“Advancements in assessment of contaminated sediment remobilization risks in unnavigable watercourses in Flanders, Belgium”

SEDNET– 07/11/2013

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VMM - Nik Dezillie
ALBON - Petra Deproost
Content presentation

I  Policy in Flanders
II  Tools
III Monitoring project
IV Modeling project
V  Conclusion
VI Recommendations
I Policy in Flanders

In Flanders fields
I Policy in Flanders

Interface of different policy frameworks

EU Water FD
- Decree on integral water policy
  - River Basin Management plans
  - River Sub Basin management plans

EU Waste FD
- Decree on soil remediation and soil protection
- Decree on materials

Coordination commission
Integrated Water policy
I Policy in Flanders

OVAM - Public waste agency of Flanders:
waste management / soil remediation

LNE - Environment, Nature and Energy Dept:
soil protection eg. erosion

VMM - Flemish environment agency:
preventing, limiting and eliminating the harmful effects to
water systems and the atmosphere

CIW - Coordination integrated water policy Flanders:
platform for environmental agencies and water course
managers
I Policy in Flanders

History ~ development of legislation

1981: start of waste (and soil) policy
   • Decree on Waste Management of 2nd Juli 1981

1995: start of contaminated soil policy
   • Decree on Soil Remediation 22nd August 1995

2006: after 10 years, re-evaluation of decree on soil remediation -
   Sediments explicitly included
   • Decree on Soil Remediation and Protection 27th of October 2006
     (into force since 1th of June 2008)
Decree on soil remediation and soil protection

- Flemish government indicates on regional scale which contaminated sediments need to be investigated
  - Use of guideline for investigation of contaminated sediments
    - Serious contamination of sediments?
      - yes
        - Flemish gov. indicates sediments to be remediated
          - Remediation
Specific guideline ‘Sediment Investigation Unnavigable watercourses’

Objective

- First: Serious soil contamination present?
- Secondly: Risk evaluation
  - Possible remobilization of contamination to ground- or surface water?
  - Exposition to human/plant/animal?

Structure of investigation

- Historical-site investigation
- Development of a sampling strategy
- Defining contamination
- Risk evaluation incl. remobilization
I Policy in Flanders

- Start at source
- only when **sustainable** remediation
- 2008 – 2012: pilot investigations OVAM-VMM
II Tools for risk evaluation

• Project ‘assessment of remobilization risk’
  • ? Best evaluation procedure to assess the stability of the contaminated sediment volumes?
  • 2011-2012
  • Team: Antea Group, Arcadis
  • Client: OVAM

• Project ‘Modelling sediment supply towards, and sedimentation processes in unnavigable watercourses in Flanders’
  • = 1D-Modelling deposition and resuspension in all unnavigable rivers in Flanders?
  • 2013-2016
  • Team: Antea Group, KULeuven
  • Client: VMM & ALBON
III Project ‘assessment of remobilization risk’

Scope

- Physical risk!
- Now: risk if $v > 0.3$ m/s, $v > 0.8$ m/s (consolidated)
- Improvement: shear stress as risk parameter

<table>
<thead>
<tr>
<th>Critical shear stress $\tau_c$</th>
<th>Current shear stress $\tau_b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Resistive force)</td>
<td>(Attacking force)</td>
</tr>
</tbody>
</table>

Sediment properties

- Grain size distribution
- Density
- Compaction
- Water content
- Organic material

Flow properties

- Current velocity
- Discharge
- Slope
- Water depth

Measurements
III Project ‘assessment of remobilization risk’

Measurement method

- In situ
- Large scale approach → quick analysis
- Possible methods: CSM, JET, MAF, EROMES, EROMOB, AMF, Graviprobe...
  → CSM selected
- ICBR, Rhine study: “CSM only to use for comparison”

Source: Westrich, 2004
III Project ‘assessment of remobilization risk’

Results

Verloop transmissiviteit (per jetdruk)

Erosieprofiel (B1-MU04)
III Project ‘assessment of remobilization risk’

Results

- Positive correlations CSM-values with density, water content, grain size
- Comparison with bed shear stress

<table>
<thead>
<tr>
<th>To, crit</th>
<th>Location 1</th>
<th>Location 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM</td>
<td>40 %</td>
<td>5 %</td>
</tr>
<tr>
<td>Shield</td>
<td>90 %</td>
<td>86 %</td>
</tr>
<tr>
<td>Lick et al., 2004</td>
<td>95 %</td>
<td>73 %</td>
</tr>
<tr>
<td>Chepil, 1959</td>
<td>10 %</td>
<td>10 %</td>
</tr>
</tbody>
</table>

Advancements

- Shear Stress better estimate then velocity
- CSM: Easy to use on larger scale
- Timespan? ICBR: $T_{b,10y} > T_c$
IV Project ‘Erosion & sedimentation modelling’

Scope

• Modelling sediment supply towards, and sedimentation processes in unnavigable watercourses in Flanders
• Hydraulic modelling: Infoworks RS or ICM
• Maarkebeek as test area → Infoworks RS is only option

Source: VMM
Selected sedimentation zones

- Measurements of sediment discharges & sedimentation volumes

Source: VMM
IV Project ‘Erosion & sedimentation modelling’

tests on event 4/7/2005

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>rho (kg/m³)</th>
<th>Transport equation</th>
<th>Proportion</th>
<th>Cohesive threshold (N/m²)</th>
<th>Cohesive Vs (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.050</td>
<td>2650.0</td>
<td>Vestrich &amp; Jurashak</td>
<td>0.900</td>
<td>X</td>
<td>1.960</td>
</tr>
<tr>
<td>0.200</td>
<td>2650.0</td>
<td>Engelund &amp; Hansen</td>
<td>0.100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Measurements at downstream section

- Measurement
- Simulation

Simulation Plot Produced by d12335 (26/09/2013 13:49:34) Page 1 of 2
Selection List: Custom Selection

River Section maa037 Test_MAA_Sed_VG1_2_NoGrading+Tau+VSyy
Total Bed Change (m)
IV Project ‘Erosion & sedimentation modelling’

Measurements upstream

Concentration (mg/l)

= measurement

= simulation

<table>
<thead>
<tr>
<th>Min</th>
<th>Max</th>
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<tbody>
<tr>
<td>54.121</td>
<td>23144.049</td>
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</table>
Complementarity of both projects

- **Project 1:** Monitoring campaigns for assessment resuspension risk
  - Goal: Assess risk
  - **But also:** estimation of critical model parameter values

- **Project 2:** Erosion & sediment transport models
  - Goal: Assess erosion/sedimentation
  - **But also:** assess physical risk for resuspension, possibility for capping, ...

= MORE WITH LESS
VI Recommendations/questions

**Monitoring**

- Standard method for CSM?
- Alternatives for CSM?
- Spatial/depth variation?
- Erosion rate?
- Suspension samples!

**Modelling**

- Stability issues!
- 1D + 2D (retention basins, flood areas)?
- Scenarios: include capping?