Improving **WFD status at the catchment scale:**
The role of **Natural Flood Management**

David Hetherington\(^{1,2}\), Alex Nicholson\(^1\) and Paul Quinn\(^2\)

\(^1\) – Arup, Central Square, Forth Street, Newcastle Upon Tyne, NE13PL, UK
\(^2\) – Newcastle University, Department of Civil Engineering, Newcastle upon Tyne, Tyne and Wear NE1 7RU

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Running order

1) Sustainable Catchment Management
2) NFM
3) NFM links to WFD
4) NFM Experience at Belford
5) Conclusions
6) Mini Workshop
   (Barriers and enablers by geography)
By restoring damaged rivers are we focussing on the symptoms, rather than the cause?
Sustainable Catchment Management (for WFD)

- “Working With Natural Processes”;
- As far as possible, restoring the catchment in its natural state;
- Where its not possible restore, look to mimic or replicate (or over-naturalise?);
- Taking advantage of natural recovery, vegetative development and geomorphological change;
- Become more resilient to Floods, Droughts and Geomorphological change;
Driving Sustainable Catchment Management

- River Restoration
- Blue Green Corridors
- Green Infrastructure
- Ecosystem Services
- SuDS
- Water Sensitive Urban Design
- Wetlands (Artificial and restored)
- Land use change
Driving Sustainable Catchment Management

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- Water Framework Directive
Quick intro to NFM:

- NFM is a landscape-based approach to flood risk management.
- It involves the alteration, restoration, or use of landscape features to reduce flood risk.
- Catchment systems engineering is a key component, focusing on managing water quality and quantity.

Diagram notes:
- Gate at top of field
- Hedgerows
- Temporary overland flow pond
- Tramlines deliver surface flow to ponds and buffer strips
- 5m buffer strip
- Well-structured soil (with worms) high infiltration and storage capacity
- Vegetated ditch
- Slow flow
- Natural buffer area in hollow
- Within-ditch storage pond
WFD aspects related to NFM

- The “Catchment Waterbody”
  - Hydromorphology;
  - Water Quality;
  - Ecology.

- WFD Mitigation Measures (non-exhaustive list):
  - Physical Restoration;
    - Remeander, Regrade, Reconnect rivers.
  - Sediment Management;
    - Buffer Strips, alter land use regime, fencing,
  - Alter Flow Regime;
    - Ensure appropriate baseline; flow manipulation;
NFM benefits for WFD

- **Hydromorphology**
  - Reduced low flows and “naturalisation” of flood peak and frequency;
  - Improved habitat diversity and dynamism in restored reaches;
  - More wetland and backwater habitat;
  - Improved floodplain connectivity;

- **Water Quality**
  - Increased residence time of waters +
  - Increased vegetation and surface area =
  - Increased natural treatment and filtration

- **Sediment Management**
  - Reduced/naturalised energy levels and sediment delivery;
  - Reduced velocities and increased deposition/vegetation;
  - Increased vegetation and “locking away” of sediment;
  - Interaction with farms to maintain features and reuse sediment.
Flooding in Belford

Unnatural rates of run off and sediment delivery due to agriculture impacting on all 3 WFD elements (hydromorphology, water quality and ecology)
Mitigation Explained

Legend:
- Arable
- Buffer strip
- Farm tracks and hard standings
- Meadow
- Belford Village
- Pasture
- Road
- Rough grazing
- Woodland
  - Overland flow interception
  - Online ditch features
  - Offline features
  - Large woody debris
  - Other

OVERLAND FLOW

LARGE WOODY DEBRIS

ON- and OFFLINE RAFs

ARUP
Runoff Attenuation Features (RAFs):

Key design attributes of RAFs:

• easily accommodated in the landscape;
• do not impact on farming;
• typically small (<500m$^3$), or located within a ditch or small stream;
• designed as an extension of farming and land drainage (i.e. not solely flood engineering projects);
• provide multiple benefits, e.g. nutrient transport (Barber & Quinn, 2012)
RAF types – Soil interception bund (RAF-11)

Based on LIDAR data, this feature has an estimated capacity of 200m³. This is based on a bund length (with a maximum height of 1m) of 70m. This would create a pool area of 1100m². This feature needs further assessment.
RAF types – Soil interception bund (RAF-11)

- RAF-11 disconnecting rapid runoff in steep arable field 490 m$^3$
- Palmer 2012 estimated 0.99 tonnes of sediment were retained in feature, the equivalent of 91 kg ha$^{-1}$.
RAF types – Leaky barriers (RAF-0)

Photo provided by Mark Wilkinson
RAF types – Leaky barriers (RAF-0)

Photo provided by Mark Wilkinson
RAF types – Large Woody Debris (RAF-7)
RAF types – Offline ponds (RAF-1)
RAF types – Offline ponds (RAF-1)
RAF types – Offline ponds (RAF-1)
Features built in Belford and estimates of typical capacity and cost. (Consultancy and research costs are not included)

<table>
<thead>
<tr>
<th>Feature type</th>
<th>Number built</th>
<th>Typical min, max storage m³</th>
<th>Estimated cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overland flow interception</td>
<td>5</td>
<td>300-1000</td>
<td>1K-5K</td>
</tr>
<tr>
<td>Online ditch features</td>
<td>9</td>
<td>50-150</td>
<td>1K-3K</td>
</tr>
<tr>
<td>Offline ponds</td>
<td>5</td>
<td>200-3000</td>
<td>2K-6K</td>
</tr>
<tr>
<td>Large woody debris</td>
<td>8</td>
<td>50-150</td>
<td>1K-3K</td>
</tr>
<tr>
<td>Other opportunistic sites</td>
<td>3</td>
<td>100-3000</td>
<td>1K-10K</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>Estimate for Belford 8,000m³</td>
<td>£70K-100K</td>
</tr>
</tbody>
</table>
Where should a RAF be located?

Get the right feature in the right place. In the field, in the ditch, in the small channel...
Offline ponds for larger channels and any opportunistic sites
NFM simulated hydrographs:

Removal of “artificial” peak and hydromorphological restoration?

>30% reduction
Summary

- NFM is a sustainable way of managing runoff & has low cost and offers multiple benefits;
- Disconnection of runoff pathways at source reduces flood peaks locally and captures sediment. Maintenance is needed to preserve pond volume.
- The network of RAFs provides downstream benefits.
- Intrinsic WFD benefits of NFM for all 3 elements;
- More research is needed on the specific / quantified benefits of NFM for WFD (requiring risk aversity and a “leap-of-faith”).
- Why are we not doing more NFM?.....
Workshop task

What are your key barriers to NFM implementation?

• Take 10 coloured dots each;

• Place dots against listed barriers (as many as you like if you feel a barrier is important);

• Add a post it note (with a comment) to barriers if you think that it particularly applies to your country;

• Add post it notes to the solutions section if you have ideas;

• Keep talking….!!

Results will be summarised and circulated afterwards.