The Oslo Harbour Remediation Project
Challenges for confined disposal in a deep fjord basin

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Introduction: Sediments in the harbor of Oslo have been seriously contaminated during the last centuries as a result of industrial activities, dockyard operation, municipal wastewater, as well as urban surface run-off. A sediment layer varying in thickness from 0.1 to 4.5 m is highly contaminated by heavy metals and organic contaminants. Redevelopment of old harbor sites as part of the Oslo city plan has been the subject of several studies during the last 15 years. The construction of a submersed road tunnel to redirect the main traffic away from the city centre required dredging in the most contaminated parts of the harbor and triggered an immediate need for remediation. Through a joint effort of the Oslo Port Authority, The Norwegian Road Administration and the Norwegian Pollution Control Authority a remediation plan for the harbor of Oslo has been implemented.

Remediation plan: The remediation plan, which will be completed the coming 2 years, includes dredging of the shallow parts of the harbor down to 15 m water depth (approximately 700,000 m3), capping of the deeper parts of the harbor (1,000,000 m2) as well as construction of a deep water confined disposal facility (CDF) for the dredged material in the Oslo fjord.
The deeper parts of the Oslo fjord consist of basins, which vary in depth from 50 to 150 m. These basins can be actively used for sub-aqueous containment of contaminated sediments as long as the chemical stability of the sorbed contaminants is high and physical resuspension of the sediments can be prevented. Based on an evaluation of transport distance, existing contamination levels in the basin, water current velocity, natural thresholds, and containment capacity a location at Malmøykalven was selected as most appropriate for a CDF. The deepest part of the basin is at – 72 m and the water current velocity is generally less than 3 cm/s, resulting in conditions that promote sedimentation and accumulation of fine particulate matter. The thresholds surrounding Malmøykalven have an elevation of -43 m at three sides. To be able to contain the total volume of contaminated sediments, an artificial threshold of 3 m high will be established at the north-east site of the location. This results in a basin with an area of 350,000 m2 and a containment capacity of 1,200,000 m3.

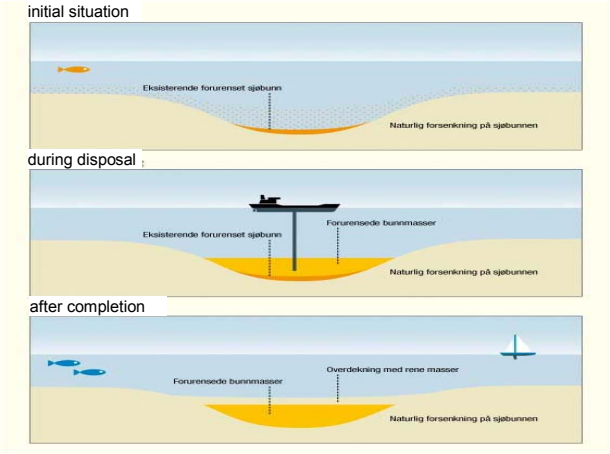

Fig. 1: Construction of CDF in deep fjord basin.

Progress: Presently sediments are being dredged in the harbor, using a specially designed closed grab in order to minimize resuspension. The dredged material is transport by a barge to the site of the CDF and pumped down to 70 m using a submerged pipeline. Salt is added to correct the specific density of the slurry and improve sedimentation. To supervise the operations at the site an on-line monitoring system is operated that consists of 7 buoys with turbidity loggers and a water current velocity meter. In addition periodic sampling and analysis of water samples is carried out. Sedimentation and consolidation of the sediments at 70 m water depth is monitored using a ROV (Remotely Operated Vehicle) and multi-beam sounding equipment from a surface vessel. This allows 3-D imaging of the new sediment surface.
A cap will be placed on top of the sediments after dredging has been completed, using several subsequent layers of 10 cm sandy material to compensate for potential cracks as a result of consolidation. Once capping is completed, diffusion through the cap will be the only remaining pathway of contaminant transport, reducing contaminant transport to the ecosystem by several orders of magnitude.).