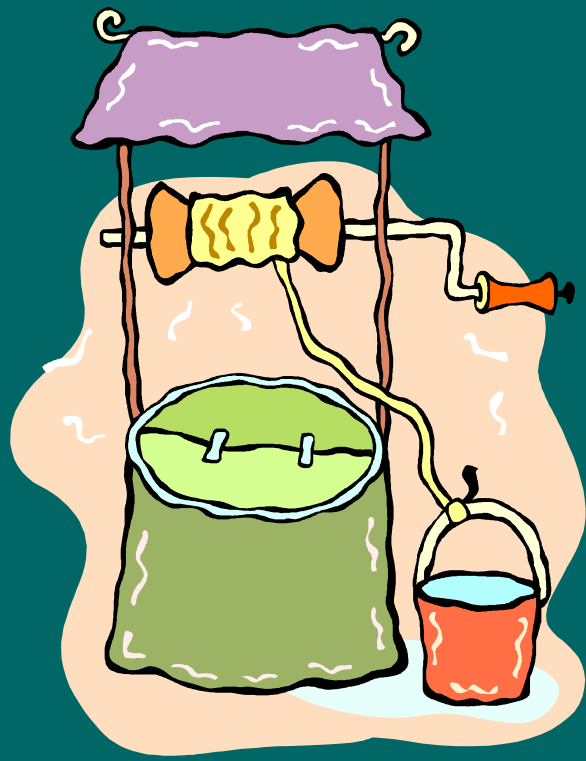
Presentation Overview

- Background
- Process Description
- Results & Discussion
- Cost Comparison
- Items to Consider
- Next steps



Background

- Wells are rehabilitated on a regular basis to improve production efficiency
- Normal rehabilitation process involves:
  - Wire brushing and scraping
  - Chemical addition (acid, surfactants, dispersants, etc.)
  - Air lifting and development
  - Disinfection
- Well rehabs are expensive and not always effective, e.g. Yukon well
- Preventative maintenance can increase the interval between major rehabs

Process Description

- SeaQuest (ortho- & polyphosphate blend) used in Southwest for corrosion control and Central for sequestration
- Theorized that could be used to sequester iron and manganese downhole, thereby reducing plugging of screens
- Developed process that was easy to execute and minimized well downtime

Process Description

- Process Needs
- 110 gallons 12.5% sodium hypochlorite
- 55 gallons SeaQuest & surge
- 55 gallons 12.5% sodium hypochlorite and 55 gallons SeaQuest along with ~ 600 gpm system water
- Let sit overnight and run to waste for ~ one day (field test for iron, manganese, phosphate, and chlorine residual)

Well Rehabilitation Using SeaQuest

You will need: 2 – 55 Gallon drums of Sodium Hypochlorite
1 – 55 Gallon Liquid SeaQuest
Water from another source besides the well (600 GPM)

Procedure:

(1) Add 1 of the 55 gallon drums of Sodium Hypochlorite down the well using a transfer pump as quickly as you can then surge* 2 or 3 times.

(2) Add 30 gallons SeaQuest also using a transfer pump as quickly as you can then surging 2 to 3 times.

(3) Add system water down the well at a rate of 600 GPM while injecting the remaining chemical (25 gal SQ, 55 gal Cl2). Do this overnight using small chemical feed pumps. (600 GPM is what we try to use, sometimes we have to use less depending on how our system is impacted.)

(4) Come back in the morning disconnect equipment then surge 2 times for mixing then run to waste until the following morning.

(5) Return to service.

*Surge means to start the well pump bringing the water to surface then shut pump off allowing the water to fall down the well creating enough energy to mix and force water through perforated areas.

Maintenance Setup

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Results and Discussion

- Process has been used at all active Southwest wells with great success; currently implementing in Central district
- Increased well production and specific capacity
- Decreased drawdown
- Initially performed quarterly on Southwest wells. Have been able to decrease to twice per year.

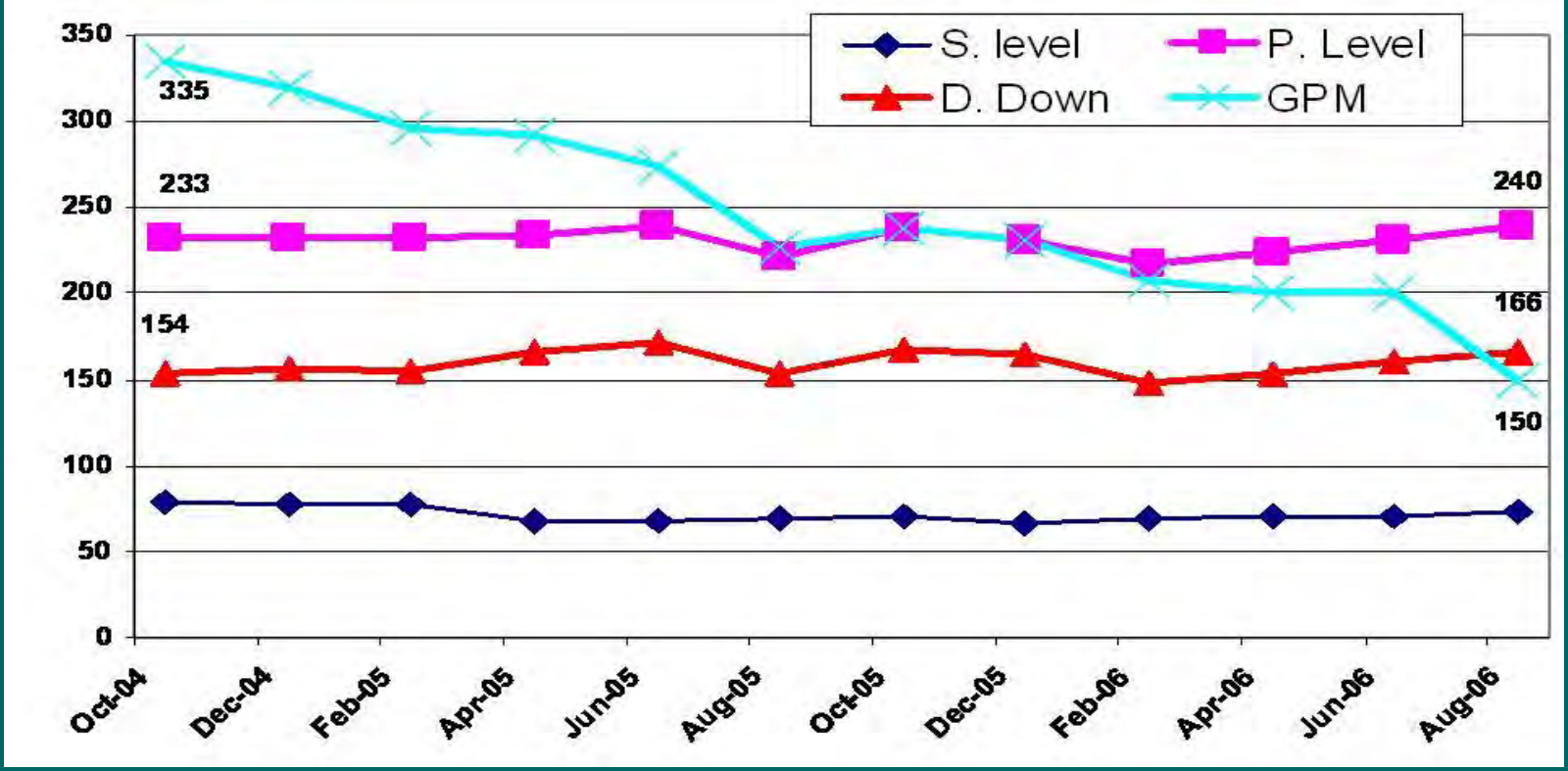
Graph Key

- S – Static Level
- P – Pumping Level
- D – Draw Down
- SY – Specific Yield

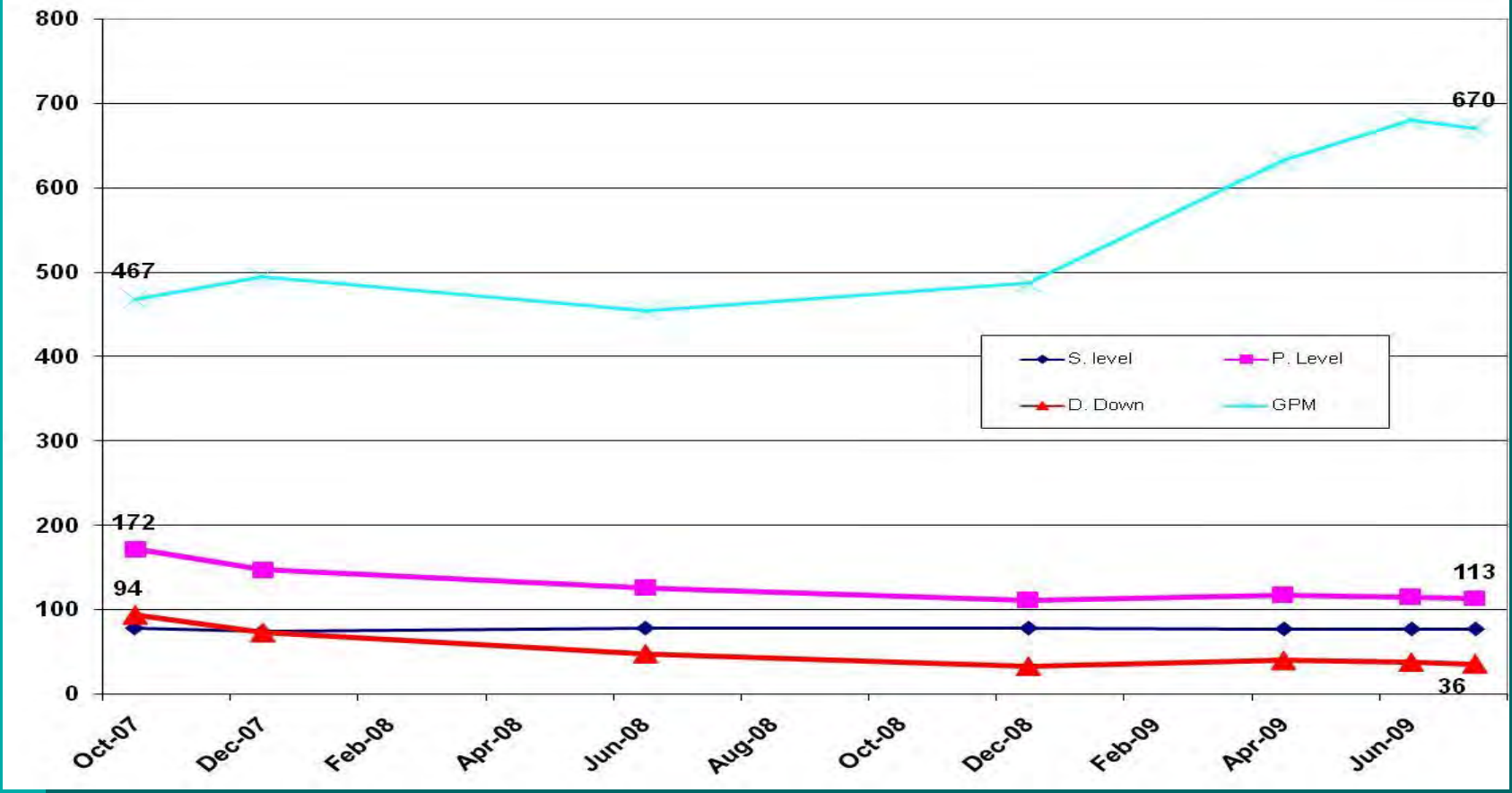
  Specific yield, also known as the drainable porosity, is a ratio, less than or equal to the effective porosity, indicating the volumetric fraction of the bulk aquifer volume that a given aquifer will yield when all the water is allowed to drain out of it under the forces of gravity:

- GPM – Gallon Per Minute

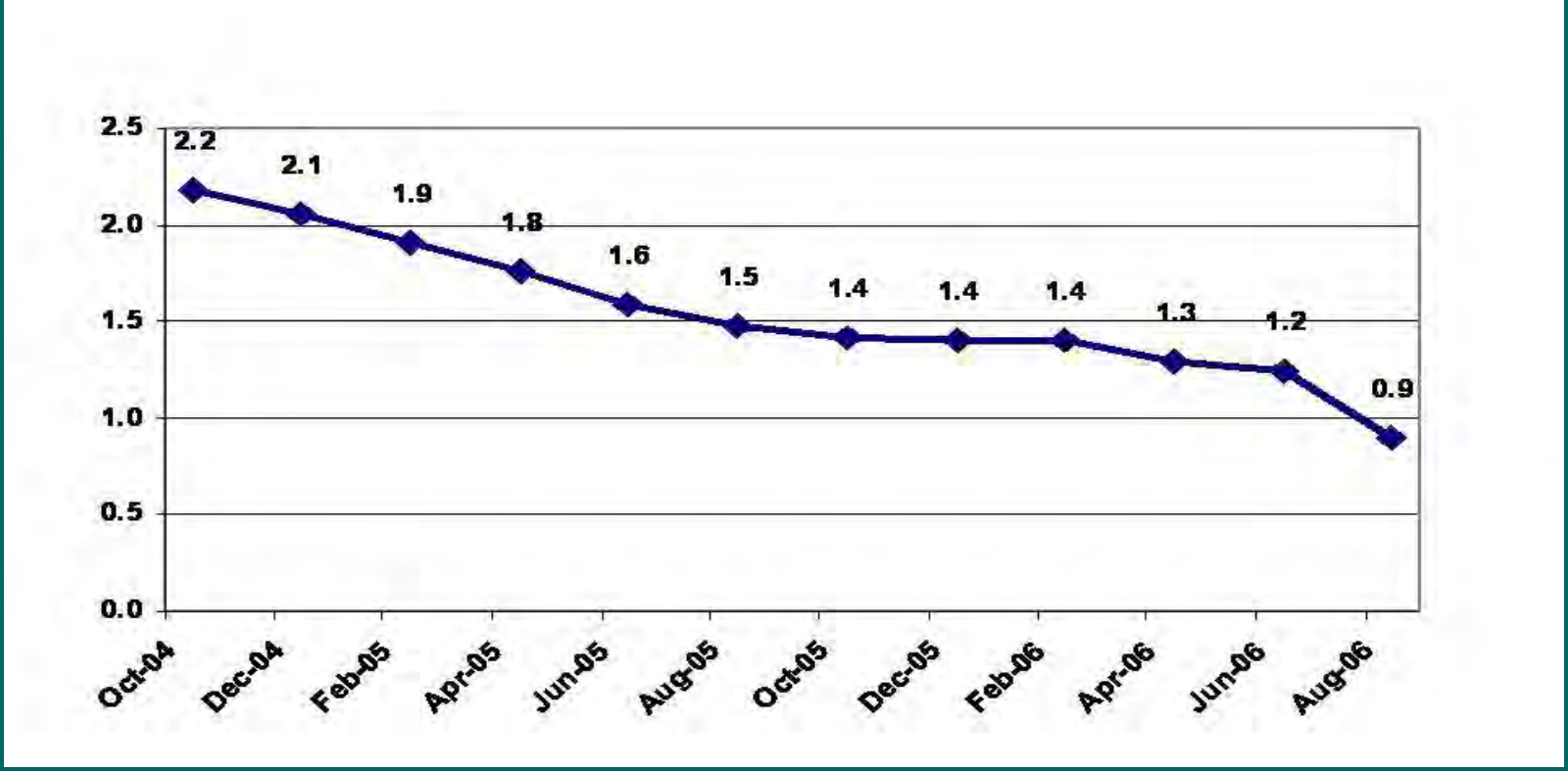
Dalton #1 Pre-Maintenance



Dalton #1 Post Maintenance



Dalton #1 Historical Specific Yield



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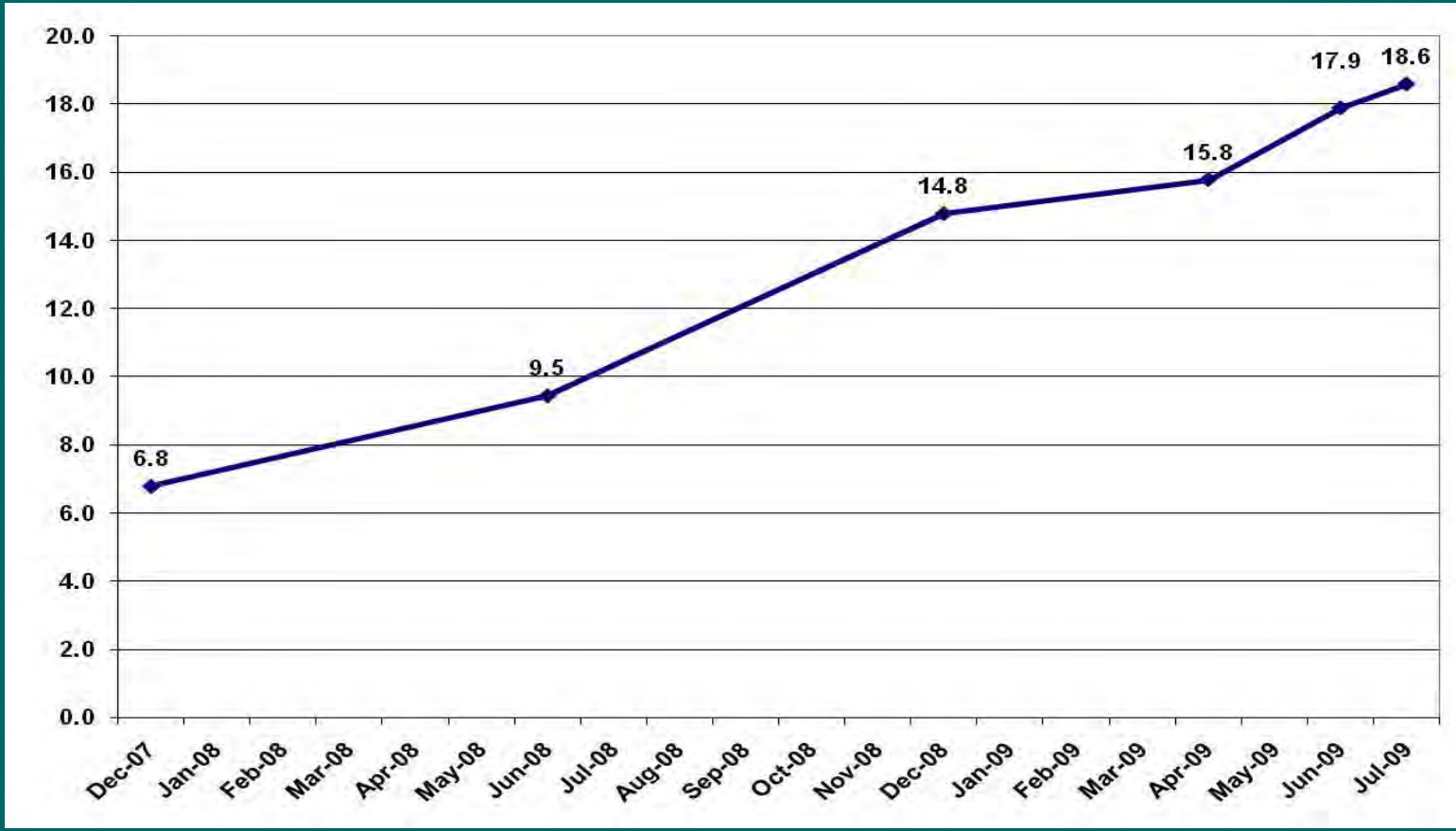
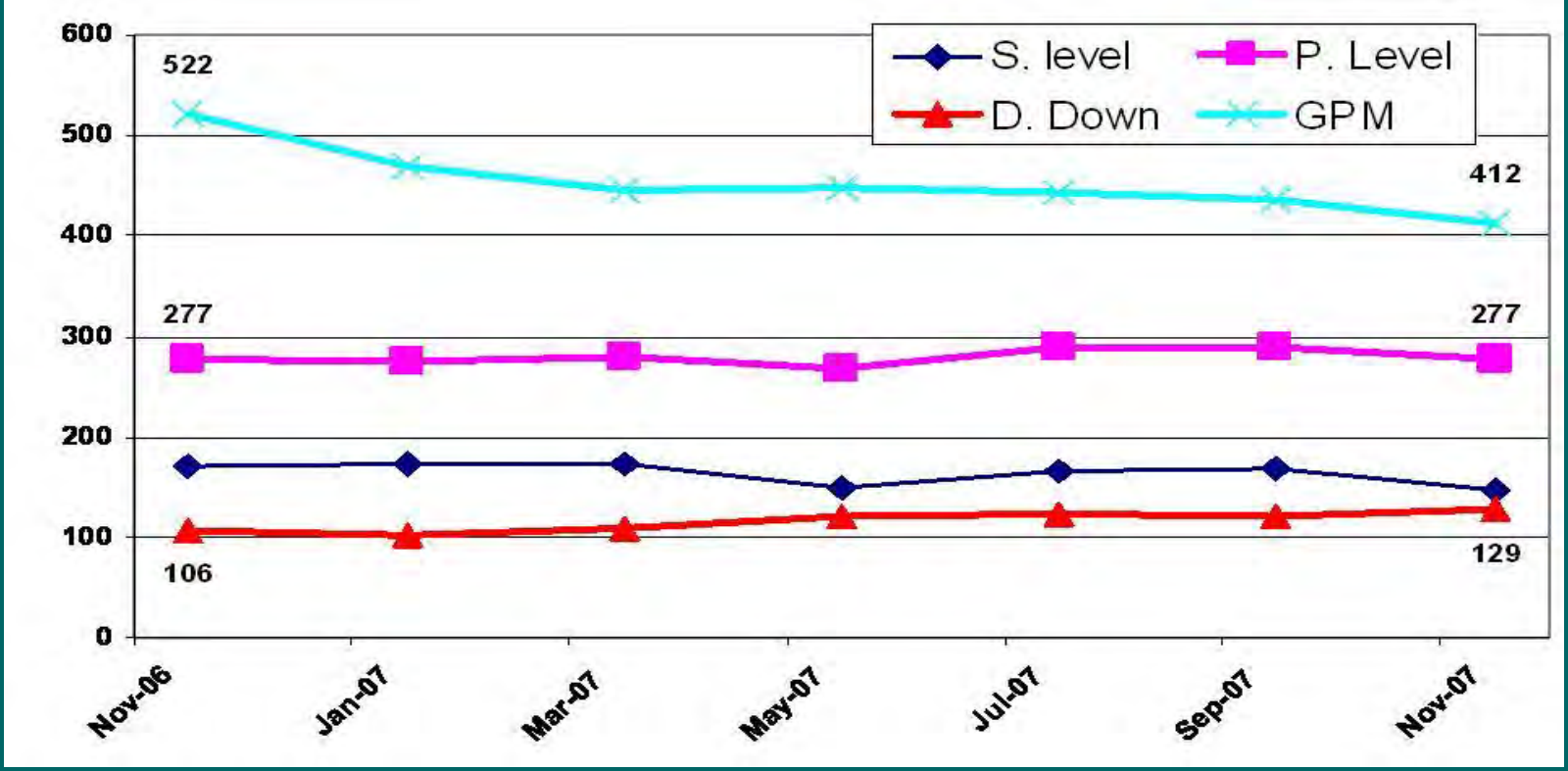
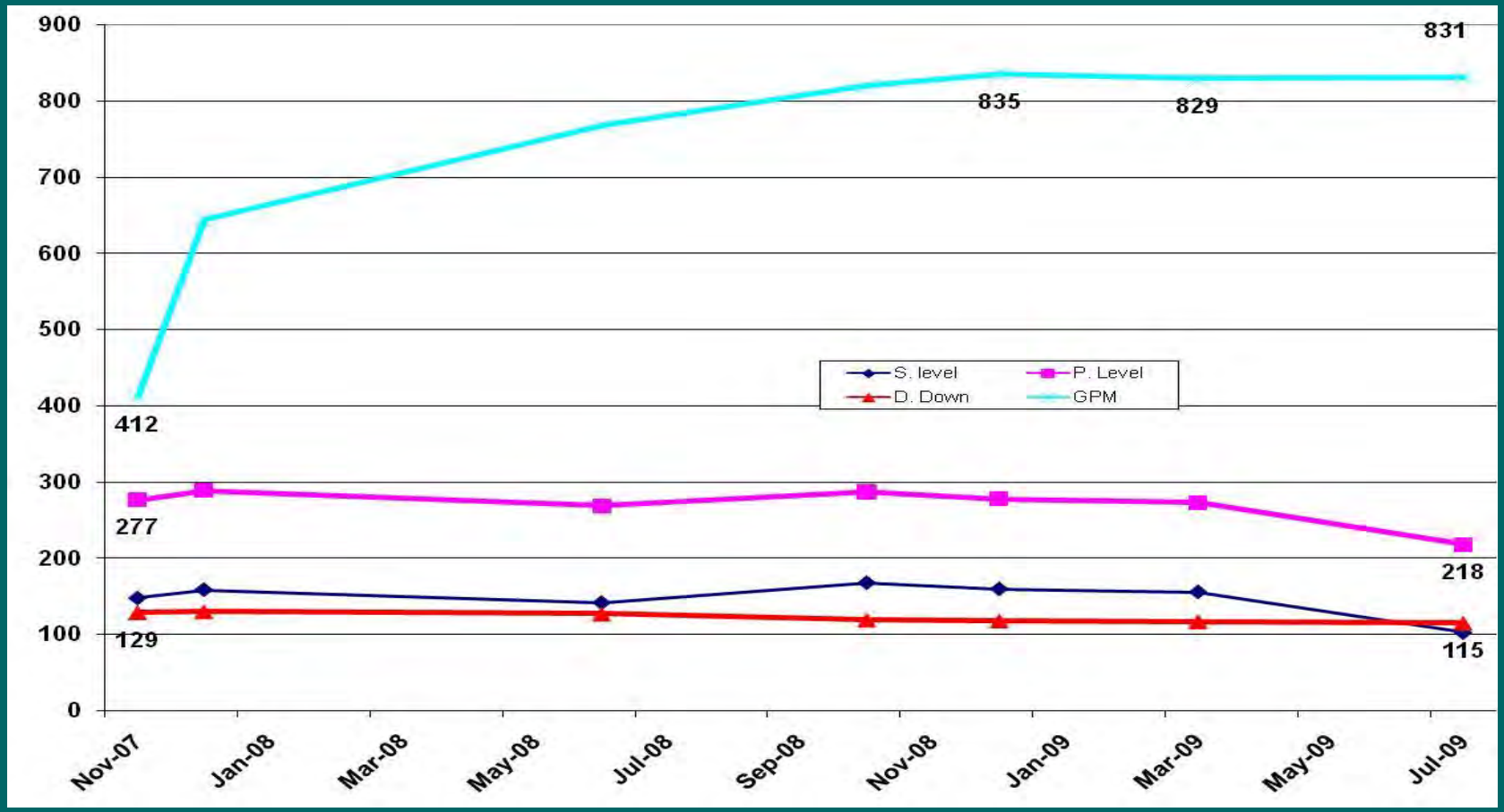


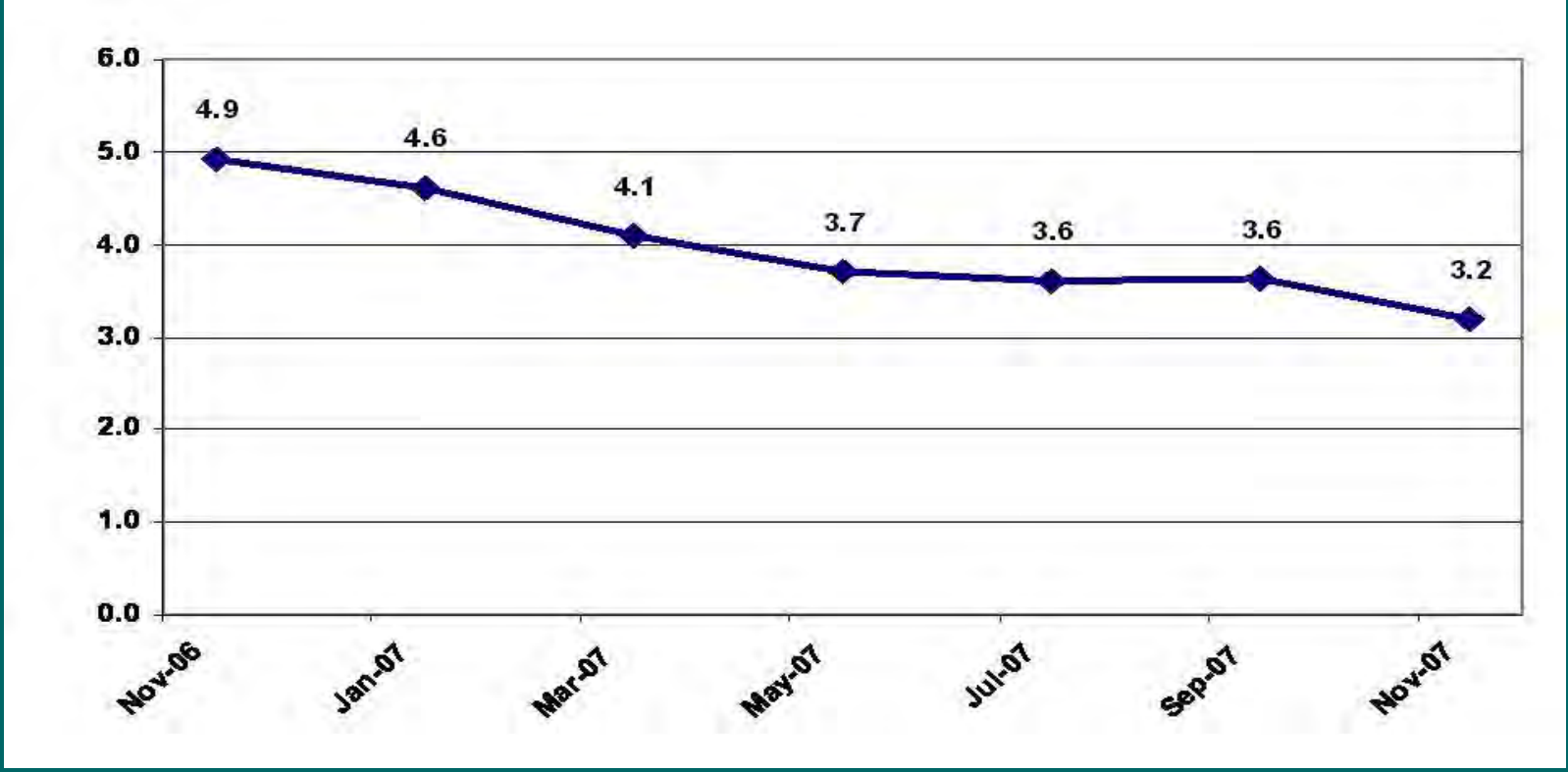
Yukon #5 Pre-Maintenance



Yukon #5 Post-Maintenance



Yukon #5 Historical Specific Yield



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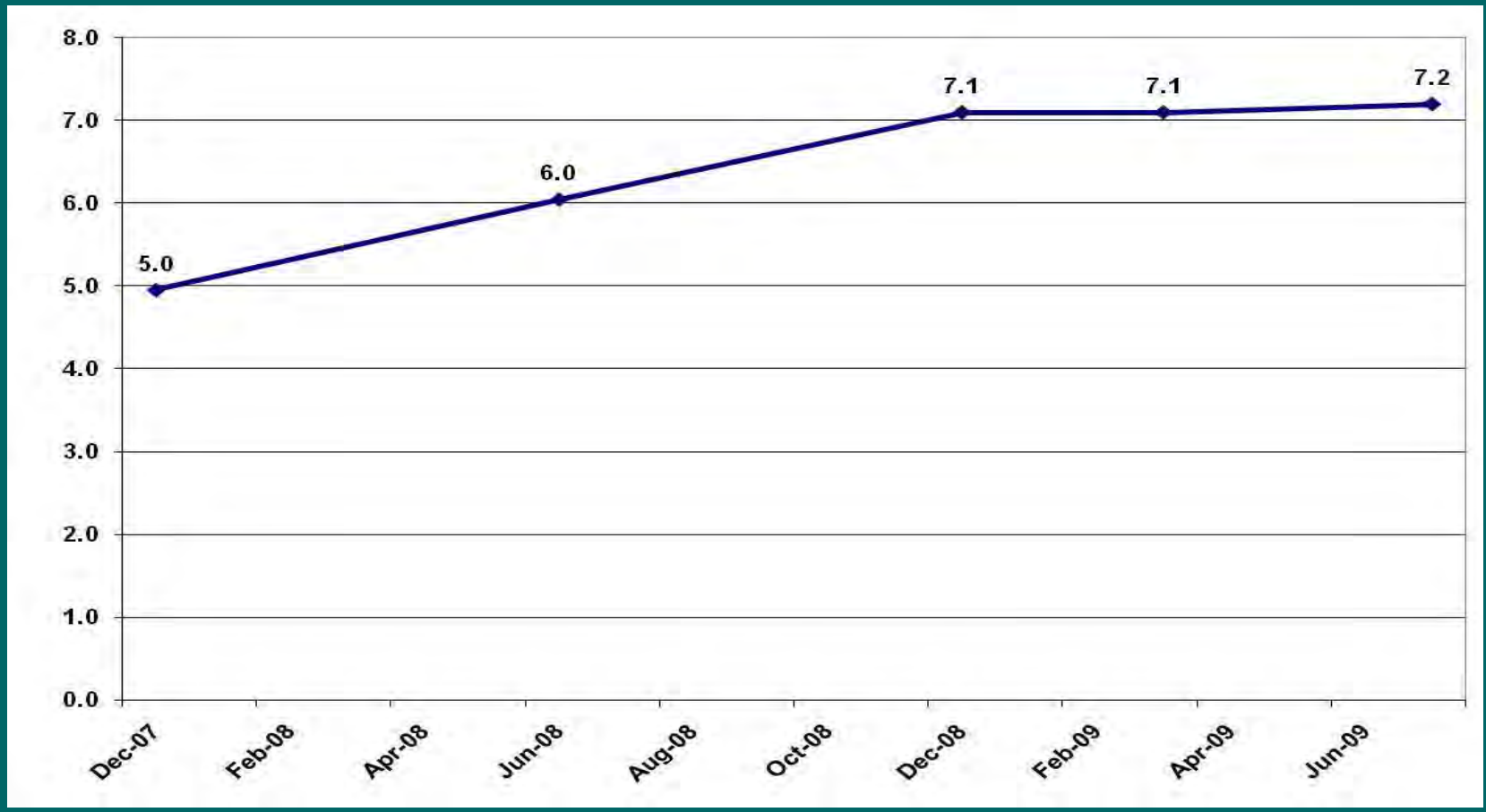
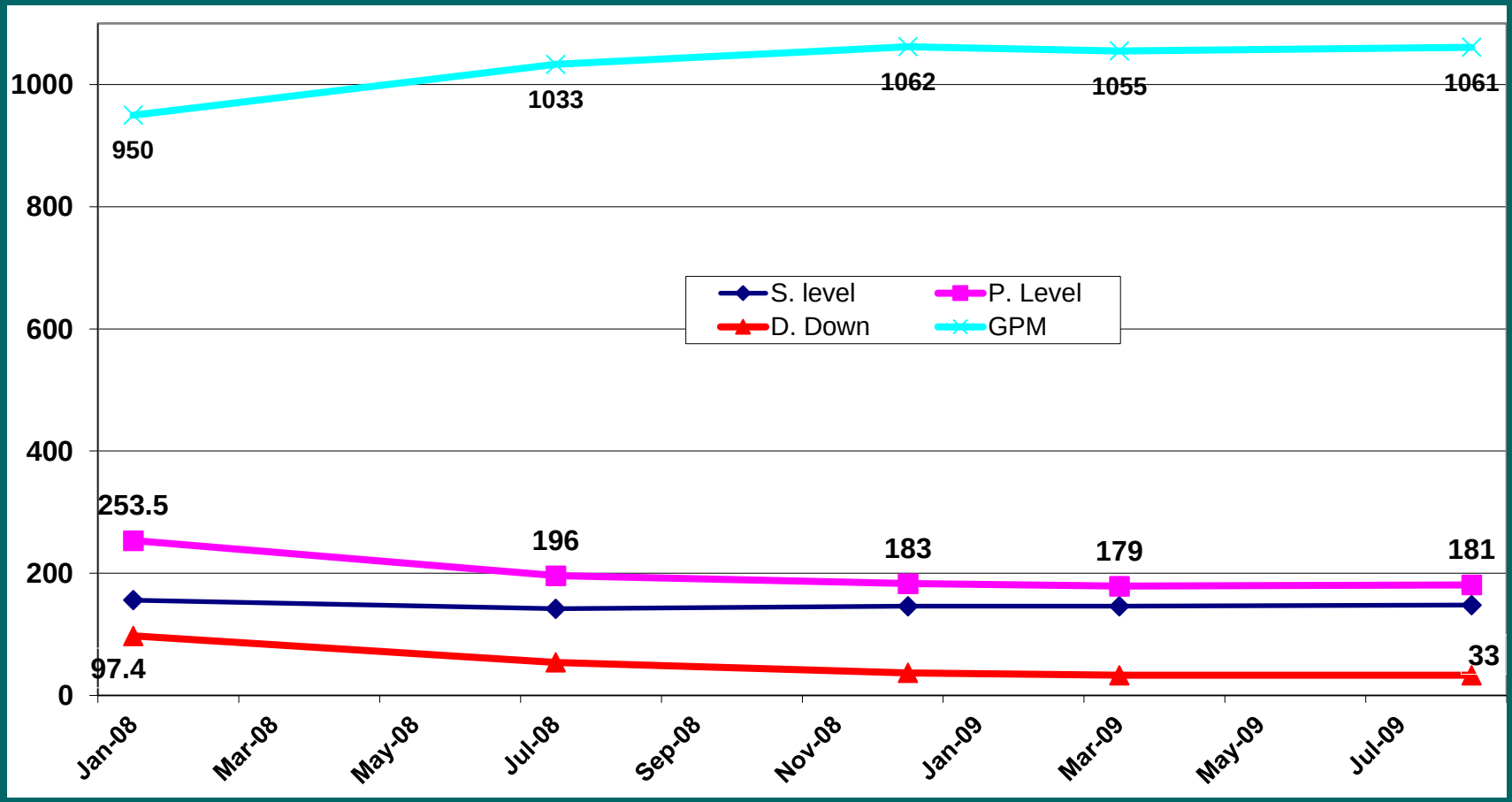
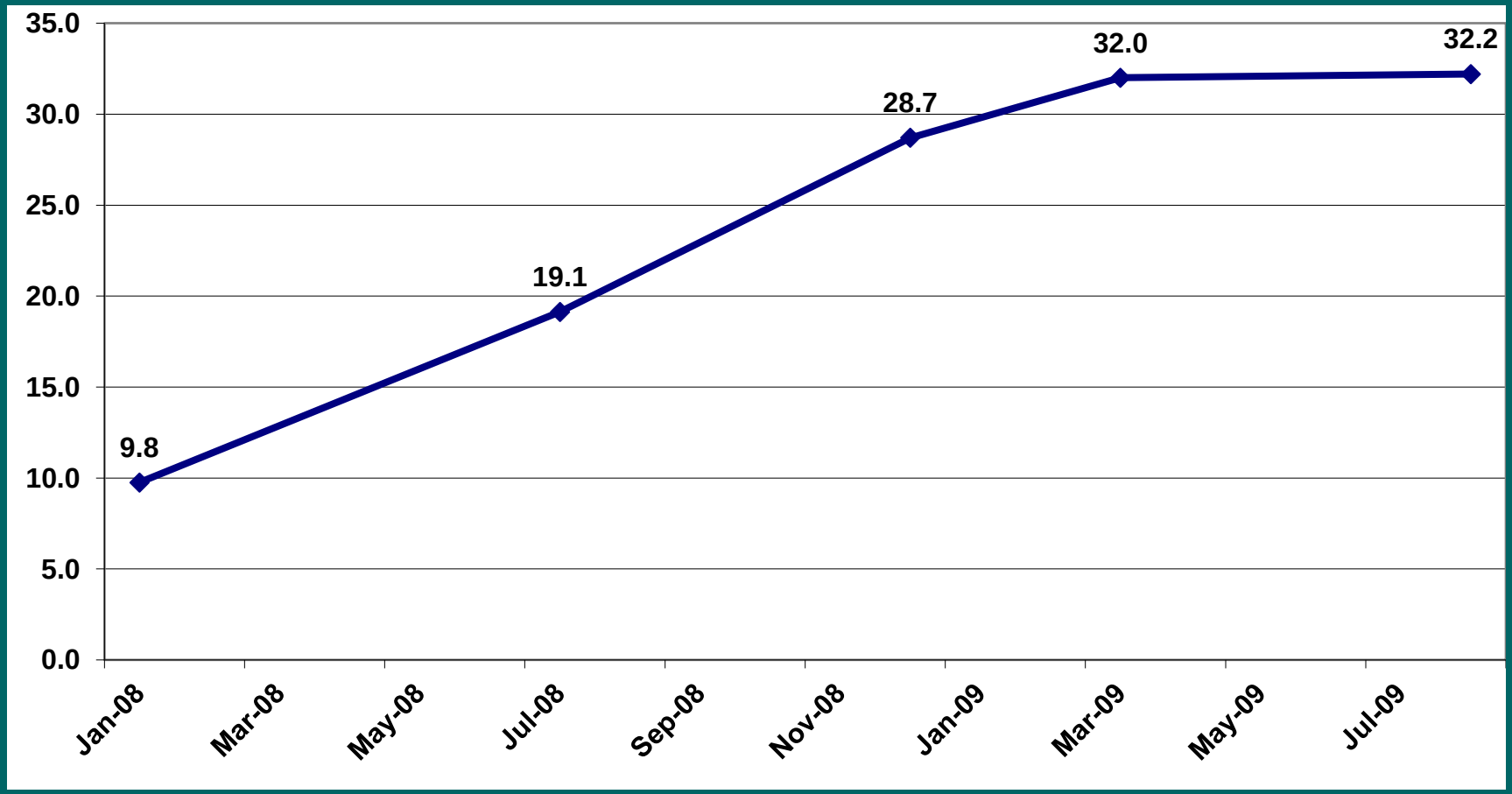


Belhaven #3 Post-Maintenance



Belhaven #3 Specific Yield Post-Maintenance



Cost Comparison

- Full well rehabilitation can cost $50 – 100K, and well is down 30 days to up to one year
- Well maintenance with SeaQuest costs approximately $1,500 (chemicals and labor) and well is down 36 hours
- Have avoided performing any major well rehabilitations in Southwest since starting this process.

Cost Benefits

- Electrical Savings have averaged **$15,000** per well site that was rehabilitated
- The increase in flows from each well site corresponds directly to more income per well as much as 200% more than before rehabilitation with SeaQuest
- Average additional income per well site **$124,000 annually**

Things to Consider

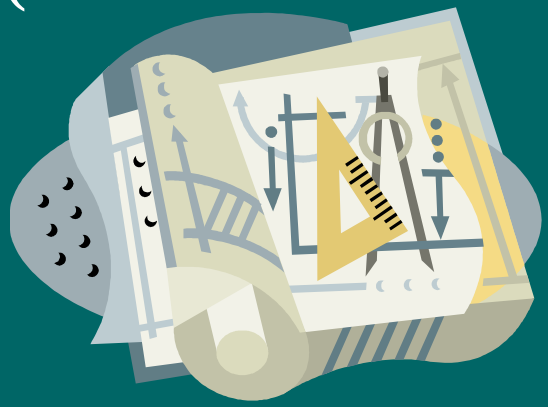
- Biological growth stimulation by phosphate
- Regulatory requirements (NPDES, DPH)

Potential for biological growth

- Concern that addition of phosphate can stimulate biological growth in a well.
- Not seen thus far (coliform, HPC, other bacteria found in wells)
- Will continue to monitor annually so that biofilm growth can be addressed early, if necessary

Regulatory Requirements

- No NPDES discharge limit for phosphate, plus used in many drinking water systems. Discharges covered under treated water permit.
- DPH informed of process and require no additional permits or approvals (use NSF-certified chemicals)



Next Steps

- Continue monitoring for biological growth
- Optimize process (frequency & chemical dose)
- Develop cost-benefit analysis for in-house maintenance vs. full-scale well rehabilitation
- Develop written procedure for potential use in other districts

SeaQuest WELL Rehab Protocol

WELL 59
El Paso, TX

Monterey Mexico
Well Rehab / Maintenance

Mexico City, Mexico
Well Rehab / Maintenance

A US System in Colorodo
Well Rehab / Maintenance

Suffolk County, N.Y. Well Rehab/Maintenance

Hard Water Well Georgetown, Guyana Rehab/Maintenance

Dry Shore Well Guyana Well Rehab/Maintenance