the River Restoration Centre

Working to restore and enhance our rivers

Delivering River Restoration: Recipes for Success

13TH ANNUAL NETWORK CONFERENCE

Restoring Europe's Rivers

DAY-LIGHTING OF A CULVERTED CHANNEL IN DYCE, ABERDEEN

River Restoration Centre Conference, University of Nottingham,
19th April, 2012

Dr. Hamish Moir, Dr. Chris Bowles, Mr. Sam Diaz

Case study of ‘constrained process restoration’

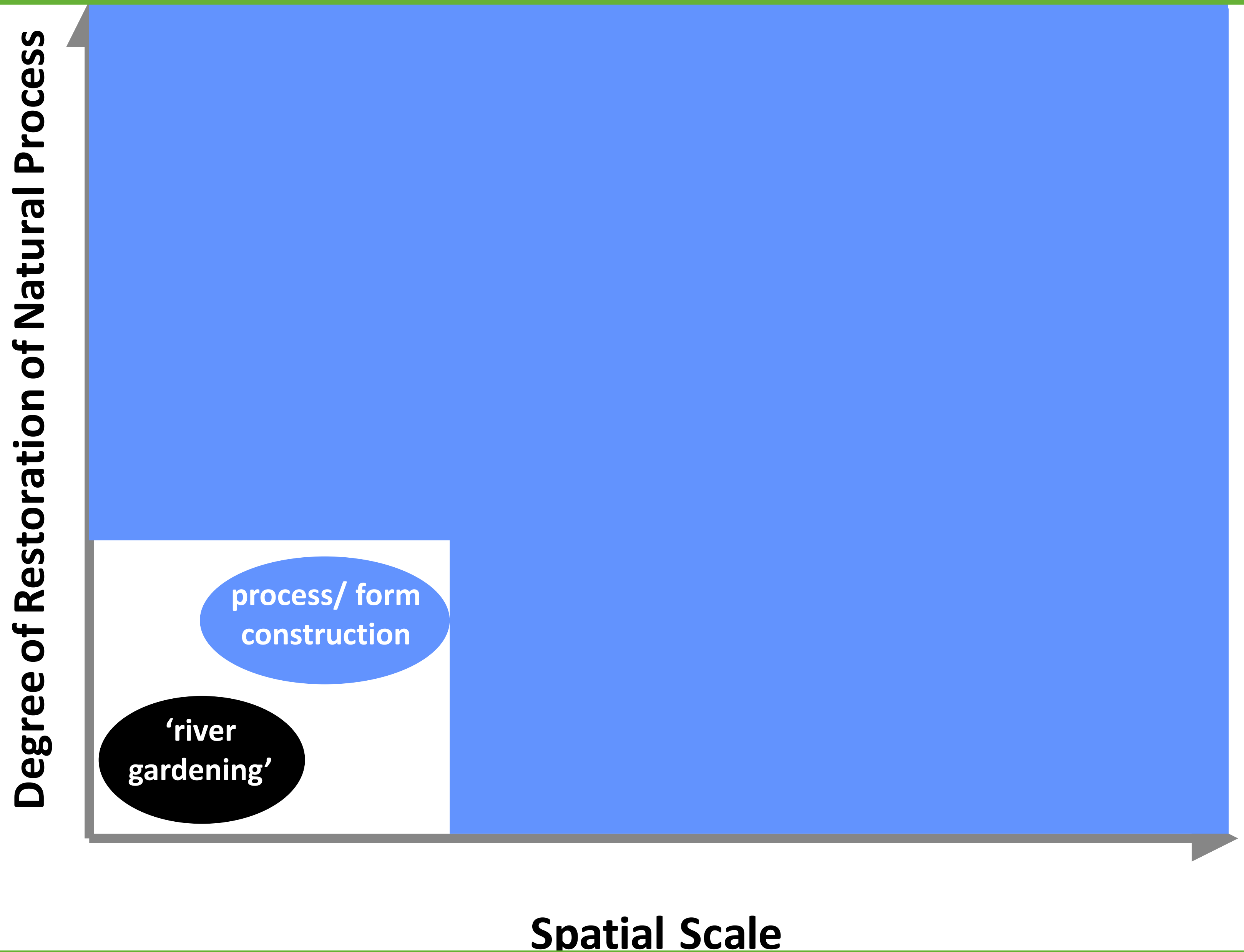
‘PROCESS RESTORATION’

- **Over-arching philosophy:** restore catchment-scale river processes as much as possible
  - Operate at largest feasible spatial scales
  - Aim to restore process rather than specific local-scale design
  - Think at longer temporal scales – not ‘quick fix’ approach
  - More sustainable approach – let the river do the work!

Practical constraints limiting scale of restoration

- Development and land-use pressures
- Fragmented land ownership and management
- Lack of catchment-scale management plans
- Inappropriate management time-scales
- Lack of sufficient funding
- Lack of knowledge and perception

‘Domain of the process restoration continuum’

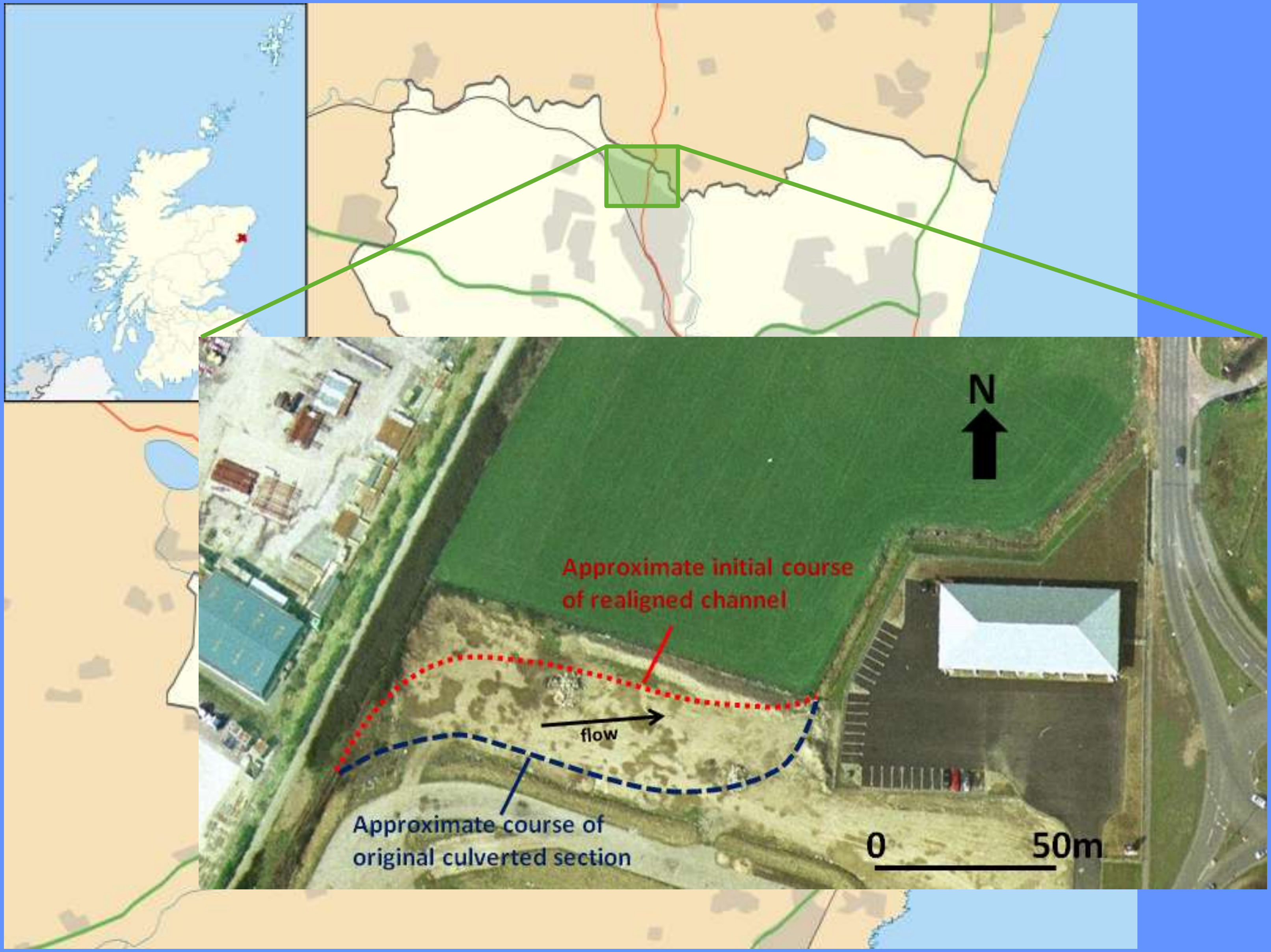


Case study of ‘constrained process restoration’

Mains of Dyce, Aberdeen

- Housing development – significant constraints to spatial scale and process
- Stream previously culverted under industrial site
- Requirement by SEPA to ‘daylight’ the stream, using expert advice
- Housing developer decided to do it themselves (not so much river gardening as river abuse!)
- Result = unstable design (leading to disaster!)
- cbec contracted to design stable channel

Study site: Mains of Dyce, Aberdeen



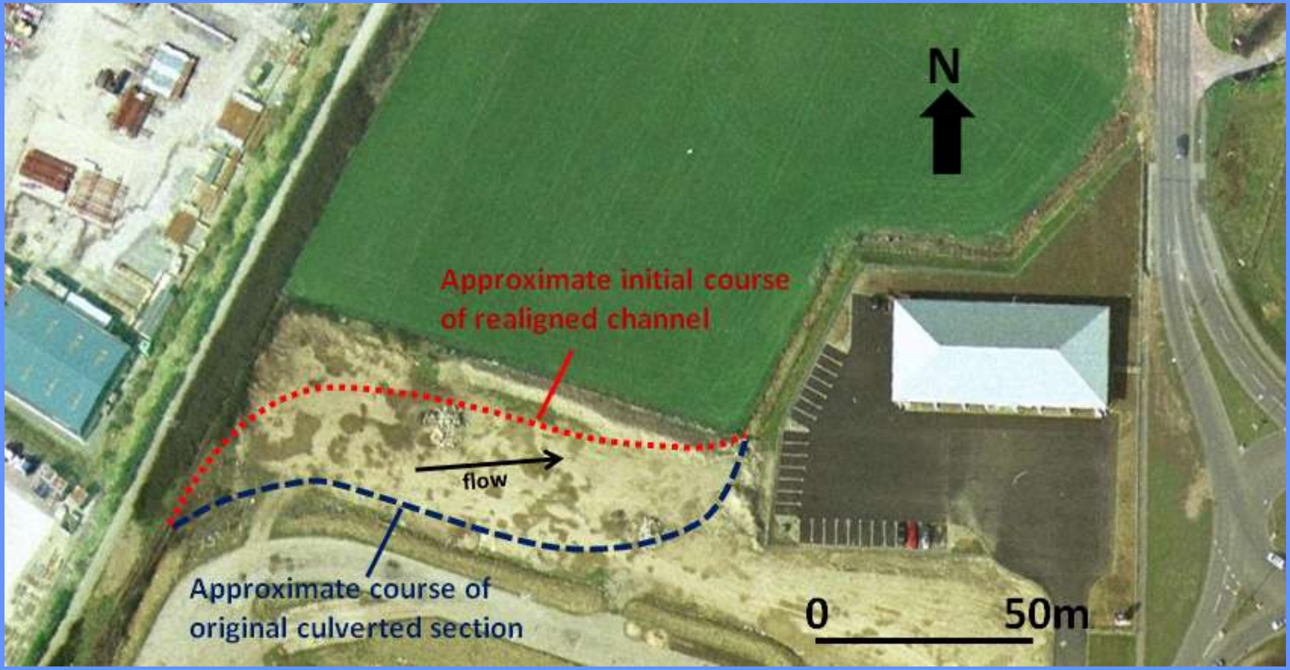
Mains of Dyce Restoration, April 2012

Study site: Mains of Dyce, Aberdeen

Mains of Dyce burn characteristics (at site):

- Catchment area: 1.1 km^2 *
- Length of channel: 165 m
- Channel bed slope : 2.6% (mean), 7.9% (max)
- Q_{50yr}: 1.8 m^{3}s^{-1} *

* highly dubious!



The site with initial channel realignment (NOT us!)

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Mains of Dyce Restoration, April 2012

High flow events prior to further analysis

Two flood events occurred on 31st Oct and 5th Nov 2009

Nearby gauge on mainstem River Don indicated magnitudes of ~10 year return interval

Site estimate indicated discharge of 2.0 – 2.5 m^3s^{-1} (i.e., design Q_{50} underestimated)

Site after high flow events

Mains of Dyce Restoration, April 2012

Site after high flow events

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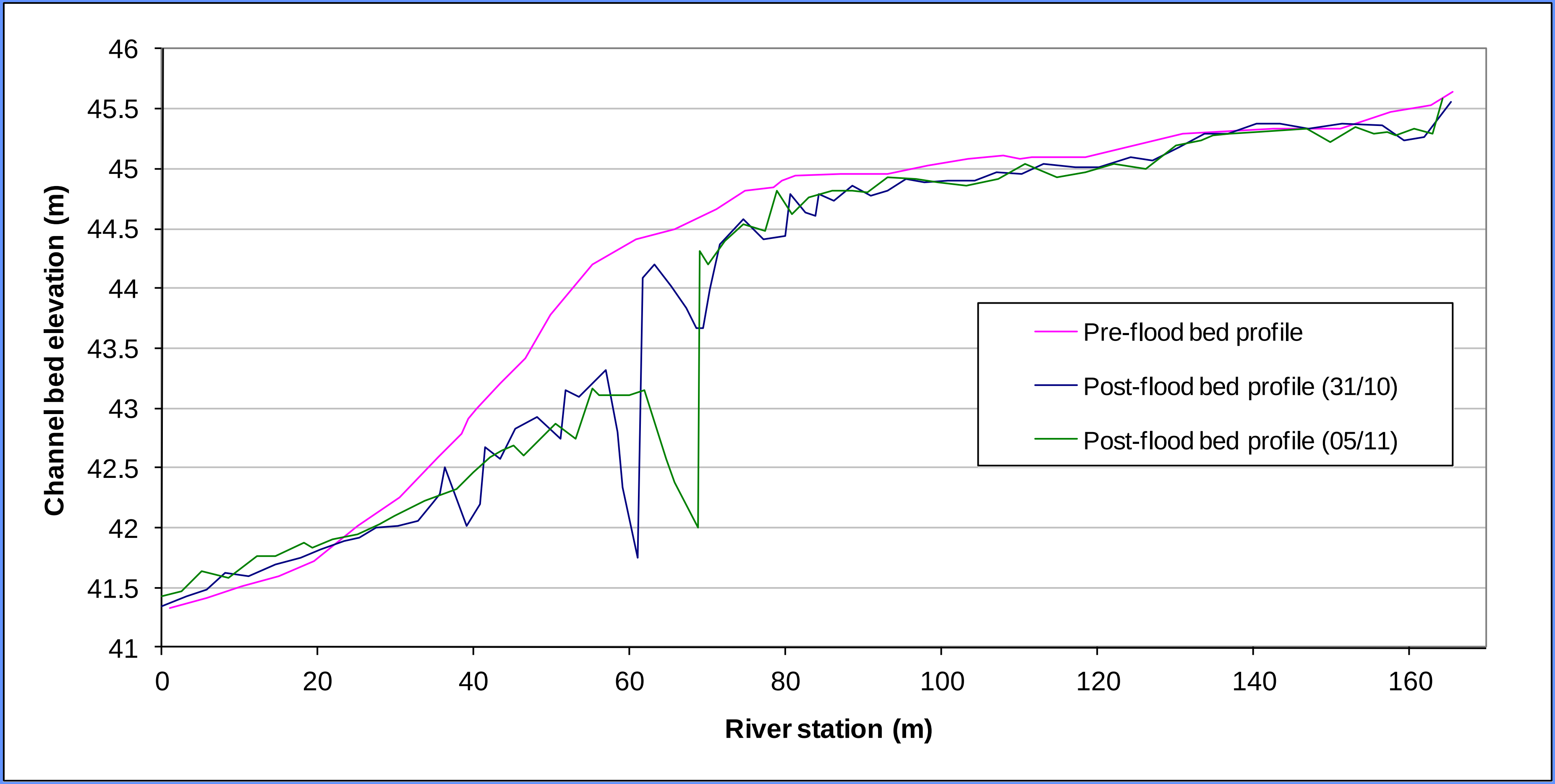
Site after high flow events

- Incision of the channel bed of up to 2.7 m
- Upstream head-cut migration of 7.5 m due to 05/11/09 event
- Total cut of 539 m^3 of material



Design process

• New design concept produced based on reproducing natural fluvial process and form given imposed conditions

• Main aspects of design to reduce forces applied to the channel bed:

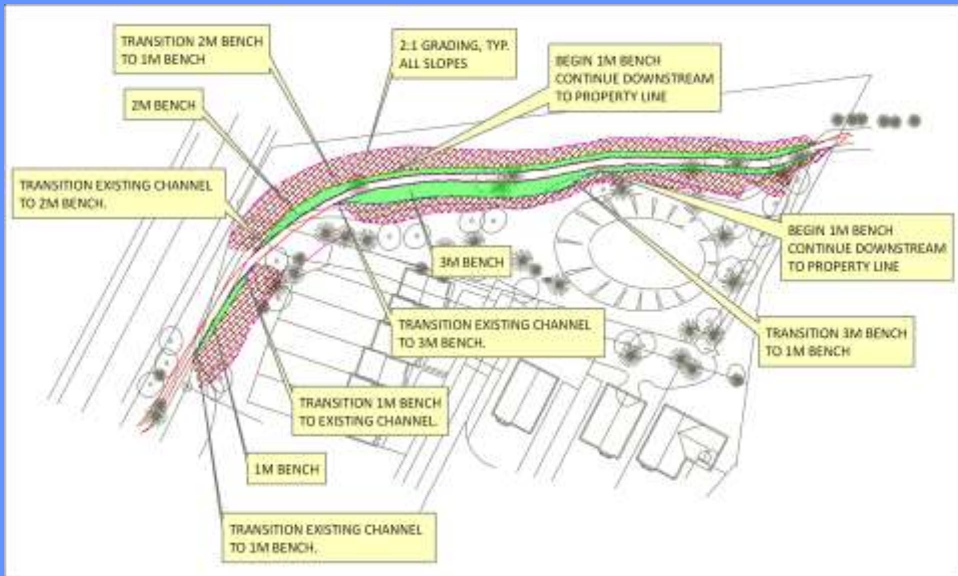
- step-pool design where basal bed slope > 3%
- inset ‘benches’ adjacent to the channel (where site allowed)
- appropriately sized bed material introduced

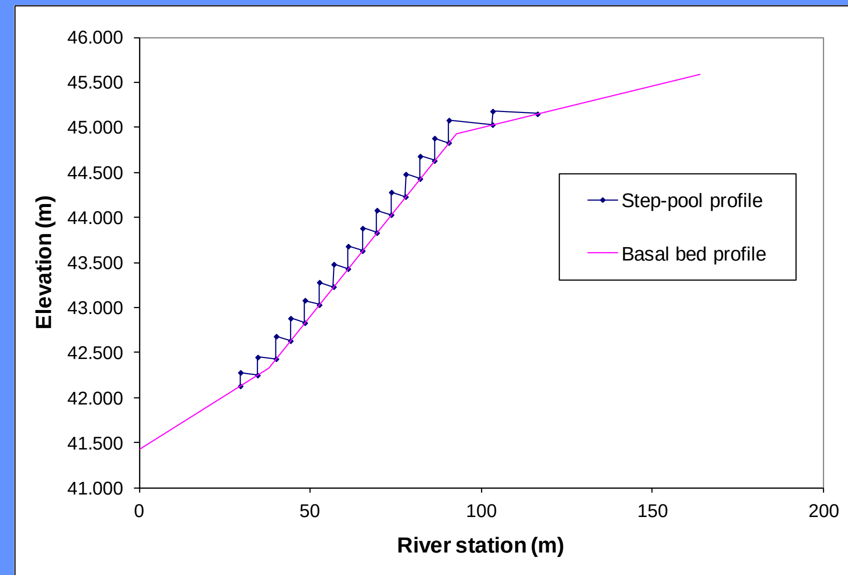
• Step-pool design based on established procedures reviewed by Chin, et al (2009) :

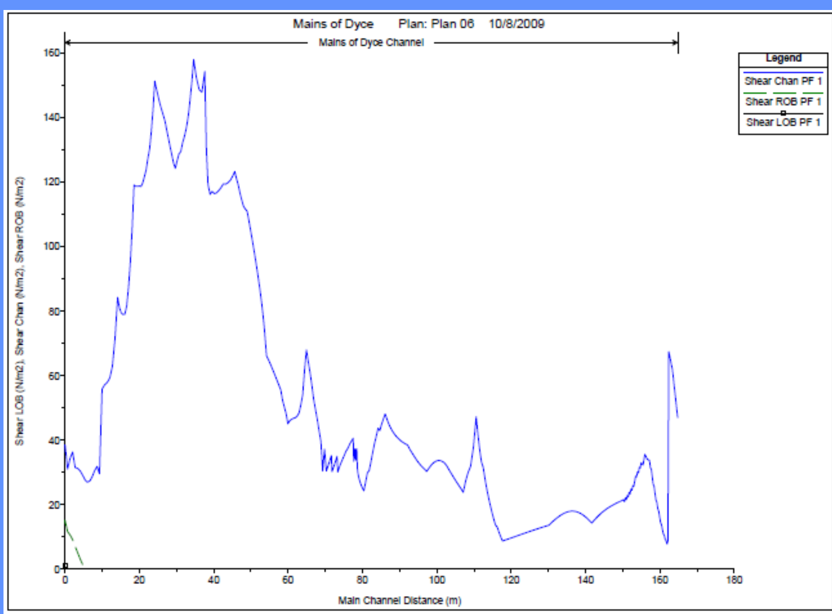
$$(H/L) \quad S = 1.25$$

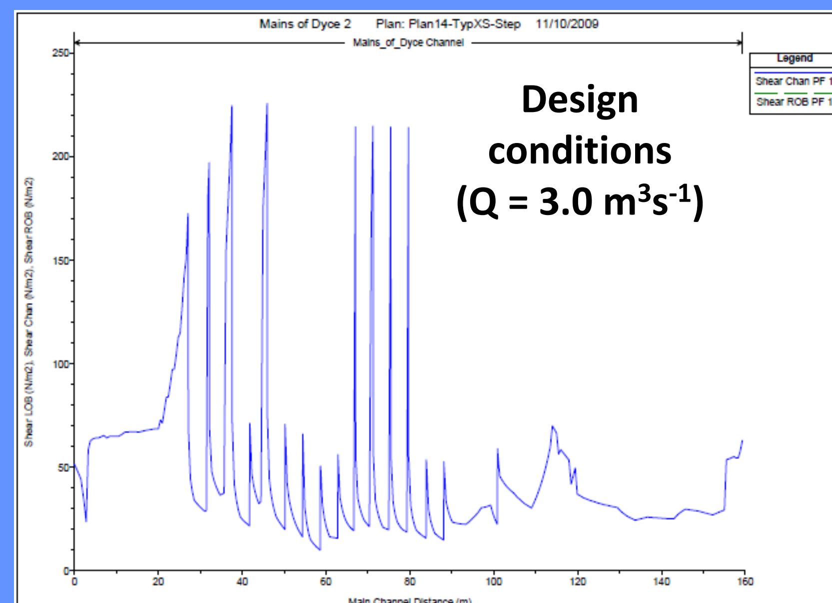
•Iterative process of modelling of design and then refinement

Design process

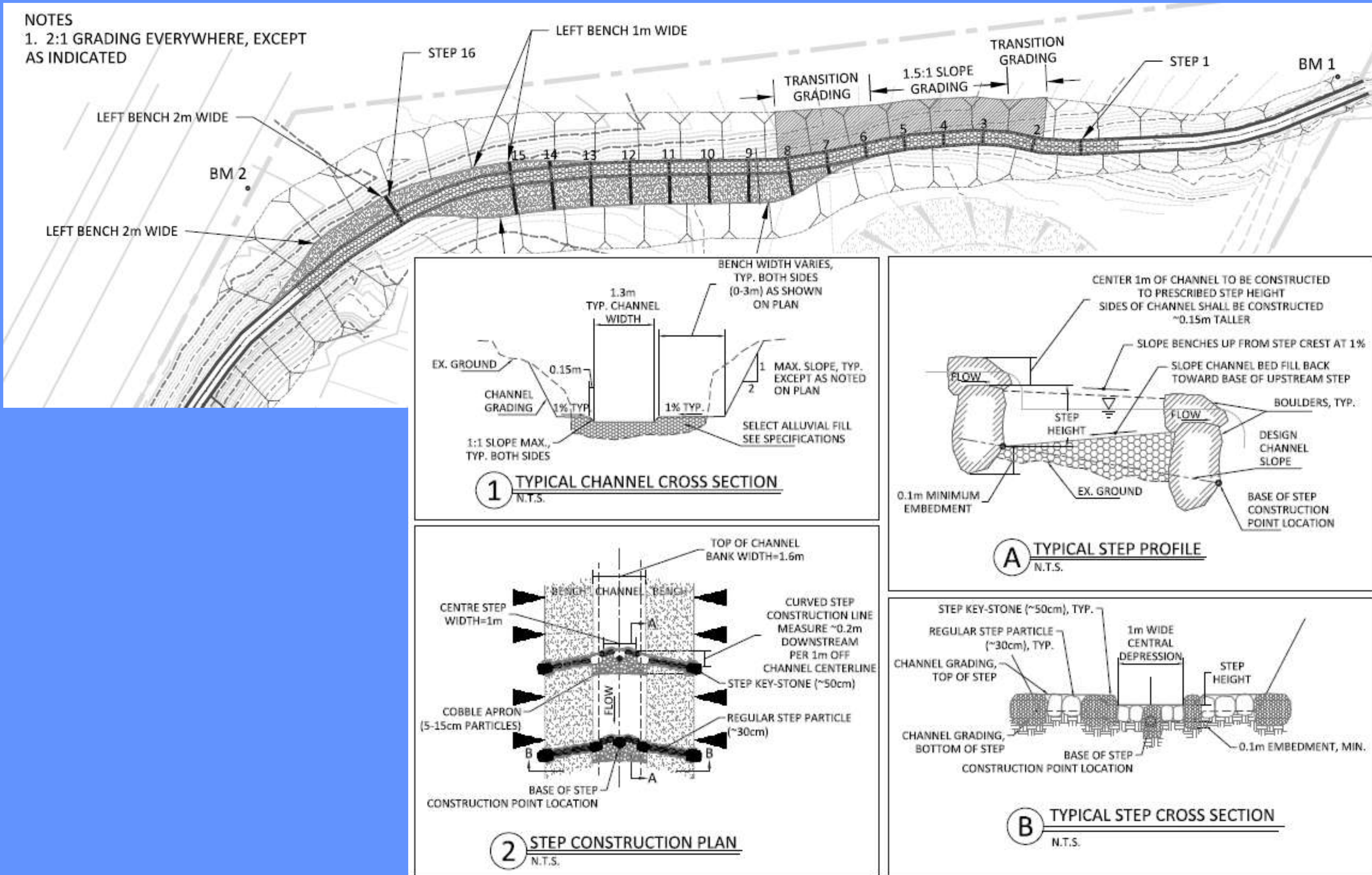








Design detail



Mains of Dyce Restoration, April 2012

Construction Process

1. Staking out

Mains of Dyce Restoration, April 2012

Construction Process

2. Bed and bank profiling

Construction Process

3. Step construction

Mains of Dyce Restoration, April 2012

Post-construction

1. Newly completed

Post-construction

2. Under high flow

Post-construction

4. Ten months after construction

Conclusions and Lessons Learnt

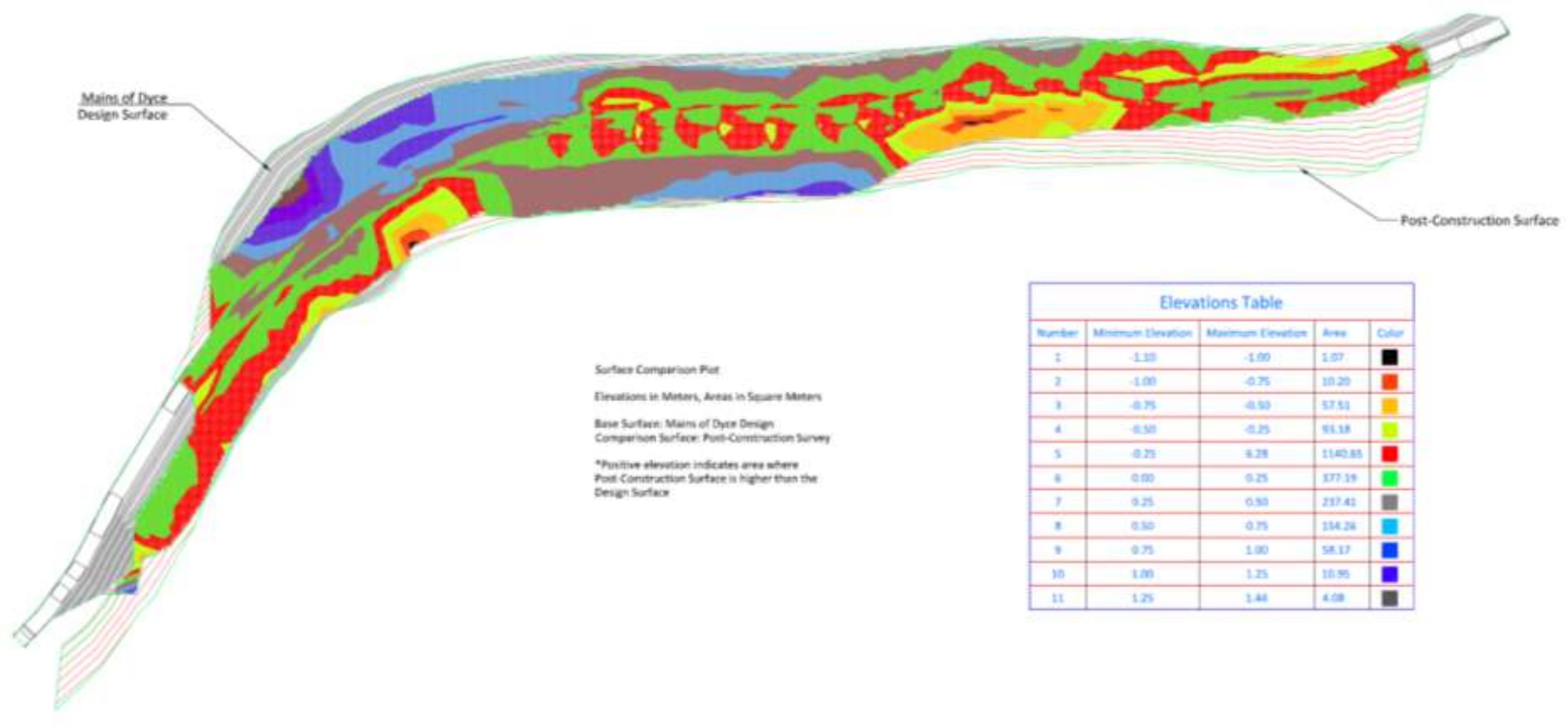
• Always room for some consideration of natural process and form in river restoration design, no matter how constrained a site is.

• Drainage of urban/ industrial areas – don't rely totally on empirical design discharge assessments!

• Monitoring during and post construction is essential to ensure design fitting

• Some of those 'managing' rivers require a greater understanding of basic river process!

Post-construction test of design fit



Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-1.10	-1.00	1.07	
2	-1.00	-0.75	10.20	
3	-0.75	-0.50	57.51	
4	-0.50	-0.25	93.18	
5	-0.25	6.28	1140.65	
6	0.00	0.25	377.19	
7	0.25	0.50	237.41	
8	0.50	0.75	154.26	
9	0.75	1.00	58.17	
10	1.00	1.25	10.95	
11	1.25	1.44	4.08