



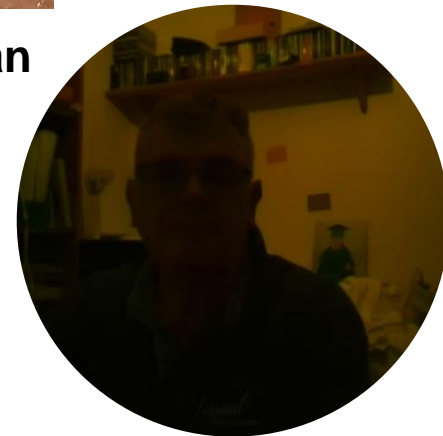
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Metals processing
site in Kosovo

Sustainability and nature based solutions with an illustrative case study

- Paul Bardos, r3 environmental technology ltd, UK
- Presented at 'Global Nature Based Solutions to Mine Tailing Waste Water: Nov. 2nd 2023, Narxoz University, Kazakhstan.





Acknowledgements

- This presentation is based on
 - A new book supported by the Foreign Environmental Cooperation Center of the Ministry of Environment and Ecology of the Peoples Republic of China.
 - Bardos P. *Sustainable and risk based land management for contaminated sites in practice. In press.*
 - Info: paul@r3environmental.co.uk
 - A LIFE+ Demonstration project called LIFEPOPWAT <https://cxi.tul.cz/lifepopwat/home> which is using combined *in situ* and engineered wetland treatments to deal with lindane polluted water





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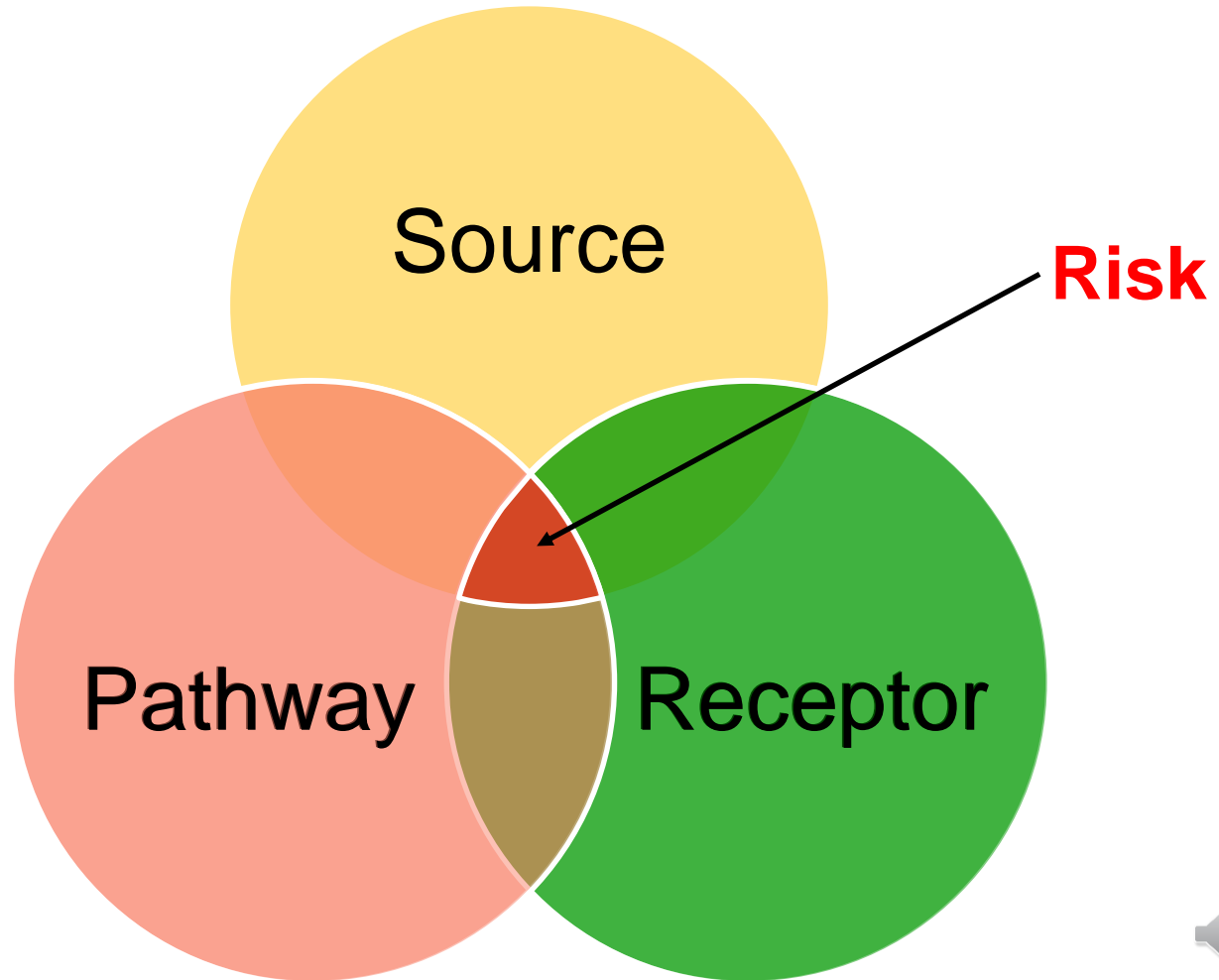
Contents

1. Risk management
2. Sustainable and risk based land management
3. Low input remediation
4. Hajek case study sustainability assessment (Czech Republic)





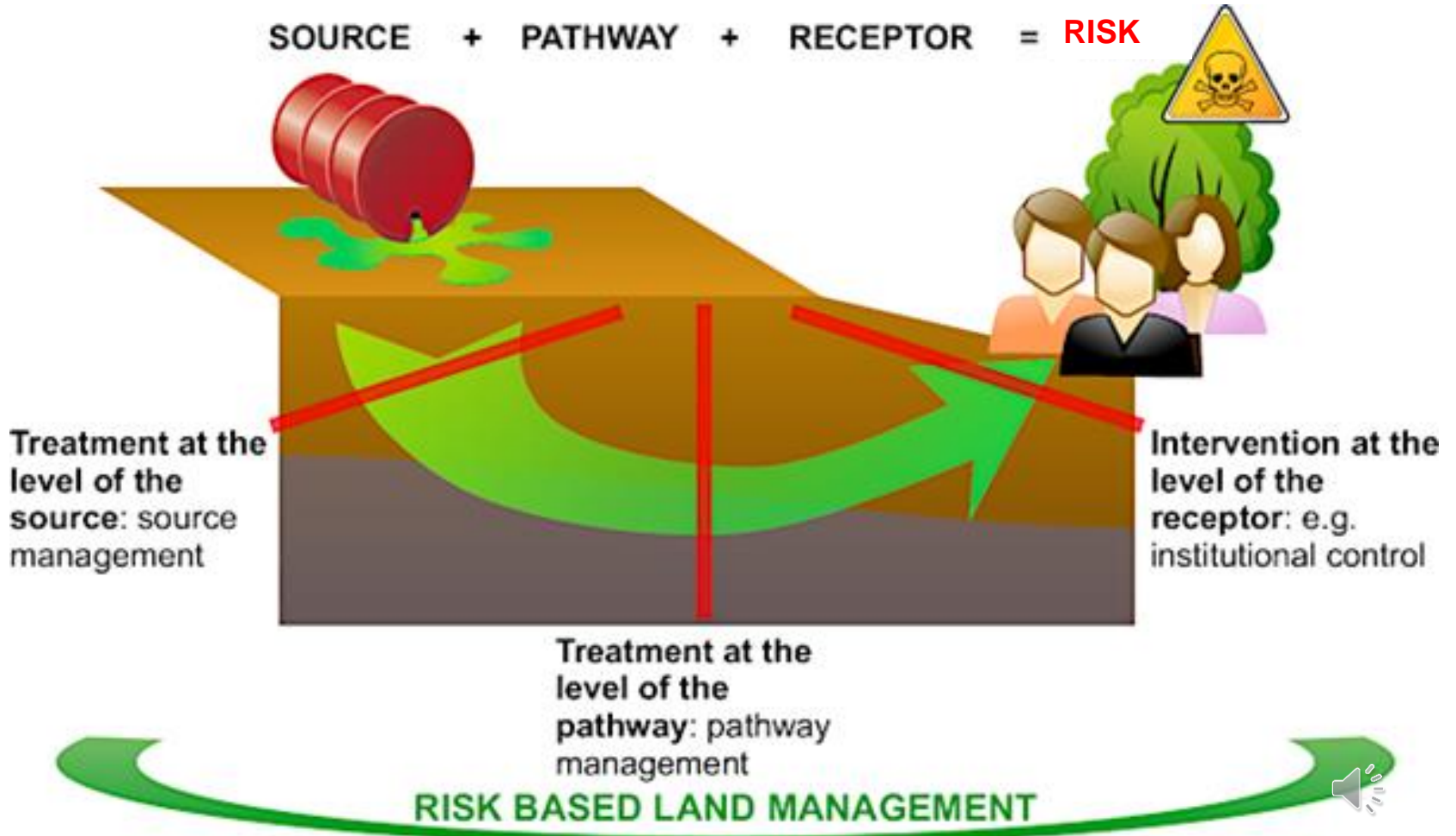
What creates a risk?





Risk-based land management

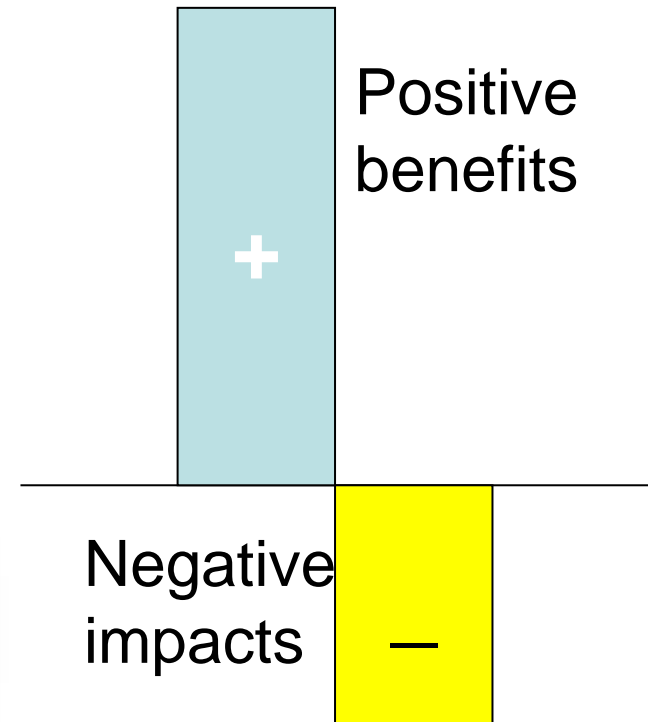
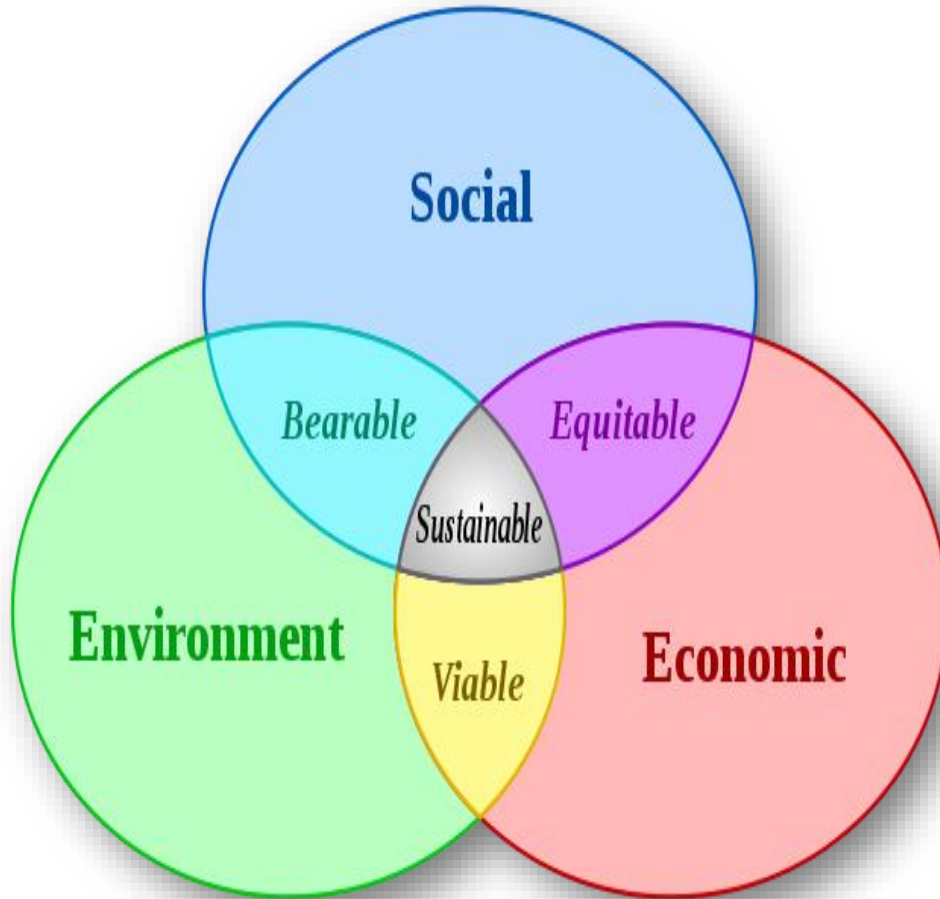
SOURCE + PATHWAY + RECEPTOR = RISK





What is sustainable remediation?

- Context = sustainable development

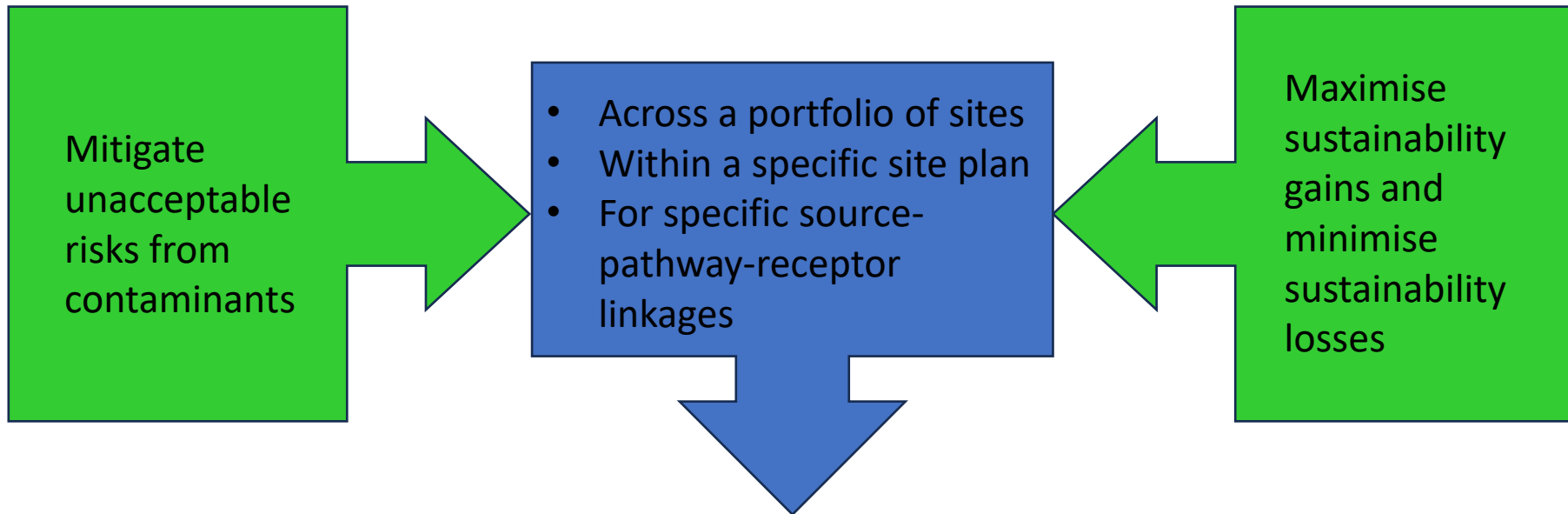


....a net benefit 



Sustainable and risk-based land management

Nutshell 3 of 4

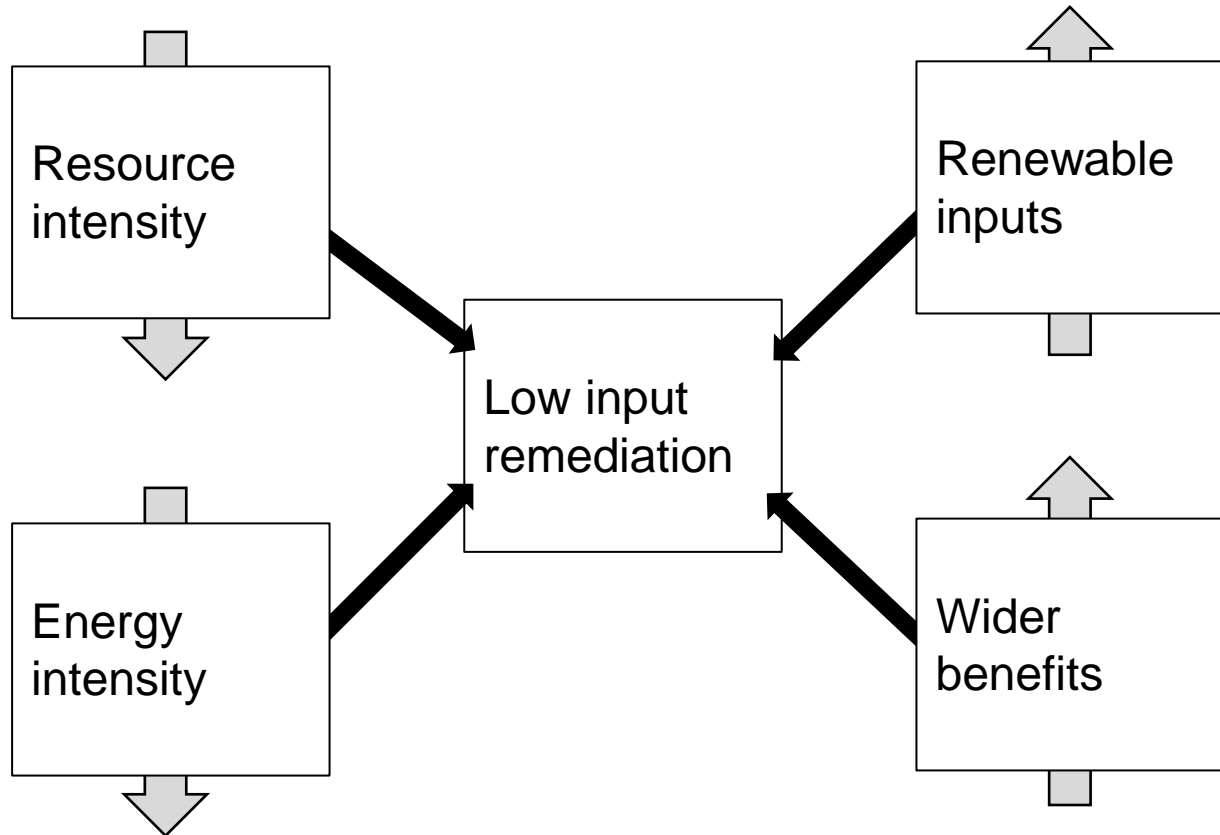


Finding an optimum remediation solution using a balanced decision-making process that mitigates unacceptable risks and maximises overall net benefit.





What is low input remediation





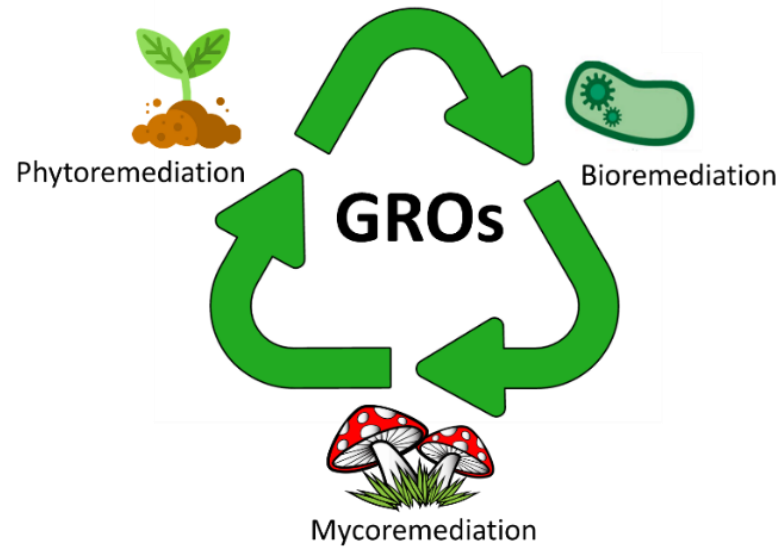
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Related concepts



Nature based solutions

From IUCN 2020,
<https://doi.org/10.2305/IUCN.CH.2020.08.en>



Gentle remediation options

From Purkis *et al.* 2022,
<https://doi.org/10.1016/j.jenvman.2022.114620>





The Hajek site

- The site at Hajek is a former uranium mining area, where lindane production wastes were dumped until 1968.
- From the 1960s to 1971) uranium mining was carried out on the site, along with kaolin, basalt and later bentonite.
- Between 1966 and 1968, the state authorities decided to dispose of lindane production wastes from the pesticide producer Spolana Neratovice (CZ) into the Hajek quarry slag heap. The estimated quantity of chemicals deposited is 3,000-5,000 tonnes in metal drums.
- In 1977, a landslide occurred on the spoil heap (over ~10-12 ha) and a part of stored chemical waste was exposed. The landslide was stabilised using crushed aggregate with a drainage system consisting of pipe drains was incorporated.
- Levels of hexachlorocyclohexane (HCH) isomers and chlorinated benzenes (CB) have been monitored at the outlet since 1989.





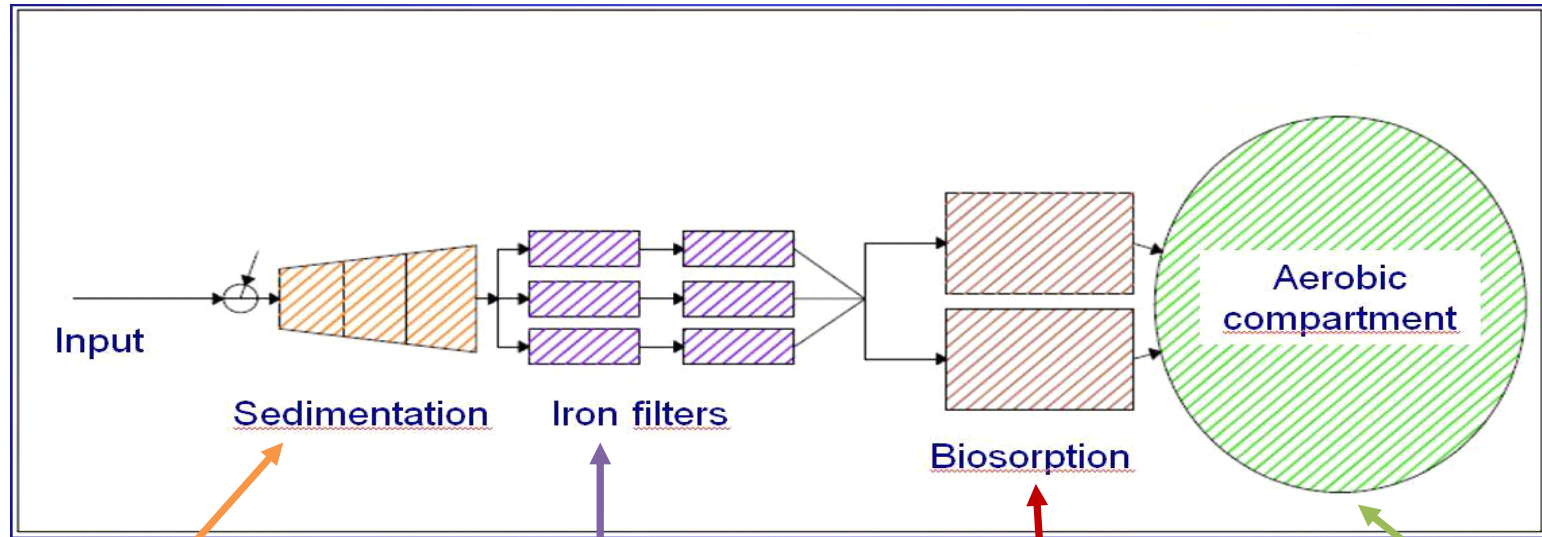
Low input remediation context

- Between 1999 and 2002, the site owner commissioned Phase I remediation work, consisting of a cover layer (0.3 m bentonite with a 0.45 m thick covering of heap material).
- The drainage from the site remains polluted with lindane, chlorobenzenes and iron.
- In 2015 a remediation option appraisal was carried out and concluded in favour of *in situ* treatment and engineered wetland





“Wetland⁺ system”



Sedimentation of suspended particles to prevent clogging of next treatment compartments

Chemical reduction of HCH and halogenated compounds, formation of reducing conditions

Self-cleaning biofilters, using natural sorbent and biodegradable substrate to maintain reducing conditions

Polishing treatment step – aerobic wetland compartment





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Installation





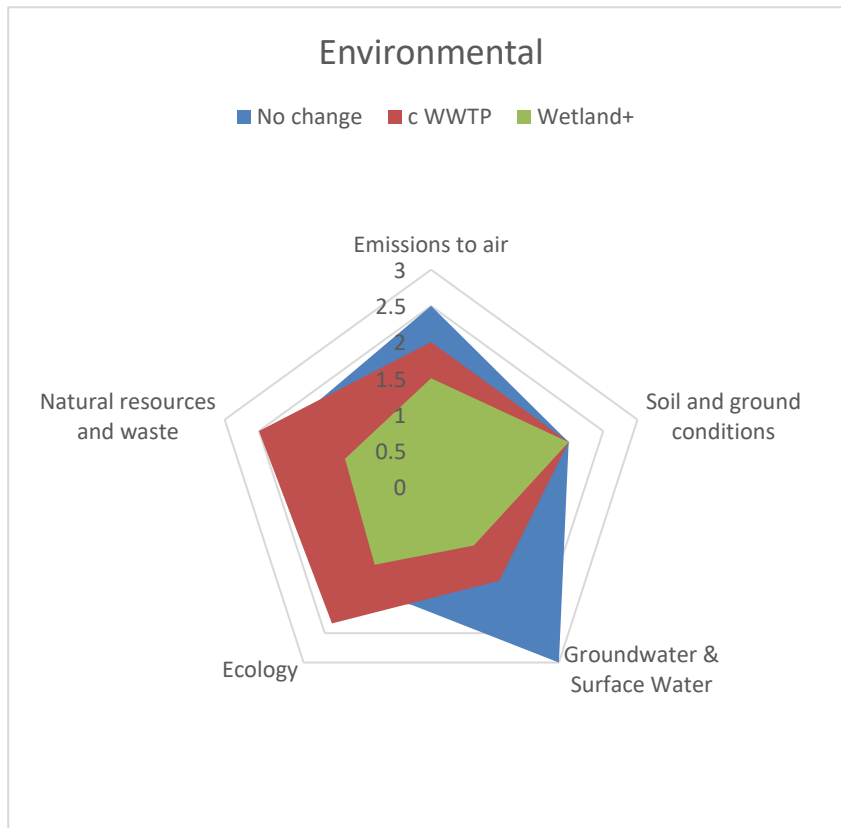
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July 2023 appearance





Sustainability assessment (ISO 18504:2017)

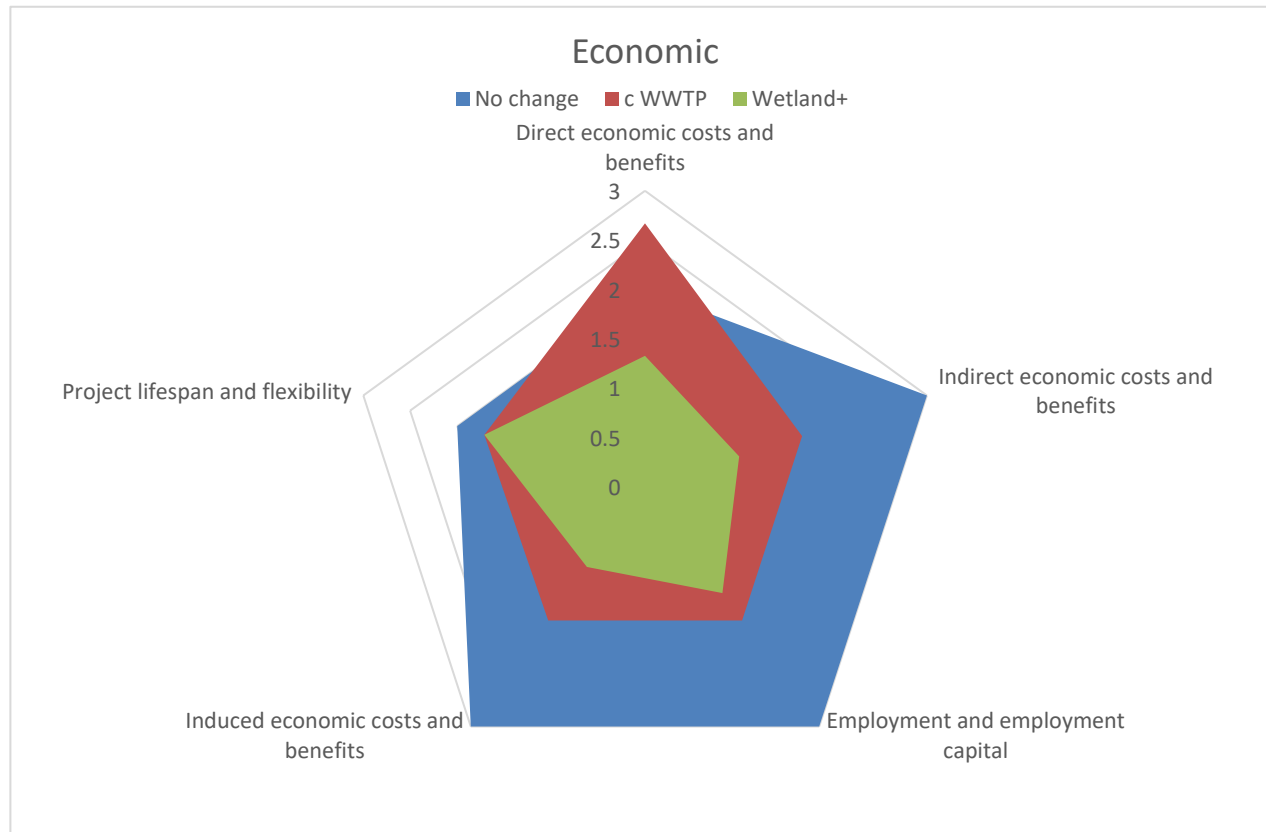


• Participants

- Site owner
- Wetland+ providers (CZ, FR)
- Wider project team
- Hunters' association
- Bird watching association
- Fishermen's association
- Municipalities
- Ministry of the Environment, CZ
- Department of landscape protection, agriculture and revitalization KÚKK -
- botanical garden at the secondary agricultural school in Dalovice
- Karlovy Vary Nature and Landscape Protection Agency 

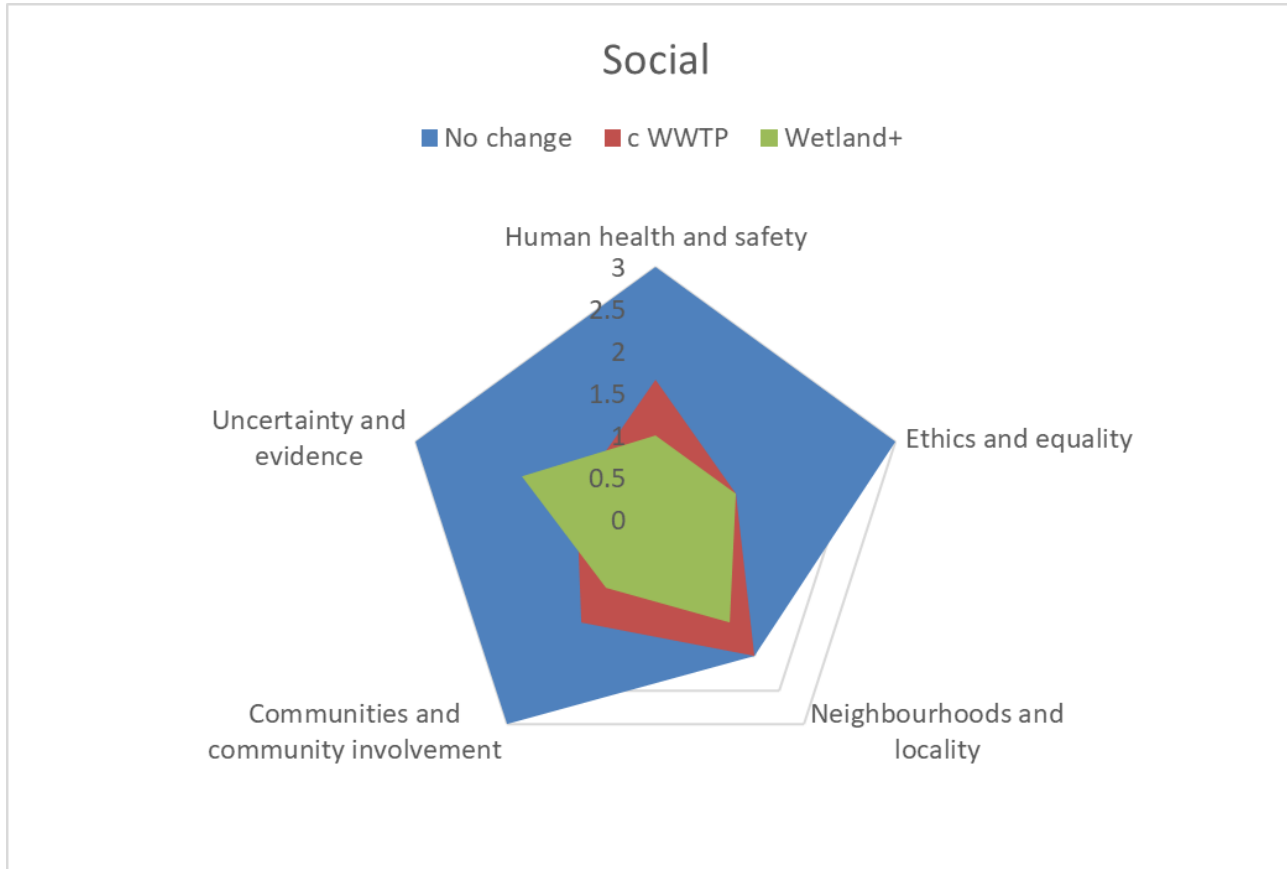


Economic aspects





Social aspects





Conclusions

- Low input remediation is worth considering
 - Also lower maintenance and lower cost
- Sustainability assessment is a useful tool for option appraisal and validation
- 2024 New Year's Resolution for you:
 - Read my book.



