Mitigation, compensation and restoration of habitats in constructed rivers

- nature-like bypass channels

EUROPE-INBO 2011 International Conference of current and future implementation of the European WFD 27.-30.9.2011

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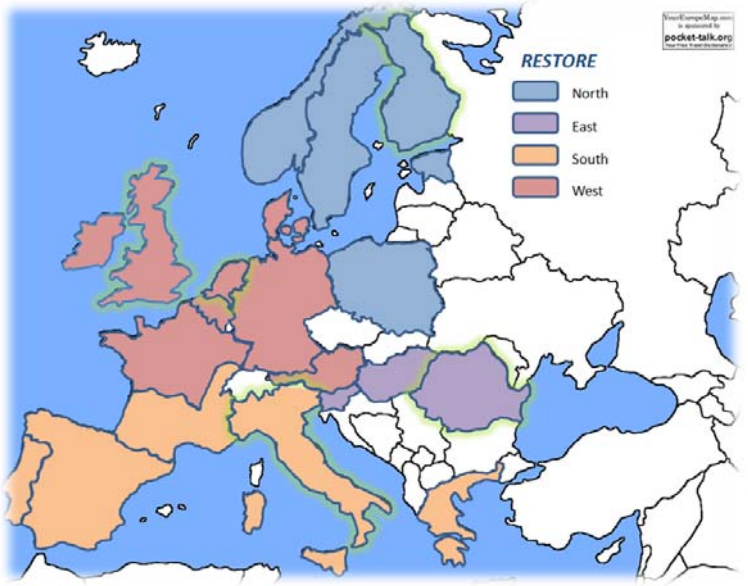
The RESTORE-project

- The *RESTORE* project encourages the restoration of European rivers towards a more natural state.
- Initated by the European Centre for River Restoration ECRR
- Co-ordinated by Environment agency, UK
- North Region co-ordinator, SYKE
- Presents best examples of river restoration in Europe
- Main tools: webpages, newsletter and wiki database of best practises



What can the required mitigation measures in the Water Framework Directive consist?

Definitions for maximum, good and moderate ecological potential for heavily modified or artificial water bodies

Element	Maximum ecological potential	Good ecological potential	Moderate ecolog
al lements	The values of the relevant biological quality elements reflect, as far as possible, those associated with the closest comparable surface water body type, given the physical conditions which result from the artificial or heavily modified characteristics of the water body.	There are slight changes in the values of the relevant biological quality elements as compared to the values found at maximum ecological potential.	There are moderate changes biological quality elements found at maximum ecological These values are significantly found under good quality.
orphological	The hydromorphological conditions are consistent with the only impacts on the surface water body being those resulting from the artificial or heavily modified characteristics of the water body once all mitigation measures have been taken to ensure the best approximation to ecological continuum, in particular with respect to migration of fauna and appropriate spawning and breeding grounds.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with th specified above for the biologi

Nature-like bypass channels – several advantages for ecology

Impact

- Loss of connectivity
  - fish, good/weak swimmers
  - invertebrates
- Loss of reproduction habitats
  - damming rapids to stagnant condition
  - dredged and filled channels
- Discharge patterns
  - regulation
  - dry old channels
  - fish pass flow summer/winter

Mitigation or compensation

- Fish passes
- **Nature-like bypass channels**
- **Constructing new compensative side channels**
  - spawning channels
  - rearing channels
  - restoration of dredged rapids
- Environmental flows
  - Minimum flows in hydropower permits
  - Requirements for migration and juvenile habitats

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Experience outside Europe

- mitigation measures in Canada since 1950'es

Voluntary PR of British Columbia Hydro

Spawning channel for Sockeye (Red Salmon) *Oncorhynchus nerka*

Weaver Creek, discharge 0,43 m^3/s, depth 0,24 m, gradient 0,065%

Rearing channel for Chinook (King Salmon) *Oncorhynchus tshawytscha*

and Steelhead (Rainbow trout) *Oncorhynchus mykiss*

Seton river, discharge 1,12 m^3/s, depth 0,38 m, gradient 0,1%

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Juvenile production in new river arms

Constructed side channel for Pink Salmon *Oncorhynchus gorbuscha* and Coho (Silver Salmon) *Oncorhynchus kisutch*, Chilliwack River

Spawning and rearing channel for Atlantic salmon

- Dunglass side channel, Conon river, Scotland

- Gradient 0,33 %, minimum flow 0,5 m3/s, length 1 km
- Juvenile production: age 0+ 160 individuals /100m2, age 1+ 70 individuals/100 m2 (much higher than in rivers normally)

Photo: Simon McKelvey

Nature-like bypass channels – combination of fish passes and reproduction channels

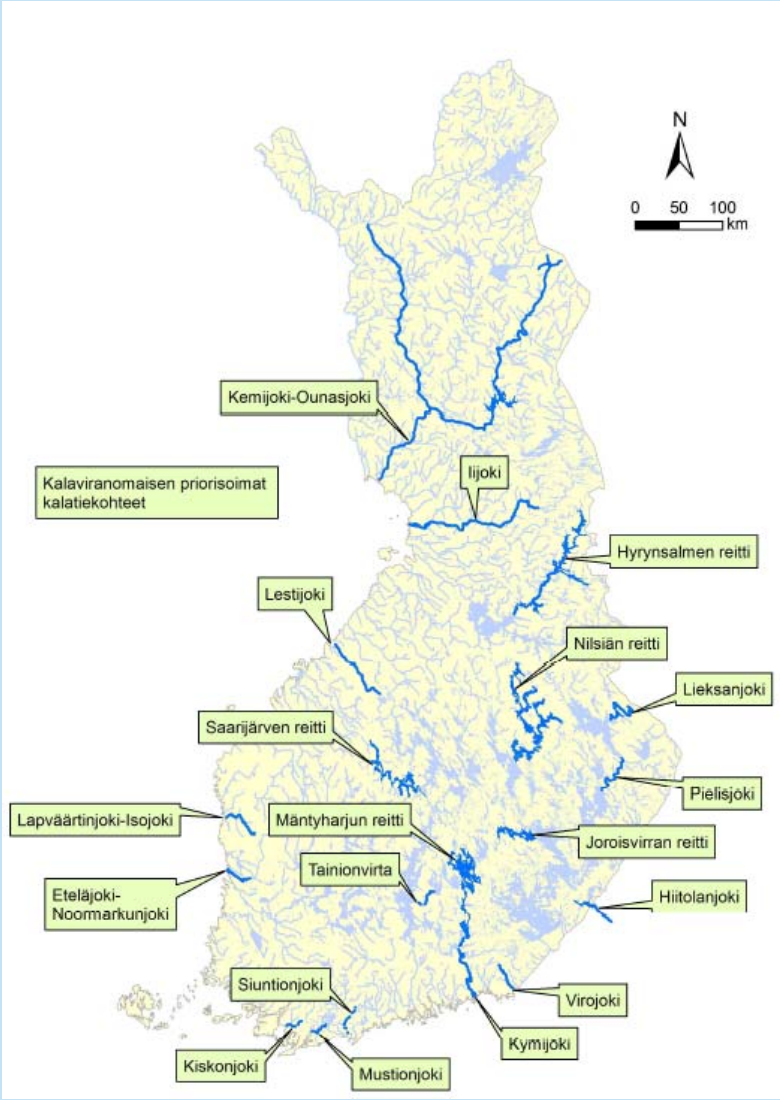
- Sågarsfors, Siuntionjoki River, Finland

New bypass channels

- Rupperswil, River Aare, Switzerland
- Nature-like fish pass combined with spawning and rearing habitats
- Fulfils best requirements of renewable energy in CH
- Used as reference for Rheinfelden bypass
  in the Rhine – 800 m long, 15 m3/,
  completed autumn 2011

Fish pass strategy for Finland 2011

- Proposed in *Water Management Plans*
- Change of policy to promote fish passes in stead of stockings
- Priorities of rivers with natural reproduction areas
- Opposition among residents of heavily constructed rivers, which were left outside
- All other stakeholders promote the strategy
- Nature-like bypasses are preferred



Case1: Planning of bypasses in heavily modified rivers

- Montta bypass plan, Oulujoki River

- Lenght 650 m, mean gradient 1,7%, maximum 5%

Järvenpää L., Jormola J. & Tammela S. 2010 Planning of bypass channels in a constructed river – Bringing Salmon back to River Oulujoki (English summary and figure texts) www.ymparisto.fi

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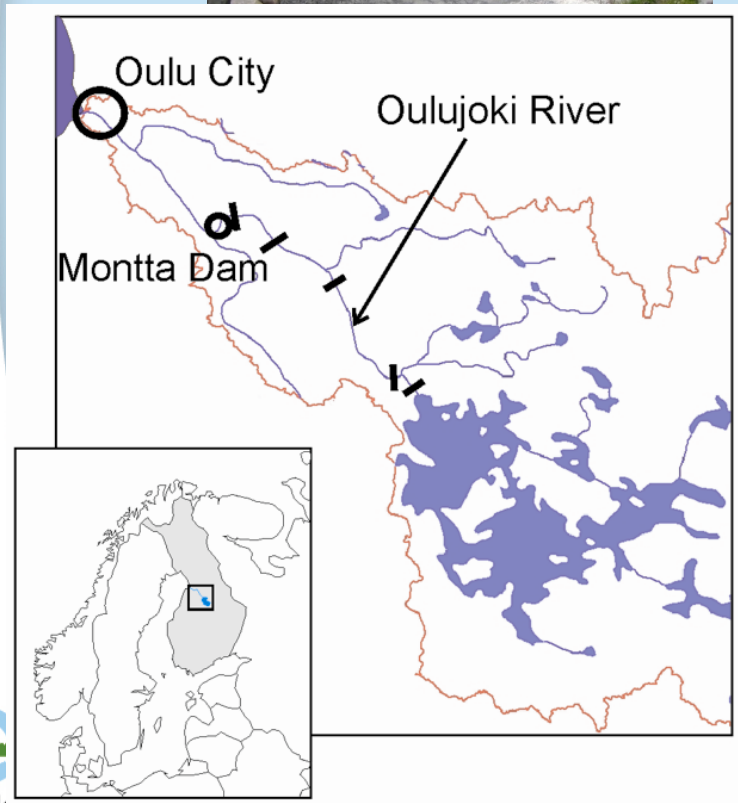
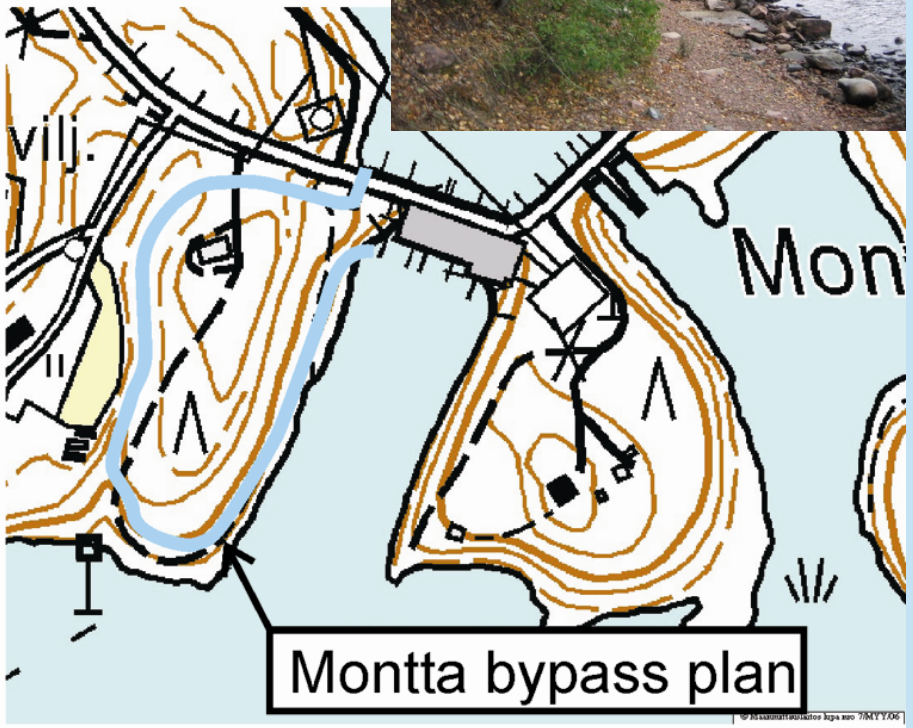
- Merikoski fish-pass in Oulu City and bypass plan for Montta power plant and remaining 5 dams

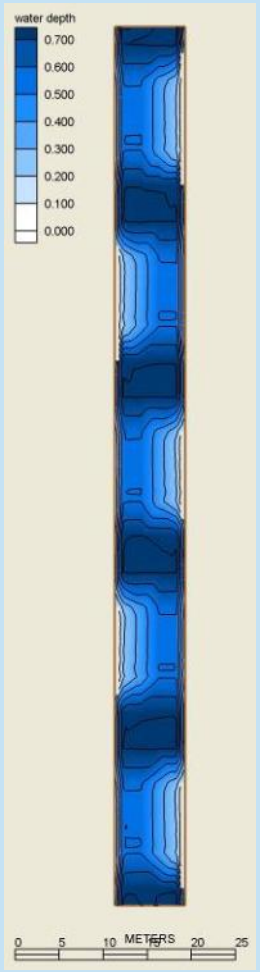




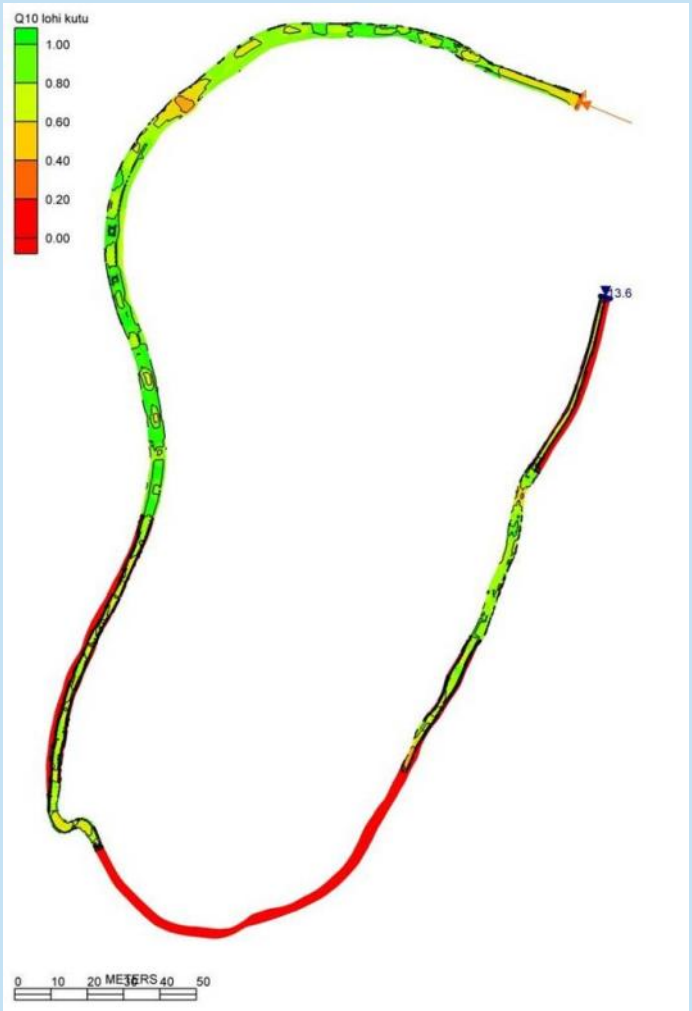
Flow and habitat modeling of planned bypass channels: to gain maximum habitat area and quality with limited discharges *Simo Tammela 2008*

- 2D flow model, spawning area, gradient 0,25%, 1 m3/s

Velocity 0,3-0,4m/s Depth 0,3-0,4 m



- Habitat modeling with bottom substrates, quality for Atlantic salmon *Salmo salar* spawning , discharge 1 m3/s



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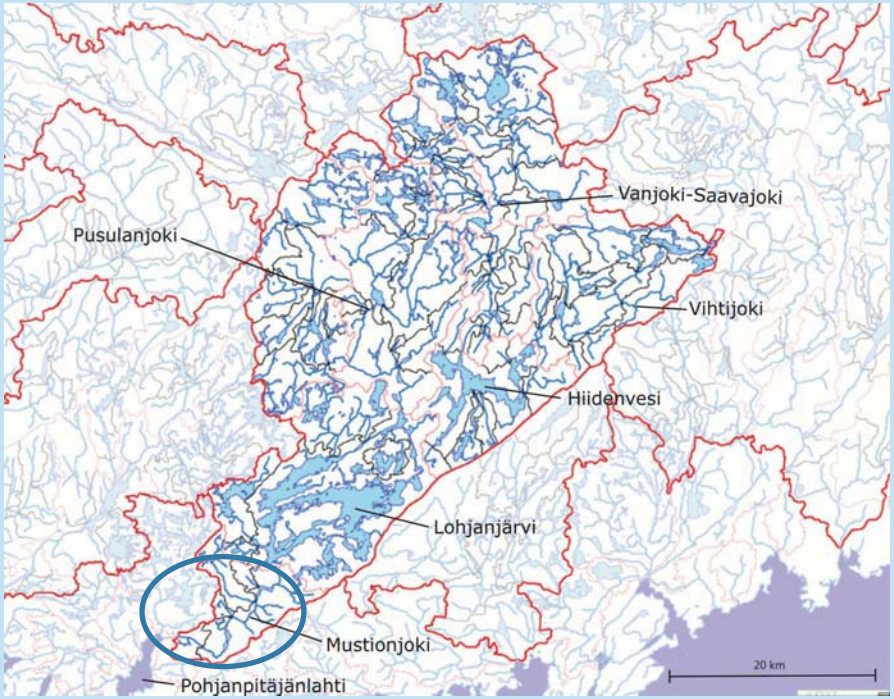
Case 2: Billnäs bypass plan, Mustionjoki River

- Salmon until 1950'ies
- Weak stock of freshwater pearl mussels
- 4 powerplants with almost total damming
- Only 3,5 ha of rapid area left
- Wide catchment could be opened with fish passes
- 0,9 ha new reproduction area in 4 bypass channels would be possible



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Billnäs power plant

- Bypass plan:
- 7 m/320 m
- Gradient 2,2 %,
- Reproduction habitats for salmon and pearl mussel
- Ideal location of entrance

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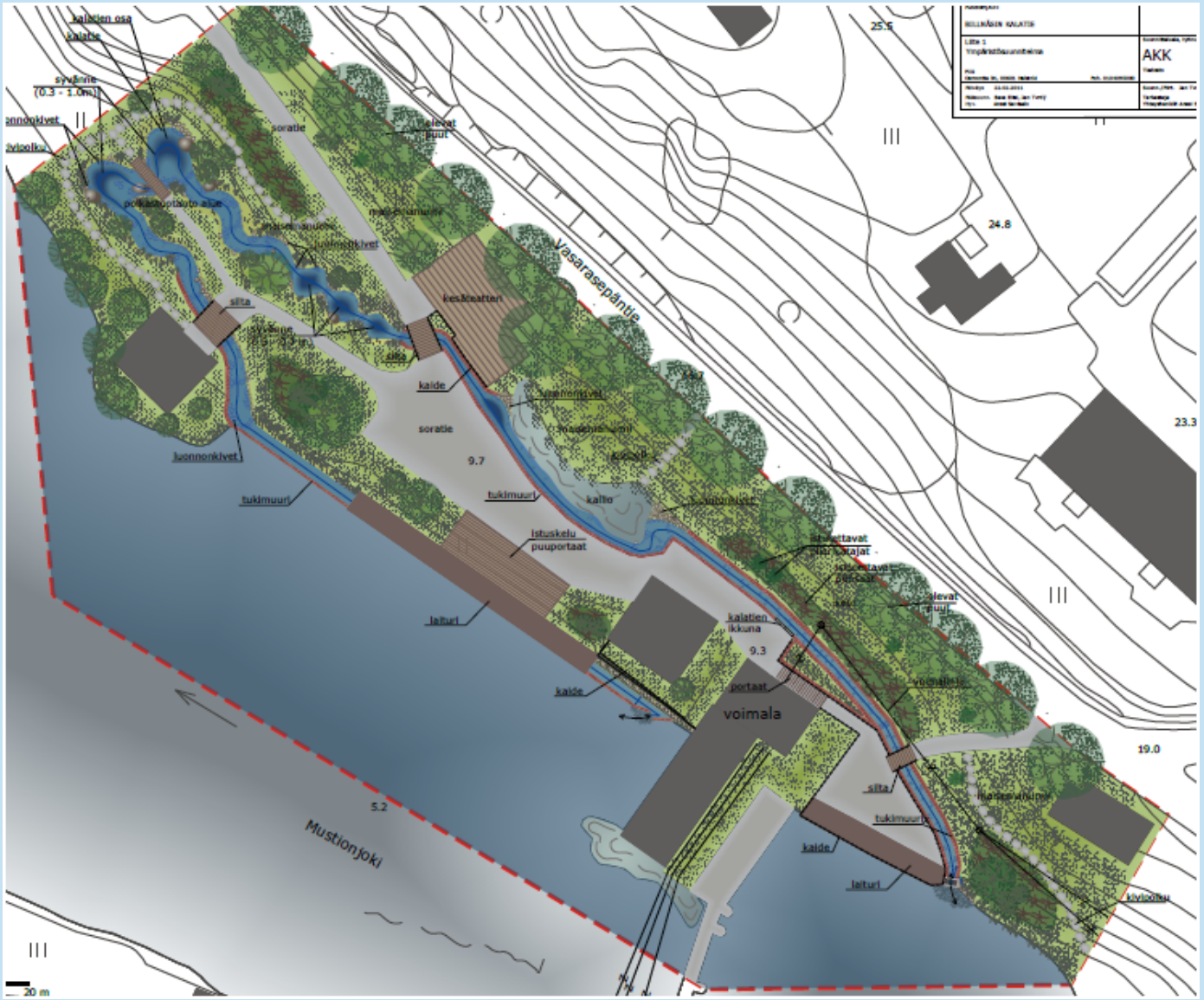
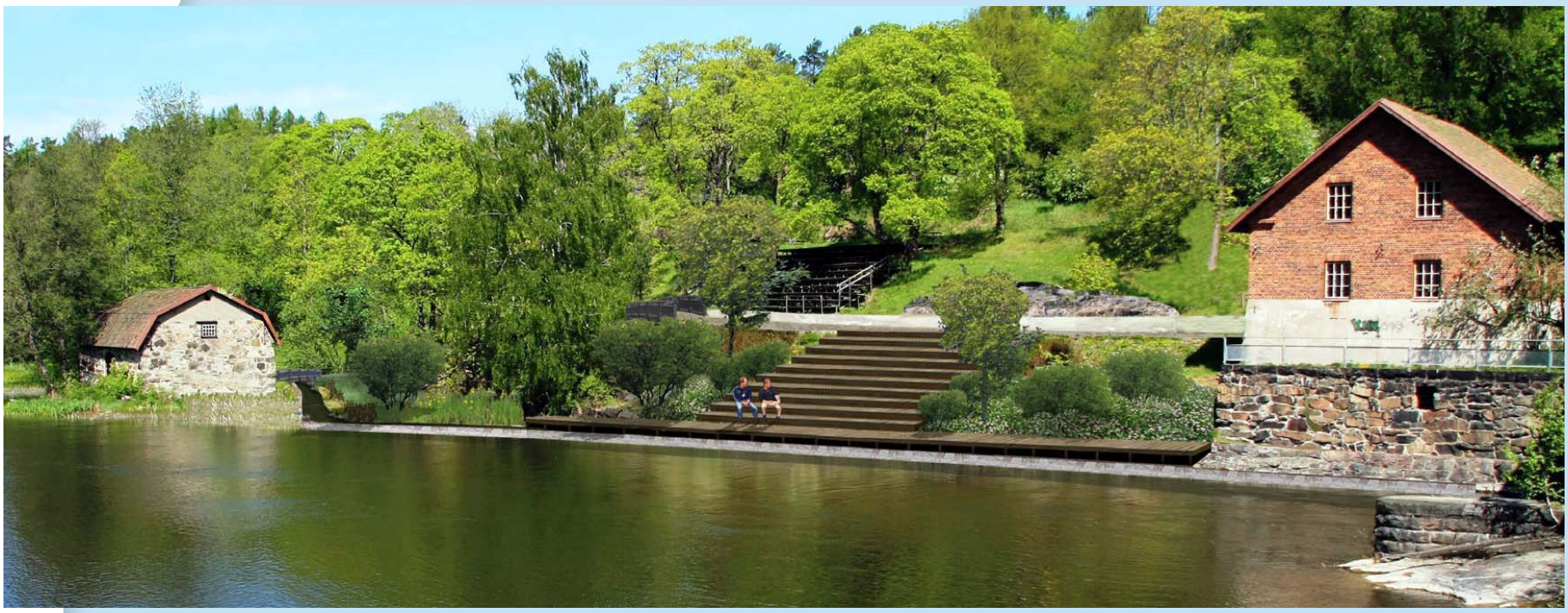
Accepted in the land use plan of the cultural environment with national value



Finnish Consulting Group FCG, June 2011



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Conclusions

- Bypass channels with reproduction habitats fulfil the demand of mitigation with several benefits
- Maximum habitat area and value with optimal discharge can be estimated by modeling
- Loss of energy can be minimized even if small discharge is needed year round for habitats
- Tools: Voluntary PR of power companies, Green energy requirements of labeling, permitting
- Conflicts between migratory fish and renewable energy can be solved (?)

Thank you!

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