The Coal Authority

A UK perspective on managing mine waters sustainably.

Dr Ian Watson CGeol,
Steve Hill, Carl Banton, Tracey Davies

MEND conference, Vancouver
December 2015

The Coal Authority

The Coal Authority

- A UK Government Agency
  - Established 1994 - Privatisation of the Coal Industry
  - The Coal Authority owns, on behalf of the country, the vast majority of the coal in Great Britain, as well as former coal mines.
  - Managing the legacies of our mining industry.
  - Cover England, Scotland, and Wales
  - An increasing amount of NON-COAL related work
  - Funded by government, primarily

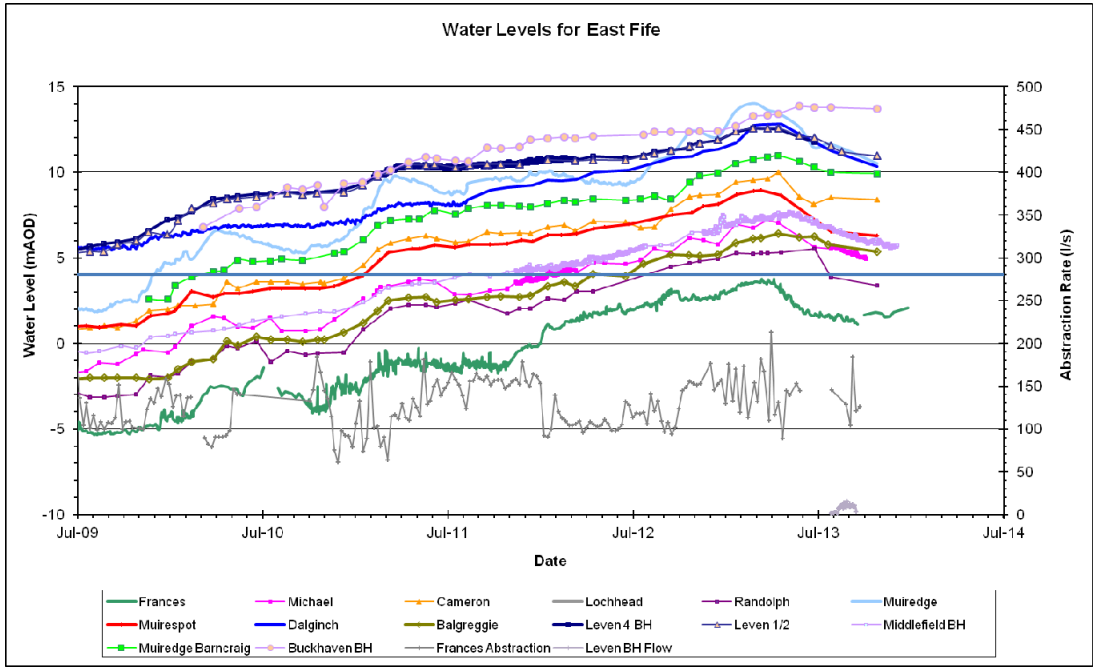
Mine Water programmes

- Environment programmes
  - Coal mine waters:
    - Remediation Schemes
    - Preventative Schemes
    - ~70 operational Schemes
  - Non-Coal Mine Waters:
    - Remediation of metal mines
    - 3 operational schemes

The Coal Authority

Preventative schemes

- Many areas of rising mine water
  - Follows near complete closure of coalfields
  - Monitored at ~800 locations
- High priority to protect
  - Groundwater
  - Surface waters



The Coal Authority

Frances
Pump + Treat Scheme

- Frances, Fife
  - Typical preventative
  - Pumping
  - Chemical dosing
  - Iron Removal
  - Desludging
  - High Cost + Carbon

The Coal Authority

Remediation schemes

- Existing discharges treated
- Prioritised with environmental agencies
- Implemented subject to:
  - Funding availability
  - Technical feasibility
  - Evaluation of benefits > costs (for whole life)

Glyncastle Mine Water Treatment Scheme

The Coal Authority

Glyncastle Mine Water Treatment Scheme

September 2005

Settlement Ponds

Reed Beds

The Coal Authority

Remediation results in Wales

Glyncastle Minewater Treatment Scheme

Before

~3 months After

Mine Water Programme National Progress

- Completed >70 treatment schemes
- Improved over 140km of watercourses
- Over 230km of watercourses protected
- Prevents 2900 tonnes of Iron ochre from entering watercourses each year
- Major drinking water aquifers protected in Durham and Cannock
- Very successful sewage/mine water co-treatment to remove phosphates at Lamesley
- Many schemes provide local amenity

The Coal Authority

Major costs

- Biggest costs of managing mine water
  - Pumping
  - Treatment
  - Waste sludges
- Many schemes >10 years old, some >20
  - Refurbishments needed
- Coal Authority continues to work on cost reduction for increased sustainability

Pumping cost reduction strategies

- Find a new pumping location
  - At a lower elevation
    - Currently planning new site near Frances
  - Ideally low enough for gravity driven flow
    - Implemented in North East England coalfield
    - Page Bank, Vinovium, Chatershaugh
    - Pumping was >100 l/s each
    - now none (gravity)
    - Kimblesworth progressing now

The Coal Authority

Water Quality in UK

- Most mine waters
  - Net-alkaline; circum-neutral pH
  - AMD is very rare in UK coal and metal mines
- Main problems are:
  - Iron (coal mines)
  - Zinc (metal mines)
  - Salinity as Chlorides (deep coal mines)

The Coal Authority

Example of AMD treatment, Blenkinsopp, England

Blue water caused by NaOH dosing into mine water with 1000 mg/l iron in 2005

After 10 years iron < 200 mg/l so dosing costs have decreased

The Coal Authority

Treatment cost reduction strategies

- Can active schemes be converted to passive?
  - Need large area available
  - Blenkinsopp now nearly fully passive (below)
  - Horden (NE England) successfully converted

The Coal Authority

AMD treatment using RAPS in the UK

- A few sites are treated by RAPS
  - Reducing, Alkalinity Producing Systems
  - Typically 50:50 mix limestone: compost
- Expected Lifetime?
  - So far oldest schemes, ~20 yr, struggling
  - Newest ~10 yr continues to do well
    - Tan y Garn, Wales

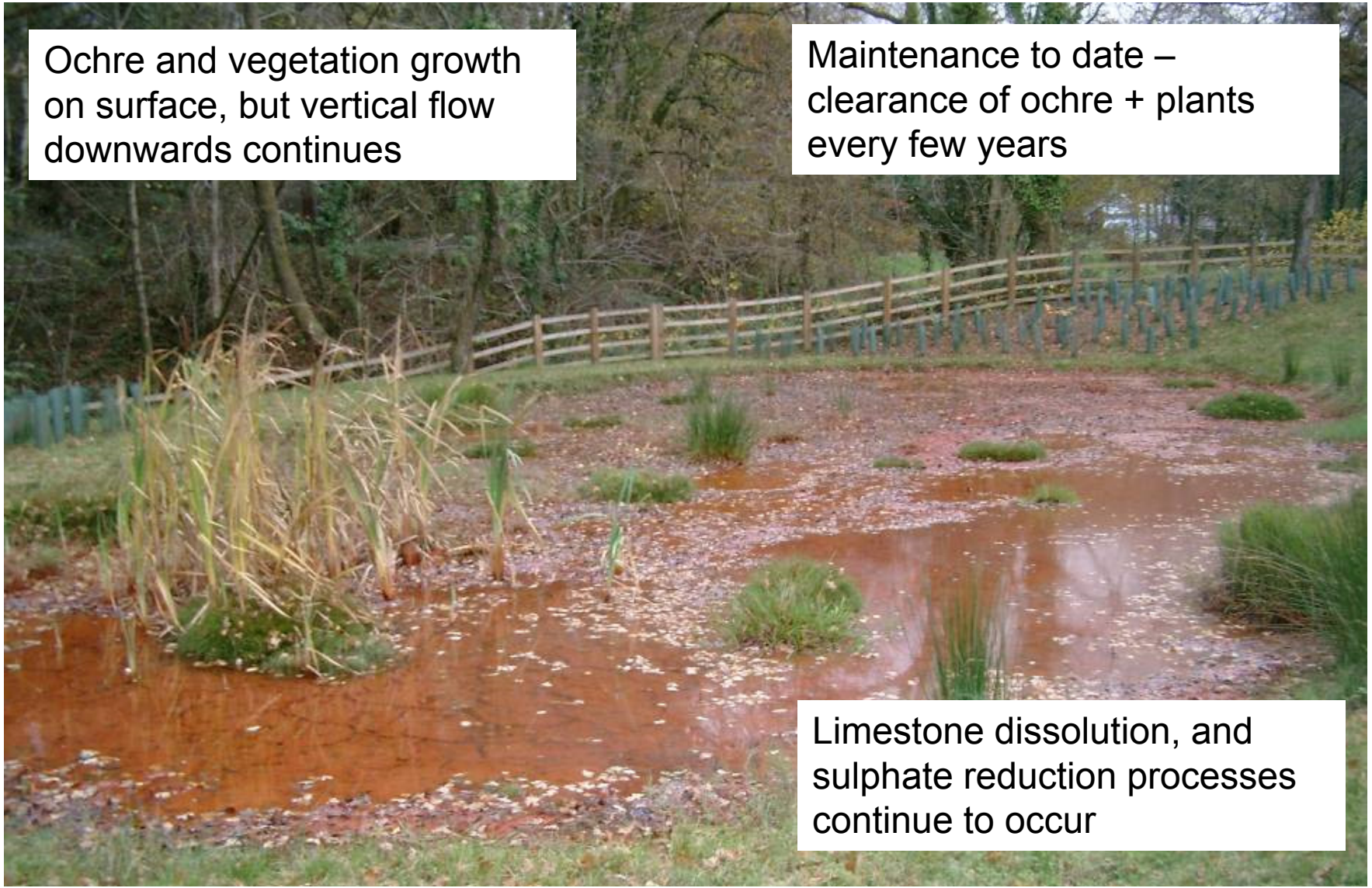
The Coal Authority

RAPS operational

After 2 weeks operation Compost barely visible through ochre

The Coal Authority

Current RAPS condition



The Coal Authority

Maintaining treatment in passive schemes

- Vast majority of UK schemes use:
- Settling ponds + / Reedbeds
- Reedbeds need occasional maintenance

The Coal Authority

Channelised Reedbeds

Channels like these typically occur after 5 to 10 years.
Cutting of the reeds normally restores uniform flow across beds.

Sludge waste cost reduction strategies

- Desludging lagoons
- Use gravity sludge drain
  - Instead of pumping or digging out
  - Need suitable topography with lagoon above drying bed
  - Implemented at 3 sites so far.

Sludge waste cost reduction strategies

- Dewatering methods
- Drying beds good, but takes time.
- Trialled methods to dry ochre sludge quicker. included
  - Centrifuge
  - Belt press
  - Electrokinetics
- EK performed well

The Coal Authority

Ochre Sludge re-use

- Ultimately aiming for full re-use
  - Avoid increasing landfill costs
- So far only limited use for bricks
  - At Dawdon HDS plant, NE England
- CA R+D team looking at several options
  - Including waste water treatment for P

The Coal Authority

Heat from mine water

Six Bells, Wales - Steam rises as snow falls

Can the heat in mine water be used, creating value, and decreasing costs of treating water ?

The Coal Authority

A heat pump trial at Dawdon

- UK has growing ground source heat market
  - Minimal use of mine water so far
- We've implemented a demonstration project to encourage wider uptake in UK.
- A small pilot trial heats offices at Dawdon plant
- DHW also provided to offices
- Mine water used: ~1.5l/s, 20degC, ~80mg/l Fe
- Heat pump unit: 12KW
- Coefficient of Performance = 5


Danger
400 Volts
Danfoss
Danfoss
Tel: 0114 270 3900
This unit is only to be connected to a heat pump
Do not connect to a gas boiler or any other
heat source that exceeds 65°C
Danfoss
L
2010

The Coal Authority

Metal Mine Water treatment challenge

- Most UK experience so far is for coal
- Cost effective treatment of zinc rich metal mine waters is more challenging.
- We are exploring several options to identify solutions with lowest whole life cost

The Coal Authority

Force Crag Pilot Trial

Research with Newcastle University, Environment Agency and the National Trust

Passive vertical flow reactor (VFR)

Pilot treatment scheme built in 2014

>95% Zn removal currently being achieved

Feasibility of using VFR technology now being assessed for other metal mine sites in UK

The Coal Authority

Metal Mine R+D

- Working with a variety of partners
- Testing various materials including
  - Ion exchange media
  - Sorption media

Treatment trial using biochar, Aberystwyth University

The Coal Authority

Summary

- Operation of ~70 schemes including closed coal and metal mines
- Continually improving sustainability by looking at a wide range of factors:
  - Pumping
  - Treatment
  - Waste Management
  - Etc
- New ideas are always welcome

The Coal Authority

WWW.COAL.DECC.GOV.UK

 Lathallan Mill mine water treatment scheme, Fife