Biochemical Reactors for Treating Mining-influenced Water

National Conference on Mining-Influenced Water

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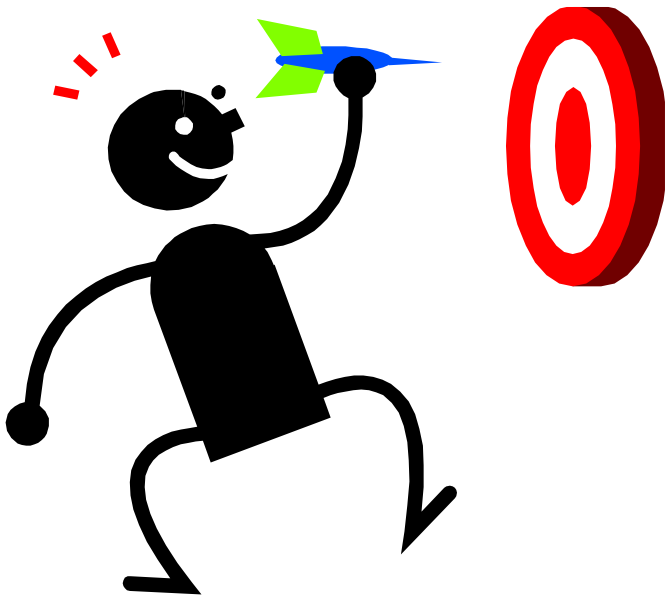
Today's Objective

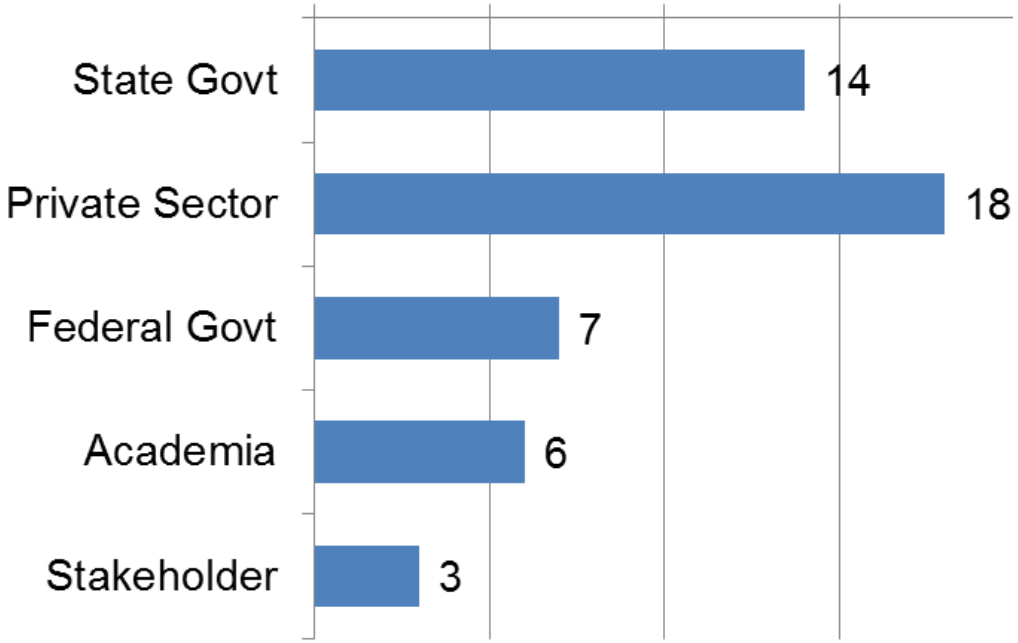
- Brief ITRC and Team introduction
- Problem introduction & Explanation of a BCRs usefulness
- Guidance Introduction
- Discussion of Implementation Targets

We need your help to identify example targets!



ITRC & The BCR Team

- ITRC is a state-led coalition which works to achieve regulatory acceptance of environmental technologies and innovative approaches.
- ITRC Team on Biochemical Reactors for Treating Mining Influenced Water



The BCR Team

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What is the problem we face?

- There are over 500,000 abandoned mine sites in the U.S.
- MIW impacts state lands, federal lands, public land, private lands
- Many sites are in remote areas with extreme climates
- Negative environmental impacts extend miles downstream
- Liability lingers for years

Unnamed creek channel, PA
Note the color changes.

One Possible Solution. . .

- Biochemical Reactor (BCR)

Penn Hill #2 BCR, PA

What is a Biochemical Reactor (BCR)?

- ***…engineered treatment system that uses an organic substrate to drive microbial and chemical reactions to reduce concentration of metals, acidity, and sulfate in MIW.***

Golinsky Mine, Shasta County, CA

Biochemical Reactor

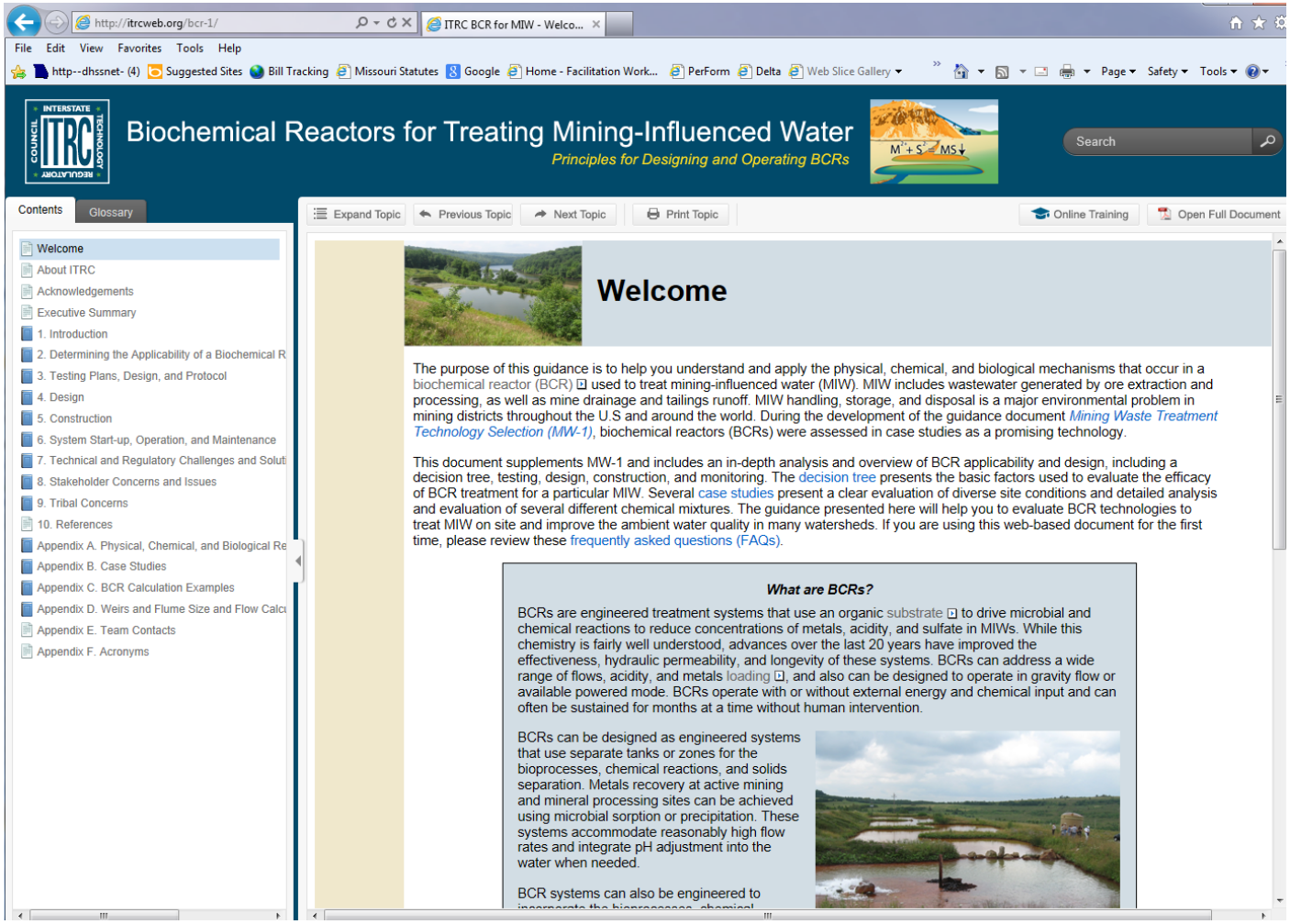
Advantages

- Low energy requirements
- May be low maintenance if designed properly
- Can be used in remote situations
- Removes metals
- Flexible and versatile
- Treats wide variety of MIW
- Will improve ecological function of receiving stream

Cautions

- BCRs may not consistently meet strict water quality standards
- BCRs are not *walk away* systems
- Monitoring is required
- Maintenance may be needed periodically

Biochemical Reactors for Mining Influenced Water



What This Guidance Can Do for YOU!

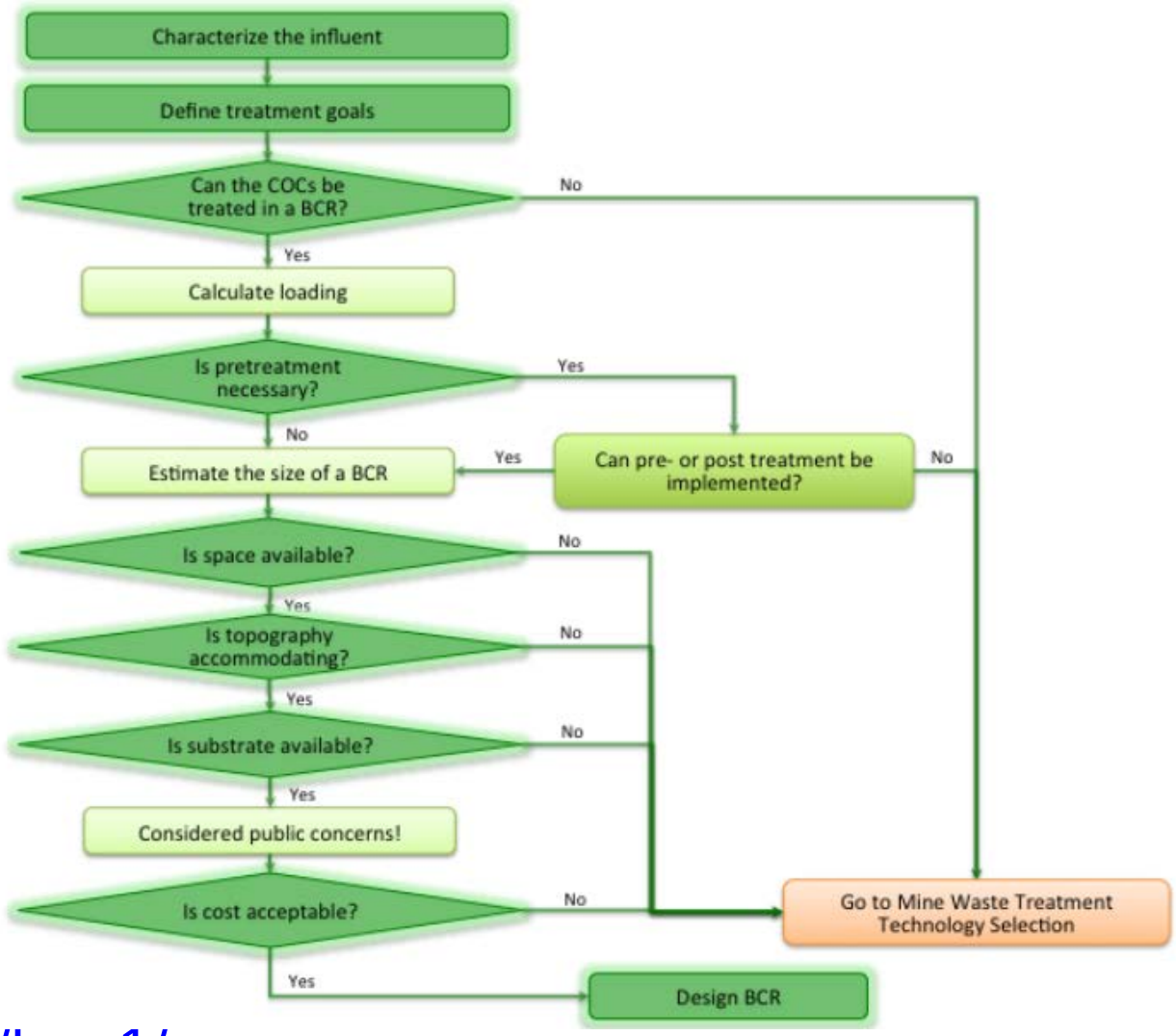
- Assess the suitability of using a BCR
- Support
  - Planning
  - Testing
  - Monitoring
  - Operating
  - Maintaining
- Provides examples of real world application of BCRs

TO REFERENCE THIS GUIDANCE

Topics Covered by the Guidance

- Applicability
- Testing
- Design
- Construction and startup
- Monitoring, operation and maintenance
- Challenges

Applicability



- http://itrcweb.org/bcr-1/

Is My Water BCR-Worthy

Periodic Table of Treatable Elements

Elements in Blue can be treated in a BCR

1 H	2											13	14	15	16	17	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	3	4	5	6	7	8	9	10	11	12	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac~	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 ---	111 ---	112 ---		114 ---		116 ---		118 ---

Actinide Series 92 U

Figure courtesy of Jim J. Gusek, 2009

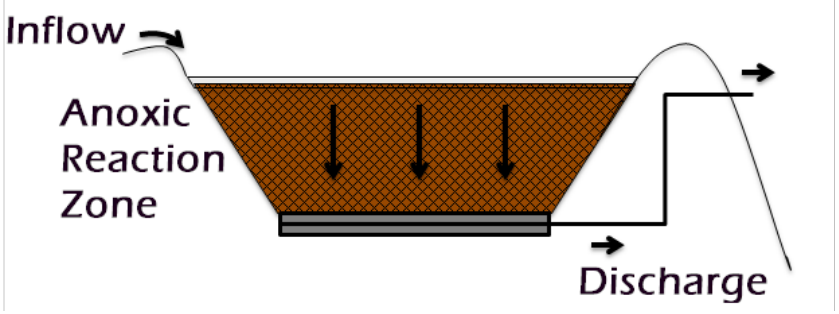
Treatability Testing

- Proof of Principle
- Bench Testing
- Pilot Testing

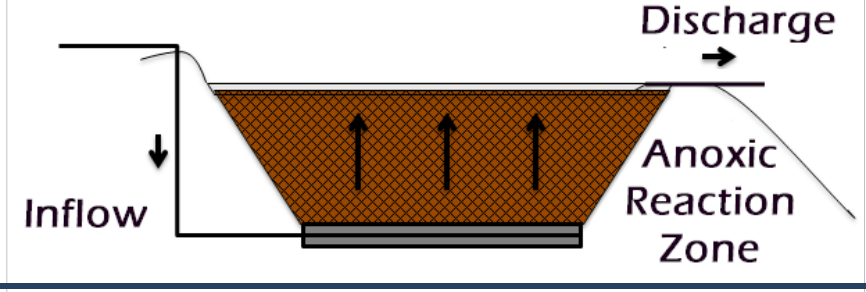
- Solid Substrate
- Liquid Substrate

Design

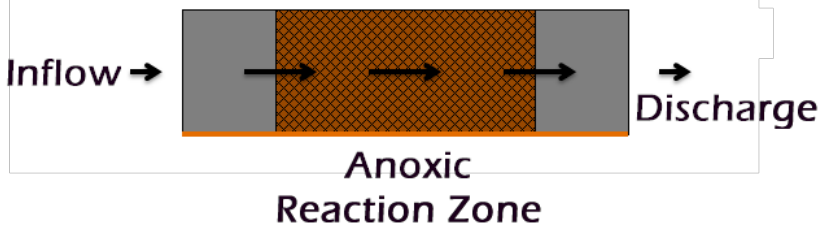
Downflow Biochemical Reactor



Upflow Biochemical Reactor

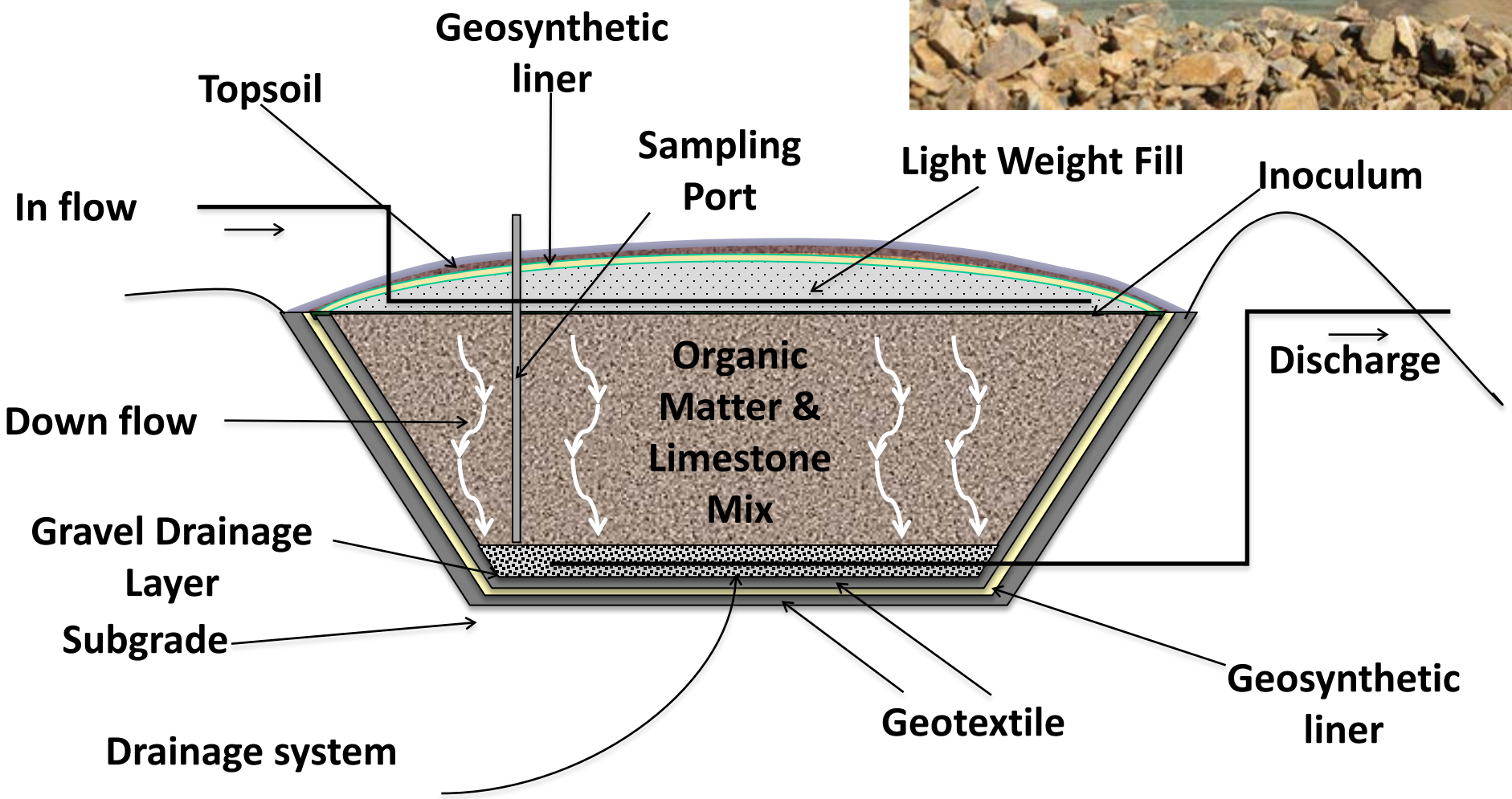


Horizontal Flow Biochemical Reactor



Appendix C – BCR Calculation Examples

Construction



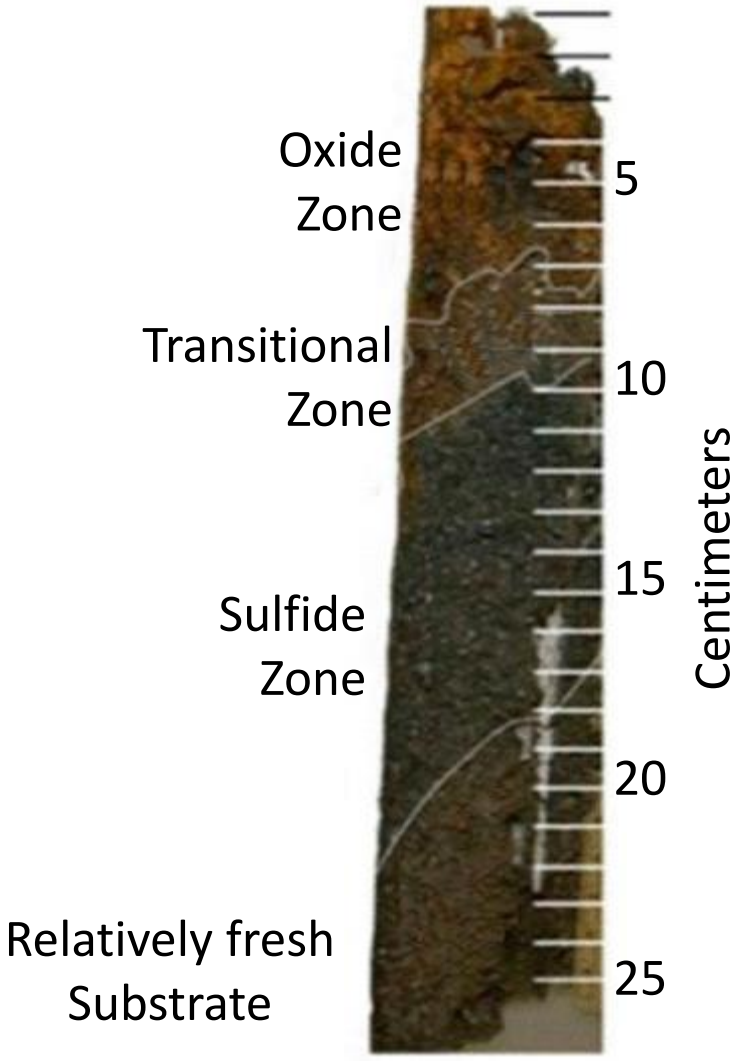
Operation & Monitoring of BCRs

- BCRs designed:
  - To run on their own with periodic oversight,
  - To be low maintenance
  - To be Low energy/passively driven systems
- Conduct monitoring for,
  - Physical conditions
  - Performance evaluations
  - Compliance requirements

Penn Hills BCR Inflow Monitoring

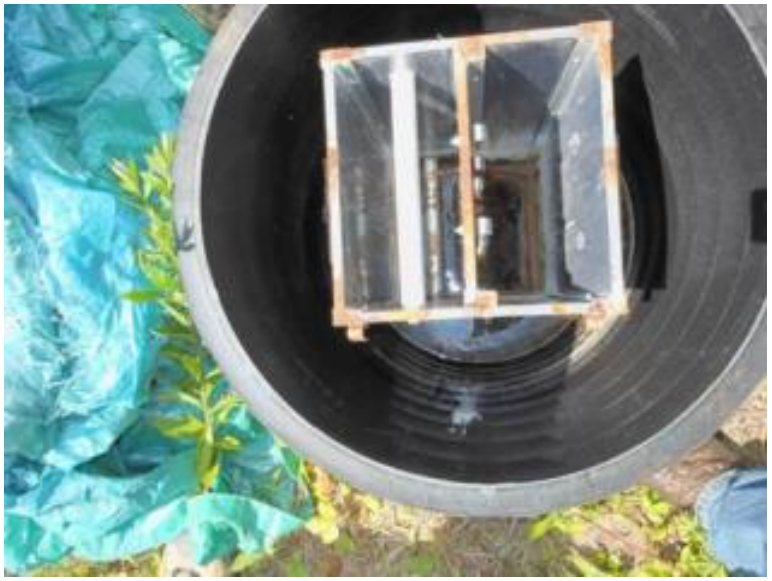
Substrate Monitoring

- Chemistry (compare to design conditions)
- Substrate testing – ORP & Physical collection
- Substrate test for disposal
- Substrate replacement or additional amendment



Troubleshooting

- Chemical trends
- Physical Trends



Adjustable Elevation Head Weir for BCR Effluent

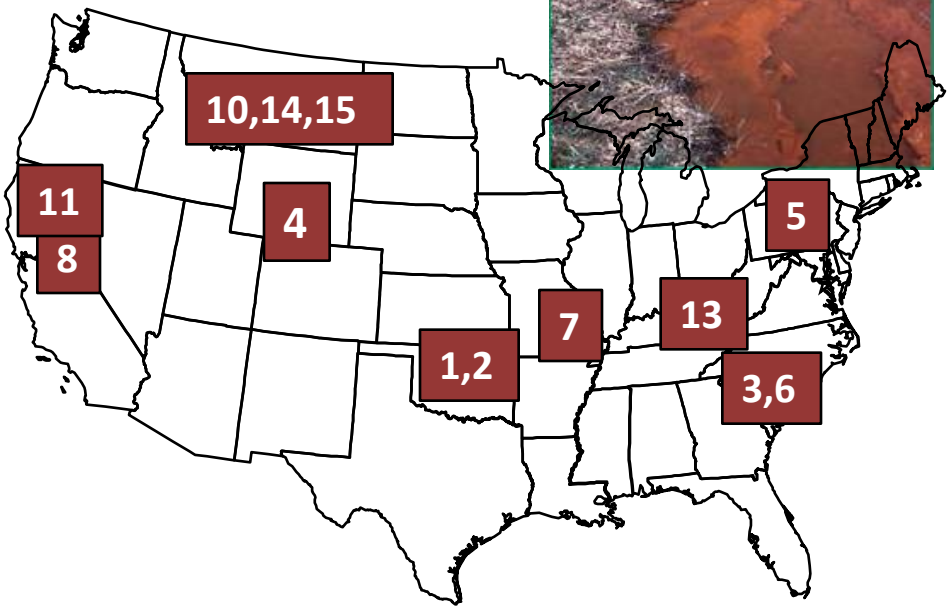
ITRC BCR-1, 2013: Section 6.3.2

Challenges

- There are technical, regulatory and stakeholder challenges, including:
  - Permitting and ability to attain strict water quality standards
  - Noise, attractive nuisance/safety, hydrogen sulfide odor
  - Long term liability concerns / Good Samaritan legislation
  - Reuse

Golinsky Biochemical Reactor, Lake Shasta, CA
Photo courtesy of Bruce Marvin

Example Implementation Targets



Key Message

1. BCRs are *viable alternatives* for treating MIW, even in remote areas
2. BCRs are *site-specific*
3. BCRs are not *walk away* systems
4. The guidance is a convenient *resource* when considering a BCR