the River Restoration Centre

Working to restore and enhance our rivers

Delivering River Restoration: Recipes for Success

13TH ANNUAL NETWORK CONFERENCE

Environment Agency · Wetlands International · SYKE · CIRF

Restoring Europe's Rivers

ACE · AlaskA · ARUP · Cain

Halcrow – A CH2M HILL COMPANY · LAND & WATER Services · Penny Anderson Associates Ltd – Consultant Ecologists · ROYAL HASKONING – Enhancing Society

rshydro · Salix · WILLOWBANK – Erosion & Conservation Services · WLW LTD

Sustainable, Cost-Effective Reservoir Discontinuance - Re-Naturalising Whicham Beck, Lake District National Park

Evan Dollar, Paul Bradley, Carl Sanders, Dale Gibbons & Gavin Hulme

RRC 13th Annual Network Conference

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PBA APPLIED ECOLOGY
United Utilities
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Baystone Bank IR

- Baystone Bank IR:
  - 6 km North of Millom
  - Completed 1876 – earth fill construction, puddle clay core, by-wash, overflow & scour facilities
  - Impounded Whicham Beck
  - 125 Ml capacity
  - Lanthwaite WTW decommissioned 1995

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Project Drivers

- Baystone Bank IR:
  - No operational function
  - Undersized overflow capacity
  - ITIOS requirements – discontinuance options – with / without residual storage
  - Continuing liability, routine maintenance costs
  - Unforeseen future costs - legislative changes

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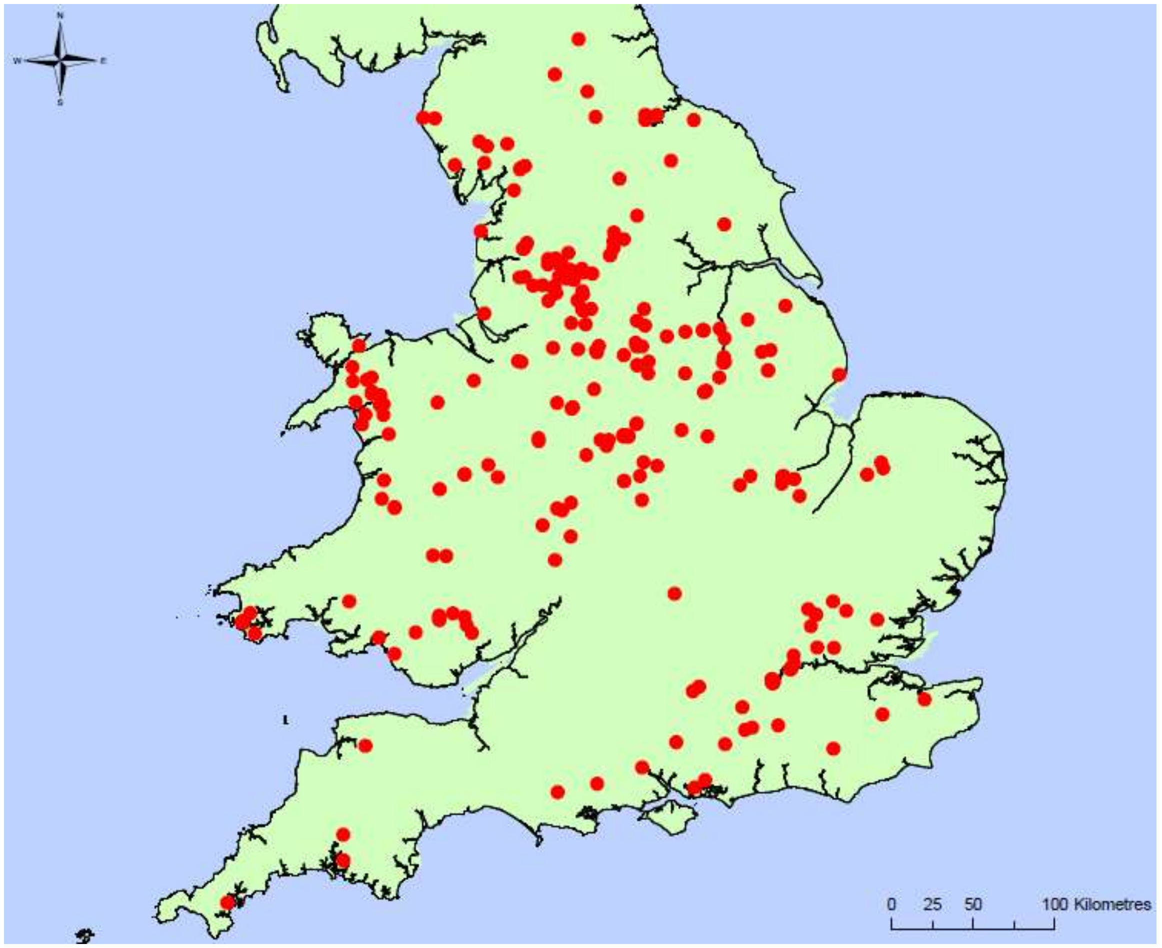
Discontinuance & Restoration

- Agreement with stakeholders:
  - Full discontinuance, no residual storage
  - Full restoration of Whicham Beck (upland gravel-bed river), floodplain & valley
  - Restore access to the upper catchment for migrant fish
  - Maintain high standards of water quality throughout the project works
  - Provision of still water habitat for spring quillwort and foraging for Daubenton's bat
- No existing full discontinuance & gravel-bed river restoration schemes in England & Wales (260) for learning



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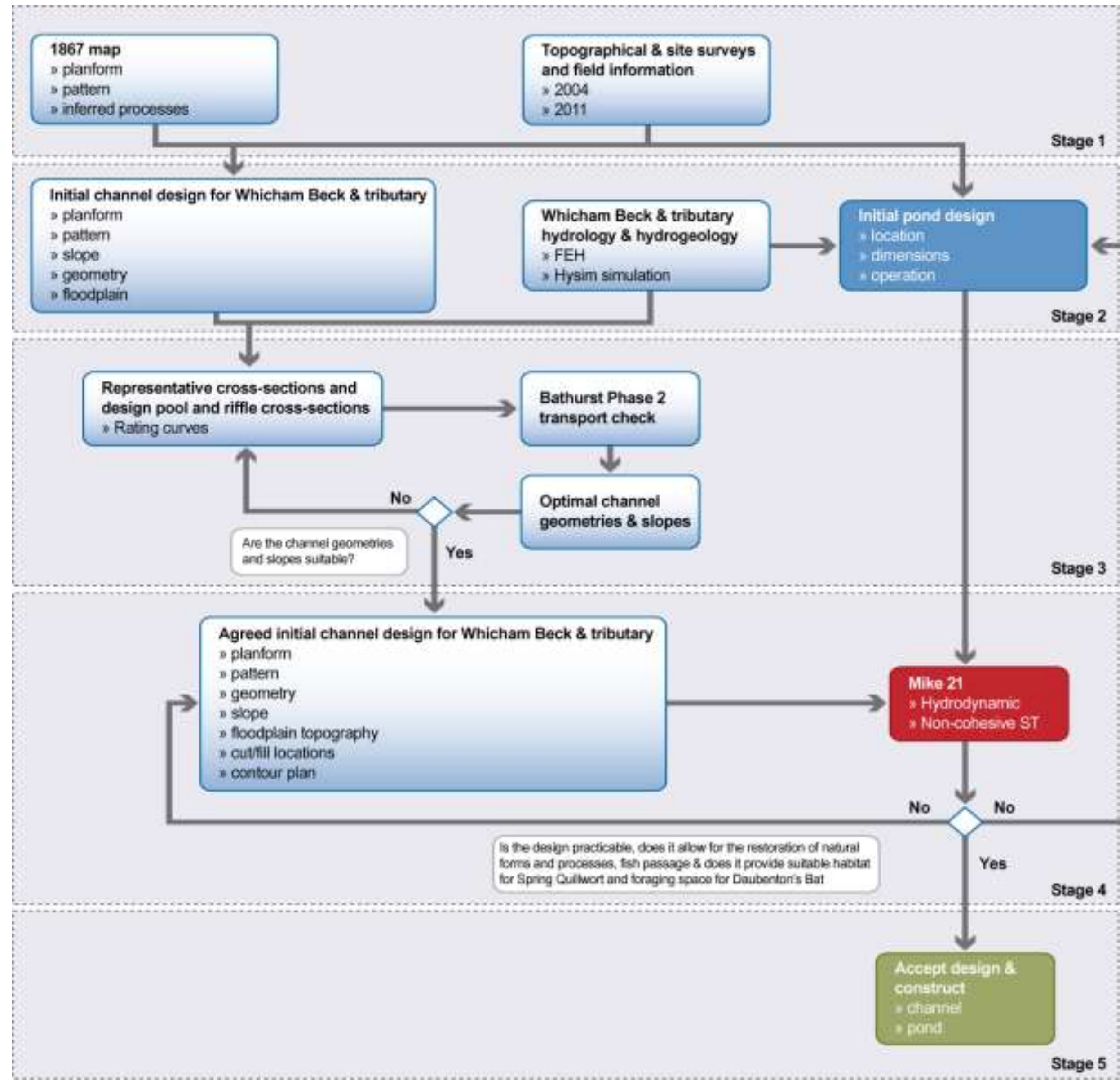
Stakeholder Agreement on Design Philosophy & Principles

- Design philosophy (success - when):
  - '… Whicham Beck & floodplain restored…restitution of natural forms and processes… provision of still water habitat…'
- Design principles (success – how sustainable):
  - Work with natural processes towards the establishment of natural, habitat-forming processes
  - Allow for variability in four dimensions
  - Allow for wide tolerances
  - Create the initial conditions conducive to allow for self-restoration

Design Approach – 5-Stage Process

- **Stage 1**: Geomorphological context, data collection & assessment
- **Stage 2**: Initial channel, floodplain & pond design
- **Stage 3**: Channel & floodplain design to sustain geomorphic processes
- **Stage 4**: Final channel, floodplain, valley & pond design
- **Stage 5**: Accept design & construct



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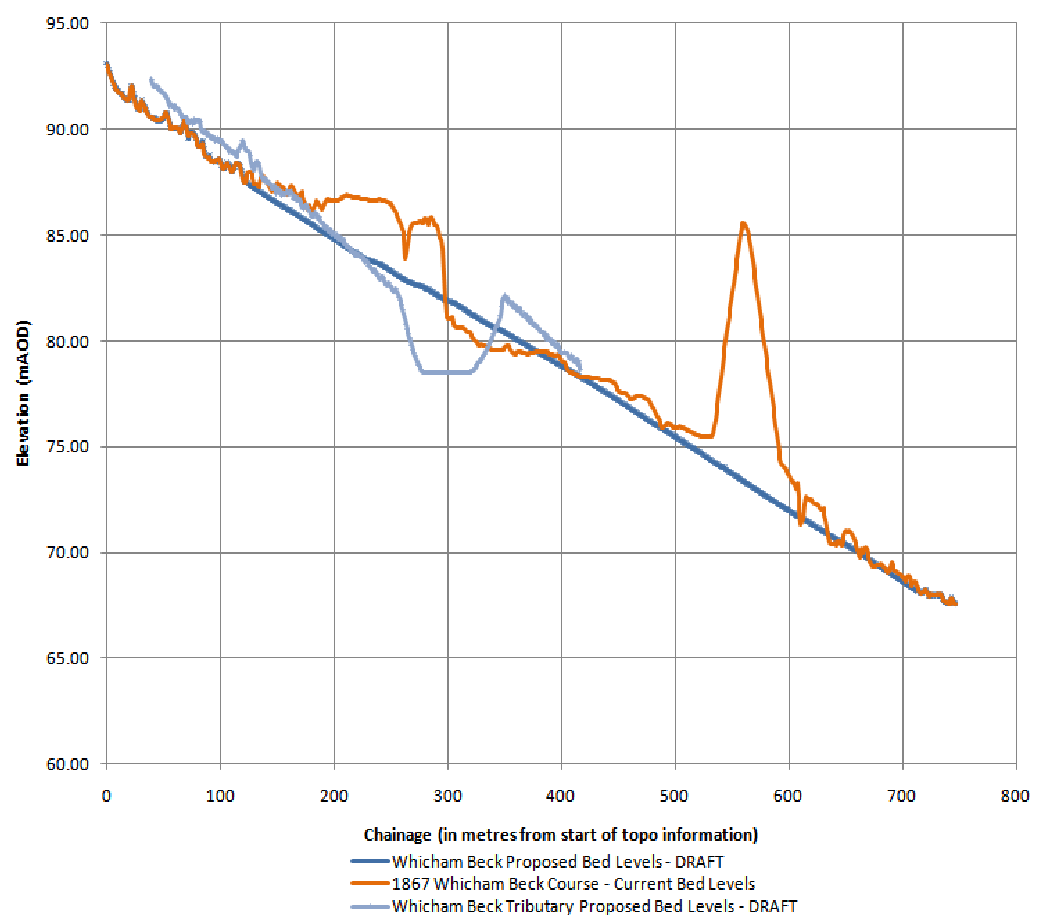
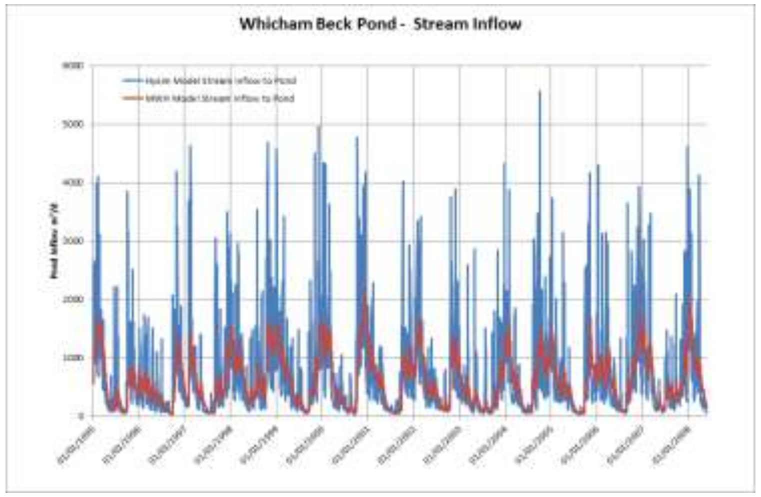
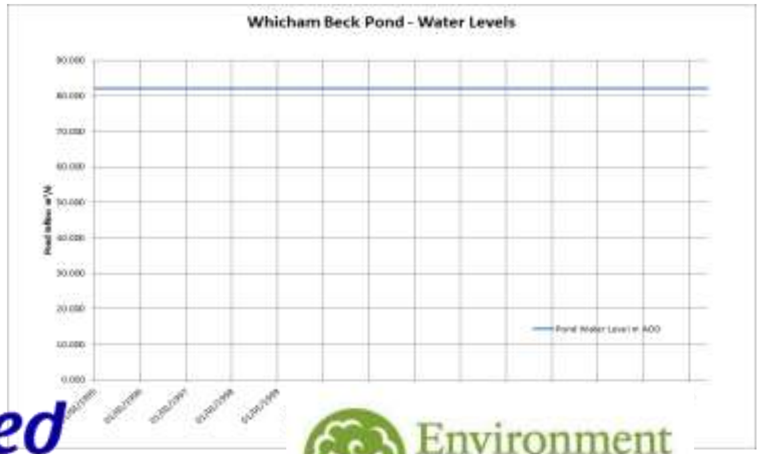

95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
Elevation (mAOD)
0
100
200
300
400
500
600
700
800
Chainage (in metres from start of topo information)
Whicham Beck Proposed Bed Levels - DRAFT
1867 Whicham Beck Course - Current Bed Levels
Whicham Beck Tributary Proposed Bed Levels - DRAFT

Stage 2: Initial Channel, Floodplain & Pond Design

- Information collected in Stage 1 was used to design:
  - Channel / floodplain complex
  - Planform
  - Slope
  - Geometry
- Pond for spring quillwort & Daubenton's bat

Typical Pool, Riffle, Floodplain Dimensions for Whicham Beck & Tributary	
Bottom width (m)	X to Y
Top width (m)	X to Y
Bankfull depth (m)	X to Y
Slope (m)	X to Y





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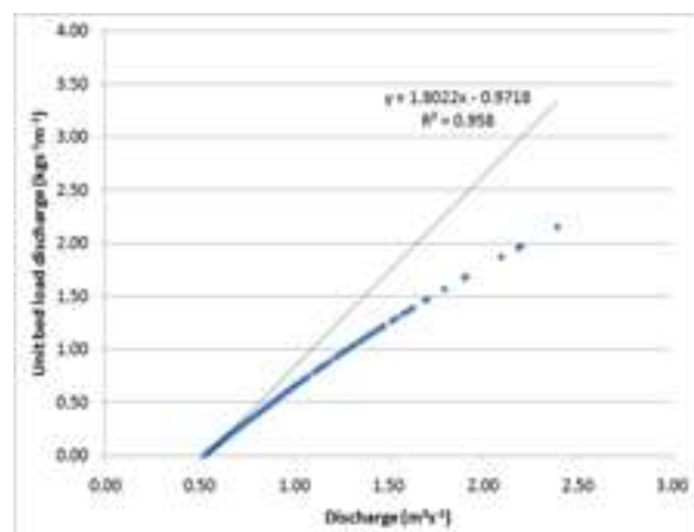
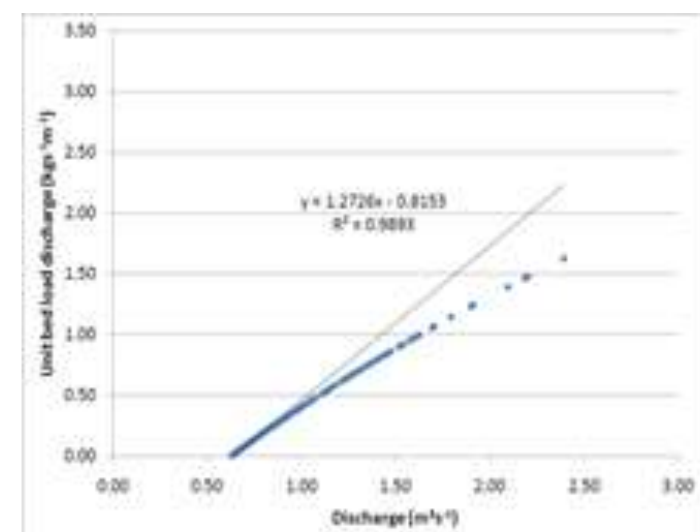
Stage 3: Channel & Floodplain Design to Sustain Geomorphic Processes

- Resistance equations
- Bathurst (2007) Phase 1 / 2 transport calculations
- Bed material samples
- Representative pool & riffle cross-sections
- Channels designed to transport as per representative upstream pool & riffle cross-sections





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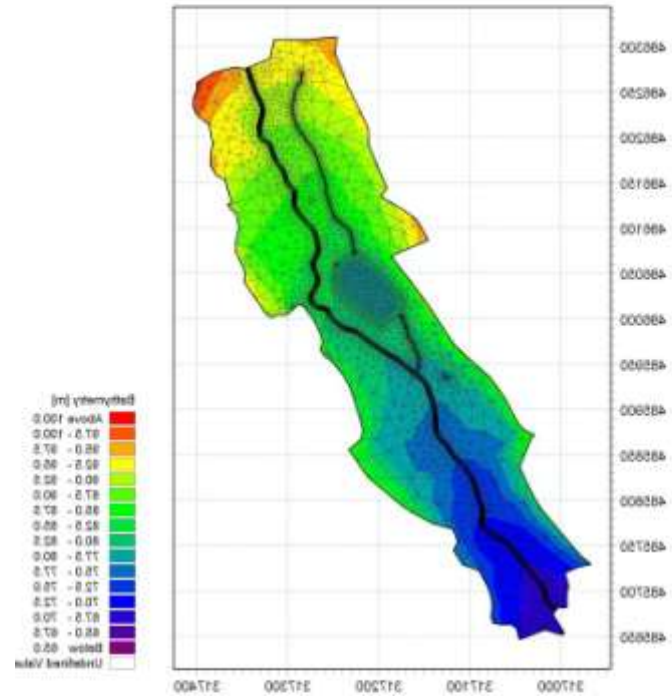
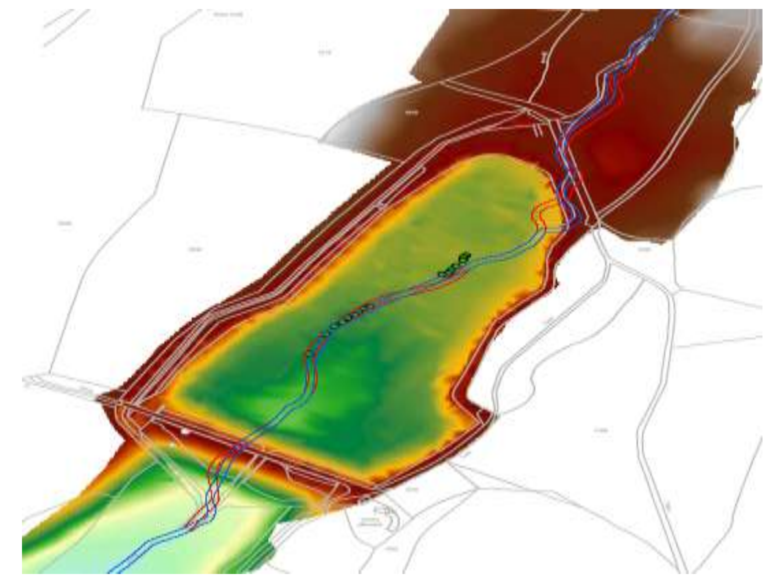
Stage 4: Final Channel, Floodplain & Valley Design (1/2)

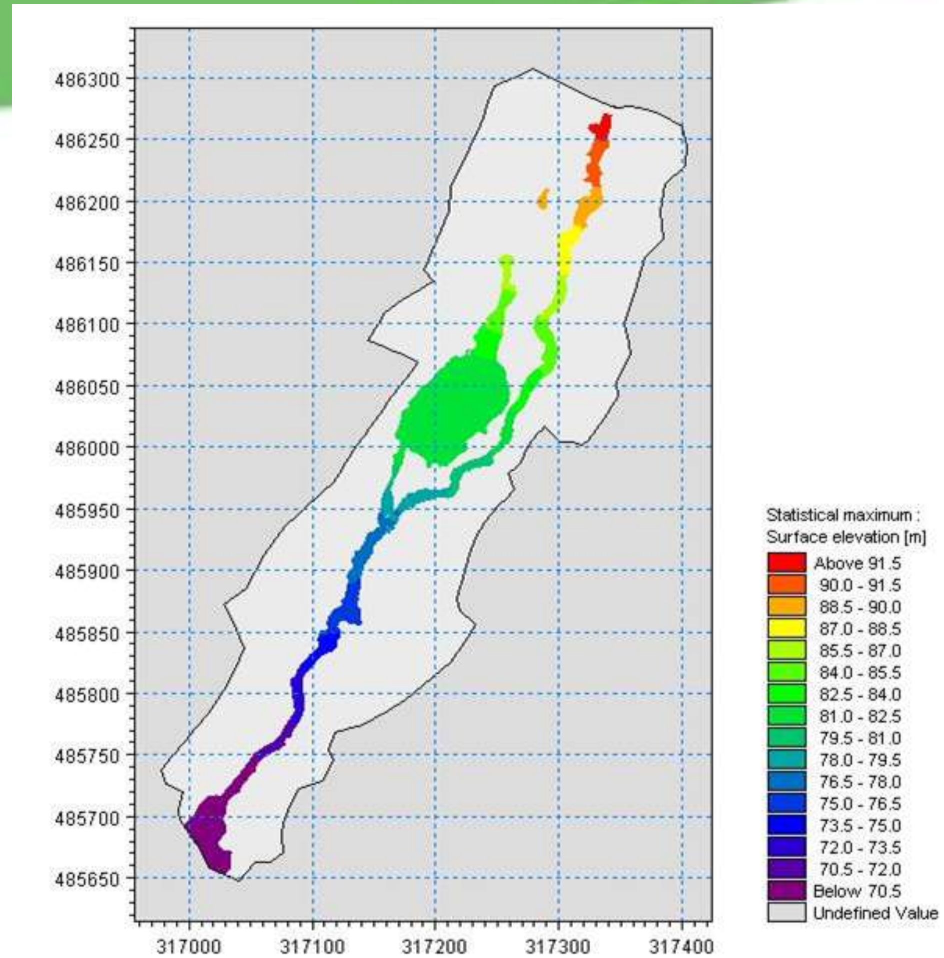
- Design channel dimensions burnt into 3D ground model
- Allowed for cut / fill volumes and locations & contour plan
- Design laid out on site
- Adjustments made for construction & where relict bed unearthed

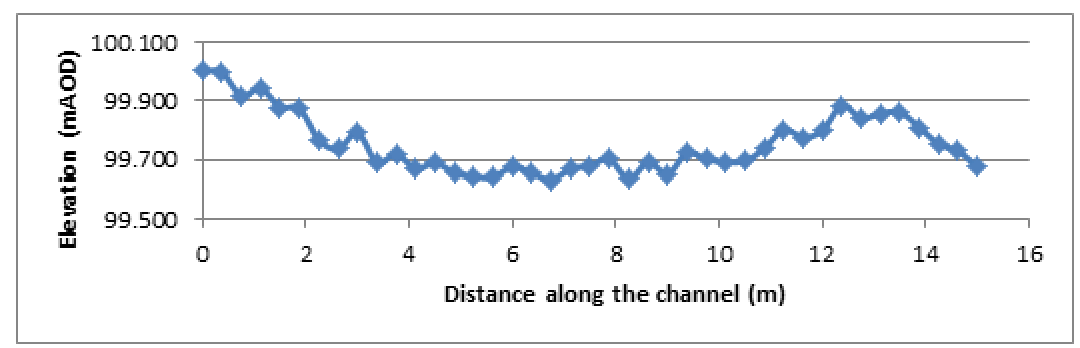




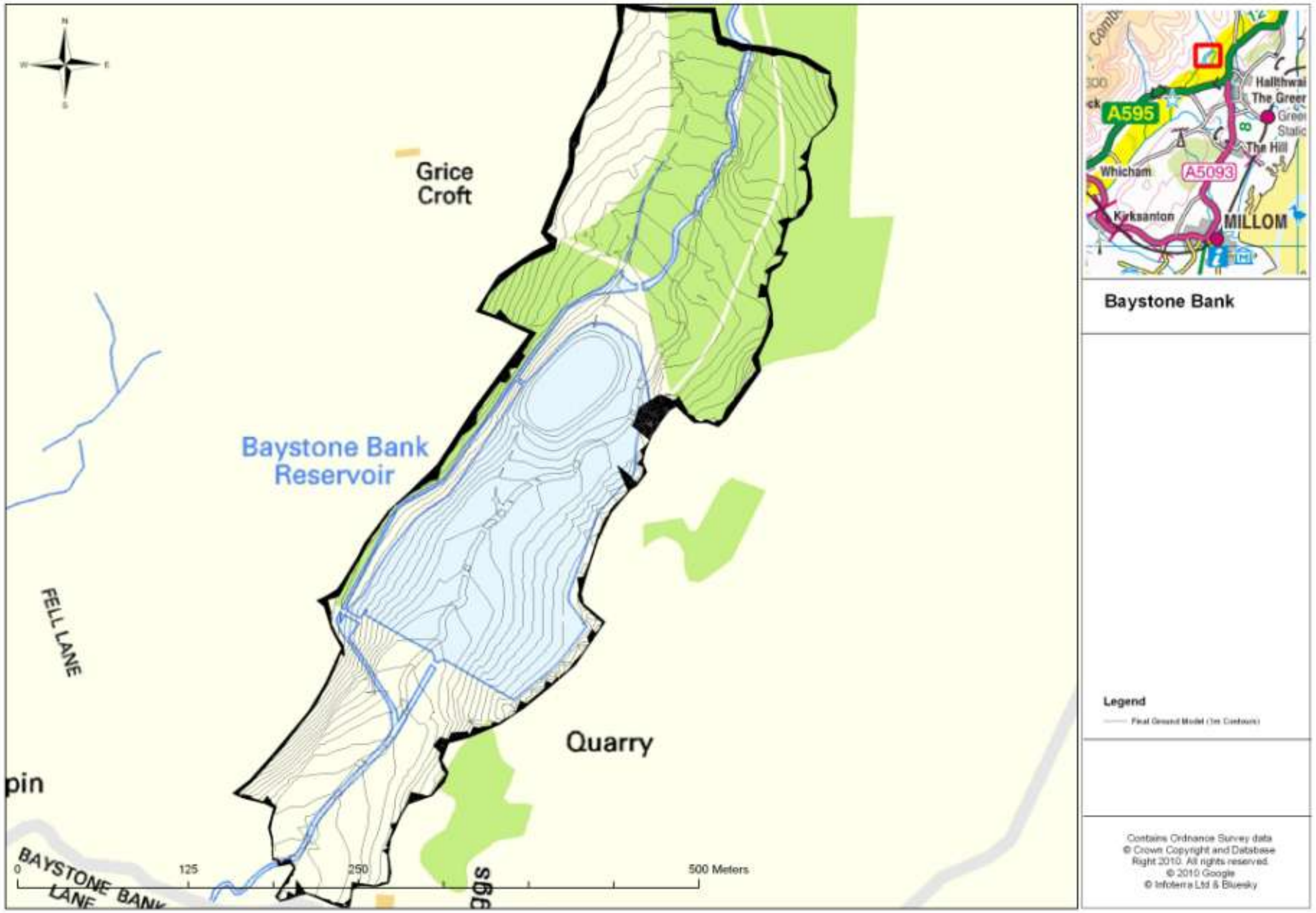
Stage 4: Final Channel, Floodplain & Valley Design (2/2)

- Mike-21 HD & ST model built
- Pool / riffle spacing & geometries added
- Interactions between pond & channel and channel & floodplain
- Areas of erosion, deposition & bank instability





Stage 5: Accept Design & Construct



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Ecological Management

- Water quality targets agreed with stakeholders & maintained during earthworks
- By-wash discontinued over 5 days
- Electro-fish rescue – 400 brown trout, 38 European eel
- Gradual turning of the flow to new channel
- No perceived fish mortality
- New channel running clear within hours

Before and After – Reconnection of Upper Catchment

2010

2011

Before and After

2010

2012

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Before and After

2010

2012

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Main Benefits

- All on site material reused
- Accumulated sediment blended with landscaping material
- 2,500 wagon movements avoided
- Estimated 175 tCO_2e in transport emissions avoided
- Removal of barrier to fish migration
- Habitat for otter, eel, brook lamprey, brown trout, sea trout, salmon, Daubenton's bat & spring quillwort
- Terrestrial habitat connectivity
- Downstream sediment conveyance

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Main Benefits

- Cost-effective discontinuance – substantially cheaper than spillway repair & embankment stabilisation
- No future cost / liability
- Sustainable pond design that does not disrupt flow & sediment continuity
- Climate change resilience