

The remediation of the former mining site La Combe du Saut



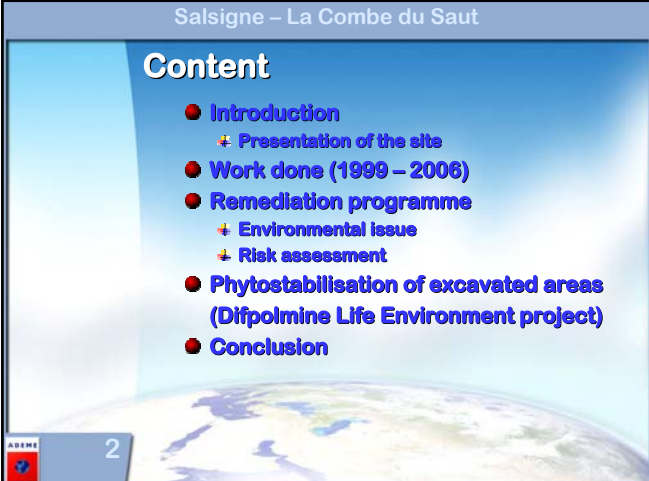
Patrick JACQUEMIN, 11th May 2006, NICOLE
Data-acquisition for a good conceptual site model



Salsigne – La Combe du Saut



Content

- Introduction
 - + Presentation of the site
- Work done (1999 – 2006)
- Remediation programme
 - + Environmental issue
 - + Risk assessment
- Phytostabilisation of excavated areas (Difpolmine Life Environment project)
- Conclusion



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La montagne Noire

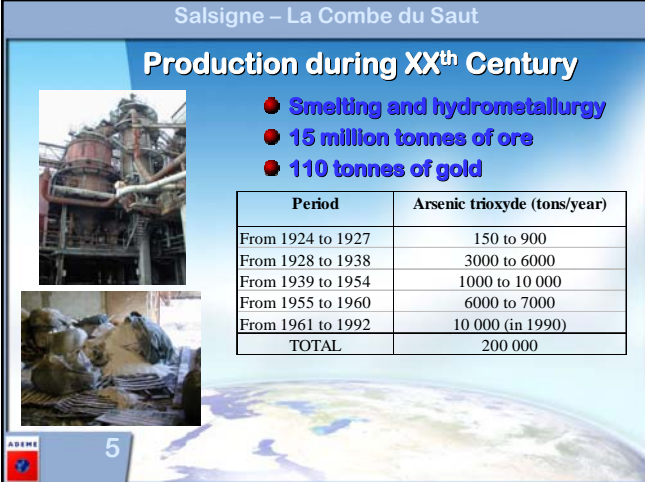


Carcassonne



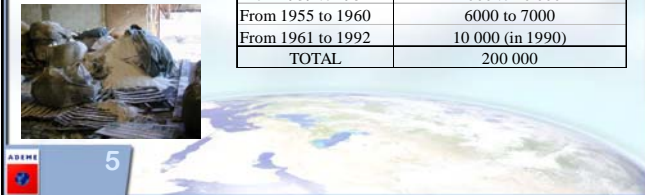
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Production during XXth Century



- Smelting and hydrometallurgy
- 15 million tonnes of ore
- 110 tonnes of gold

Period	Arsenic trioxyde (tons/year)
From 1924 to 1927	150 to 900
From 1928 to 1938	3000 to 6000
From 1939 to 1954	1000 to 10 000
From 1955 to 1960	6000 to 7000
From 1961 to 1992	10 000 (in 1990)
TOTAL	200 000



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Site owners in 1999

- SEPS : former waste treatment company (1992 – 1996)
- SNC LASTOURS : tailings retreatment (1992 – 1995)
- MOS : Mine operator (1992 - 2005)




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Mission of ADEME

1998 : 30 million of euros

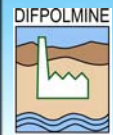
- June 1999 : **Monitoring**
Waste management
Demolition
Studies
- March 2004 : **Remediation project**
Monitoring plan



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Difpolmine demonstration project



Diffuse Pollution from Mining Activities


- Life Environment 2002
- Water management and phytostabilisation
- www.difpolmine.org
- ✦ IRH Environment
- ✦ Hasselt University
- ✦ Budapest University
- ✦ Water Agency RMC

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1999



Former valley

Water treatment

South Orbiel river North



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1999 – 2000 cleaning of the buildings




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2001 – demolition



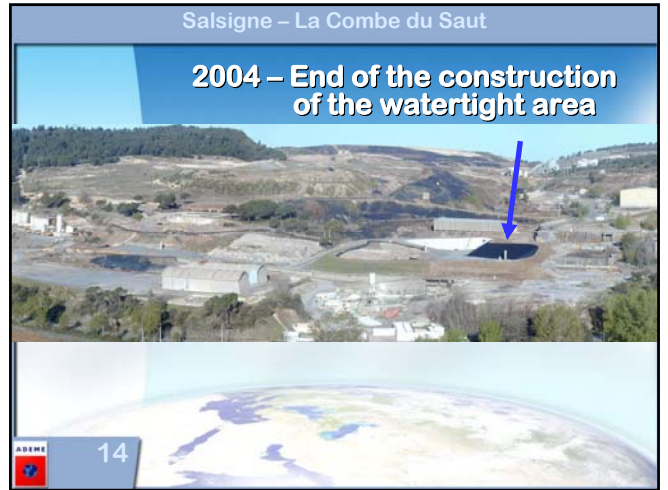

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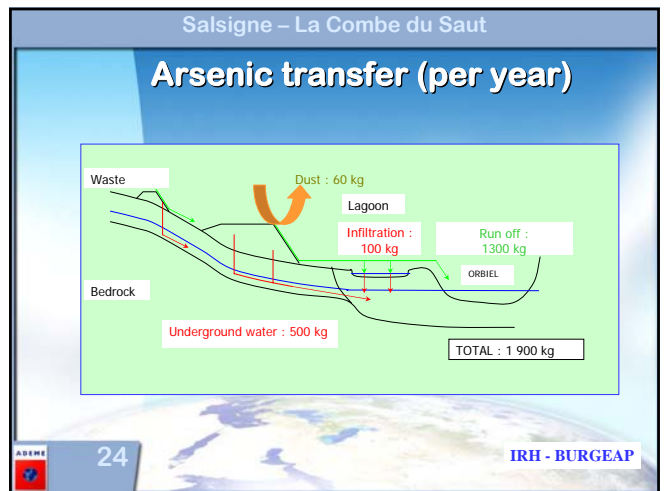
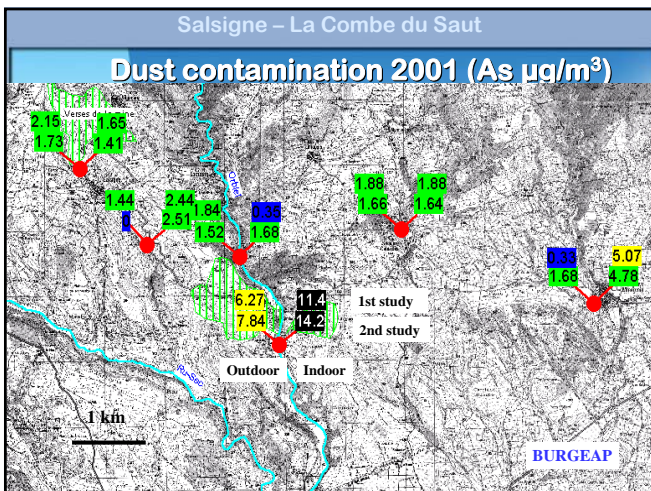
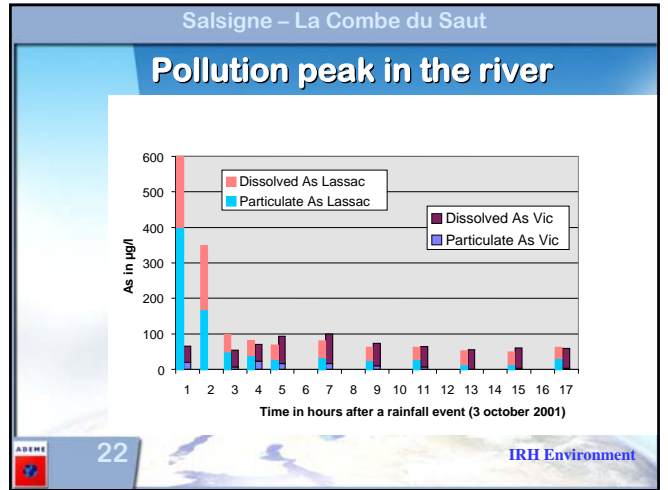
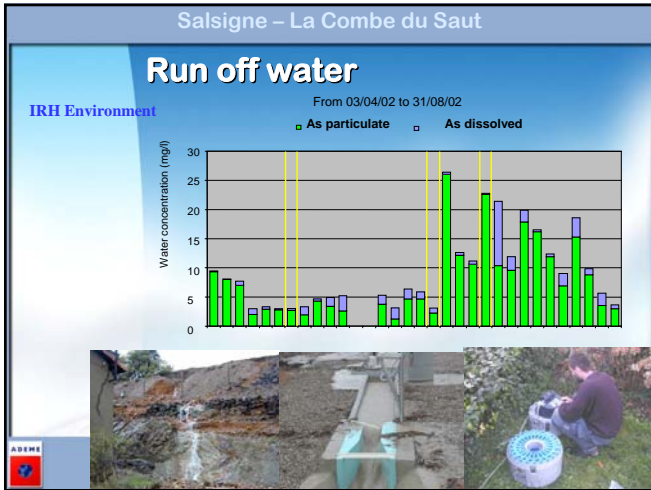
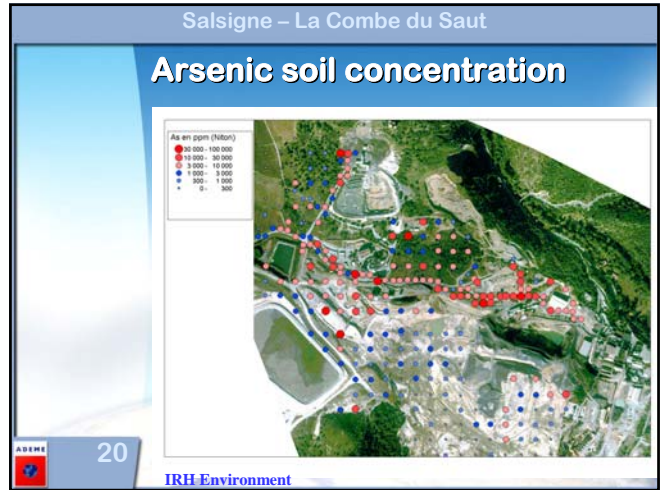
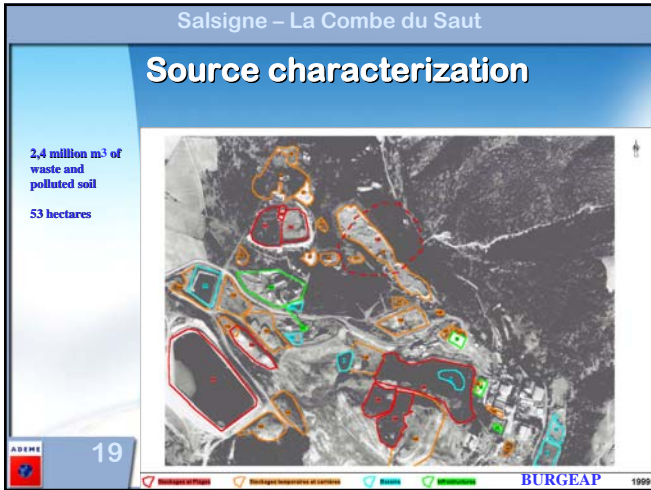
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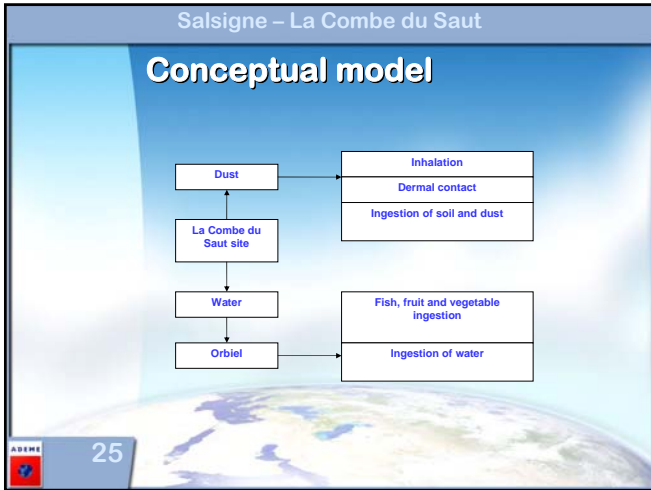
2002 – watertight area construction




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Risk assessment

Carcinogenic effects

Risk	Oral route			Breathing route		
	Resident	Farmer	Fisherman	Resident	Farmer	Fisherman
Adult	1,7.10 ⁻³	2,4.10 ⁻³	2,1.10 ⁻³	2,5.10 ⁻³	3,6.10 ⁻³	3,3.10 ⁻³
Children	3,3.10 ⁻³	3,4.10 ⁻³	3,6.10 ⁻³	1,9.10 ⁻³	1,9.10 ⁻³	1,9.10 ⁻³

Noncarcinogenic effects

Hazard index	Breathing route : toxic total			Breathing route : nervous system		
	Resident	Farmer	Fisherman	Resident	Farmer	Fisherman
Adult	1,74	2,25	2,14	5,28	6,74	6,42
Children	2,17	2,17	2,17	6,55	6,55	6,55

BURGEAP/V. Nedellec

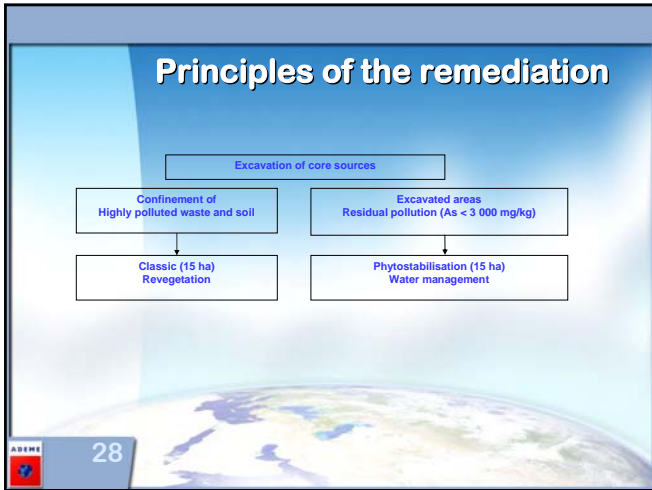
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Total cost : work done between 1999 and 2004 (million of euros)

Operation	Cost
Monitoring and water treatment :	3.5
Waste management :	3.0
Demolition :	3.5
Watertight area :	1.0
Studies and prime constructor :	1.5
Total Cost :	12.5

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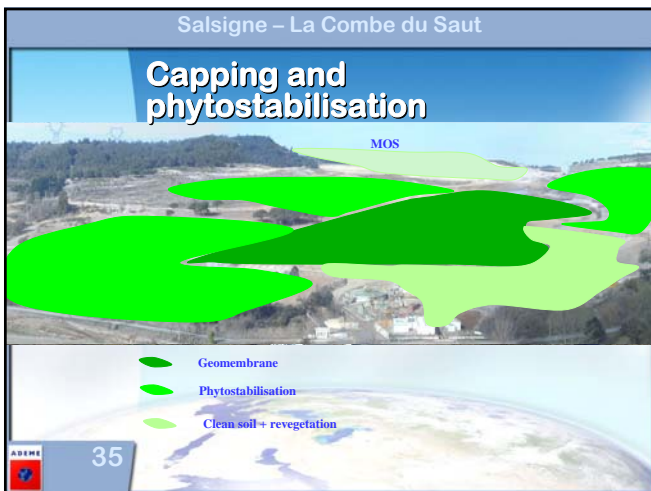
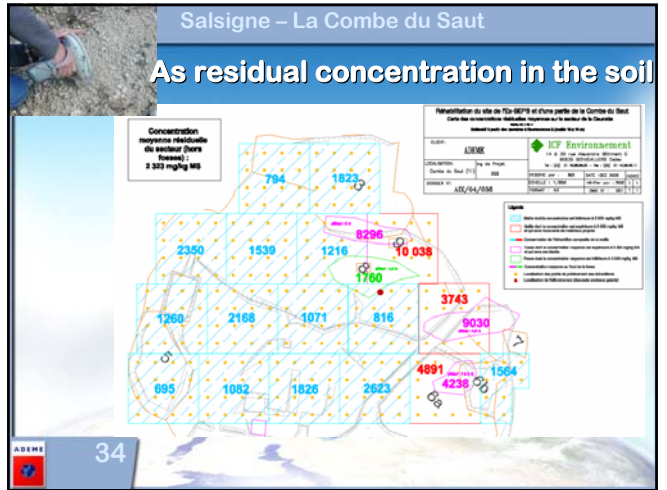
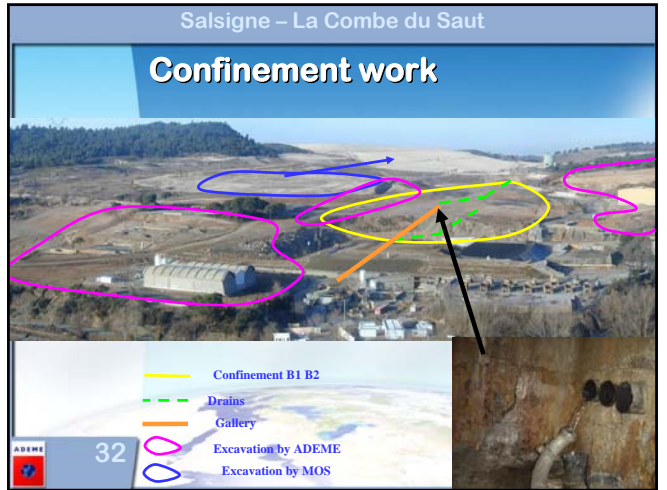
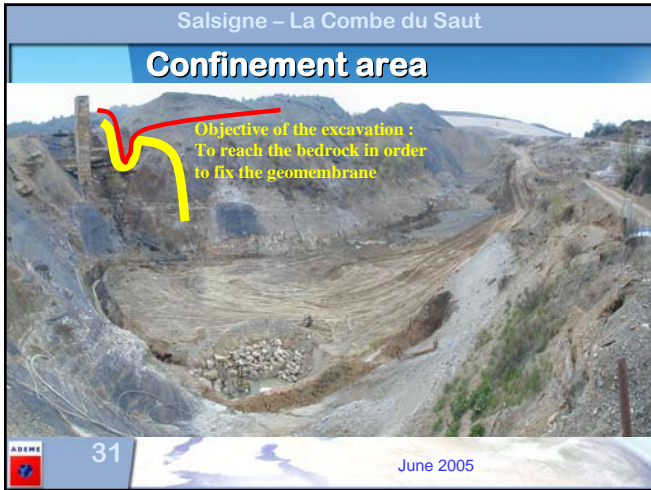
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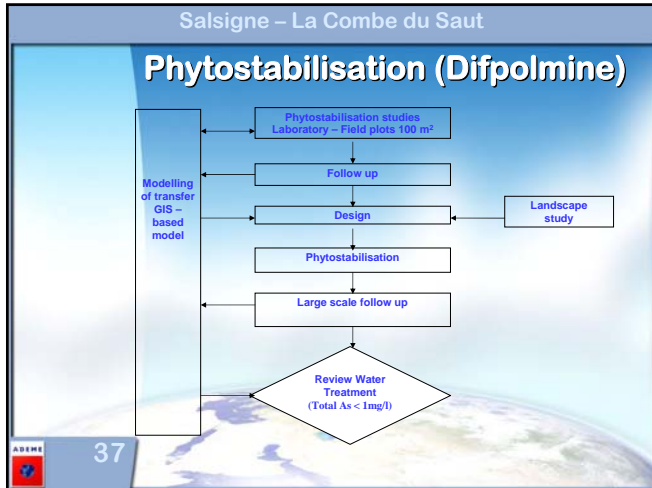
Cost of the remediation project (million of euros)

Operation	Cost
Excavation and transportation of waste and soil into the confinement area	2,5
Stabilisation of waste	1
Protection with a geomembrane (110 000 m ²)	4
Water management systems	1,5
Phytostabilisation	0,5
Prime constructor	1
Monitoring and water treatment	1
Other	1
TOTAL	12,5

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Seeds mixture

<p>Group 1:</p> <p>Grasses 46%</p> <p>Agrostis capillaris (6%)</p> <p>Arrhenatherum elatius (12%)</p> <p>Dactylis glomerata (18%)</p> <p>Festuca ovina (5%)</p> <p>Holcus lanatus (5%)</p>	<p>Group 2:</p> <p>Fabaceae 32%</p> <p>Coronilla glauca (3%)</p> <p>Lotus corniculatus (5%)</p> <p>Melilotus alba (7%)</p> <p>Medicago lupulina (5%)</p> <p>Onobrychis sativa (12%)</p> <p>Spartium juncueum: (locally)</p>	<p>Group 3:</p> <p>Other species 22%</p> <p>Daucus carota (2%)</p> <p>Echium vulgare (2%)</p> <p>Euphorbia characias (locally)</p> <p>Plantago lanceolata (6%)</p> <p>Plantago coronopus (3%)</p> <p>Sanguisorba minor (9%)</p>
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Grasses

<p>Arrhenatherum elatius (Avoine élevée/Fromental)</p>	<p>Dactylis glomerata (Dactyle vulgaire)</p>	<p>Agrostis capillaris (Agrostis commun)</p>
<p>Holcus lanatus</p>	<p>Festuca ovina (Fétuque ovine)</p>	

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Fabaceae

<p>Lotus corniculatus (Lotier comiculé)</p>	<p>Coronilla glauca (Coronille glauque)</p>	<p>Onobrychis sativa (Sainfoin)</p>
<p>Melilotus alba (Mélilot blanc)</p>	<p>Medicago lupulina (Minette)</p>	<p>Spartium juncueum (spartier à tiges de jonc)</p>

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Other species

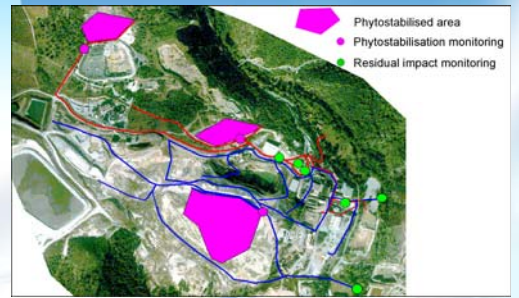
<p>Daucus carota (Carotte sauvage)</p>	<p>Sanguisorba minor (Petit pimprenelle)</p>	<p>Euphorbia characias (Euphorbe)</p>
<p>Echium vulgare (Vipérine)</p>	<p>Plantago lanceolata (plantain lanéolé)</p>	<p>Plantago coronopus (Plantain corne de cerf)</p>

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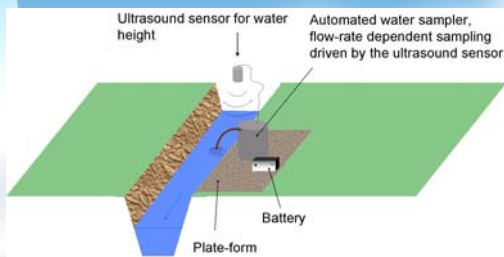
Sowing (March 2006)



Follow up



Monitoring points



Conclusion

- Large metal polluted site remediation is very costly
- Residual contamination can remain after remediation
- Phytostabilisation is able to limit the transfer of residual contamination
- Residual risks must be quantified
- Future corrective actions and modifications of the soil use restriction will have to be discussed all along the post management.

