Media Performance City of Mesa, AZ Experience

EPA Arsenic Workshop August 10, 2004

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Today's Presentation

- City of Mesa Arsenic Compliance Situation
- Technologies Being Tested in Mesa
  - Adsorptive Media
  - Ion Exchange
- Results from Bench and Pilot Testing

City of Mesa Arsenic Rule Compliance Situation

- Supplies
  - Surface Water – 136 MGD
  - 38 Wells – 90 MGD
- 22 Wells impacted because of new MCL
  - 14 Wells > 10 ppb
  - 8 Wells within 20% MCL (8 ppb)

Arsenic Removal Technology Testing in Mesa

- Project Goal
  - Determine most appropriate technologies
  - Focus on Falcon Field Well #4 Water
    - 34 ppb Arsenic
    - 7.7 pH
    - 39 ppm Silica (as SiO_2)
    - 15 ppb Vanadium
    - 0.017 ppm Phosphate (as P)
- Adsorptive Media
  - Bench Testing
  - Pilot Testing
- Ion Exchange
  - Pilot Testing

Adsorptive Media Arsenic Treatment

- Advantages
  - Low cost
  - Simple installation
  - Simple operation
  - Not limited to sole source
  - Fully automated turn-key systems available
- Limitations
  - Only removes As(V)
    - Some media
  - Lack of As selectively
  - Interferences
  - Releases
  - pH dependant
  - Waste disposal concerns

Adsorptive Media Bench Testing

- Screen adsorption treatment technologies
  - Two phases of bench testing
    - Batch Testing
    - Rapid Small Scale Column Testing (RSSCT)

ASU Graduate Students Conducting Bench Testing Under Direction of Paul Westerhoff, Ph.D.

Adsorptive Media Bench Testing

- City criteria for media selection for piloting
  - pH adjustment
  - Adsorption capacity
  - Cost & operational considerations
  - NSF approval status

Adsorption Medias in Bench Testing Program

Activated Alumina (baseline)
Iron Modified AA
ZVI w/ Silica (AsRT) developed by the University of Connecticut
Granular Ferric Hydroxide (GFH) supplied by U.S. Filter
Bayoxide E33 supplied by Severn Trent
Sulfur Modified Iron (SMI) III
Z33 supplied by Water Remediation Technology
Metsorb G supplied by HydroGlobe

Adsorptive Media Bench Testing

Phase I – Batch Tests

- Screen several adsorption media for % arsenic removal with Mesa water
- Compare media at 3 pHs to determine if pH adjustment required for pilot testing
  - Ambient (7.7)
  - 7.0
  - 6.5

Phase II – RSSCT Tests

- Conduct continuous flow column experiments with better performing Phase I adsorbents
- Determine predicted media life for each media
  - Expressed in bed volumes

Adsorptive Media Bench Testing

- Batch Test Results
  - Media performance ranked from highest to lowest

    SMI ~ ZVI > Bayoxide E33 > GFH ~ AA ~ FS50 > Z33
  - Iron release problems with ZVI and SMI
    - Decided to discontinue testing of ZVI & AA

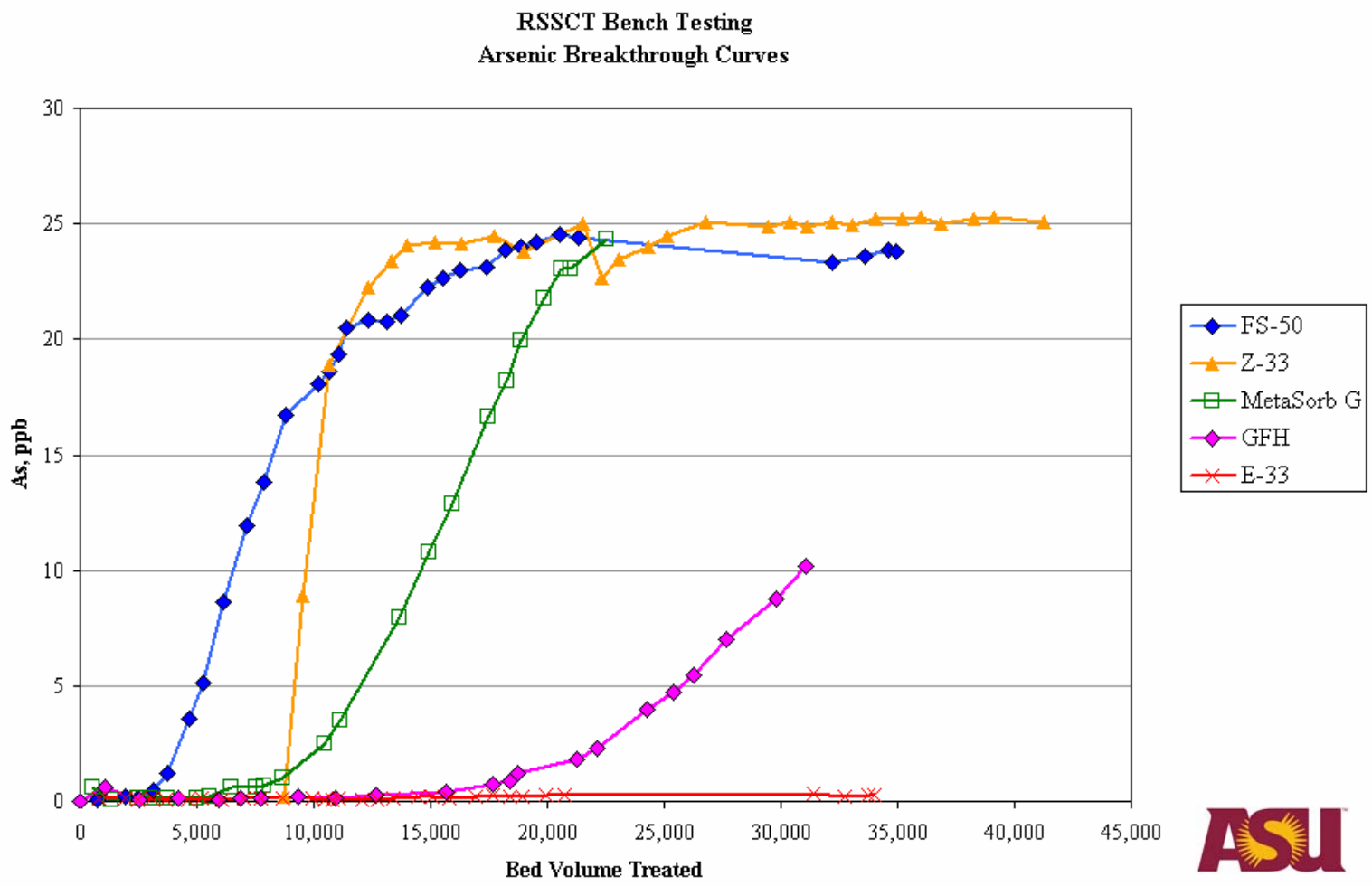
Adsorptive Media Bench Testing

- RSSCT Results
  - Media performance ranked from highest to lowest

    Bayoxide E33 > GFH >Metsorb G > Z33 > FS50

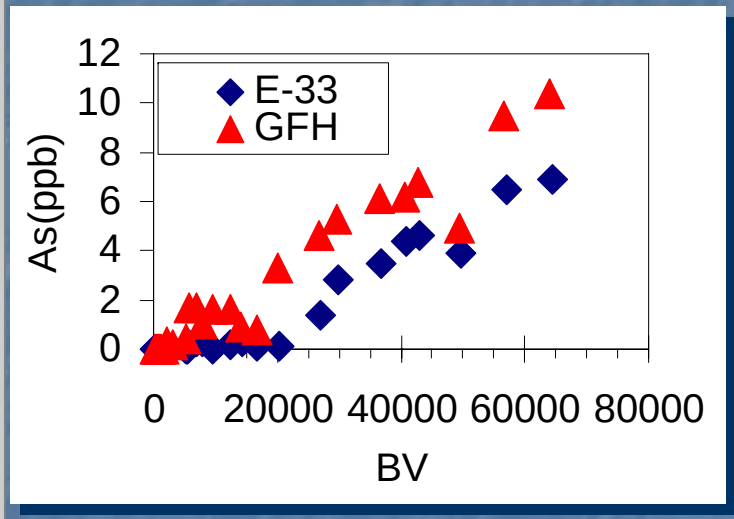
  - RSSCT bed volumes not calculated for SMI due to upflow design requirements
    - Additional iron release testing conducted

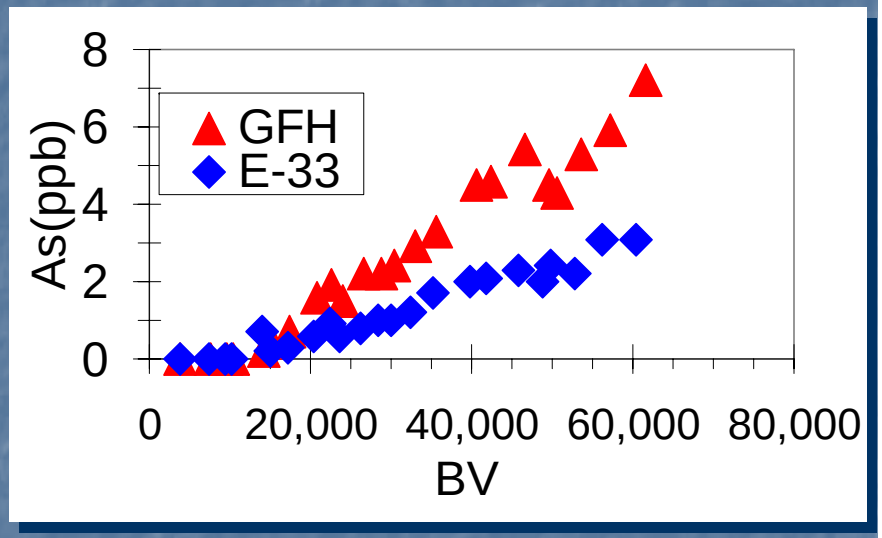
Adsorptive Media Bench Testing

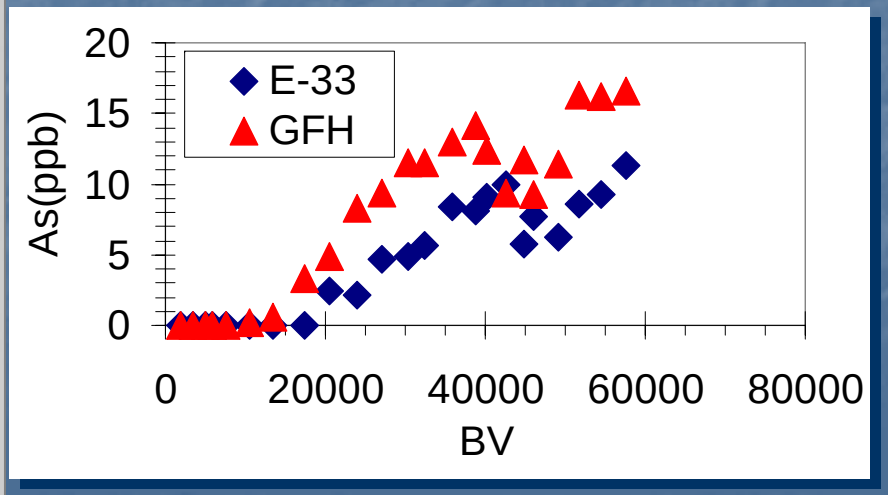


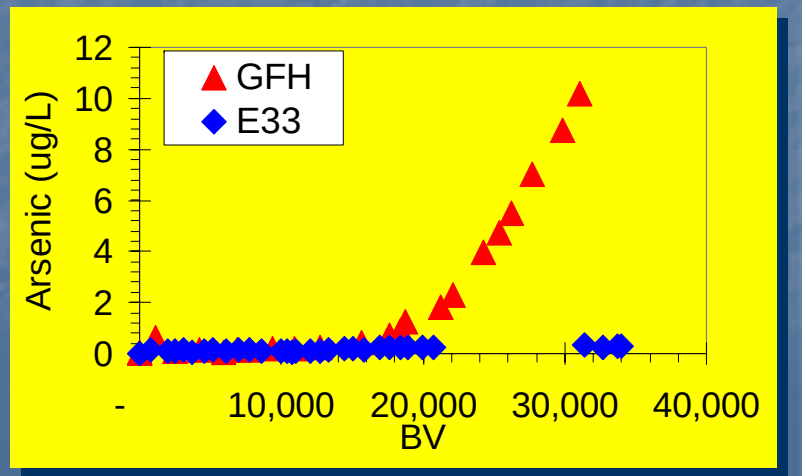
Adsorptive Media Bench Testing

RSSCT Comparison E33 & GFH for 4 GWs in Arizona









Prof. Paul Westerhoff, Civil and Environmental Engineering, ASU (Tempe, AZ)

DSWA Criteria Matrix – Adsorptive Media to be Pilot Tested

- DSWA evaluated ASU bench testing results & other criteria for media selection by descending order of importance
  - NSF approval status
  - Bed volumes/$/lb
  - Bed volumes treated
  - Iron release issues
  - pH adjustment requirement potential
- Z-33 > SMI-III > Bayoxide E33 > GFH ~ FS50

Adsorptive Media Pilot Testing

- Pilot testing conducted in DSWA pilot system
- Media
  - As:X^{np}
  - Bayoxide E33
  - GFH
  - Z33
- Design Factors
  - Downflow
  - Parallel
  - 8” Columns

Bayoxide E33 & GFH Media

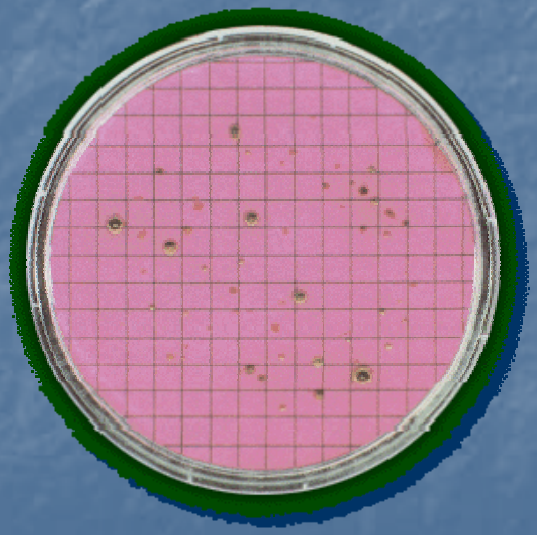
Adsorptive Media Pilot Testing

- Start-up
  - Media handling - safety
  - Conditioning procedures
- Routine Operation
  - 5 minute EBCT
  - 5.7 gpm/ft^2
- Routine Maintenance
  - Backwash driven by Δ P
  - Backwash disposal
  - Media disposal

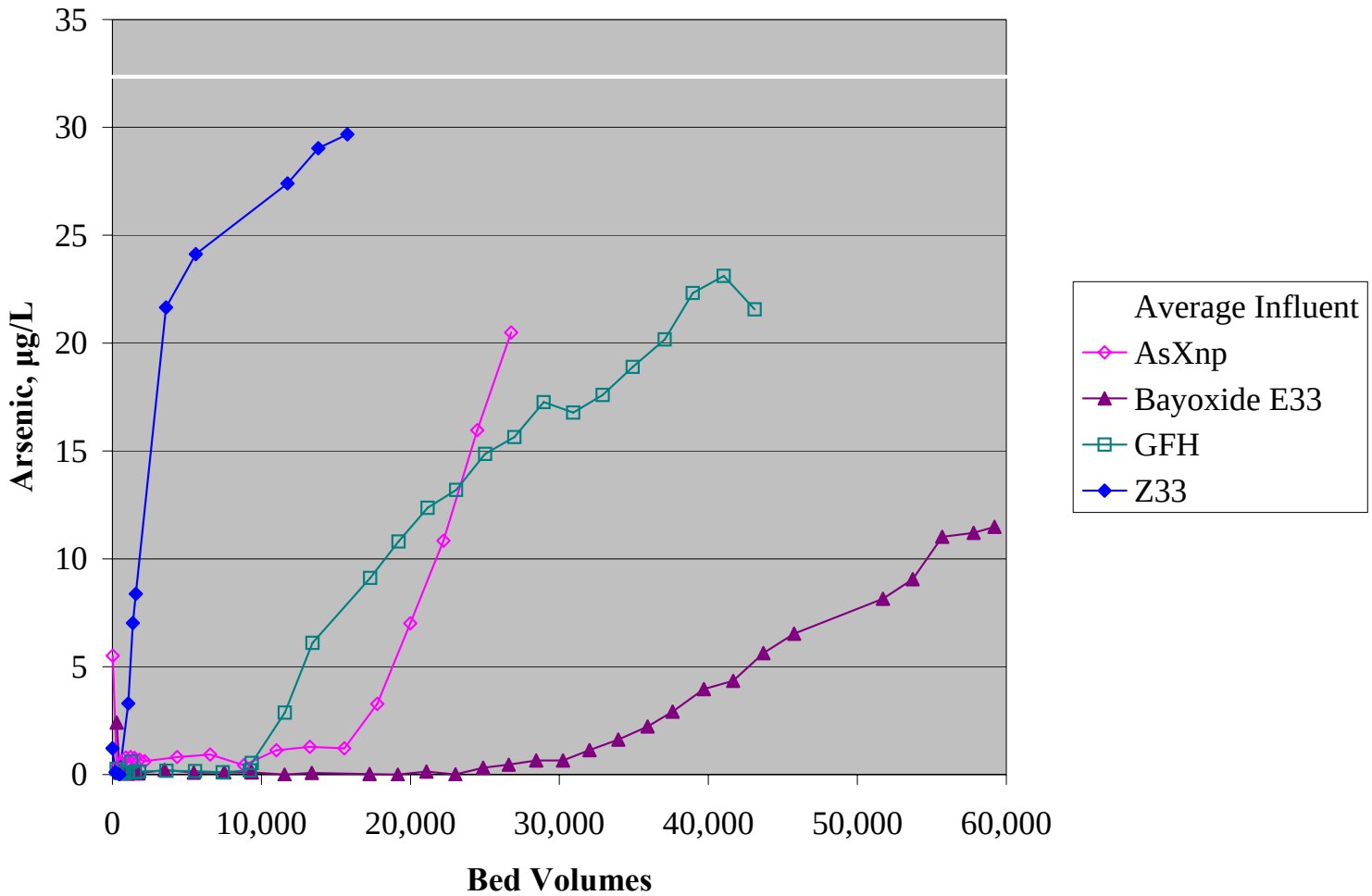
Conditioning GFH & Bayoxide E33

Adsorptive Media Pilot Testing

- Constituents of concern for this water
  - Arsenic
  - Silica
  - Vanadium
  - Heterotrophic Plate Count
  - Contaminant releases



Adsorptive Media Pilot Testing



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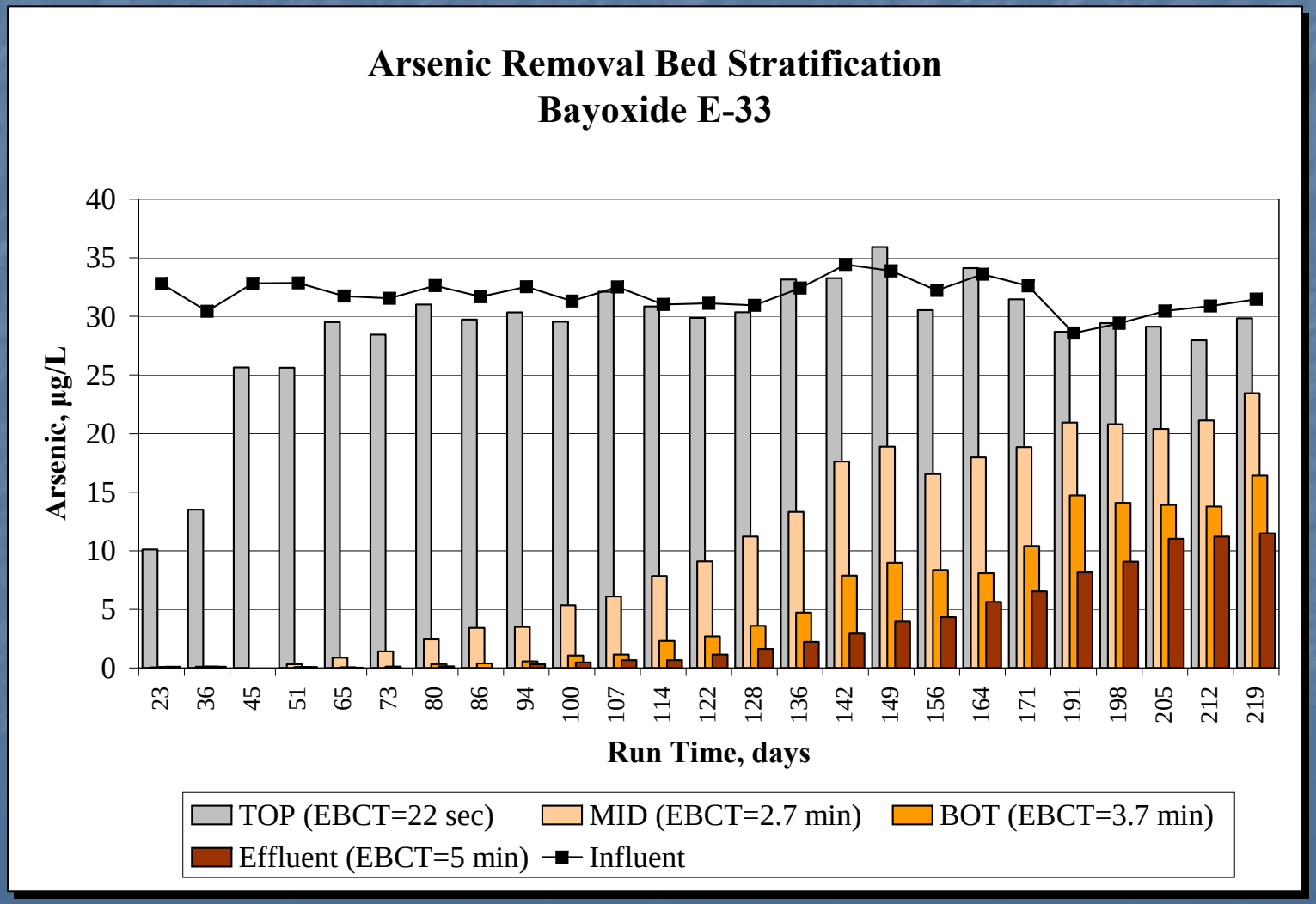
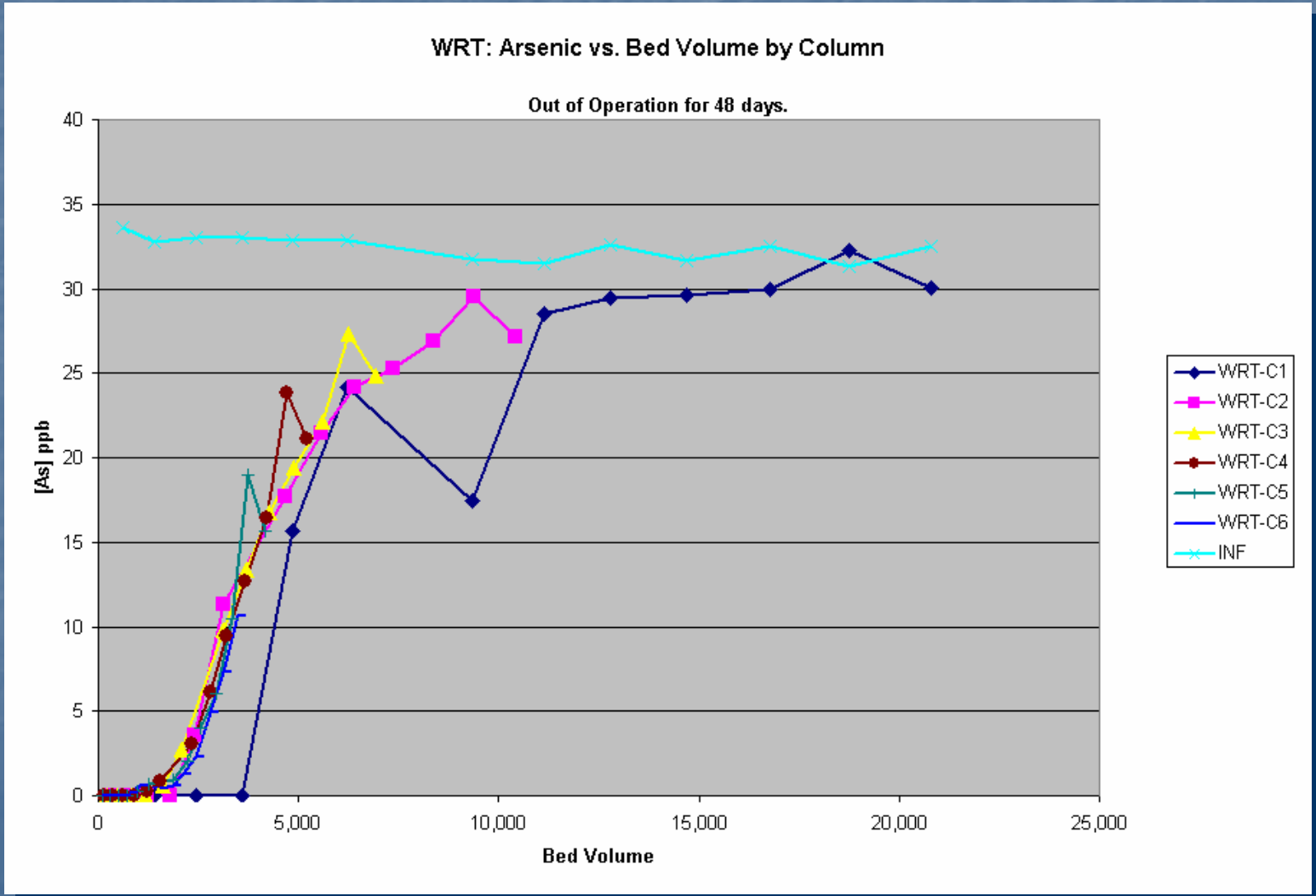


Z33 Adsorptive Media Pilot Testing

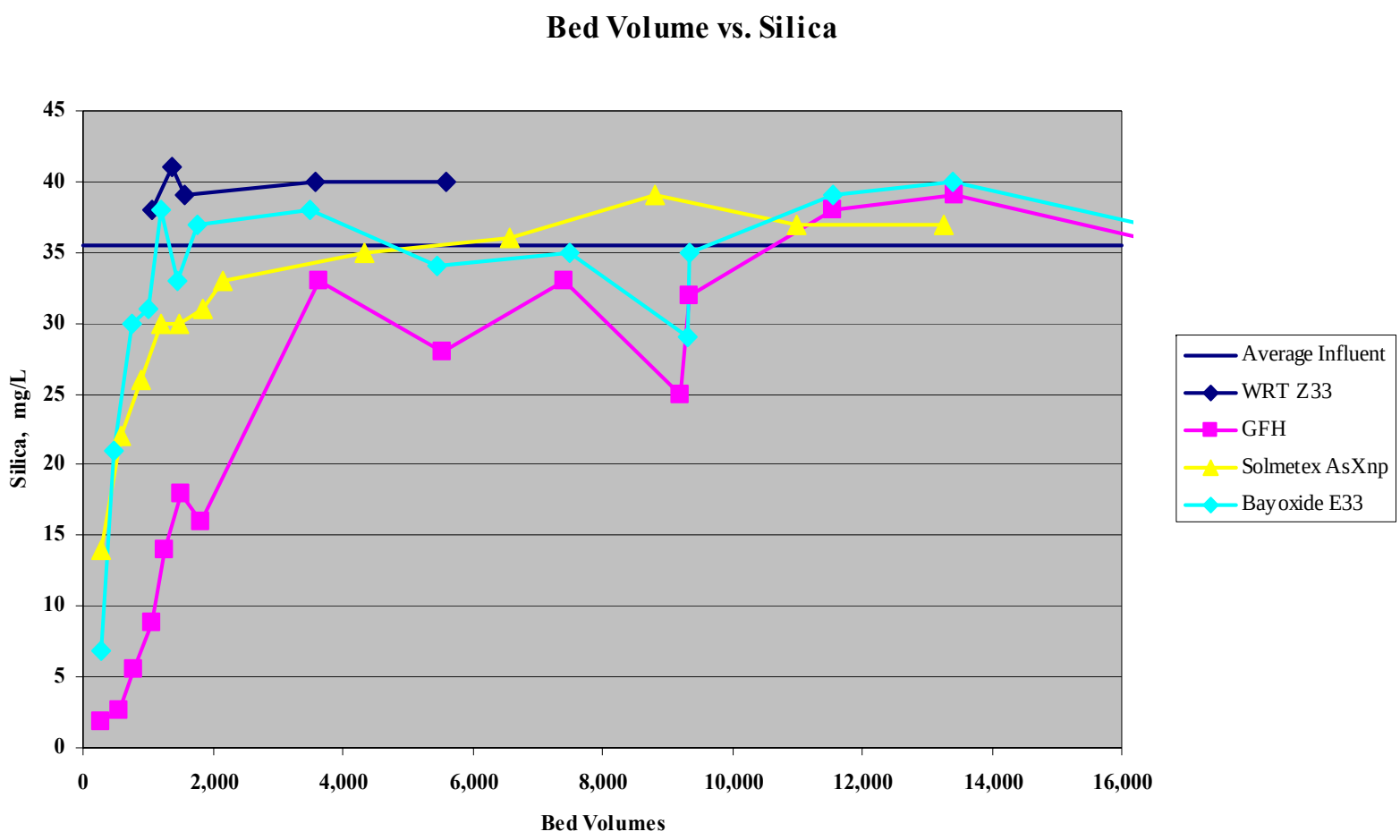
- Pilot testing conducted in Water Remediation Technology (WRT) pilot plant
- Media – Z-33
- Design
  - Upflow
  - Series configuration
    - Six columns

WRT Pilot Columns

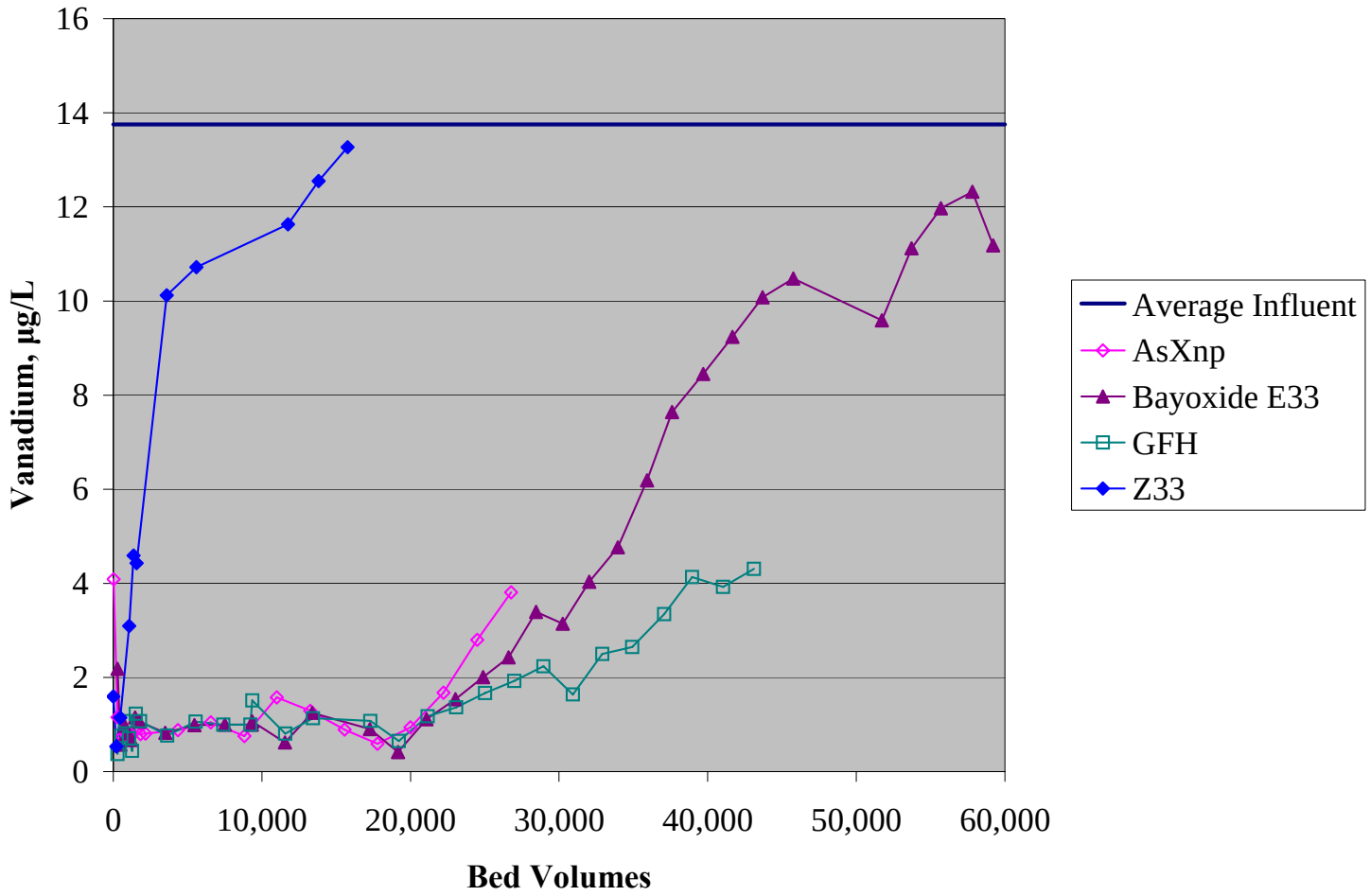
Normalized Z33 Breakthrough Curves



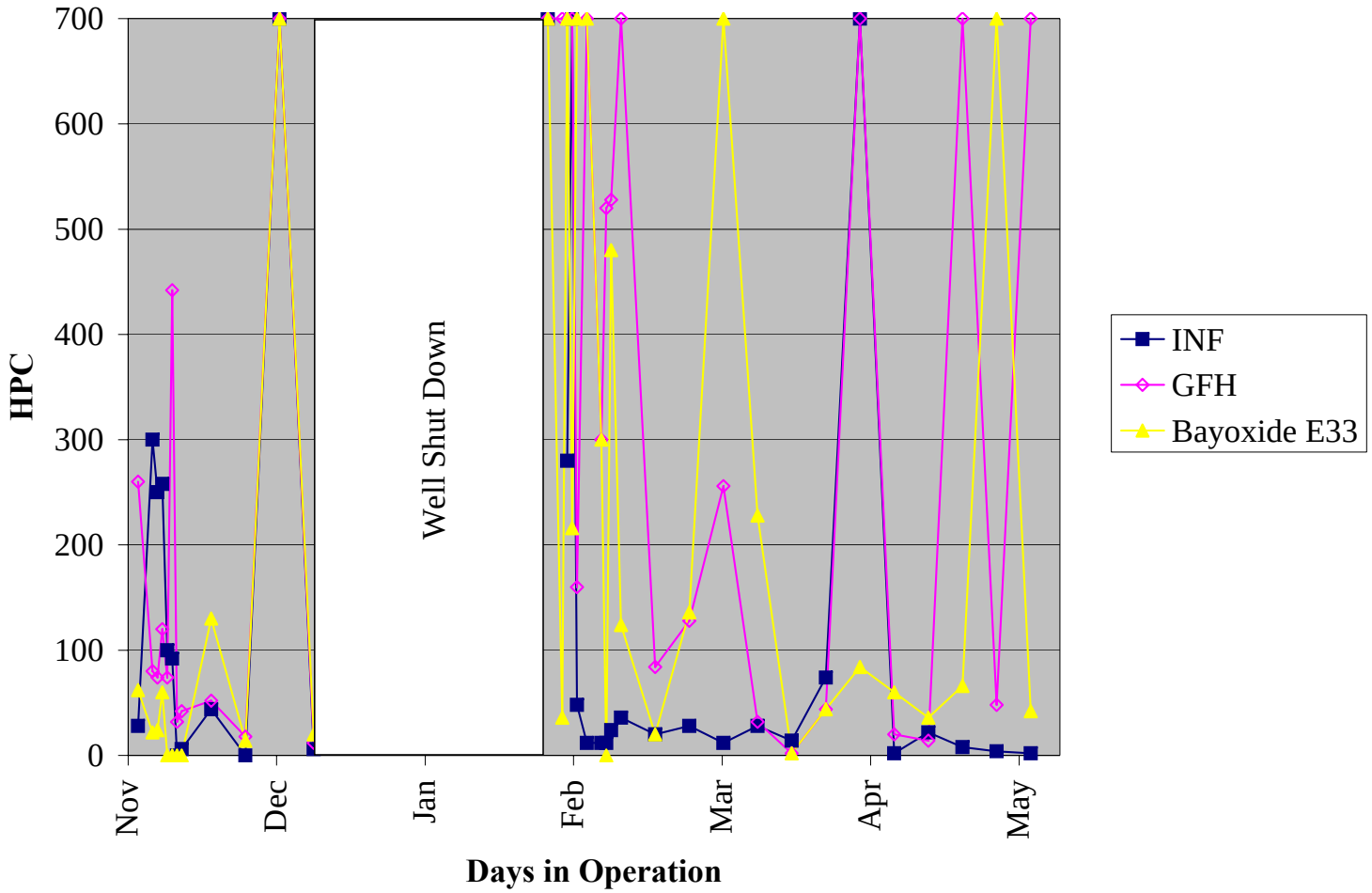
Adsorptive Media Pilot Testing



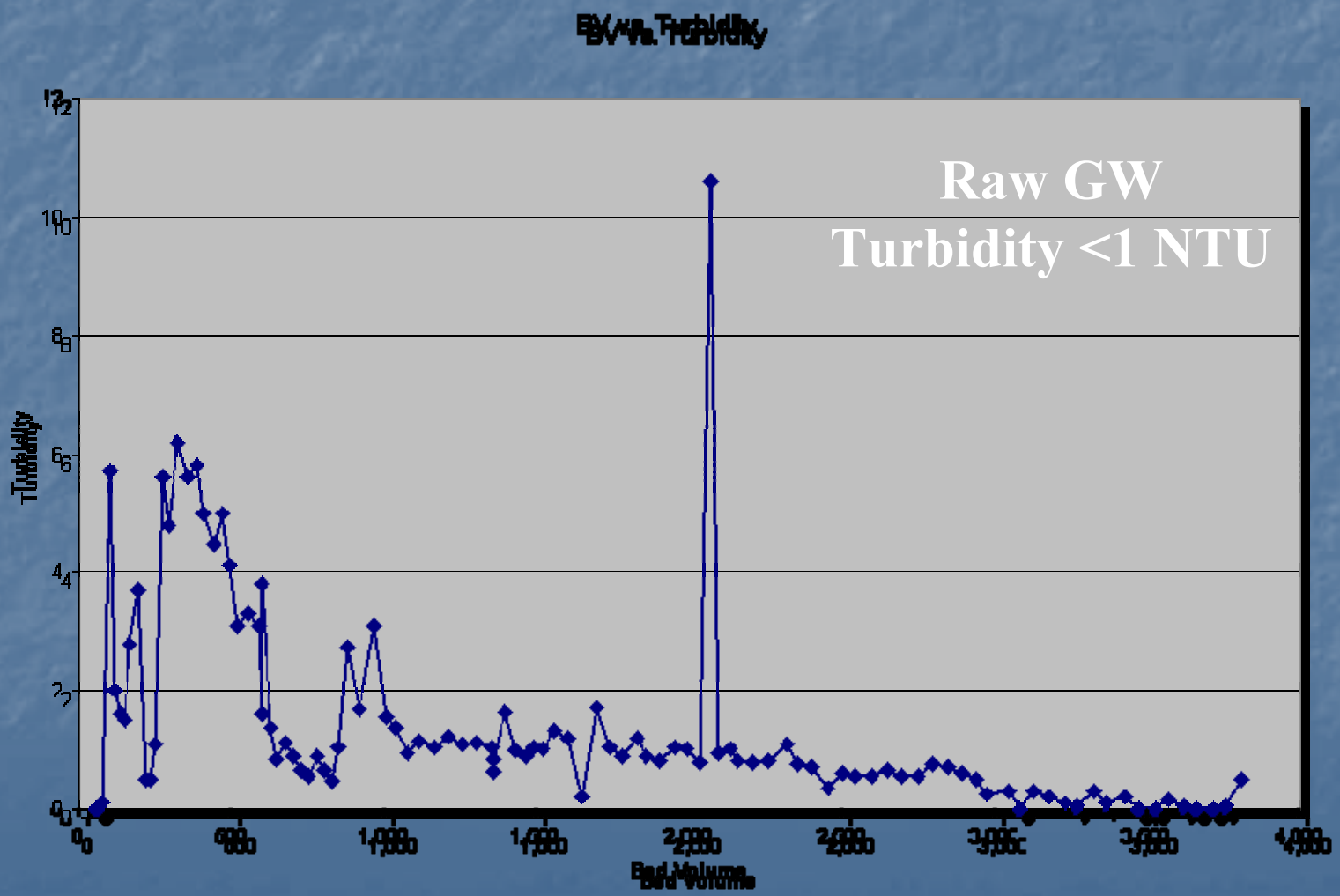
Adsorptive Media Pilot Testing



Adsorptive Media Pilot Testing



Adsorptive Media Pilot Testing



Lessons Learned

- Bench testing can be used to screen better media with specific waters
  - RSSC Testing may be used as a tool to predict media behavior if there is not time to pilot test
- Media may remove Arsenic differently due to specific water qualities
  - Sometimes they behave similarly, other times not
- Operational constraints must be tested prior to serving water to distribution system
  - Ensure media well prepared by manufacturer to avoid iron leaching (Fe/Mn field kits available)
  - Ensure media releases are avoided (measure turbidity)
  - Avoid Iron-bacteria and biofilm growth
- Operational tools can be designed to predict breakthrough
- Used media pass leaching tests, although some parameters were close to changing the classification for disposal
- E33 media sole-sourced for first round and indefinitely, unless new media provider demonstrates they can outperform E33

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Questions?

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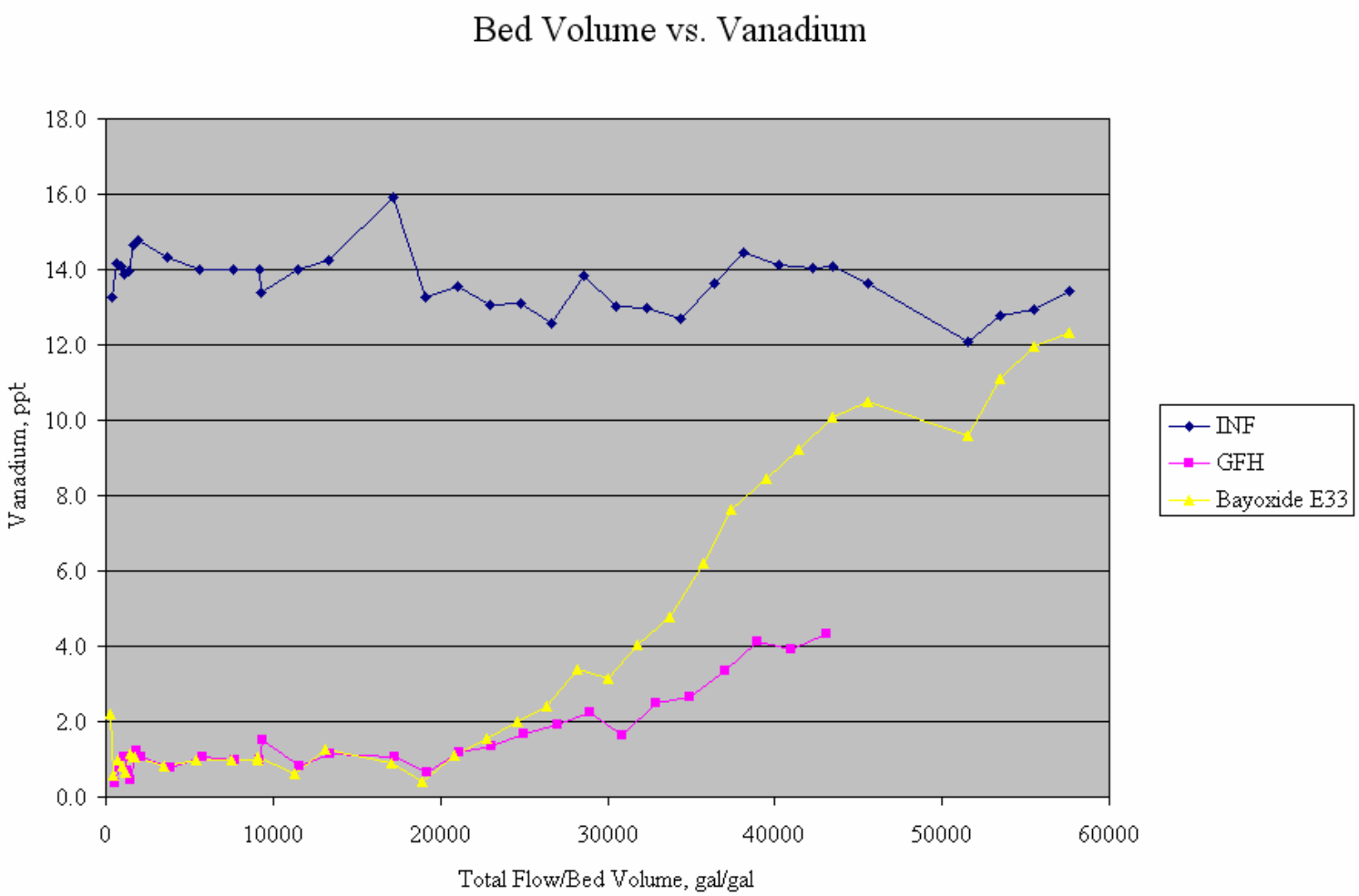
Take Home Message

- Get to know your water!
  - Collect samples for arsenic impacted contaminants at all wells above 10 ppb or within margin of safety (8 ppb)
  - Compare your water quality data to pilot test sites with similar water
  - Determine if pilot testing required for your water
  - Get started if you have not already

Adsorptive Media Pilot Testing



Adsorptive Media Pilot Testing

- Pilot testing completed with Z33, GFH, Bayoxide E33
- Additional pilot testing with As:X^{np} developed by SolmeteX

Loading GFH Media