Self-Sustainable Mine Water Treatment through Passive Iron Oxide Recovery

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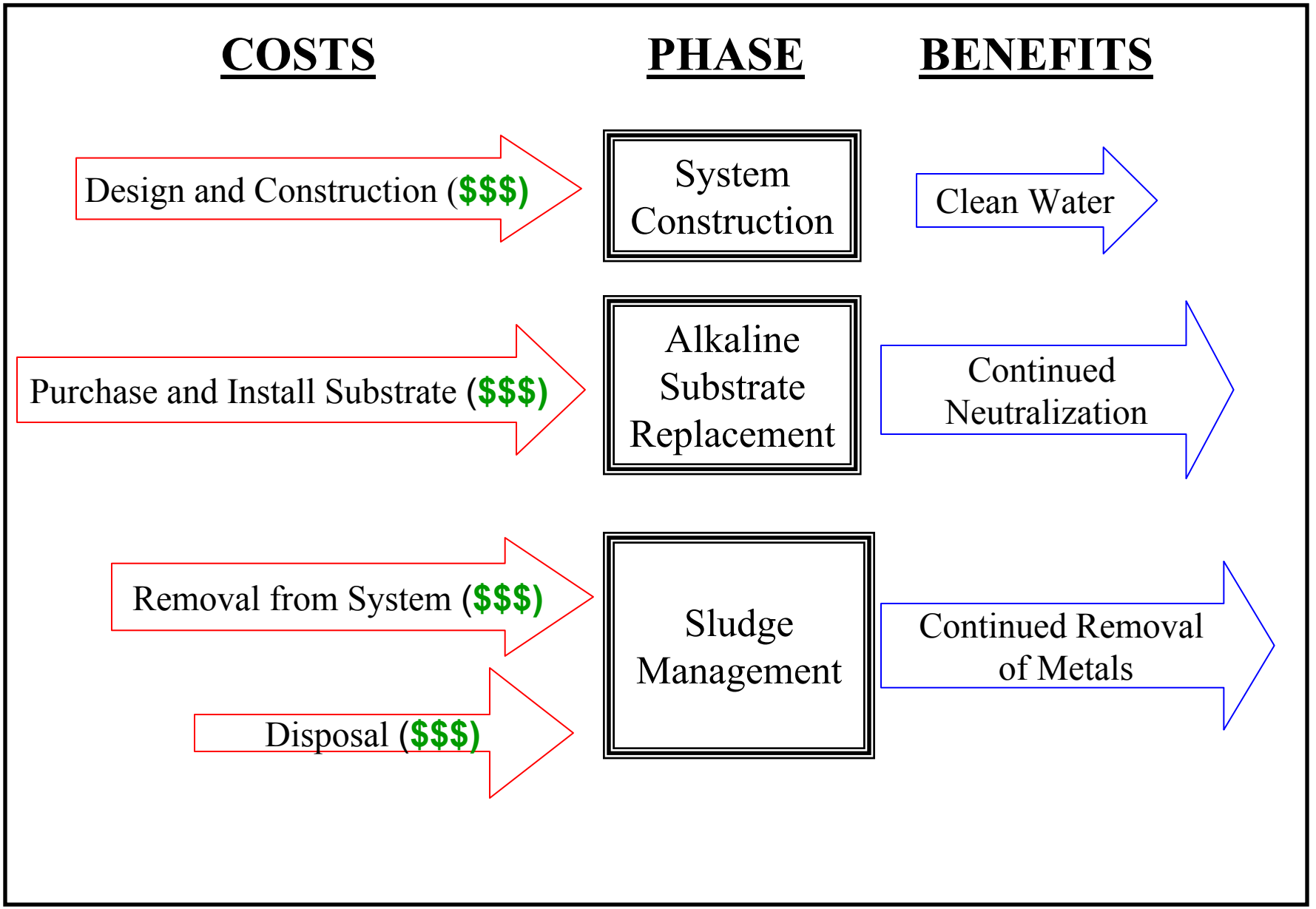
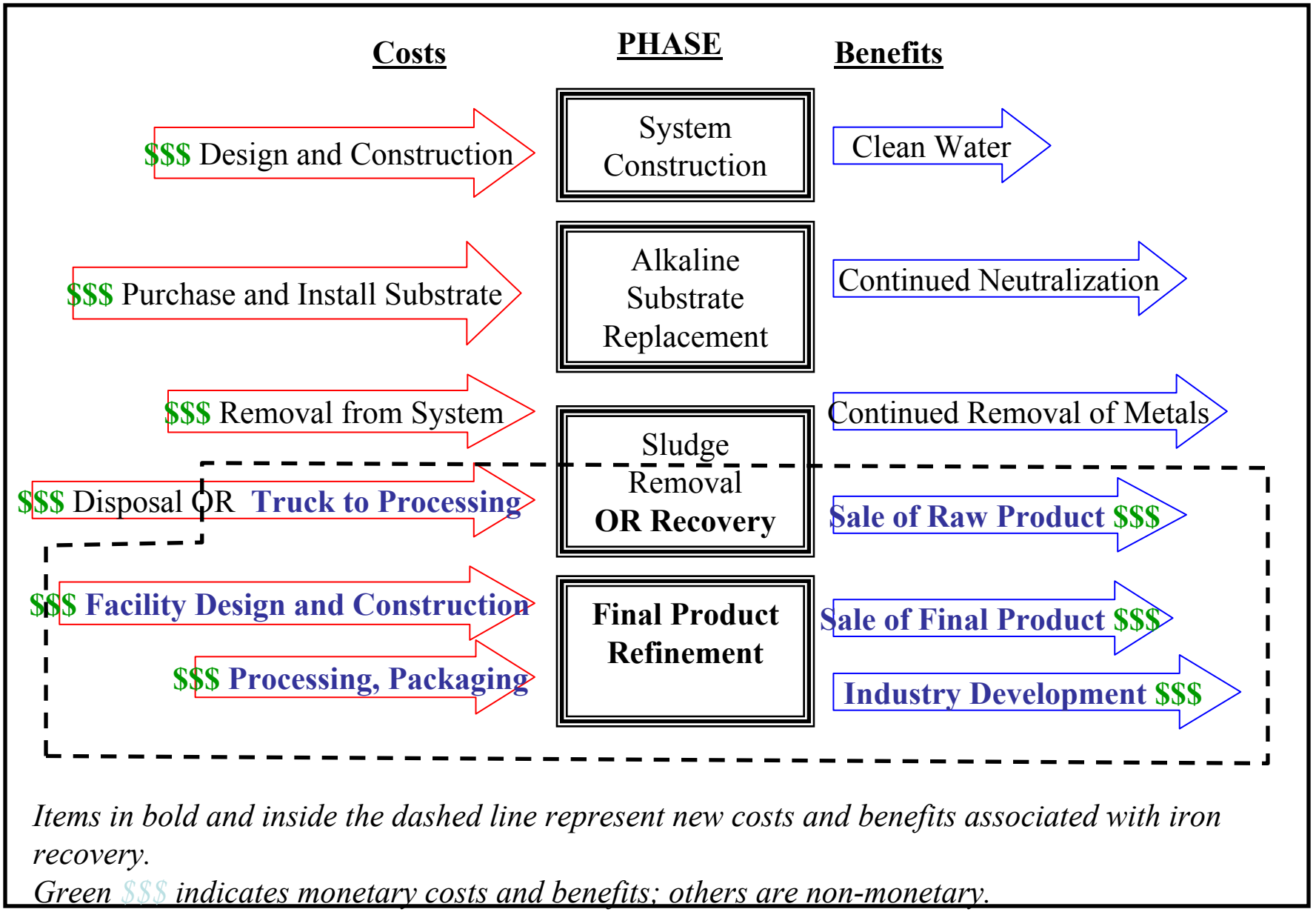
Hedin Environmental

Current Mine Water Treatment



Self-Sustaining Mine Water Treatment



Items in bold and inside the dashed line represent new costs and benefits associated with iron recovery.

Green $$$ indicates monetary costs and benefits; others are non-monetary.

Self-Sustaining Mine Water Treatment

Value (income) produced from treatment system offsets operation and maintenance costs

Self-Sustaining Mine Water Treatment: IOR Approach

- Revenue from sale of iron product
- Cost control through passive technologies
- Effective treatment through good design

How Did We Get Here?

Milestones in Iron Recovery

Year	Milestone
1995	SBIR Phase I Award from USDA to Hedin Environmental to investigate the feasibility of recovering saleable solid from coal mine drainage.
1996	SBIR Phase II Award to Hedin Environmental to continue research
1999	U.S. Patent 5,954,969 for the recovery of iron oxides from mine drainage awarded to Robert Hedin by U.S. Patent and Trademark Office
2000	Iron Oxide Recovery, Incorporated in Pennsylvania
2000	Grants from PADEP, OSM, and WPWP to Sewickley Creek Watershed Association to support IOR's pilot scale recovery of iron product at Lowber site (Westmoreland County)
2001	First sale of iron oxide as unrefined pigment
2002	EnvironOxide® registered as trademark in US and EU
2002	Grant from Richard King Mellon Foundation to Southern Alleghenies Conservancy to support construction of the IOR
2003	First recovery of saleable product from passive mine water treatment system (Howe Bridge, Fayette County)
2003	EnvironOxide™ Pigments named One of the Top Ten New Green Products in 2003 by GreenSpec™
2004	First signed maintenance agreement, Scrubgrass Creek Watershed Association and IOR, maintenance in exchange for rights to future iron (Allegheny County)
2004	Recovery of saleable product from Keystone passive treatment system (Armstrong County)
2005	First recovery of saleable product from artesian AMD discharge site (Clarion County)
2005	EnvironOxide® registered as trademark by US Patent and Trademark Office
2006	First royalties paid to landowners in exchange for iron deposits on their property (Clarion County)
2006	Lowber passive treatment system constructed and functional
2006	Record year for iron oxide production (664 tons)
2007	Iron oxide processing center scheduled to open in Clarion County

1999 Patent

2001 First Sale

2003 First Recovery from Passive System

2003 EnvironOxide ™ is Named Top 10 New Green Building Product

2004 First Maintenance Agreement Signed

2006 First iron royalties paid

2007 Clarion iPARC

Howe Bridge
Jefferson County
58 tons, existing system

Lowber
Westmoreland County
1,610 tons, pond/channel

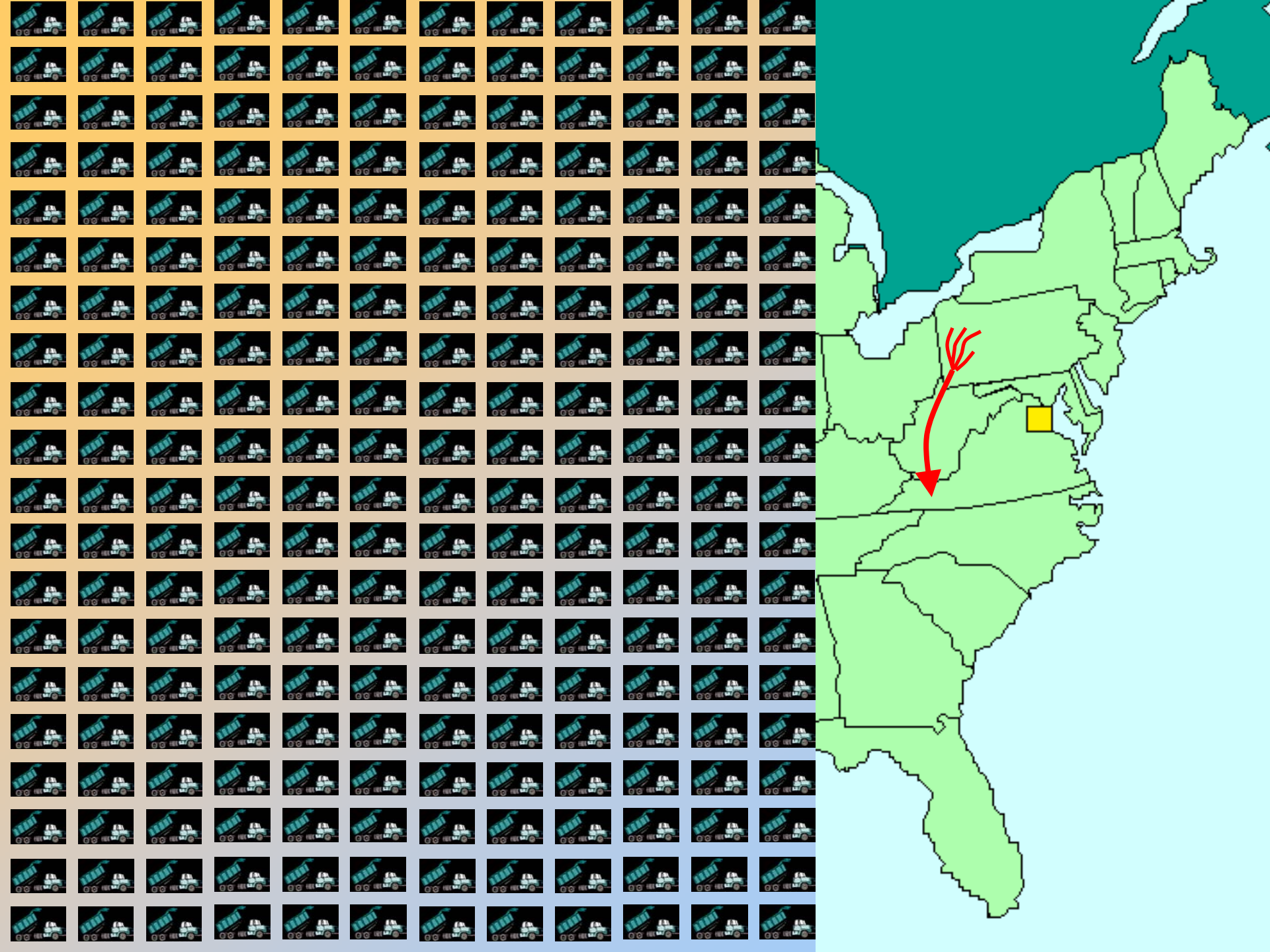
Schwabenbauer
Clarion County
89 tons, artesian deposit

2,400 tons sold from 6 sites

Keystone
Armstrong County
239 tons, existing system

Scrubgrass
Allegheny County
48 tons, existing system

Horner
Clarion County
367 tons, artesian deposit



… recovery is occurring at two construction sites…

Farmington

Wilson

…and being considered at many other sites.

Honeypot

Hoyman

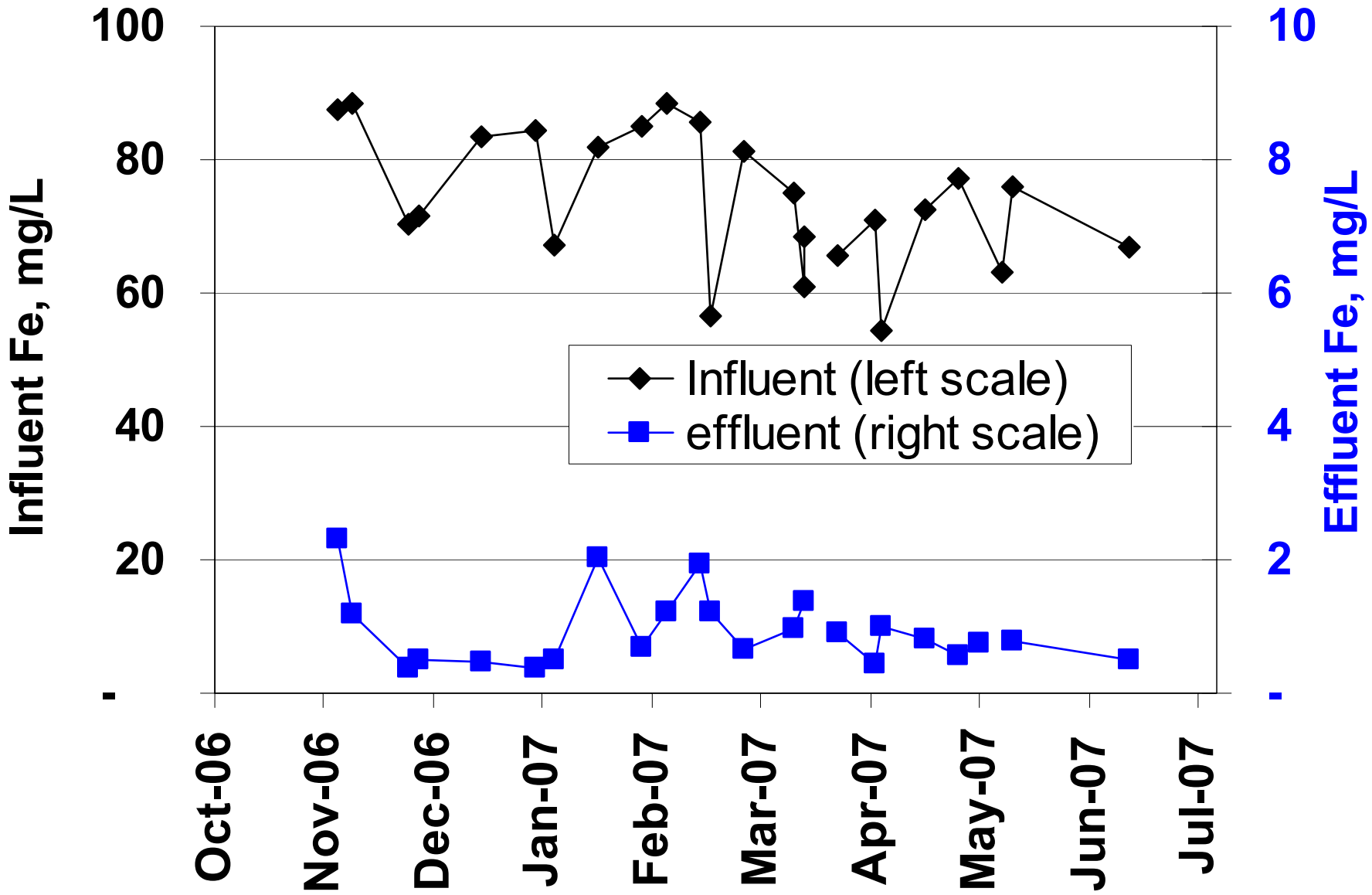
Hall


Are We There Yet?
The Present State of Iron Recovery

Effective Treatment

- Marchand Discharge
  - Sewickley Creek
  - Flow, 1400 – 2250 gpm
  - Fe, 65 – 90 mg/L
  - Fe, 1500 lb/day
  - FeOOH, 800,000 lb/yr
- Passive Iron Oxide Producing System
  - series of settling ponds and constructed wetlands
  - $1.3 million

Fe removal by the Marchand System



For the visually oriented…

Pond A

Final Discharge

Anticipated Long-term Costs and Values

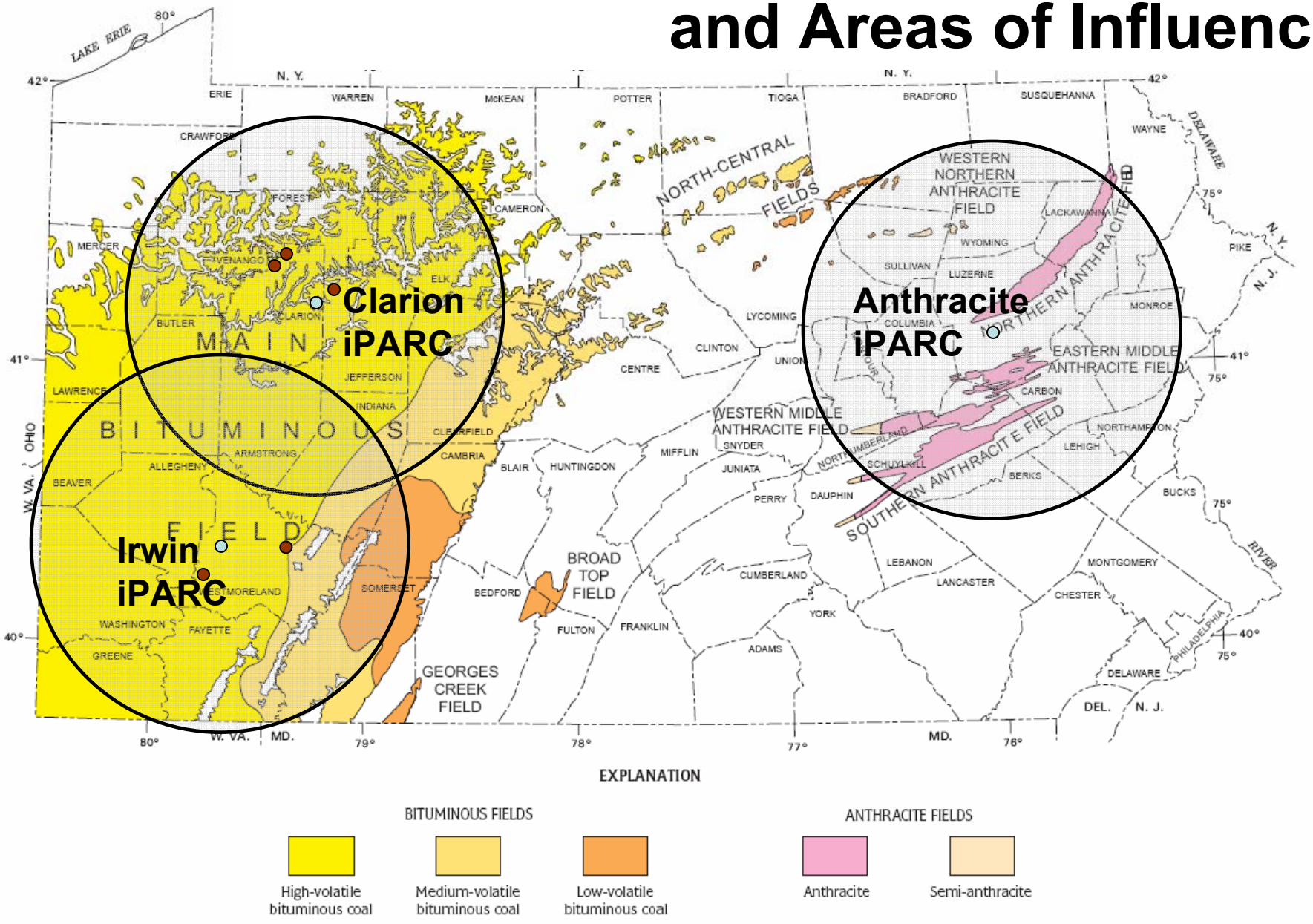
- Routine O&M: $4,000 per year
- Sludge recovery
  - years 0-6, no recovery
  - years 7 forward, 400 tons/yr
  - $75-100/ton (delivered to PC)
- Sludge value (delivered to PC)
  - $100/ton

Where Are We Going?

IOR Processing Center

- Located near I-80 in Clarion County
- Iron sludge will be dried, screened, and blended
- Highest quality product will be sold to existing customer
- Lower quality products will be marketed for lower-value uses
- 2007: accepting Fe sludge from 3rd parties
  - Sludge must be pre-approved
  - Paying royalties, recovery costs, and trucking in some cases
  - Avoid landfilling, restore treatment system effectiveness, reclaim degraded AML

iPARC Network (3 sites) and Areas of Influence



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Next Steps

Short-Term

- Open PC and develop processing procedures
- Establish new markets for bulk unfinished products
- Develop market for iron sludge

Mid-Term

- Establish sludge recovery feasibility across PA
- Increase iron sludge production

Long-term

- Advance processing capabilities: produce finished products
- Develop other PCs in PA

Questions?