

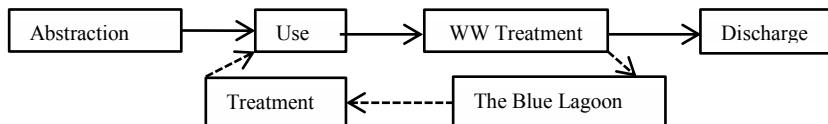
# The Blue Lagoon: Design of an alternative drinking water supply for Copenhagen

*Sven A. MacAller*

DTU Environment, Technical University of Denmark

Copenhagen and the surrounding municipalities face serious water supply challenges due to the combined effects of population growth, urbanization, pollution, and political pressure from the EU Water Framework Directive. The Blue Lagoon has been identified as a possible solution to these challenges that would improve both the self-sufficiency and long term sustainability of the city's water supply through the utilization of an internal resource that is currently considered as a waste product. In addition, the lagoon would provide an environmental benefit through reduction of the nutrient load that is currently released from wastewater treatment plants during normal flow and overflow events. The Lagoon could also be a valuable component of an improved storm water management system.

Presently, water is abstracted from groundwater resources, used, treated, and then pumped to either the Øresund or Køge Bugt. The Blue Lagoon would reuse the waste stream that is currently discharged and recycle the resource back into the urban water cycle [Figure 1]. An artificial lagoon would be used to mix effluent from wastewater treatment plants with seawater, and then used as a source for a Reverse Osmosis (RO) water treatment plant. In addition to improving self-sufficiency and sustainability, this configuration would reduce the salinity (TDS) of the source water for the RO plant and reduce the economic and energy burden when compared to conventional desalination of seawater.



**Figure 1- The current urban water cycle and the role of The Blue Lagoon**

Data regarding possible flow sources to the lagoon was compiled and combined with other information in a model to evaluate possible lagoon configurations, resulting water quality and whether or not the lagoon would meet requirements that had been established. In addition, an economic analysis was conducted to further assess lagoon configurations and the economic viability of the lagoon compared to direct desalination of water from Køge Bugt.

Results indicate that connection to one or two treatment plants would provide a constant supply and excess lagoon volume for dilution with seawater while still achieving a 35-80% reduction in TDS in the feed stream to a RO plant. No configurations met the water quality standards that had been set for the lagoon. Additional treatment processes are necessary to reduce the average total phosphorus concentration in treatment plant effluent streams from approximately 0.5 mg/l to 0.04 mg/l. Economic evaluation revealed that the operational cost of producing water via the lagoon would be 0.003 to 0.018 DKK/m<sup>3</sup> cheaper than direct seawater desalination.

Through efficient lagoon configuration, dilution of wastewater effluent is achieved, while still reducing TDS in the feed stream to the RO plant. More investigation is necessary to fully evaluate The Blue Lagoon; however none of the results of this project indicate that this concept is a "pie in the sky". On the contrary, there is ample evidence to indicate that this is a viable solution that would provide a reliable, high quality, sustainable, and self-sufficient water supply for the city of Copenhagen and the surrounding municipalities.