Decision support tool for sustainable management of contaminated sediments

Göran Holm, R&D Director
Swedish Geotechnical Institute

Bo Svedberg, Tech Lic
Luleå University of Technology
The solution?

(Lundestad 2005)
Handling alternatives

Principal fates of contaminated sediments

Scenario 1 – Beneficial use
Using for ex stabilization of sediments and beneficial use as material in structures. No landfilling.

Scenario 2 – Landfill
Sediments are landfilled. New materials needed for structures. No landfilling.

Scenario 3 – Sea disposal
Sediments are disposed of at sea. New materials needed for structures. No landfilling.

Scenario 4 – Fill
Confined fill behind an Embankment. New material needed for structures. No landfilling.

Scenario 5 – In-situ
Capping or other protective actions. New materials needed for structures. No landfilling.

6- No action
Pollution of Seas. New materials needed for structures.

Resources: Materials and energy

Given: Continuous construction activities in the society.
Reduced use of natural resources needed
Beneficial use of contaminated sediments applying the stabilisation/solidification method
Green Remediation
Nov 9-10, 2009
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Film from Oxelösund, Sweden
Stabilisation/solidification of dredged contaminated sediments to be used as subbase for port facilities

Stabilization & Solidification for beneficial use in port of Oxelösund
Pilot- Basin for test
Pilot- Dredging
Pilot - Stabilization & Solidification
Sustainability in a sea of decisions

Based on Arts J, (2009)
What to and how to measure?

Legislation and policies
What is supposed to be measured according to current legislation and policies

Assessment tools
What and how can we measure the key issues

Stakeholders opinion
What are the key issues to be taken into account

MCD-tools
How can a multi criteria decision be made using existing tools?

Proposed indicators for decision making
## Proposed indicators

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Commentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy aspects</td>
<td>Investment cost including project risk</td>
<td>Risk for contamination of nearby land</td>
<td>Toxic impact on water and land areas</td>
</tr>
<tr>
<td>National economy</td>
<td></td>
<td></td>
<td>The cost related to the developer/project owner</td>
</tr>
<tr>
<td>Socio-cultural aspects</td>
<td>Local protection areas</td>
<td>Risk for toxic effect on organisms</td>
<td>Toxic impact on vegetation and organisms</td>
</tr>
<tr>
<td>Regional and national protection areas</td>
<td></td>
<td>Risk for health effects</td>
<td>Toxic impact on humans</td>
</tr>
<tr>
<td>Environmental aspects</td>
<td>Environmental impact on a site specific scale</td>
<td>Use of finite resources</td>
<td>Use of materials and fossil fuels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use of land and water areas</td>
<td>Enabling or limiting use of areas on land or in water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emissions to air and water</td>
<td>Emissions from transport and material manufacturing (for ex green house gases, and acid substances)</td>
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</tr>
</tbody>
</table>

**Proposal for indicators**

- **Level 1**: Economy aspects
  - Investment cost including project risk
  - National economy

- **Level 2**: Socio-cultural aspects
  - Local protection areas
  - Regional and national protection areas

- **Level 3**: Environmental aspects
  - Environmental impact on a site specific scale
  - Environmental impact on a global scale

**Commentary**

- **Economy aspects**
  - The cost related to the developer/project owner
- **National economy**
  - Economy in a broader context
- **Socio-cultural aspects**
  - Impact on nearby environment, including acceptance/worry concerning recreation, noise, accidents etc.
- **Regional and national protection areas**
  - Impact on national interests such as culture, power supply, fishing etc, for ex Natura 2000
- **Environmental aspects**
  - Toxic impact on water and land areas
  - Toxic impact on vegetation and organisms
  - Toxic impact on humans
  - Use of materials and fossil fuels
  - Enabling or limiting use of areas on land or in water
  - Emissions from transport and material manufacturing (for ex green house gases, and acid substances)
Proposed tools for assessment

- Ecology – EIA with RA & ESA/LCA
- Economy – Investment cost (statutory) and CBA on national economy
- Socio-culture – n.a.
Use of resources

Förbrukning av abiotiska resurser (Metod B)

Scenario 1 (Stabilisering)
Scenario 2 (Deponering)
Scenario 3 (Tippning)
Scenario 4 (Invallning)

MJ exerginnehåll per funktionell enhet

- Råolja
- Olja och diesel (bränslen)
- Naturgas
- Kol
- Lignit
- Uran
- Kalksten
- Bergmaterial
- Natursand
- Magnetit
Global warming & energy use

- Scenario 1 (Stabilization)
- Scenario 2 (Landfill)
- Scenario 3 (Sea disposal)
- Scenario 4 (Fill)

Graph showing global warming potential and energy consumption for different scenarios.
MCD - Tools

Multi Criteria Decision Tool  Web-HIPRE (www.hipre.hut.fi)

Märkta skapning:

Bestämliga (tillgängliga)

Igong Driftens kapacitet

Ovänta intressenter (nyckelpersoner, omgivande miljöorganisationer, transportbolag)

Procedera:

1. Identifiera indikatorer (kriterier) för ett 
2. Fördröja vilja avsluta alternativ
3. Samla information om indikatorerna 
4. Avsektion av alternativen 
5. Riktiga & välja slutlig alternativ

Viktiga:

För beräkning av indikatorer i de tre dimensionerna: ekologi, ekonomi och samhälle-kultur (Kap 4)

För beslutsanalys (t.ex. multiobjektivanalys): t.ex. beslutssupportsystem (Kap 5)

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Case studies with major ports - ongoing
Conclusions – Project level

1. A sustainable approach should be applied to select BAT considering technology-economy-environment-social aspects
2. Stabilisation and solidification in the Oxelösund case
   Beneficial use of contaminated sediments
   Less energy consumption and global warming
3. The BAT-approach was necessary for Oxelösund
4. One project it’s not significant to the Baltic Sea issue, further decisions levels should be addressed
Today addressing pollutants, tomorrow including climate and resources

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**Focus for tool**

<table>
<thead>
<tr>
<th>Included aspects</th>
<th>Policy, Plan, Program</th>
<th>Region</th>
<th>Company</th>
<th>Project/Object</th>
<th>Product</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural resources</td>
<td>IAM-RAINS</td>
<td>EF</td>
<td>Em</td>
<td>MIPS</td>
<td>MIPS</td>
<td>SFA, RA</td>
</tr>
<tr>
<td>Environmental impact</td>
<td>SEI, EIA</td>
<td>TMR</td>
<td>Ex</td>
<td>EIA, RA</td>
<td>RA</td>
<td></td>
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<tr>
<td>Natural resources and environmental impact</td>
<td>PA, CBA</td>
<td></td>
<td></td>
<td>EIA, ESA/LCA</td>
<td>LCA</td>
<td></td>
</tr>
<tr>
<td>National economy, natural resources and environmental impact</td>
<td></td>
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**SMOCS**

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**STABCON**

Green Remediation
Nov 9-10, 2009
SMOCS - Bridging the gaps

Based on Arts J, (2009)
Sustainable Management of Contaminated Sediments in the Baltic Sea

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Further info and contacts

Göran Holm, SGI
Co-ordinator

goran.holm@swedgeo.se
+46 13 20 18 61

Bo Svedberg, LTU
Communications

bo.svedberg@ltu.se
+46 730 300 410

SMOCS – www.smocs.eu (introduced late 2009)
STABCON - www.stabcon.se, www.stabilgrunn.no
Thank You!!