A Review of Physical, Chemical, and Biological Treatment Systems for End of Pipe Selenium Treatment

The 31st West Virginia Mine Drainage Symposium Task Force

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Morgantown, West Virginia

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Agenda

- **Drivers**
- **Challenges**
- **Systems Approach**
- **Non-Passive or Process Oriented Systems**
  - Membrane
  - Biological
  - Ion Exchange
  - Iron
- **Conclusions**

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Drivers

- Low level discharge requirements
- Complete source control challenging
- Part of an overall pollution prevention management strategy
- Can create immediate impact
- Controllable processes

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Challenges

- Exists in a variety of chemical forms
- Regulated to below 5 µg/L
- Relatively dilute or very low mass to volume ratio
- Variable flows
- Water matrix interferences/competing chemistry/scaling potential
- Creates by products or residuals
- Re-release from residuals can occur

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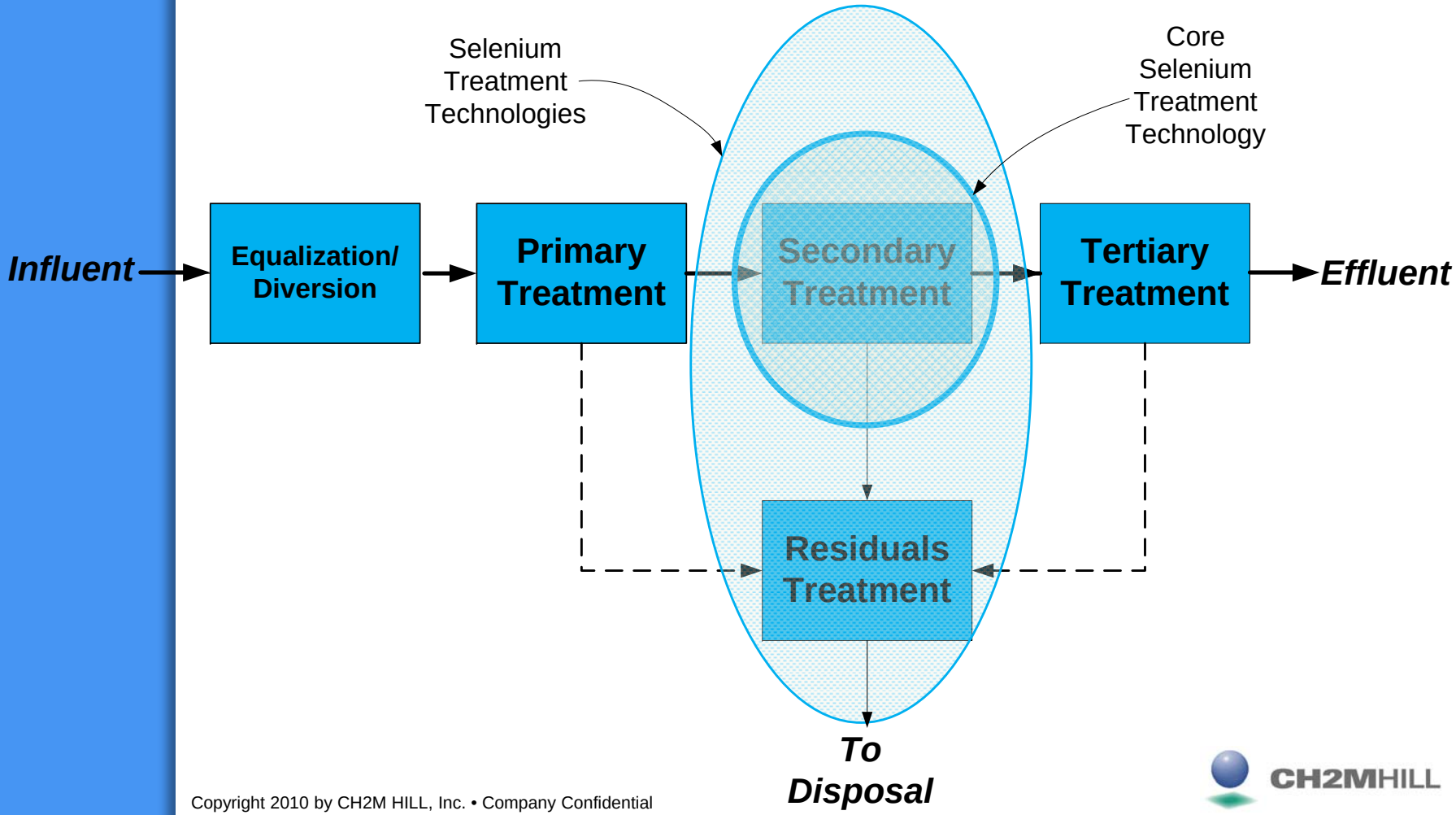
Process Oriented Systems Approach



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Typical Treatment Unit Processes in Systems

- **Primary Treatment**
  - Suspended solids
  - Inorganic scale
  - pH
  - Temperature
- **Tertiary Treatment**
  - Suspended solids
  - pH
  - Temperature
  - Biochemical Oxygen Demand
  - Other NPDES parameters
- **Residuals Treatment**
  - Application core or secondary selenium treatment technologies
  - Thickening
  - Dewatering
  - Chemical fixation/stabilization

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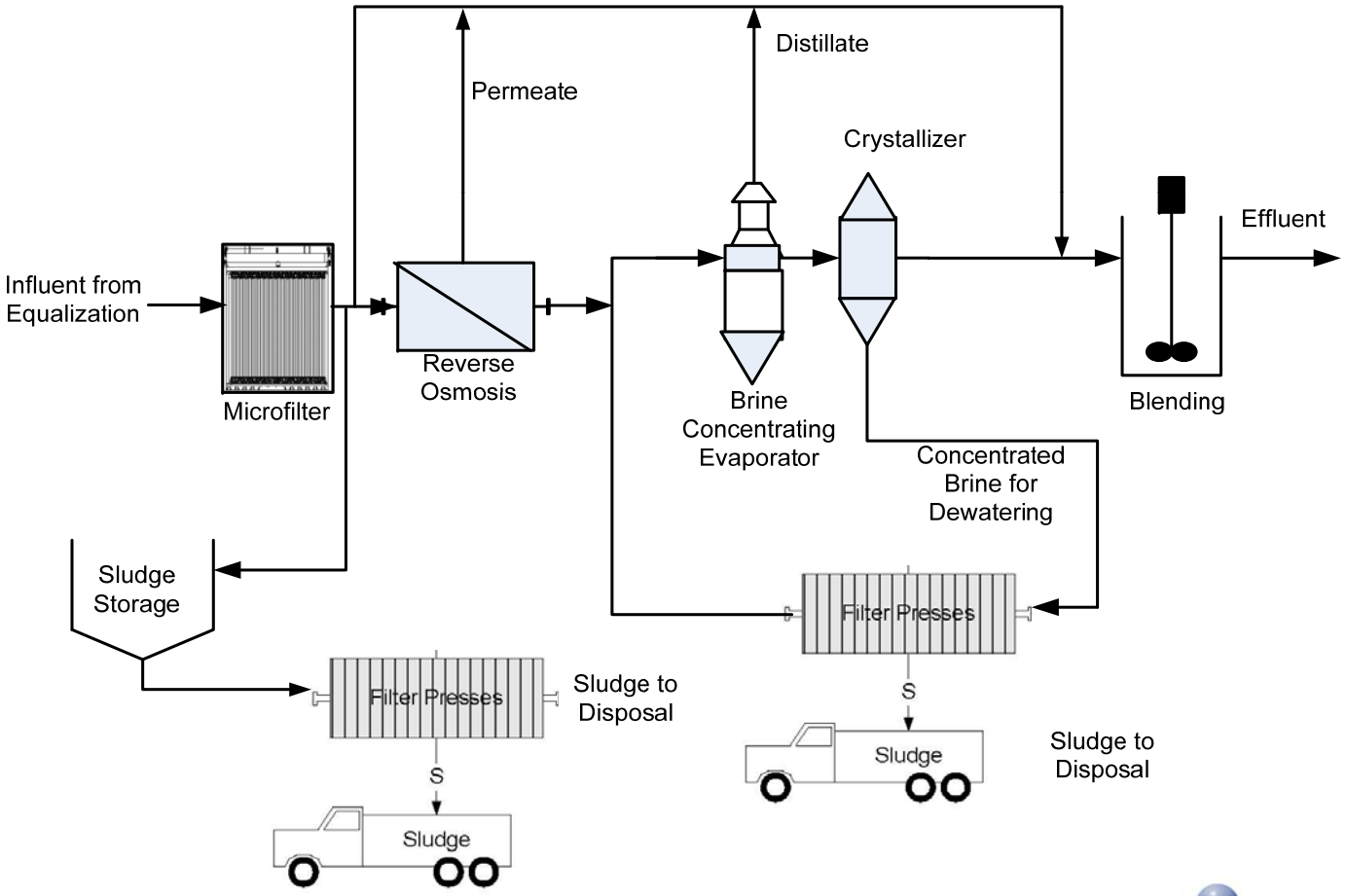
Reverse Osmosis



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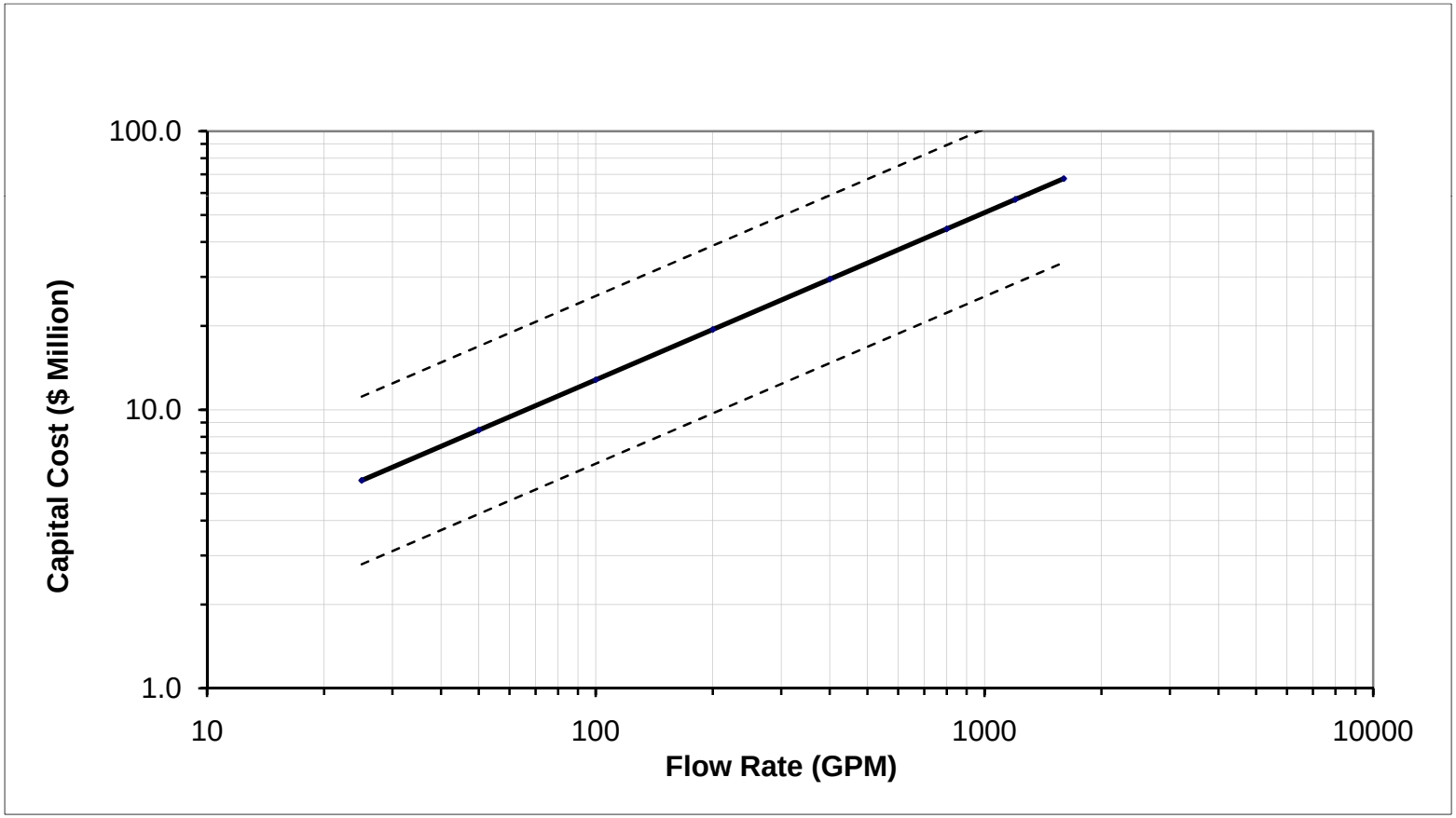
Reverse Osmosis Total Installed Costs



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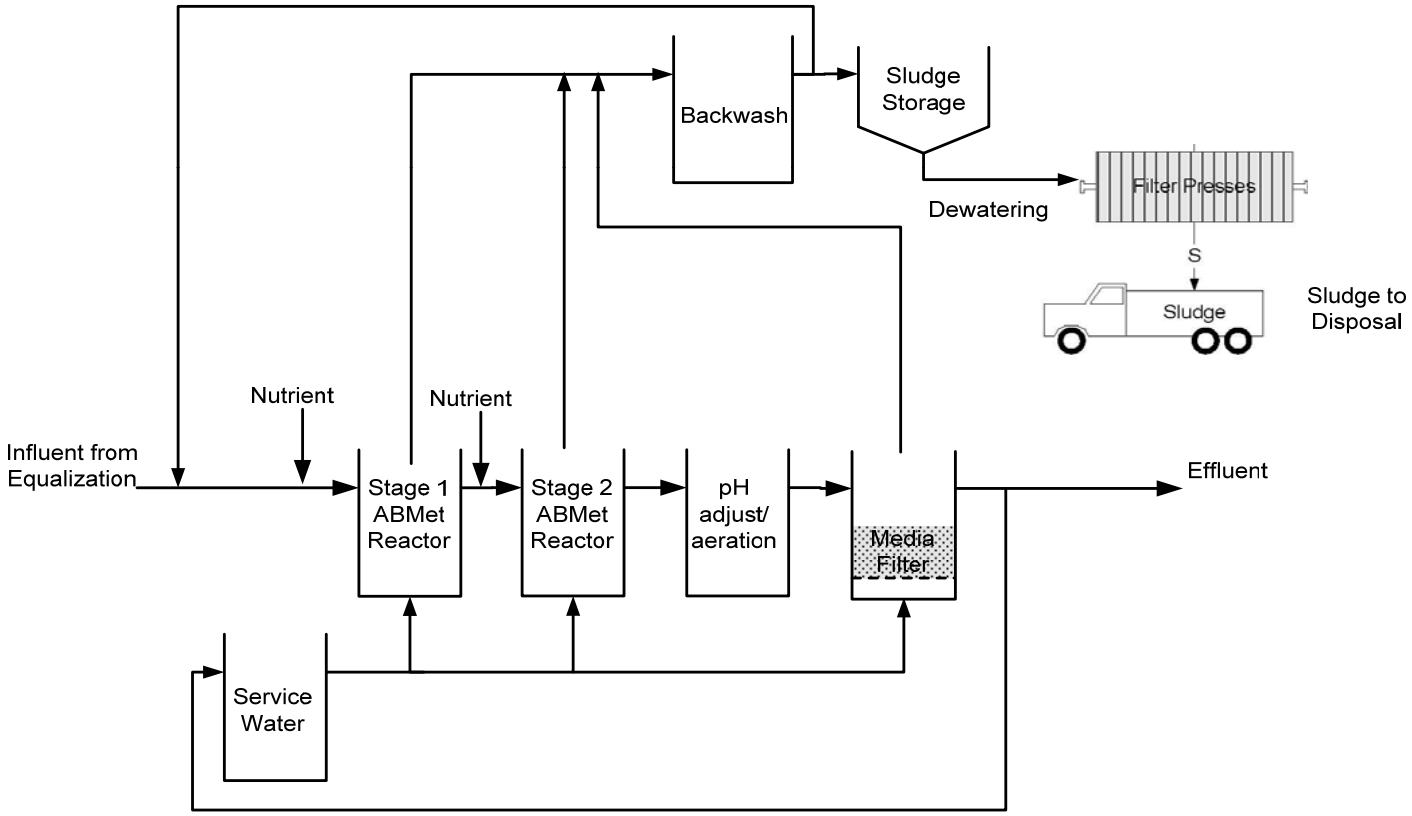
GE ABMet® Biological Treatment



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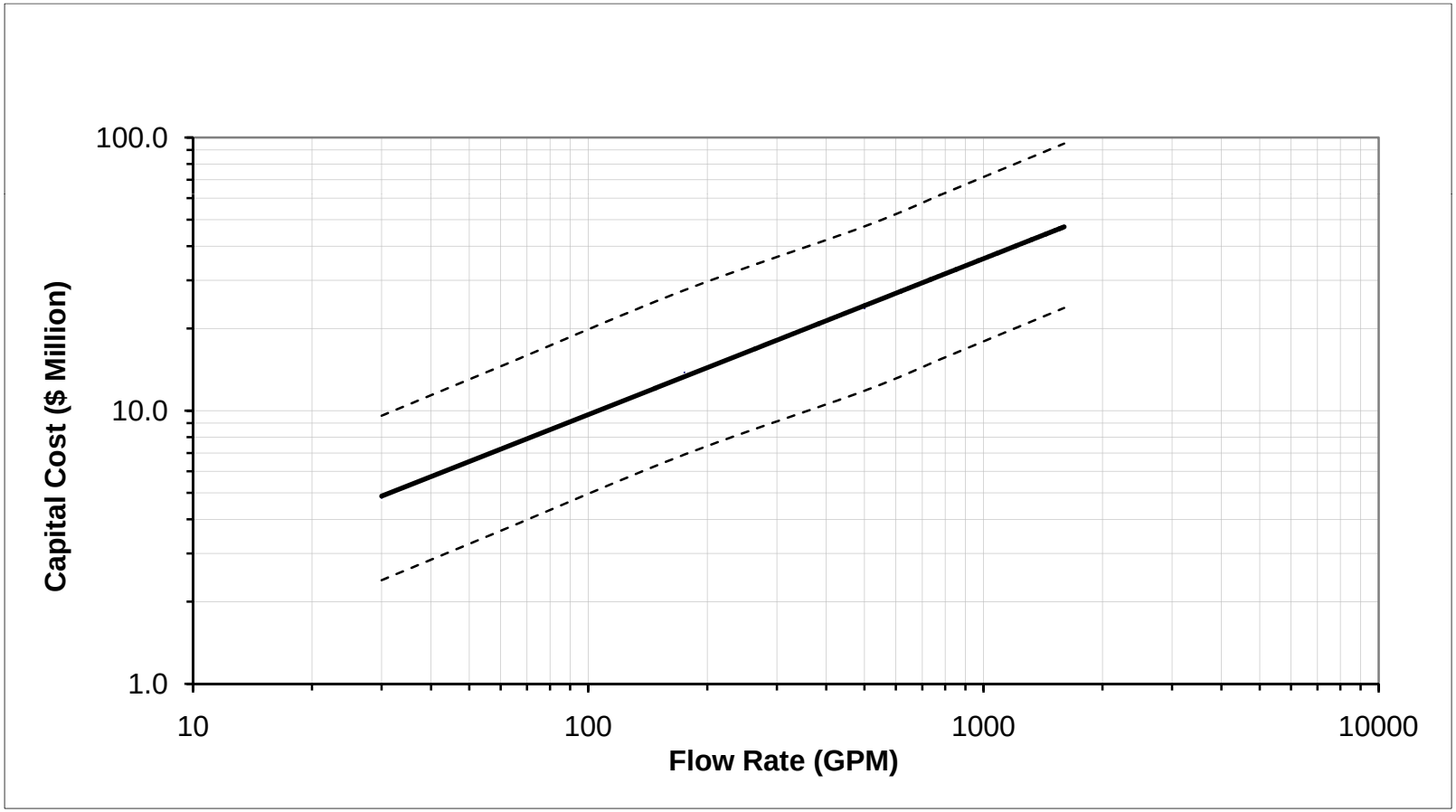
GE ABMet® Total Installed Costs



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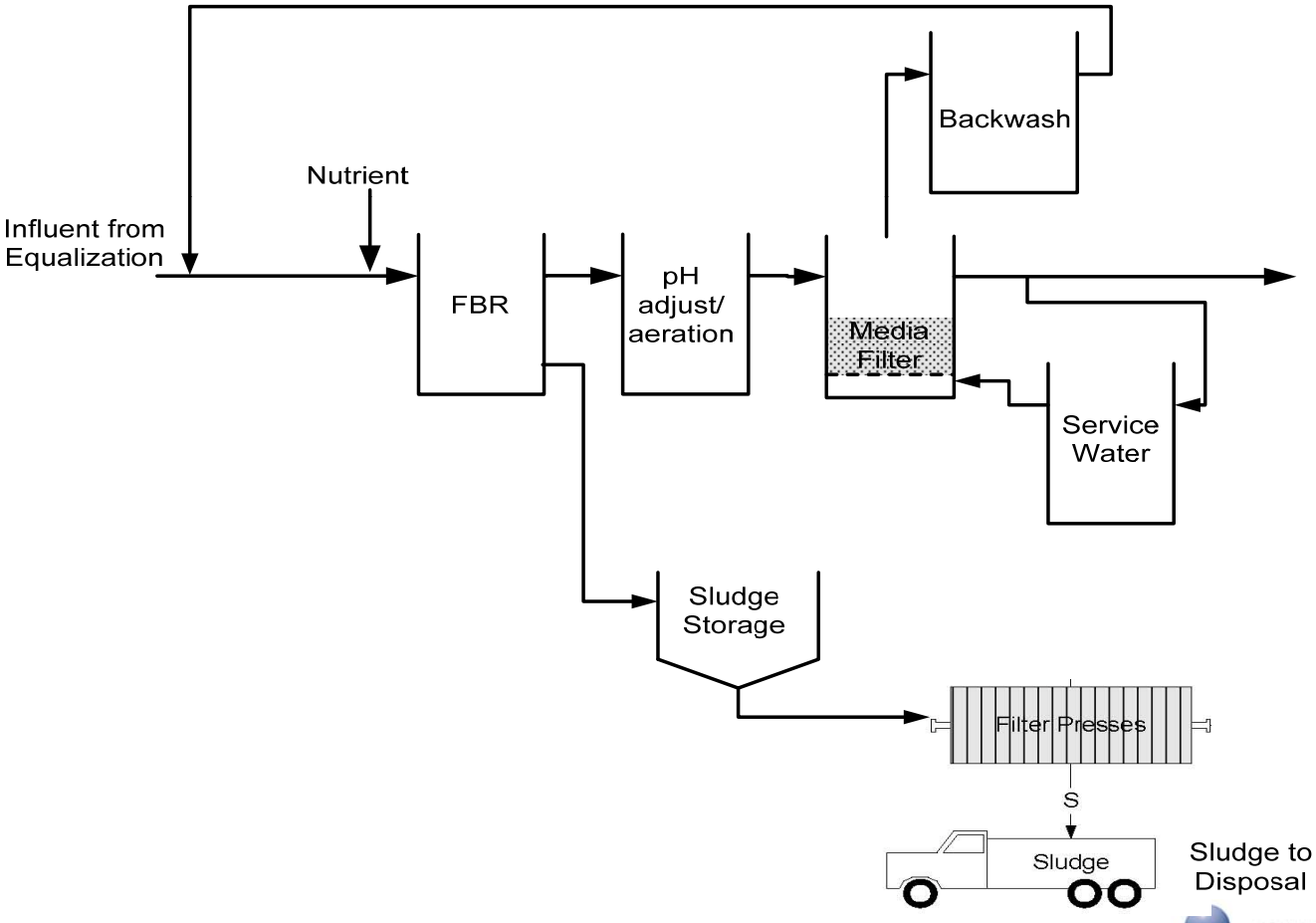
Fluidized Bed Reactor



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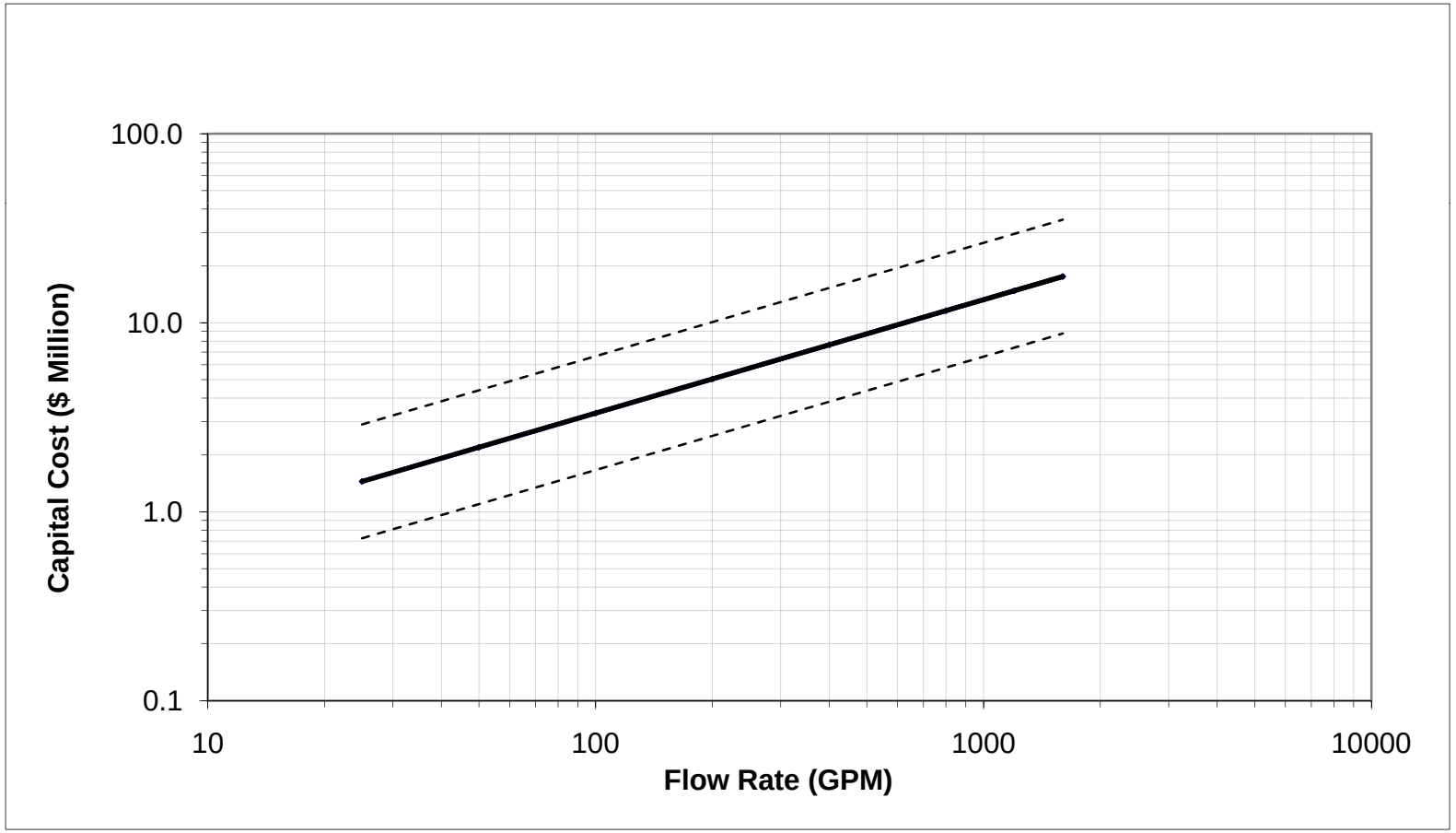
Fluidized Bed Reactor Total Installed Cost



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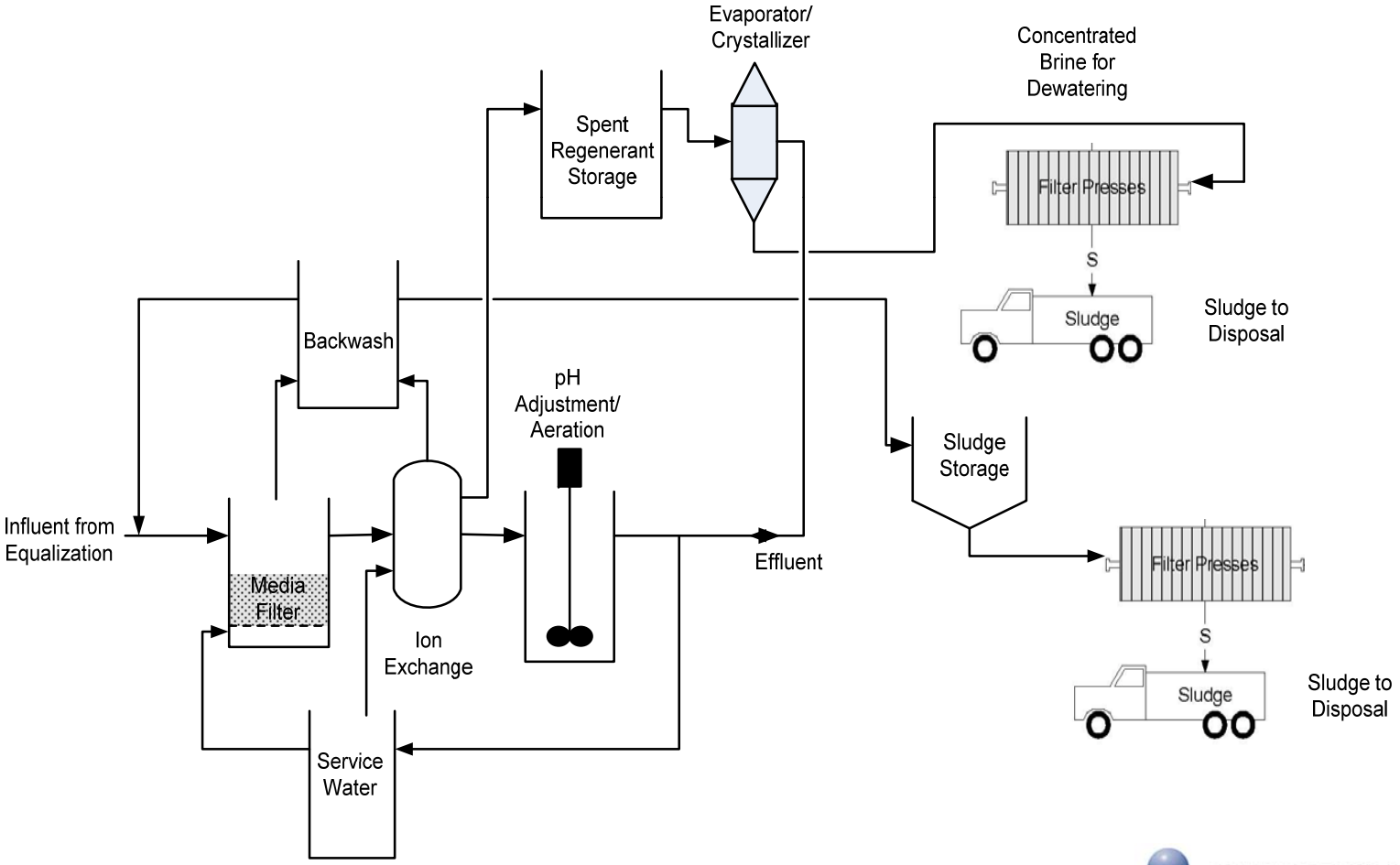
Ion Exchange



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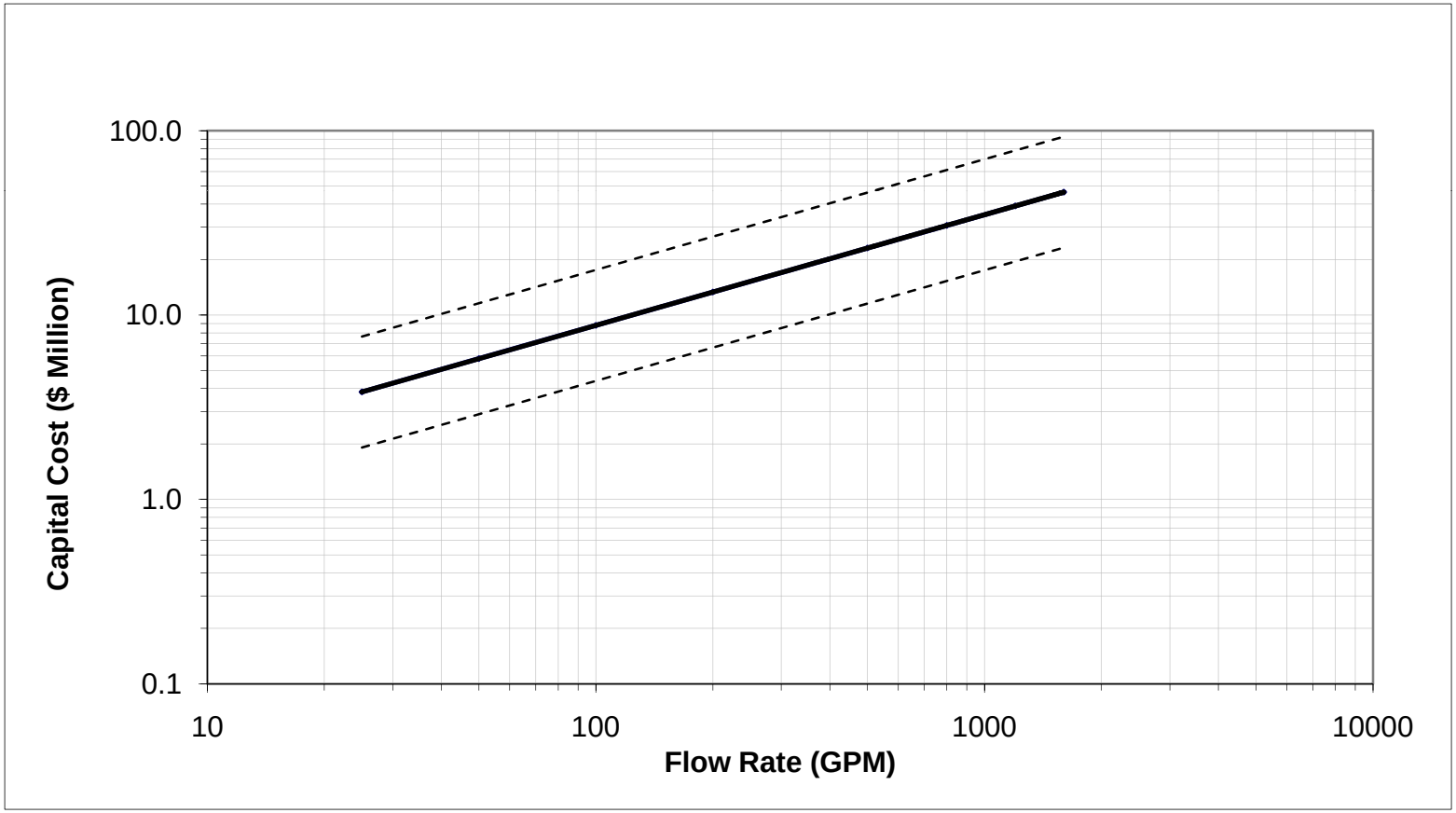
Ion Exchange Total Installed Costs



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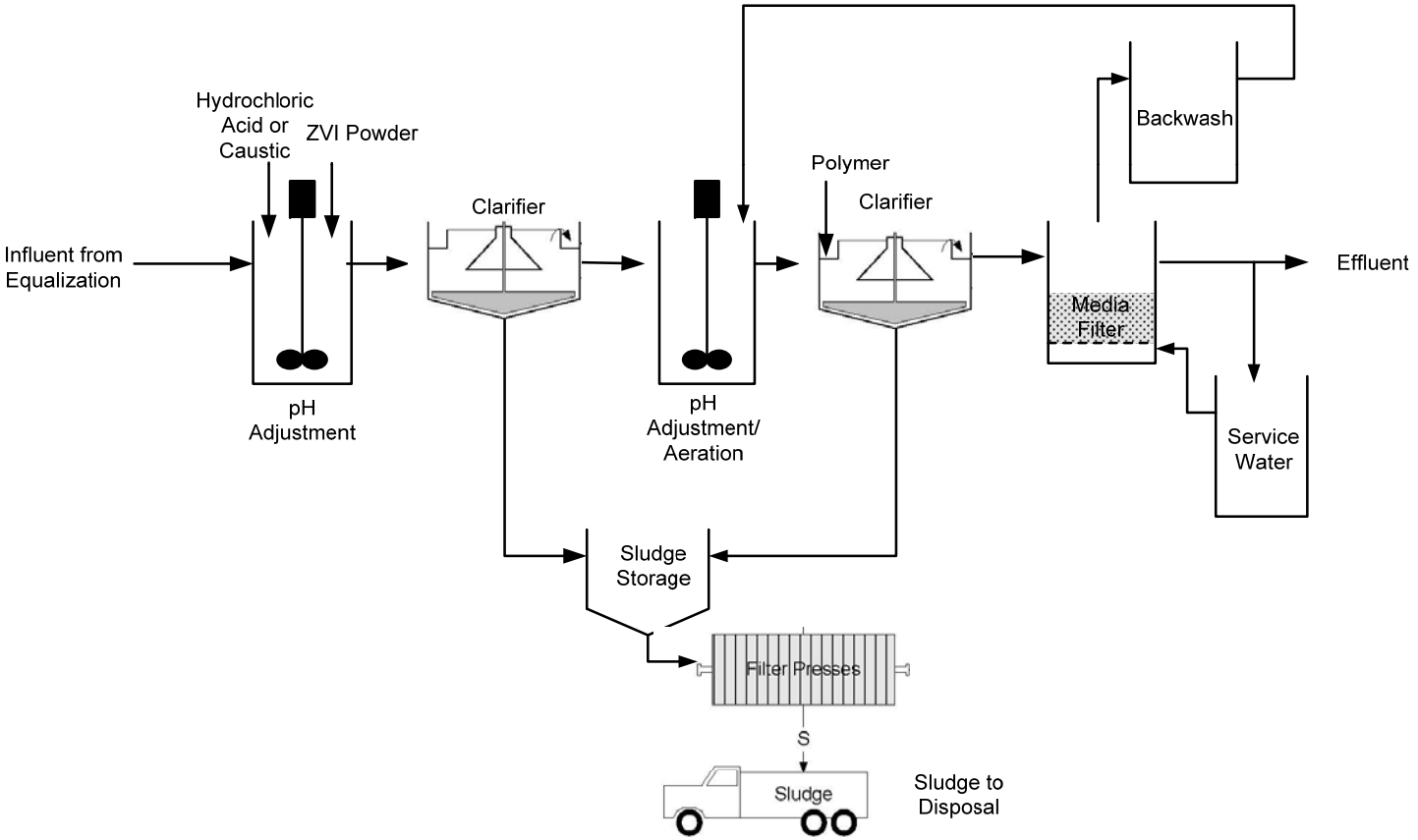
ZVI Filings/Powder



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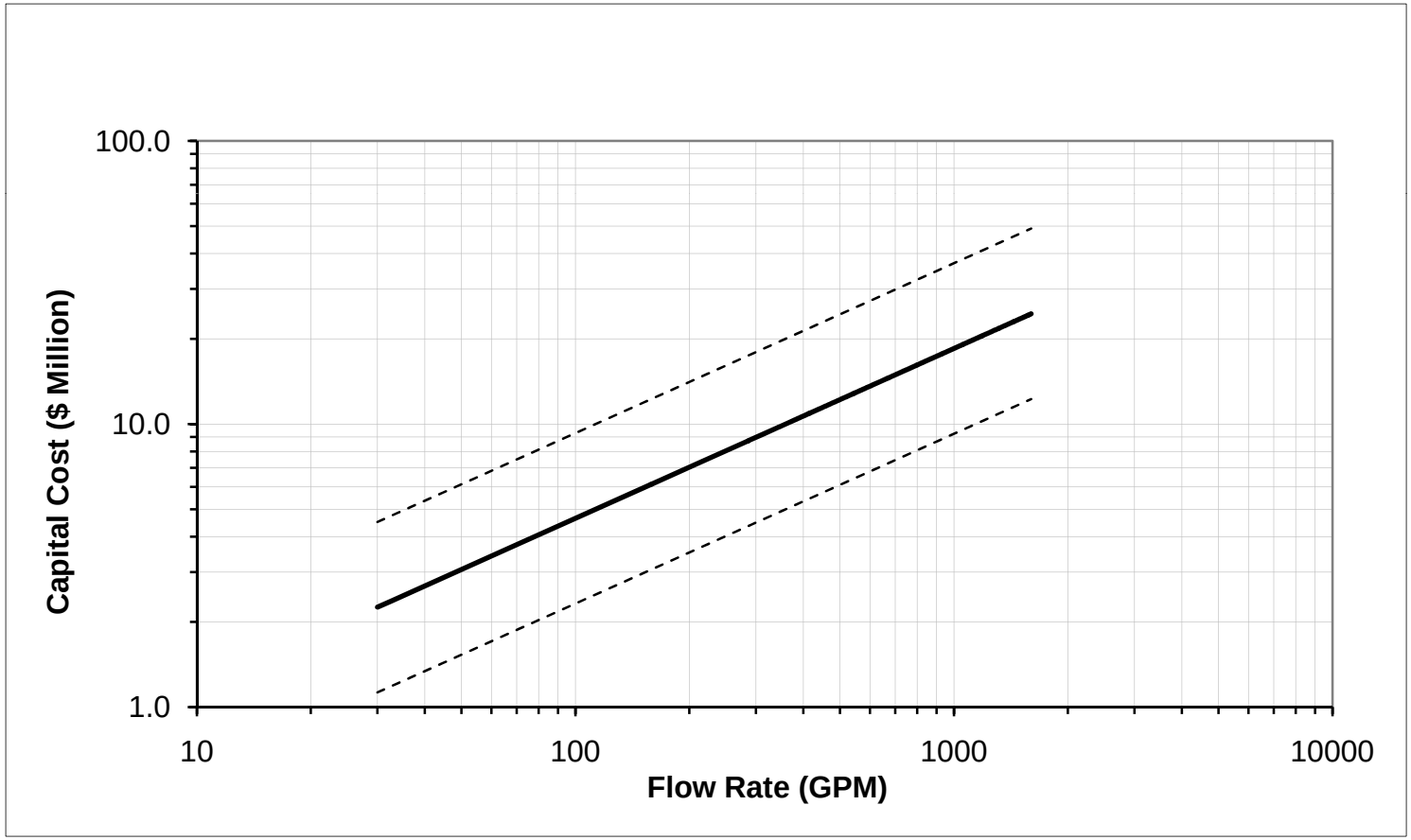
ZVI Filings/Powder Total Installed Costs



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Conclusions

- Very few, if any proven full scale to consistently reduce Selenium to below 5 µg/L
- Matrix characteristics impact the application of treatment technologies
- Performance must be validated on a case-by-case basis
- Need a systems approach considering water matrix challenges
- Need to Consider Process Engineering Experiences with System Configurations and Application of the Science

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