A Dynamic Economic Analysis of Oil Sands Processed Water (OSPW) treatment alternatives in Alberta

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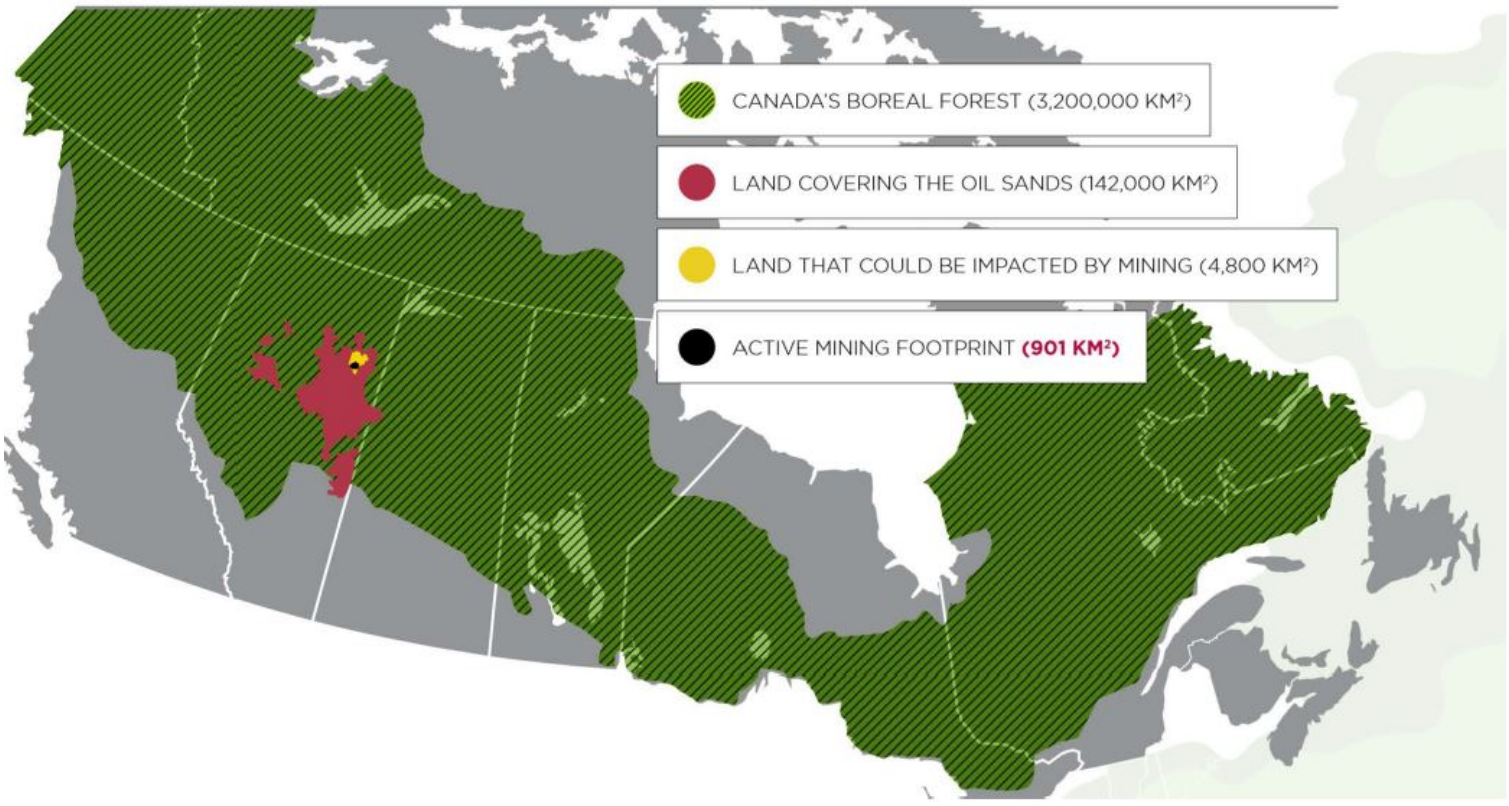
Water reclamation in the Oil Sand Industry

1. Oil Sand Processed Water (OSPW) continues to accumulate in tailings ponds in Northern Alberta

2. OSPW can be recycled for the production process and different treatment technologies are being tested

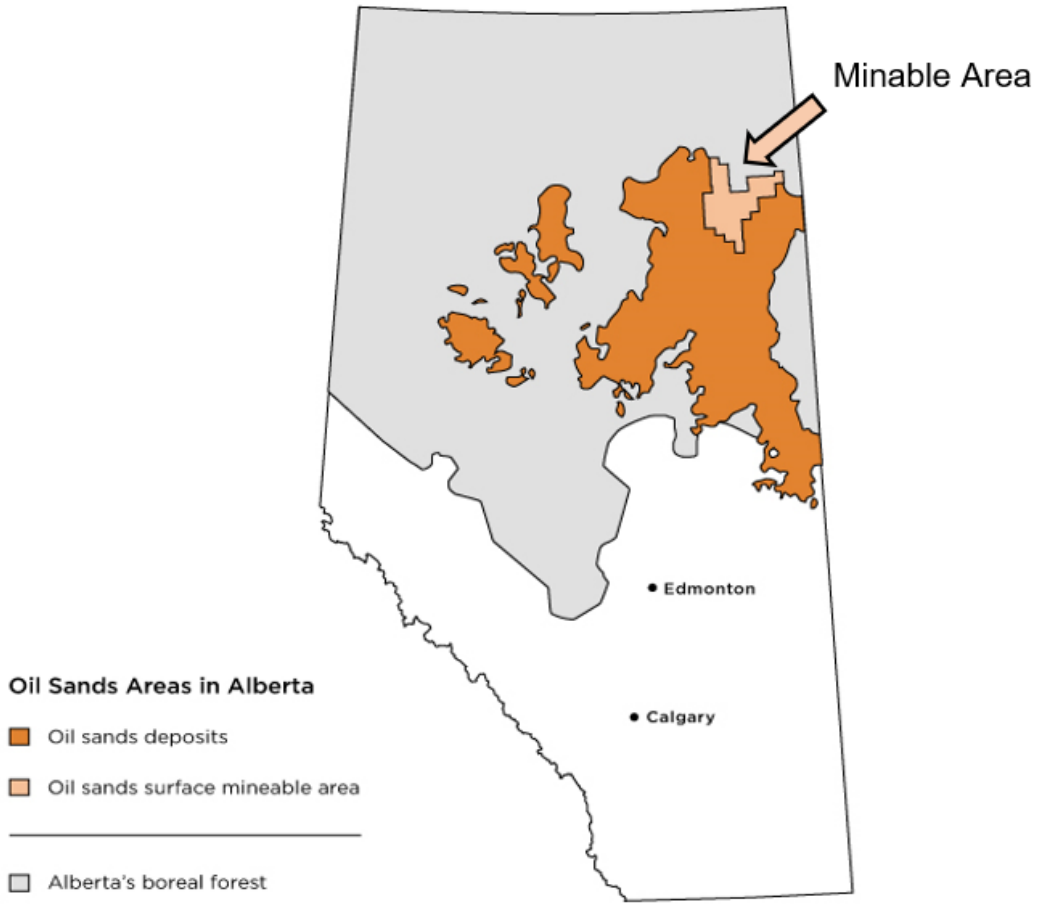
3. Mine firms have to decide when to treat the water, but at the moment they cannot release it as there is no water quality standards

Oil Sands Industry



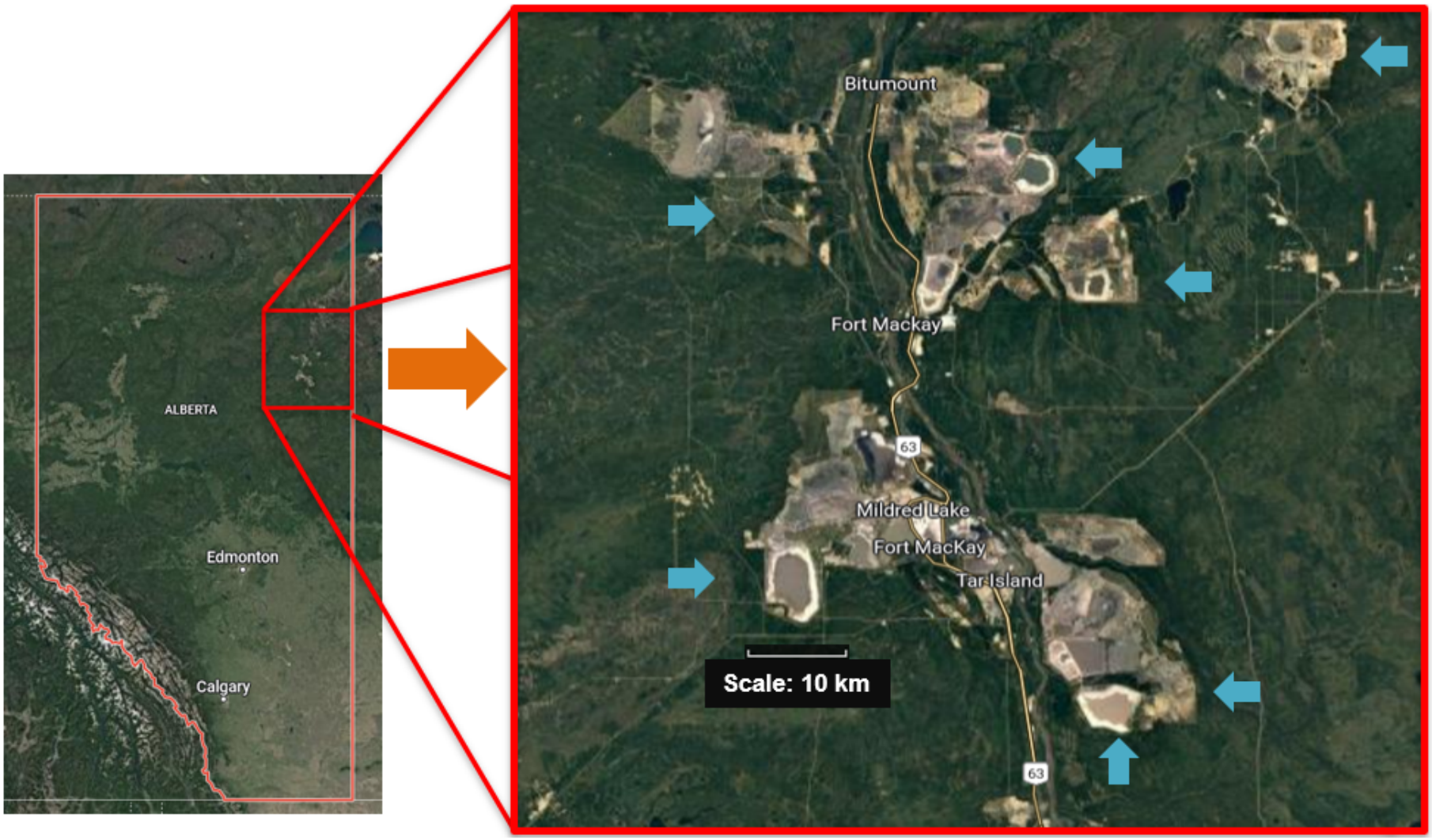
Reference: https://www.capp.ca/canadian-oil-and-natural-gas

Oil Sands Industry



Reference: https://www.aer.ca/providing-information/by-topic/oil-sands

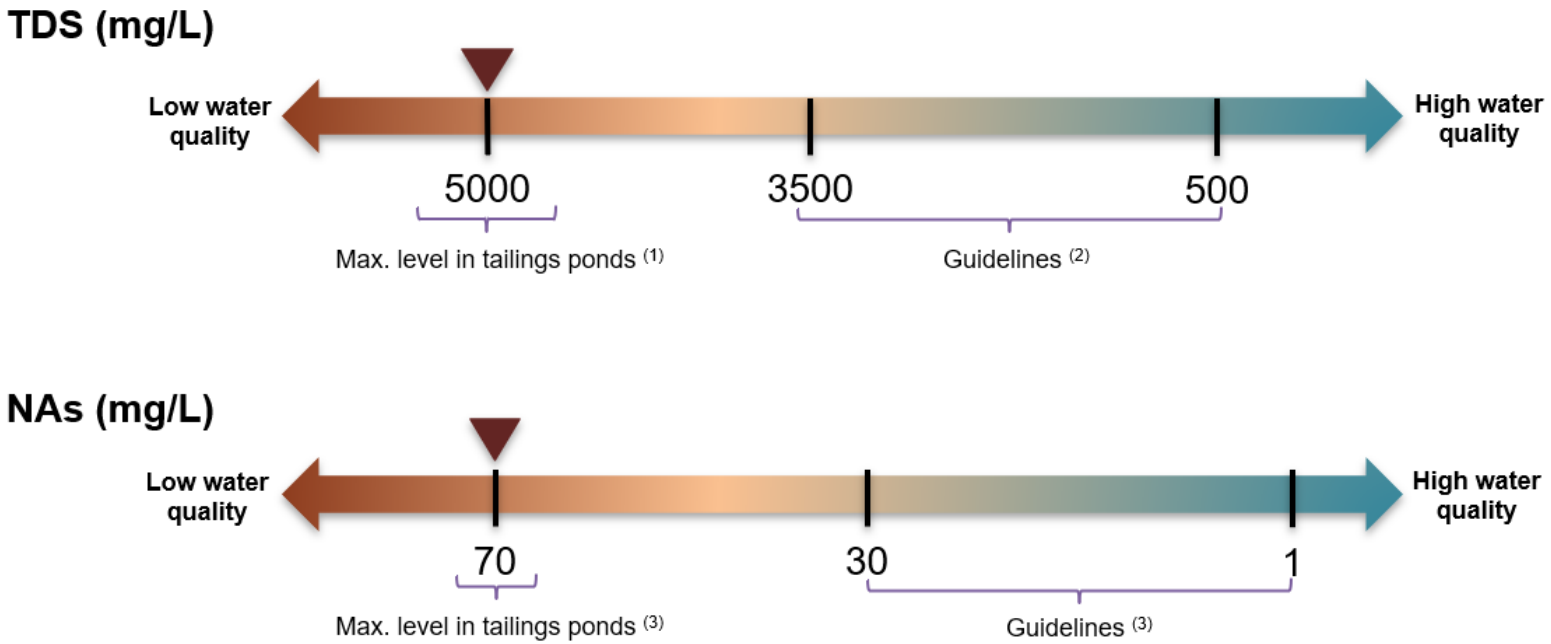
Oil Sands Industry



Reference: https://www.google.com/maps

Oil sand processed water (OSPW)

1. **OSPW** is a toxic by-product of Oil Sands production that can be dangerous for wildlife and might affect the water quality of the Athabasca River (Gosselin et al. 2010).



Reference: [1] Golder Associates, 2006; [2] Goverment of Alberta, 2018; [3] Allen, 2008

Oil sand processed water (OSPW)

Reference: https://www.reuters.com/article/us-canada-wildfire-syncrude-idUSKCN0XY0HJ

Research objectives

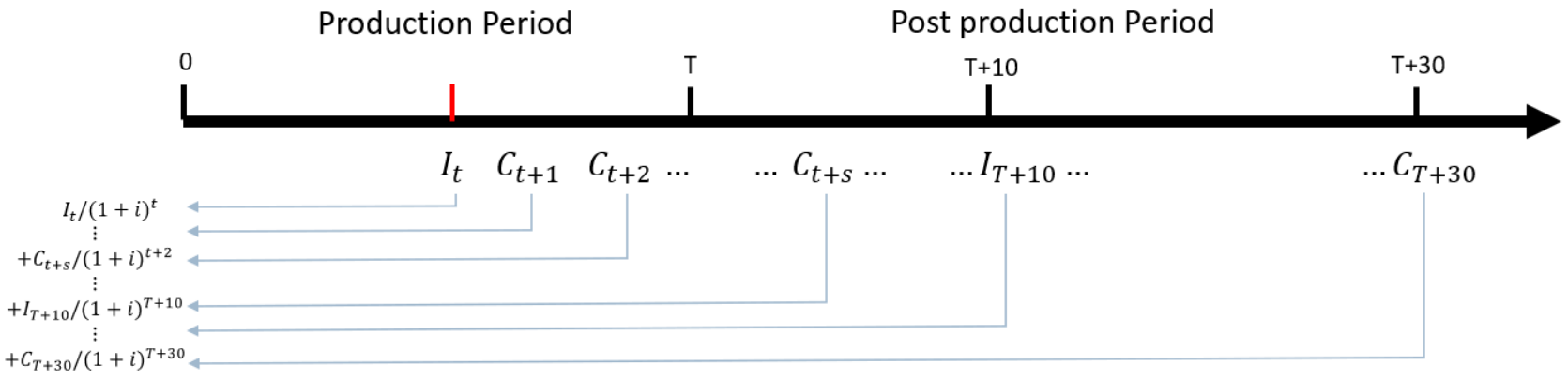
1. **Estimate the treatment costs associated with different water quality standards, treatment timing requirements, and available technologies.**

2. Identify the optimal time for a firm to start the treatment of OPSW.

3. Propose recommendations to complement and/or improve the current reclamation policy for mining water and land reclamation in Alberta.

Mathematical programming model

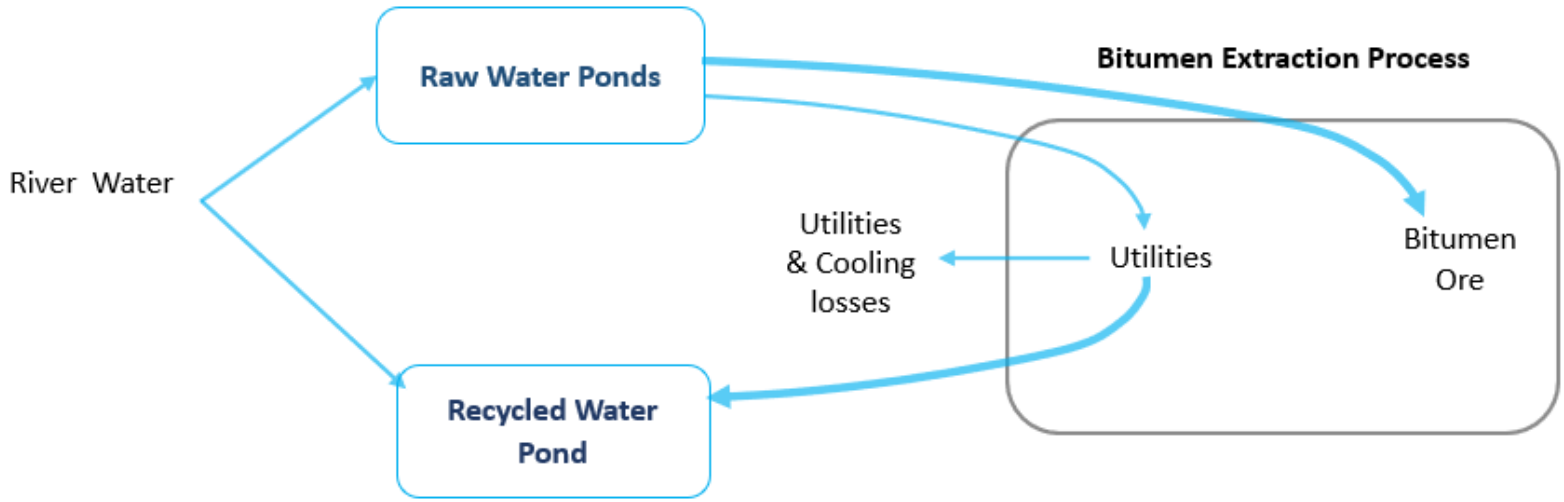
Minimize: Discounted Sum of OSPW treatment cost over time (virutal mine)



Subject to:

1. OSPW balance during each period time
2. Chemical balances during each period time (concentrations)
3. Available Technologies and their characteristics
4. Water quality limits (Regulations)

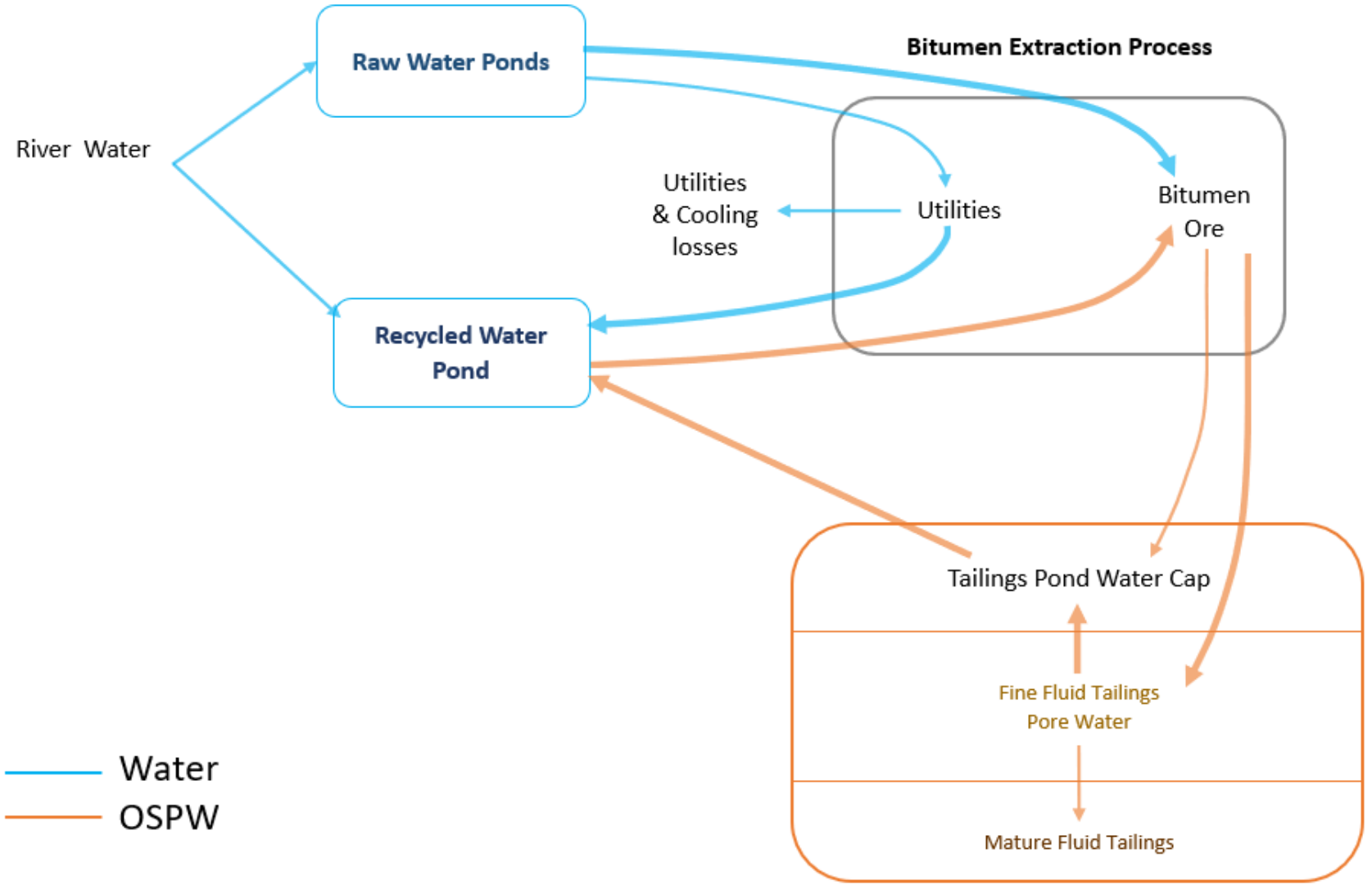
Water / OSPW cycle in the Post-Production Period



Water

OSPW

Water / OSPW cycle in the Post-Production Period



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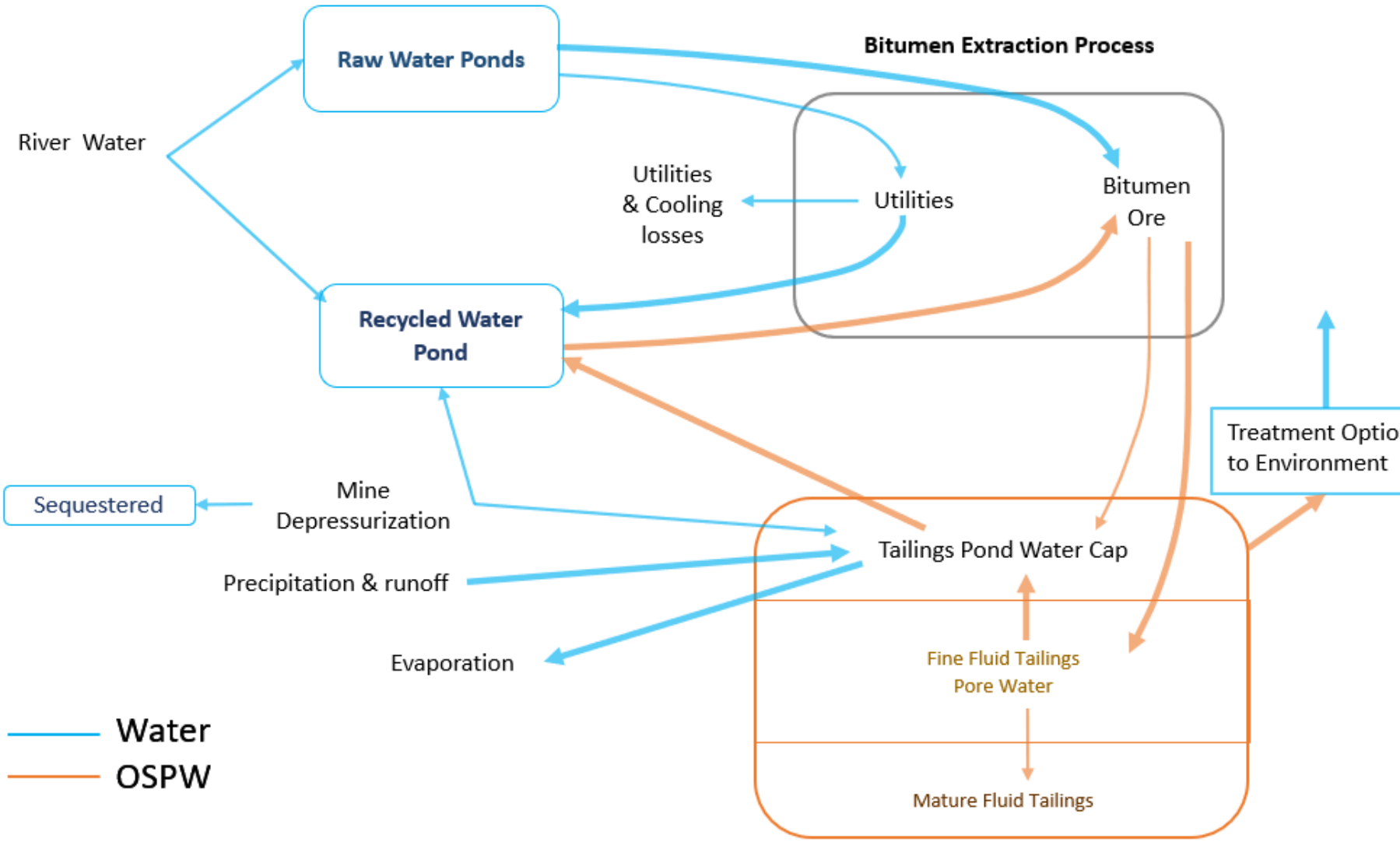

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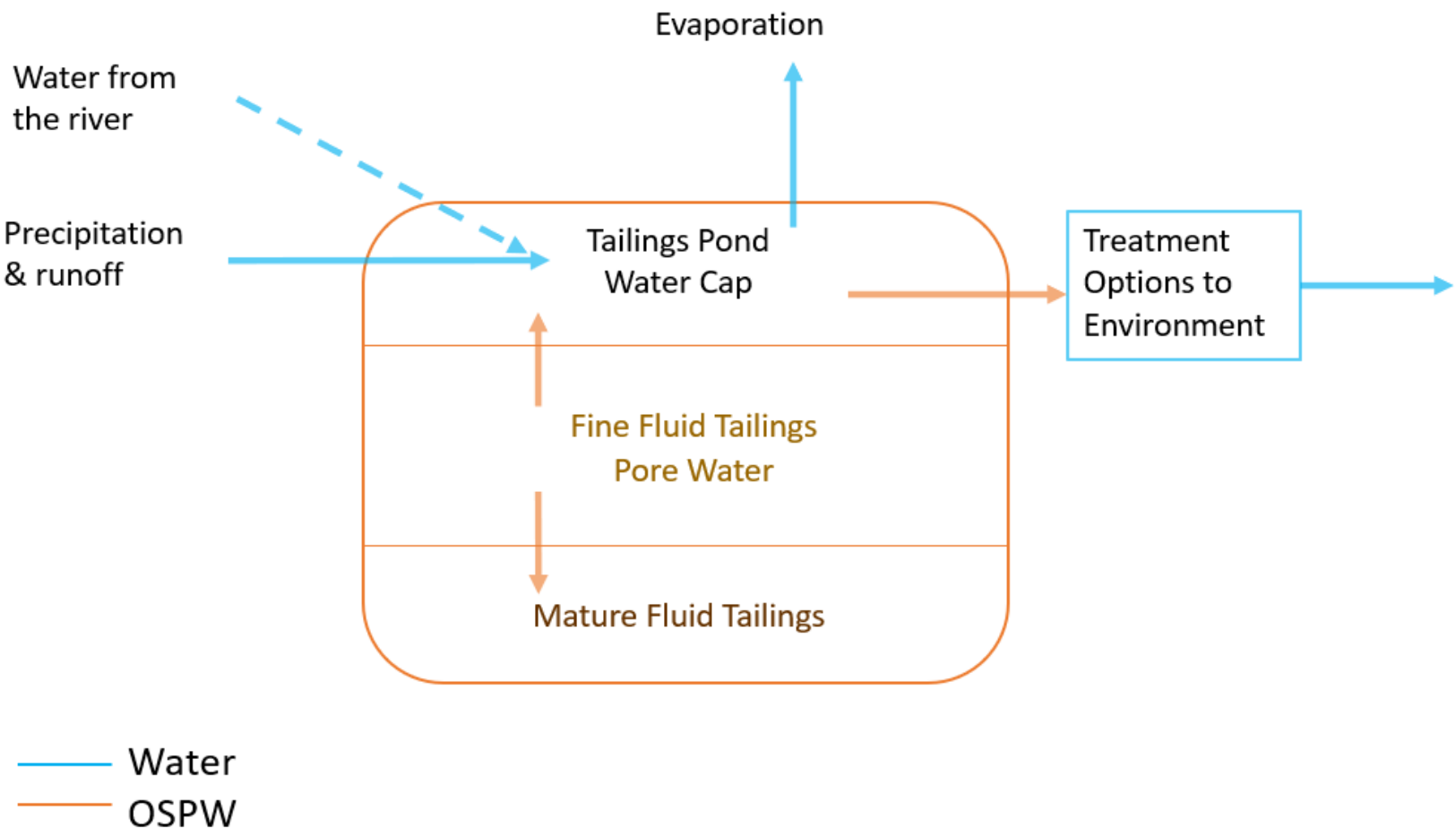


Treatment technologies

Membrane Bioreactor (+ Granulated Carbon)

Pit lakes

Wetlands

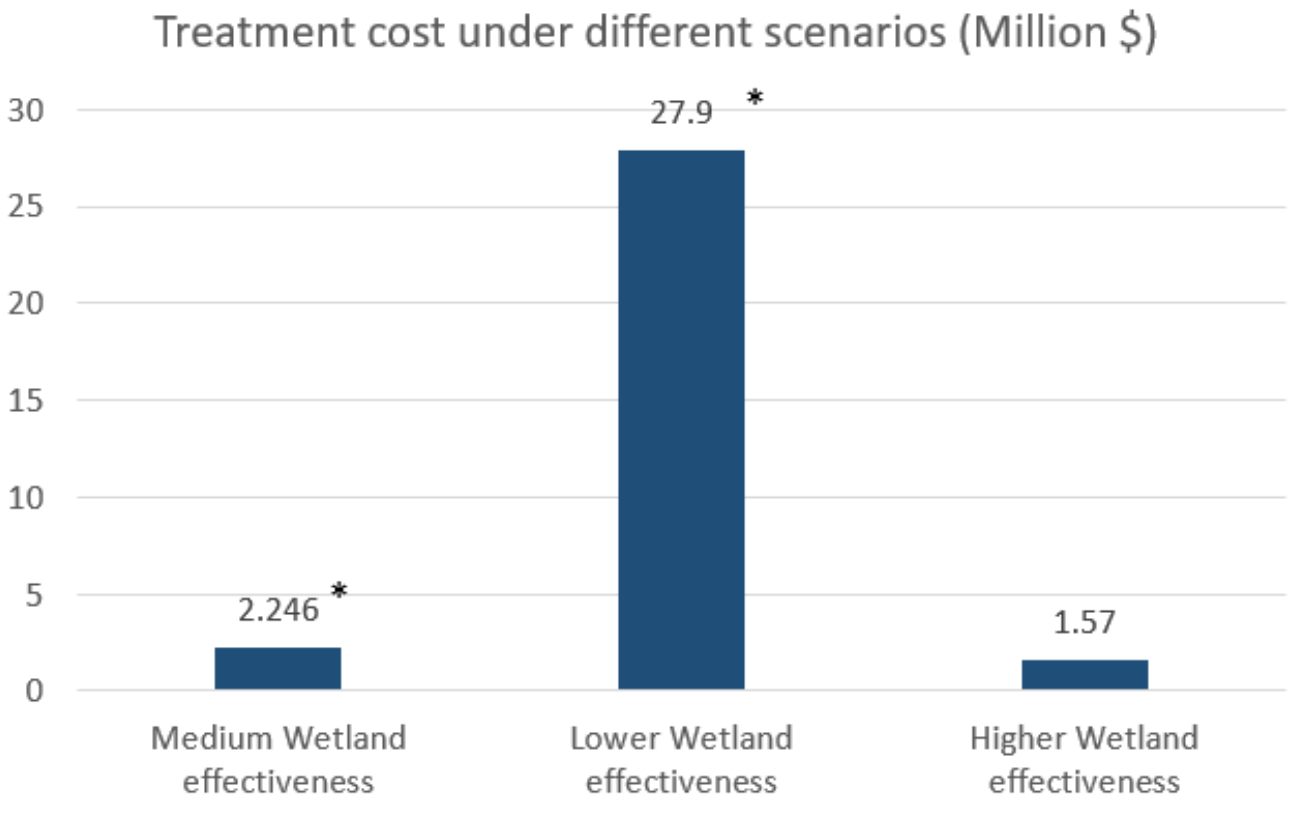
Attributes
Treatment time (Days)
Treatment capacity (m^3/year)
Seasonality (Winter, Summer)
Infrastructure (Permanent, temporary)
Complementarity
Land requirements (hectares)
Water quality outcome (treatment cycles)

Technology Cost Function

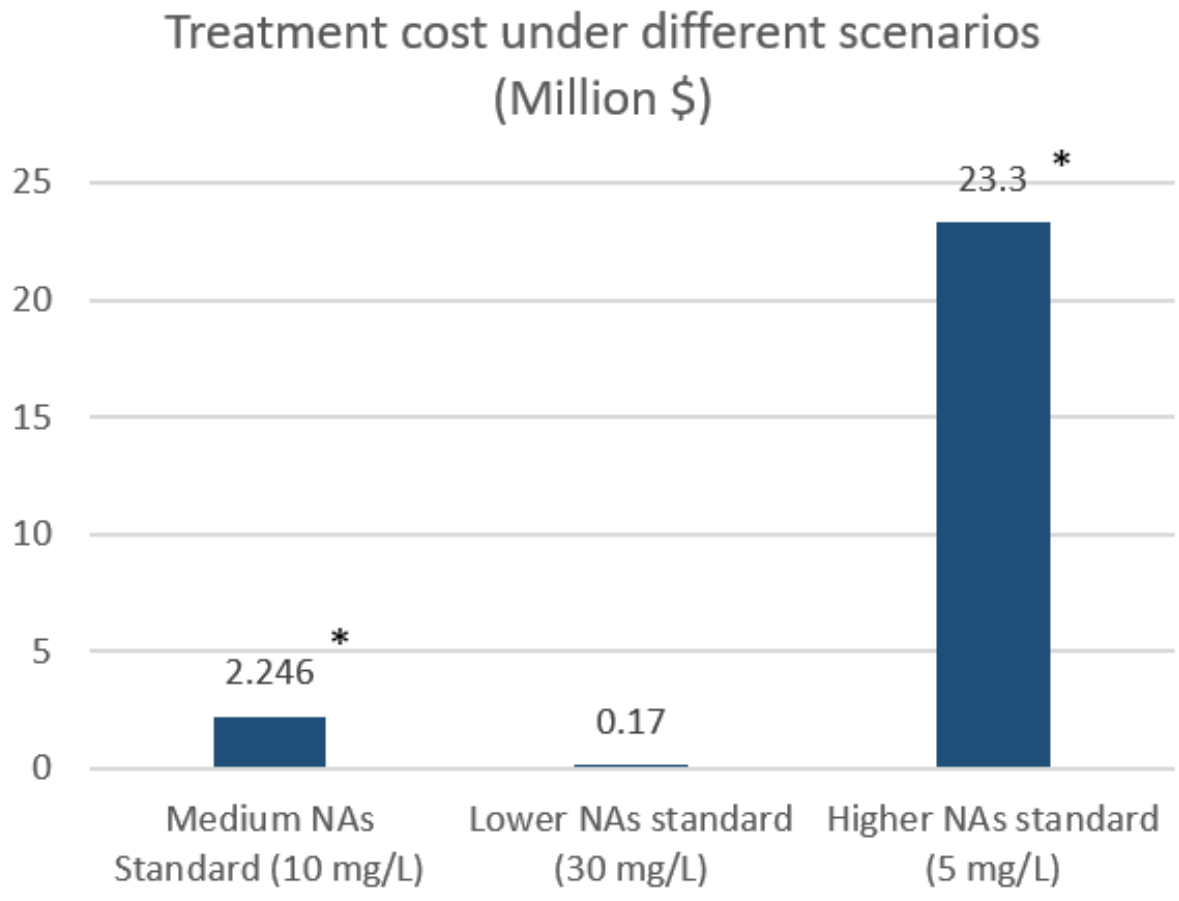
Preliminary results: Assumptions

1. Virtual Mine producing 60 Million bbl
2. Early treatment (*): Wetland with Membrane Bioreactor
3. Principal treatment: Wetland to be transformed into a Pit-lake
4. Wetland effectiveness: Low, Medium, High
5. NAs standard (Mg/L): Lower (30), Medium (10), Higher (5)

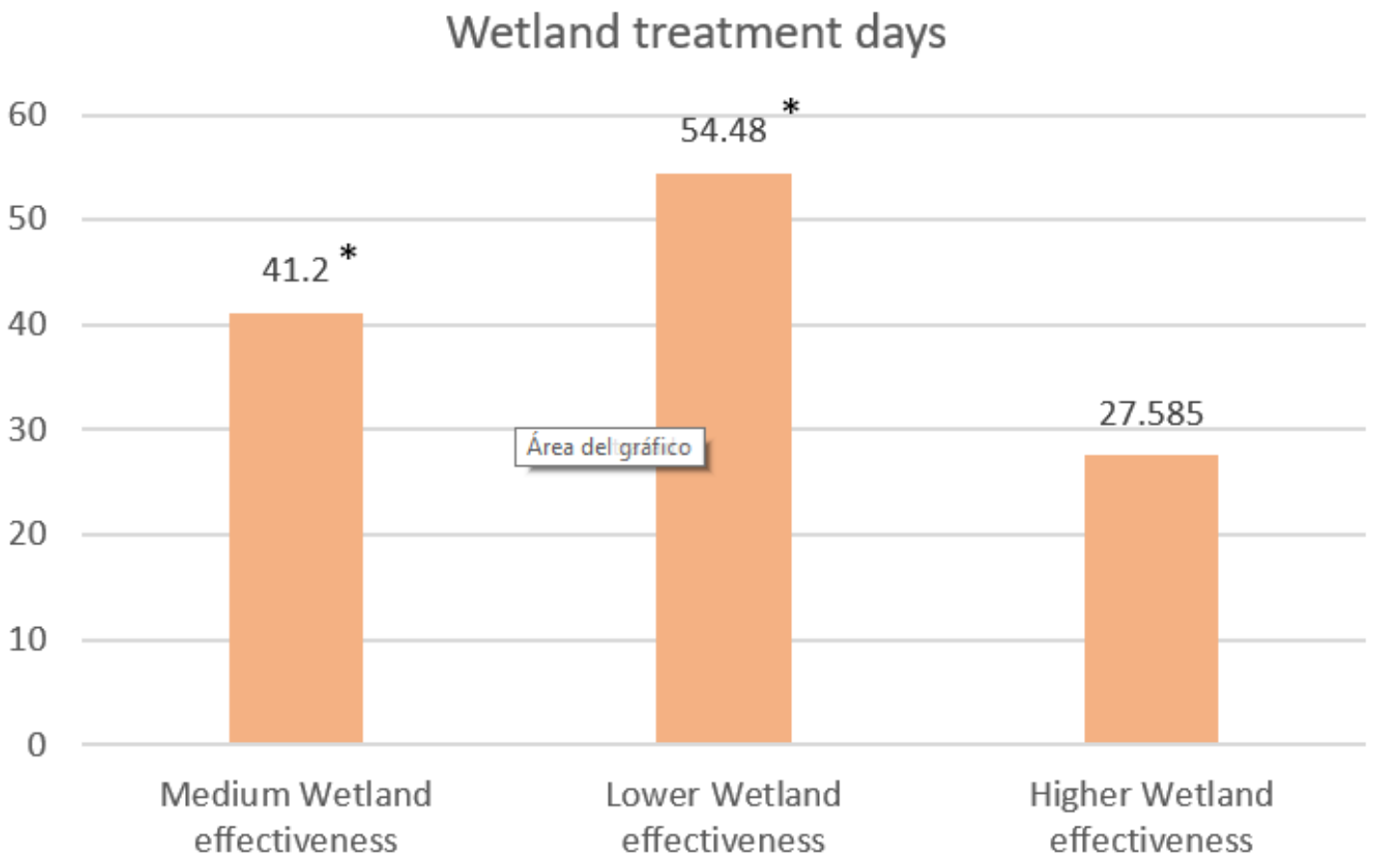
Preliminary results: Costs



Preliminary results: Costs



Preliminary results: Treatment days



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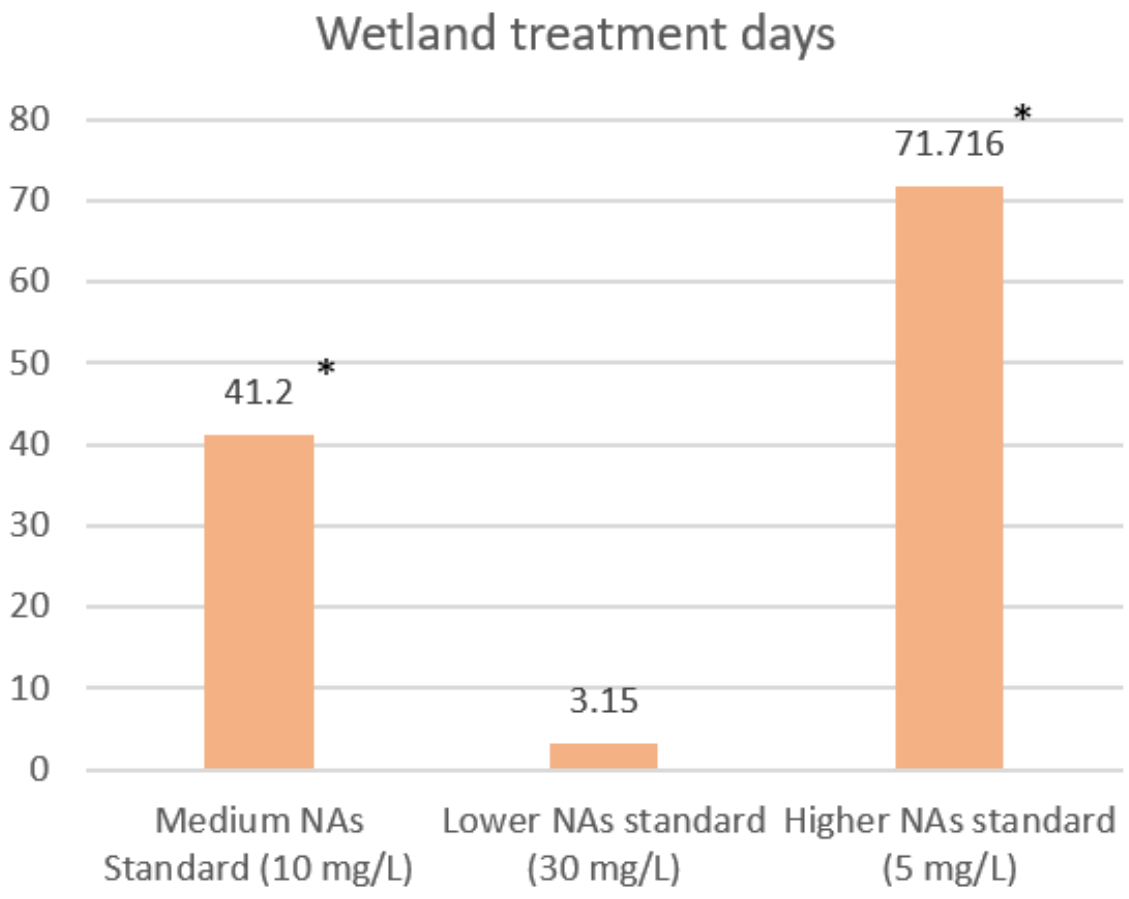

Preliminary conclusions and future steps

1. Costs can very sensitive to assumptions about treatment effectiveness and effluent standards

2. Cost for treatment effectiveness and water quality changes can be 10 10 times higher than the initial case with passive technologies

3. Active technologies will be included, as well as different scenarios regarding the water quality standards

Thank you