Hitler's deadly submarine
- the cost and benefits of salvaging the vessel

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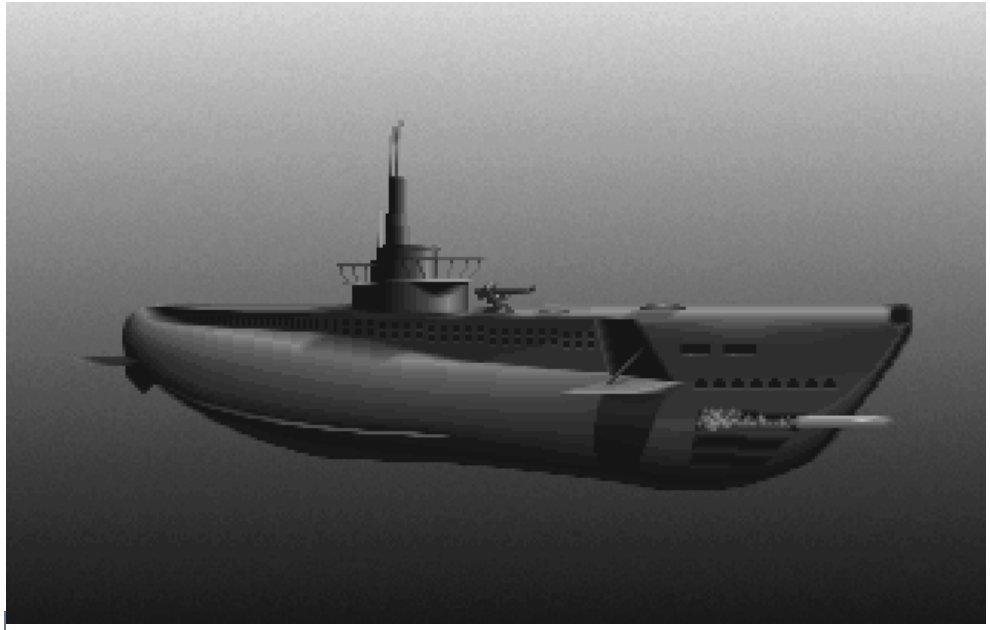

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September 20th, 2012

BETTER PROJECTS – THE KNOWLEDGE TO GET YOU THERE

Ministry of Finance scheme for quality assurance of major public investments (the QA scheme)

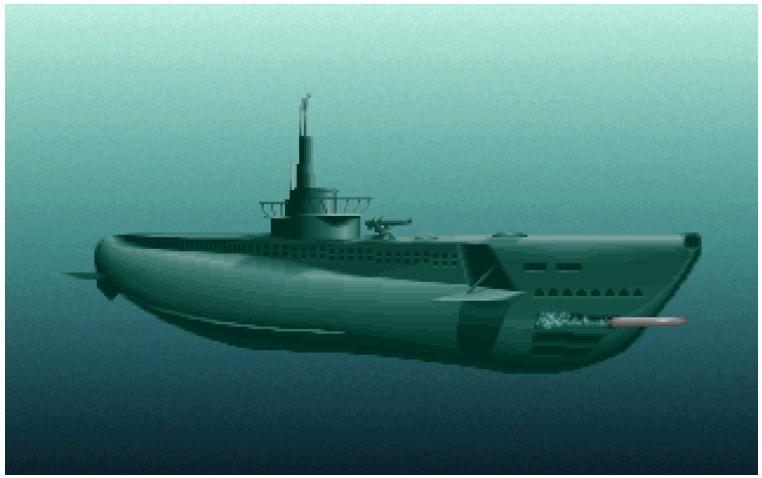
The Norwegian QA scheme includes two external reviews in an investment project's planning process:

- QA1 – Quality assurance of choice of concept before Cabinet decision to start a pre-project
- QA2 – Quality assurance of the management base and cost estimates before the project is submitted to Parliament for approval and funding.

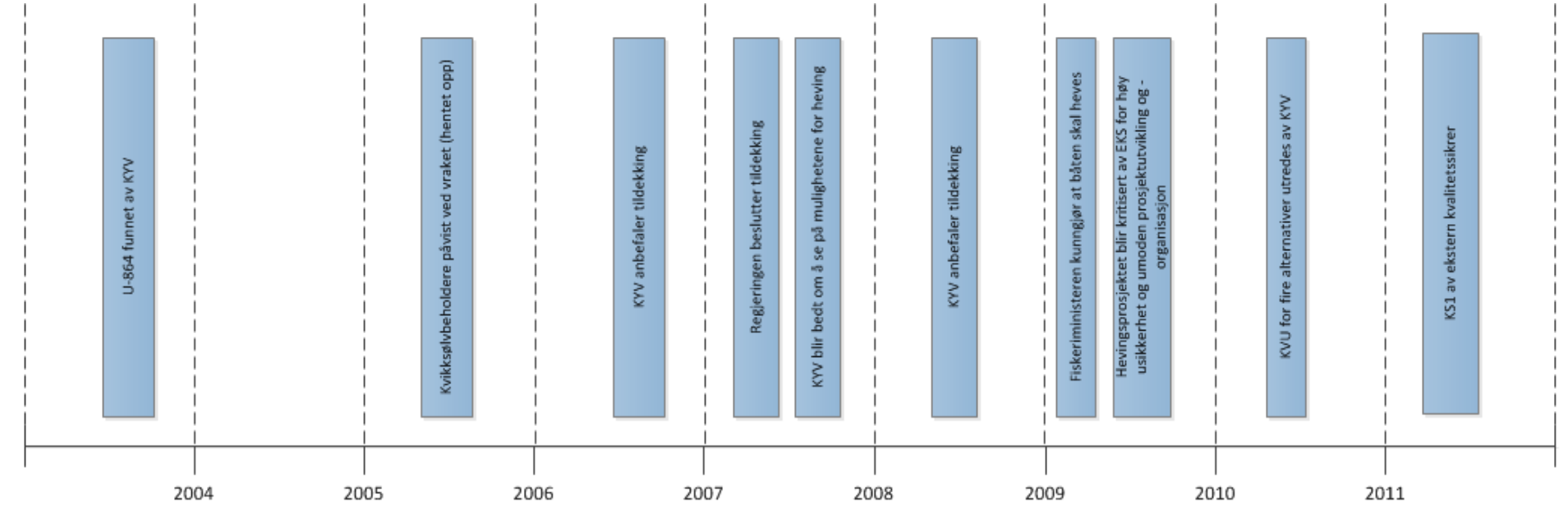
Quality assurance of the choice of concept (QA1)

1. Needs analysis
2. Overall strategy
3. Overall requirements
4. Possibility study
5. Alternatives analysis
6. Guidance for the pre-project phase

Background / History



- U-864 was torpedoed on the 9. February 1945 by the British submarine HMS Venturer
- The entire crew of 73 died, including two Japanese soldiers.



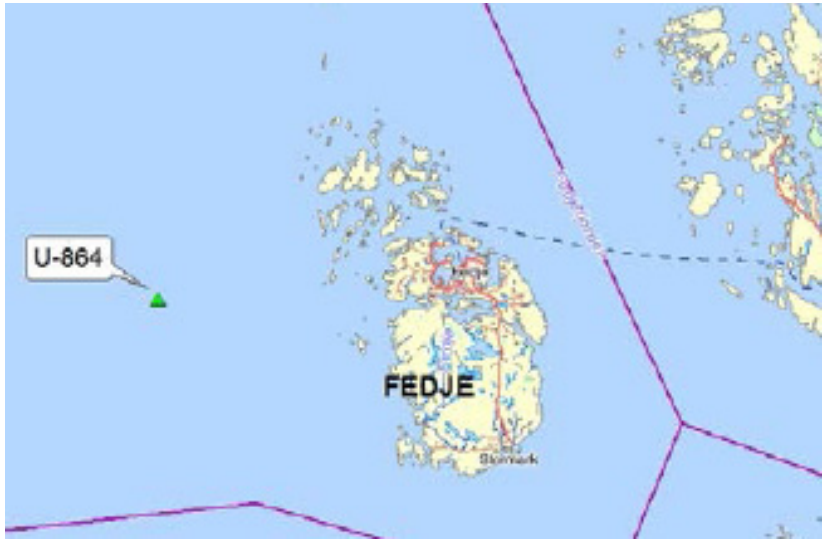
Contributors and Stakeholders

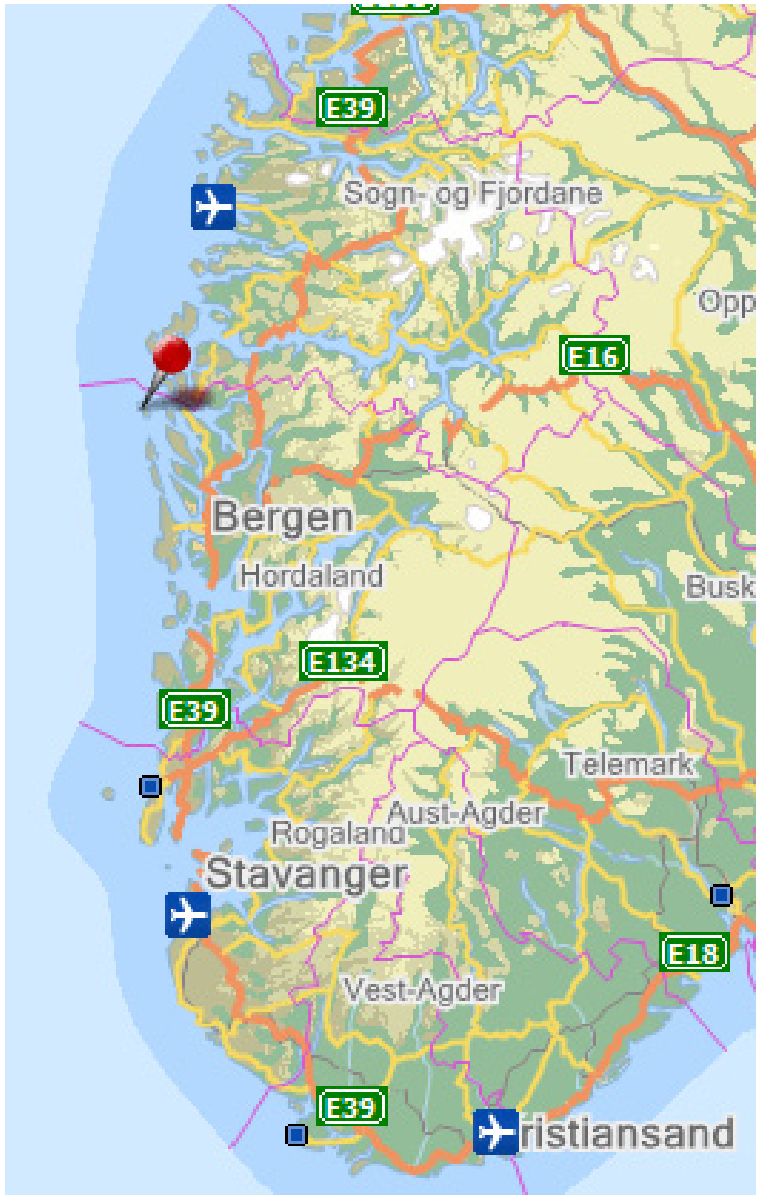
Public	Consultancies	Maritime resources / Suppliers	Individuals	Other Stakeholders
Kystverket	Det Norske Veritas	Geoconsult AS	Wolfgang Lauenstein	Aksjonsgruppa for heving av U864
NIFES	Holte Consulting AS	NCC	Kjell K Kjellstrup	Fedje Kommune
Havforsknings instituttet	NGI	Scanmudring AS	Jurgen Osten	Norges Miljøvernforbund
Sjøforsvaret	Vista Analyse AS	AGR AS	John Watson	Aksjonsgruppa for heving av U864
FFI	Ingenium AS	Franzefoss AS	Anders Goksøyr	Hordaland Fylkeskommune
KLIF/SFT	NUI AS	NOAH AS	Einar Sletten	Bellona
Mattilsynet	London Offshore Consultants Ltd	Mammoet Salvage BV		Stiftelsen Neptun
Folkehelseinstituttet	Geopartner AS	Smit Salvage BV		Greenpeace
Krigsgravtjenesten	NIVA	Sonsub AS		Naturvernforbundet
Statens Strålevern	Smit Salvage BV	Van Oord		UiB - Privatperson
Fiskeridirektoratet		Jan de Nul		

Mercury - Hg

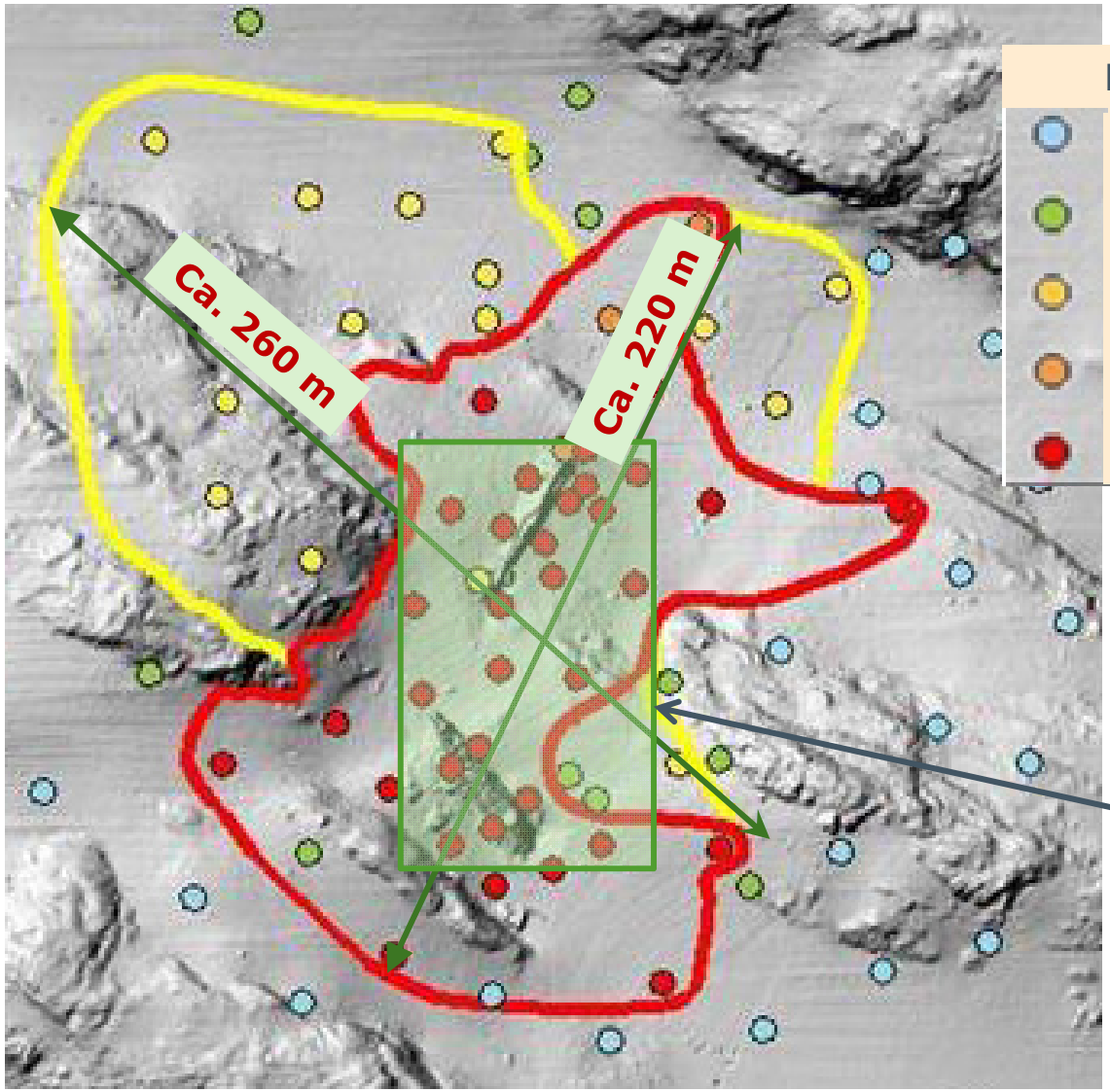
- Use: Industry, mining, thermometers, etc.
- Important forms of Mercury
  - Metallic – as in U864
  - Methyl mercury – toxic
  - Vapor – very toxic
- Dangers of Hg exposure:
  - Can affect the central nervous system
  - Can cause birth defects
  - Diarrhea, headache, insomnia, muscular problems, etc.
- Handling – in principle two solutions
  - Recovery
  - Storage

Location of U-864





Wreck and contaminated area



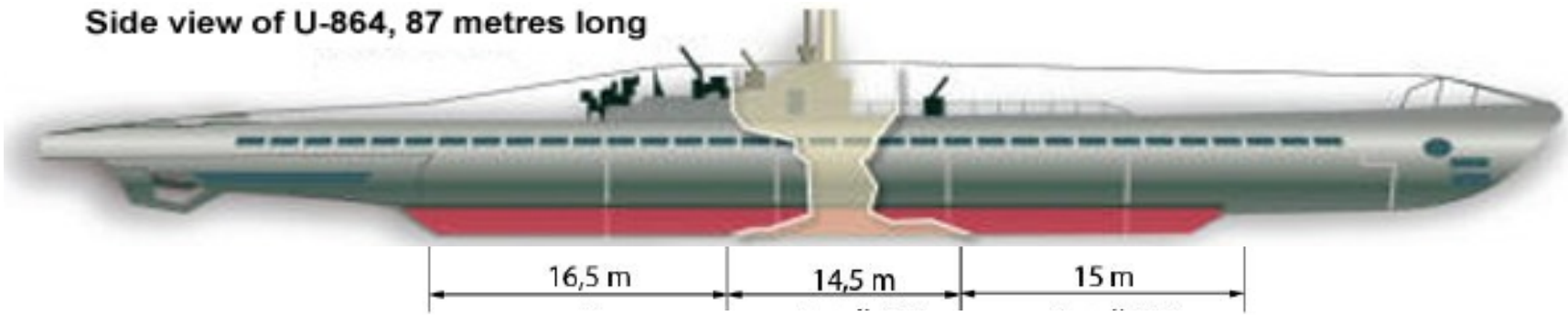
Level of contamination

- Low or insignificant
- Moderate
- Significant
- High
- Very high

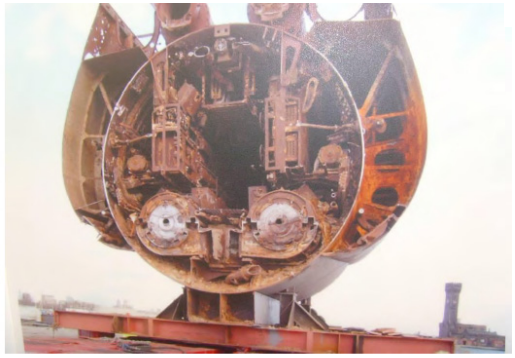
Footbal pitch

Contaminated area:
Approx. 30.000 m2

The U-864 wreck

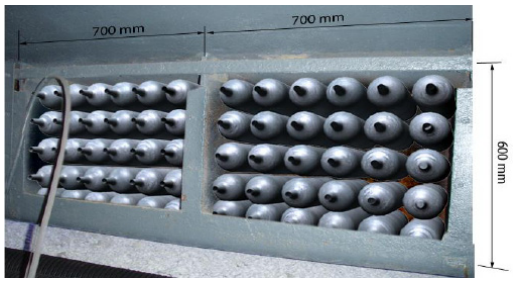


A total of 131 storage compartments



6. CUT SECTION IN TRANSPORT – N.B. KEEL CONSTRUCTION

Keel with storage compartments



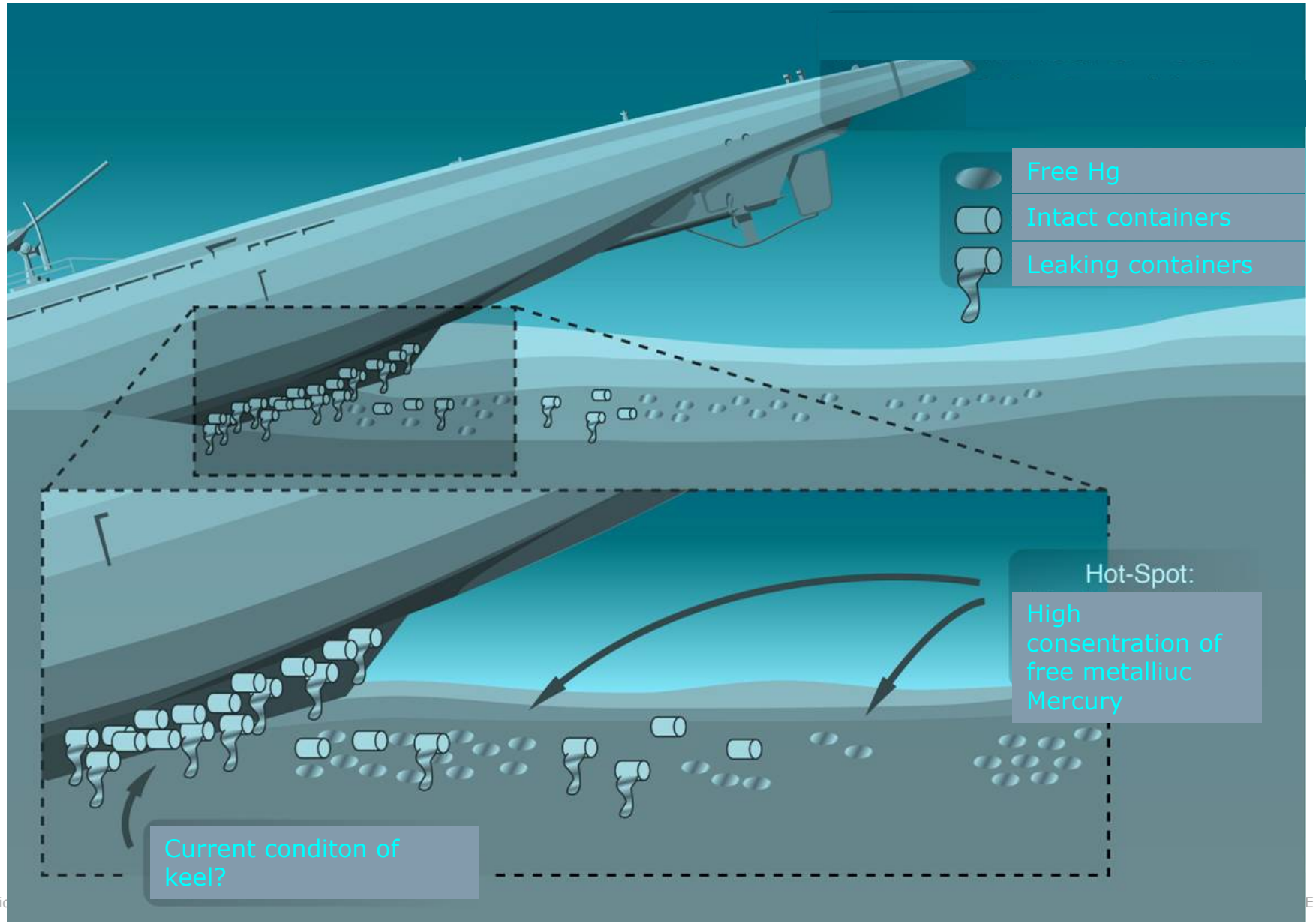
Example of assumed storage

Information

- Assumed amount of Mercury on board based on the ULTRA-archives is that 67 tons of Hg was ordered.
- Representing 1857 containers
- 1857 containers would require approx. 46 storage compartments (35% of total)
- U-864 had a total of 131 storage compartments in the keel, calculated that approximately 40 were destroyed on impact.
- Calculations estimate there to be between 300 and 1400 intact containers in the wreck today.

Hg Containers

Contamination by and in the vicinity of the U-864



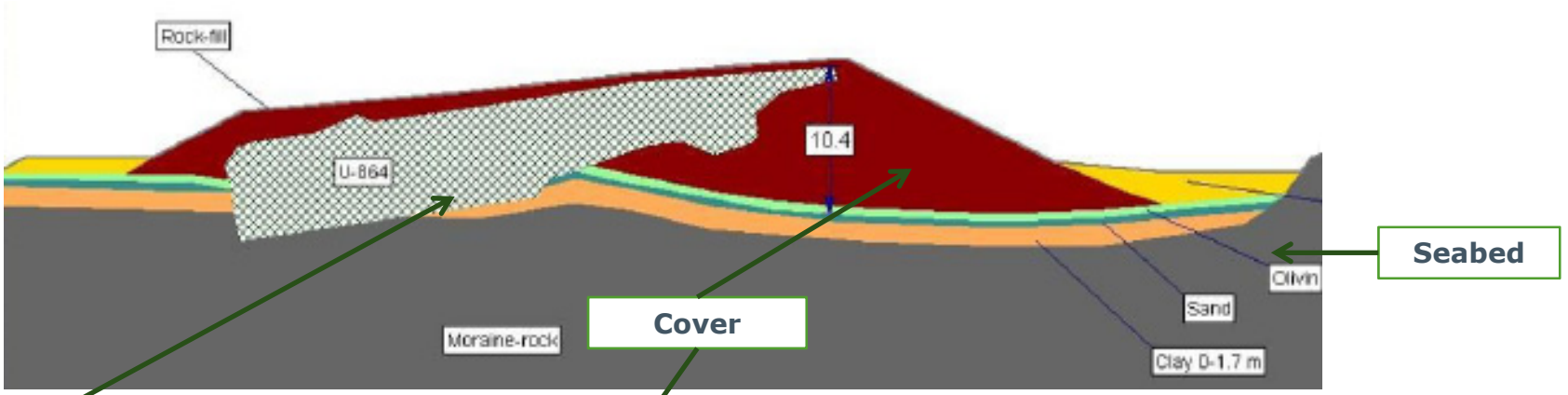
Investigation on the level of Mercury in fish and crab in the vicinity of the U-864 wreck.

- NIFES (National Institute of Nutrition and Seafood Research) carry out annual surveillance of fish and seafood in the area.
- Fish containing levels of mercury above EU limits for commercial use have not been found.
- Mattilsynet (Norwegian Food Safety Authority), for precautionary reasons, has stopped all fishing close to the wreck.
- Investigations on species such as the Cusc (Brosme) has not shown higher levels of Mercury than in other areas along the Norwegian coast.
- Crab meat shows higher levels of Mercury in the vicinity of the wreck, compared to other areas.
- The level of Mercury in fish and crab has remained unchanged since the start of investigations in 2005.

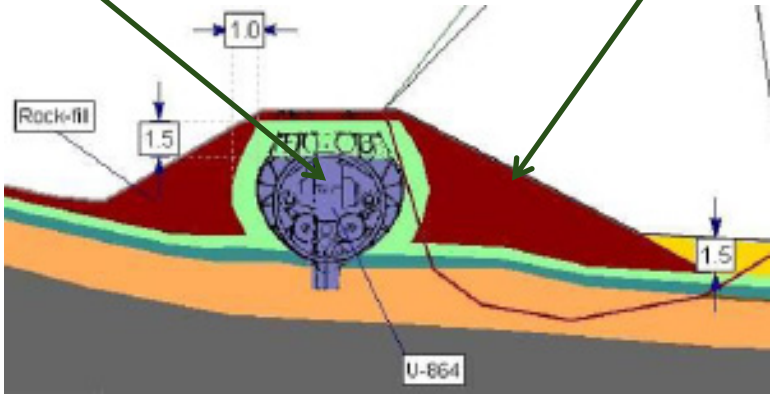
Aim of the project

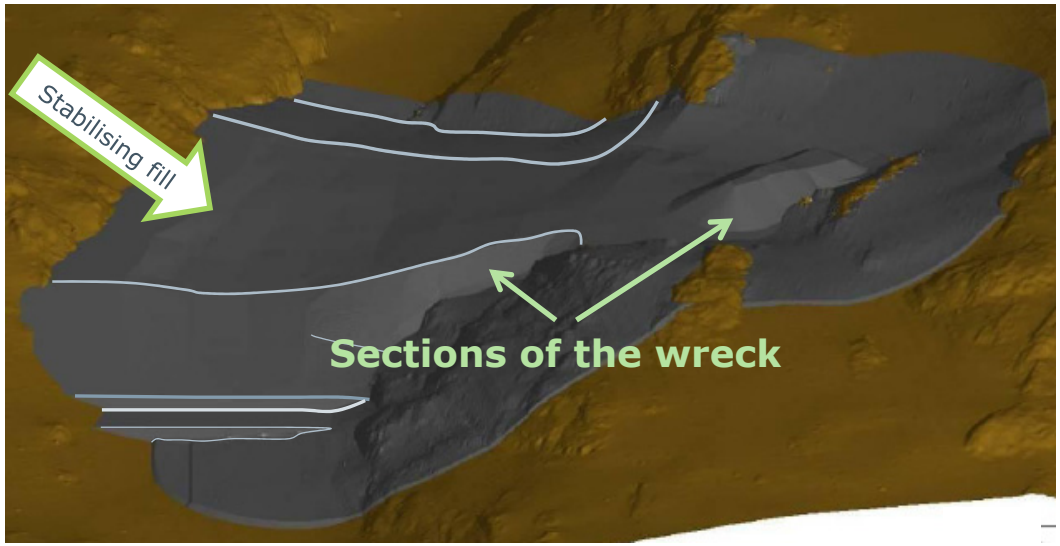
«The aim of the project is to ensure that the maritime environment around the U-864 will become and remain the same as what is currently typical for the coastal stream along the west coast of Norway»

Alternative 1: Cover and encapsulate wreck and contaminated area

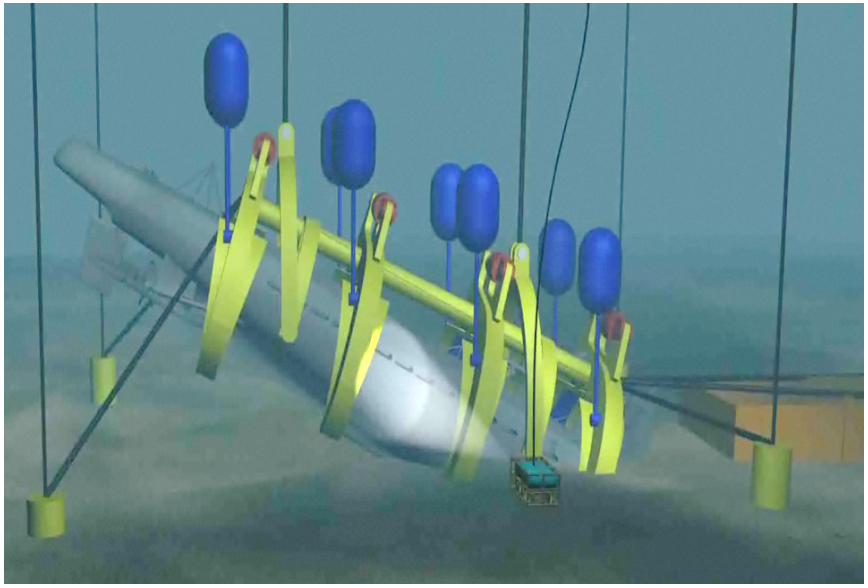


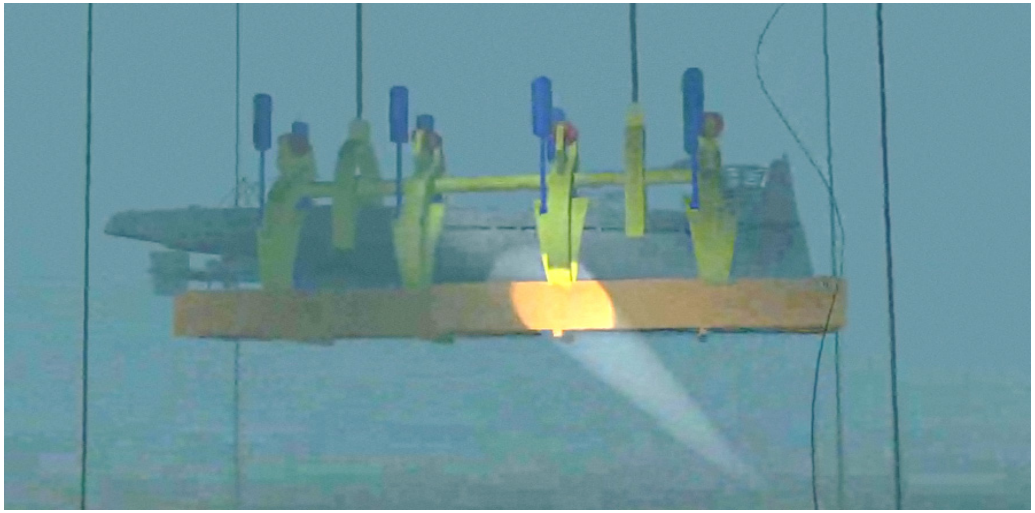
Wrecage





Alternative 2: Recover wreck, cover and encapsulate contaminated area and deposit wreck+ on land



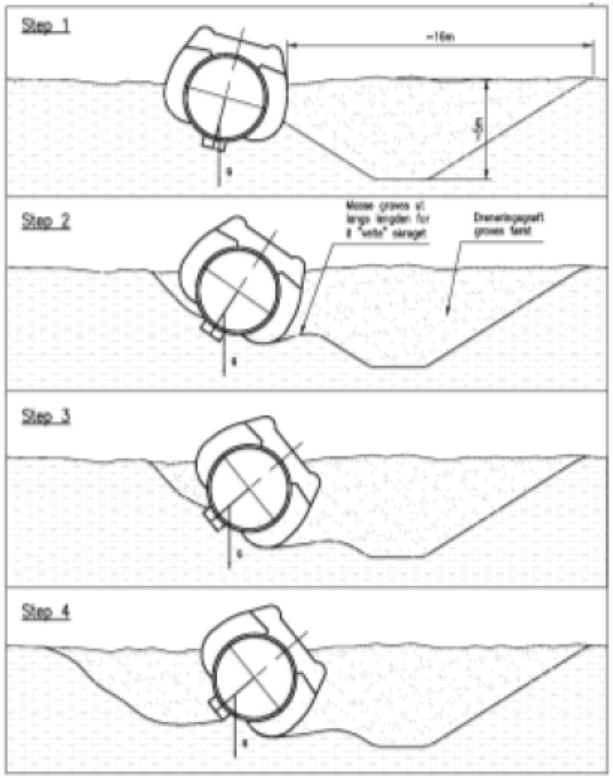


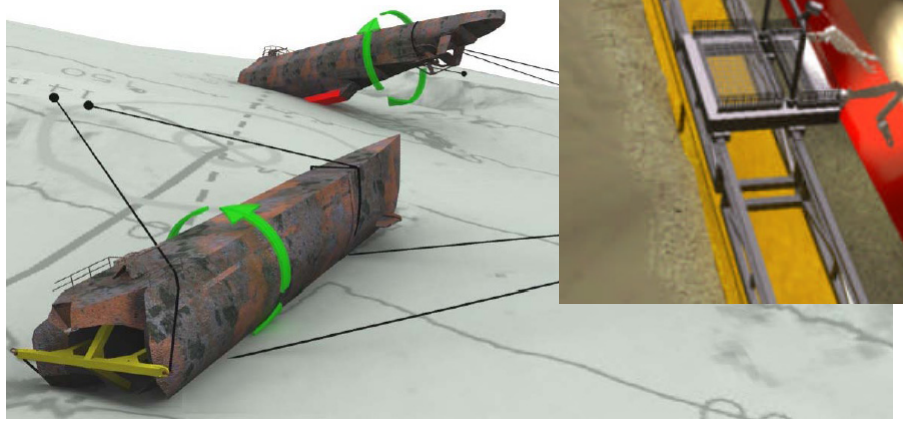
Estimated Hg recovery 60-95%

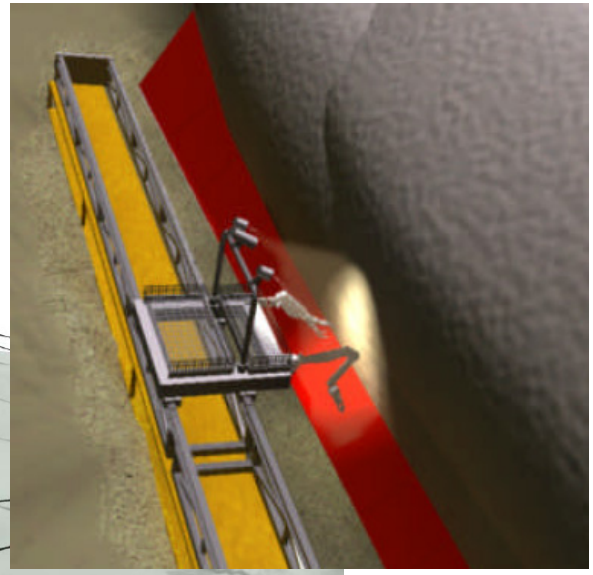
NB! These are typical sketches.
The solution has not been chosen.

Alternative 3: Recover Mercury, cover and encapsulate contaminated area and deposit on land

Estimated Hg recovery 70-95%







Potential solutions.

Alternativ 4a: Recover wreck, large scale-dredging, deposit on land
Alternativ 4b: Recover Mercury, large scale-dredging, deposit on land

Alternative 4A

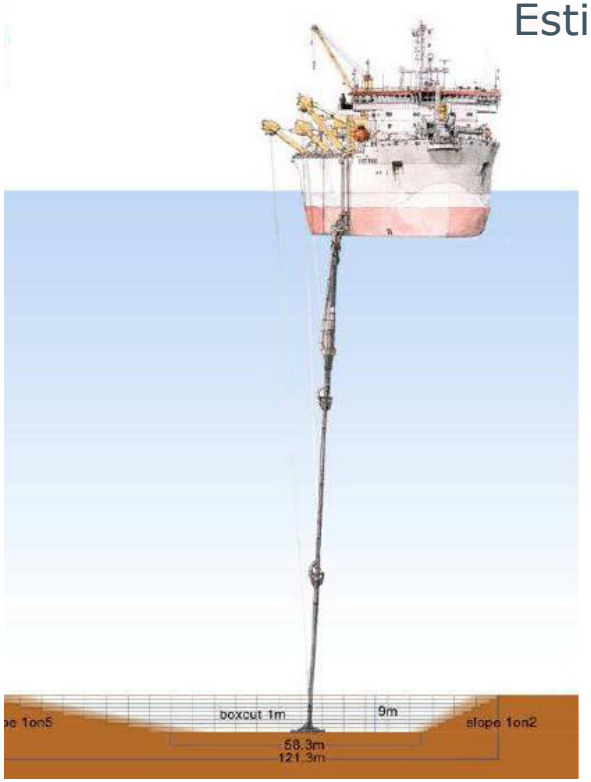
- Similar to alternative 2
- Additional large scale dredging
- No cover

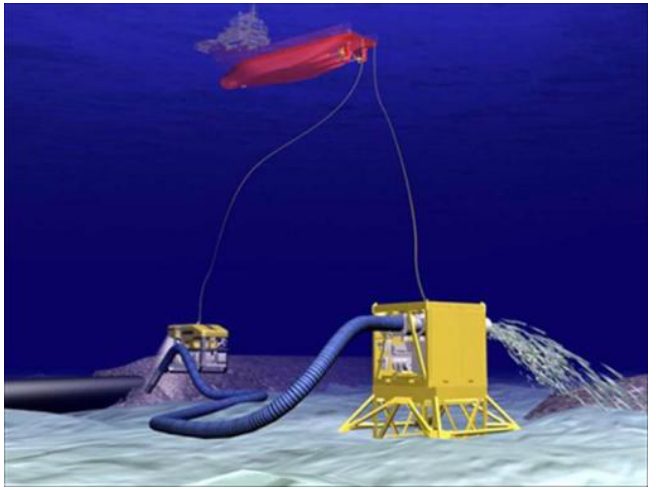
Alternative 4B

- Similar to alternative 3
- Additional large scale dredging
- No cover

Estimated Hg recovery 90-99%

Potential solutions





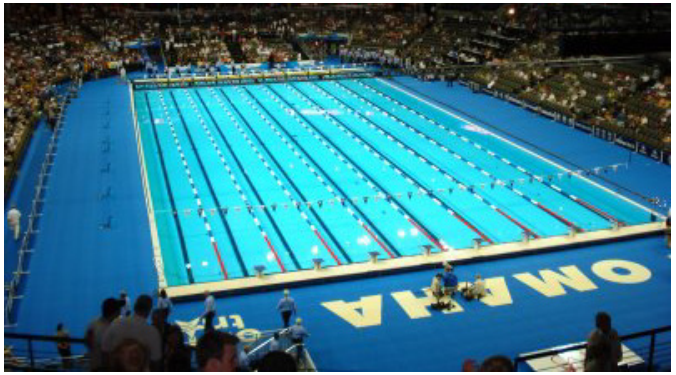
Transport and handling of recovered material alternatives: 2, 3, 4A and 4B

Alternative 2
- From hot-spot dredging – Minimum 2 500 m^3
- + Wreck and content

Alternative 3
- From hot-spot dredging - Minimum 2 500 m^3
- + Load/containers

Alternative 4A
- From large scale dredging - 270 000 m^3
- + Wreck and content

Alternative 4B
- From large scale dredging - 270 000 m^3
- + Cargo/containers



Olympisk svømmebasseng – 2 500 m^3

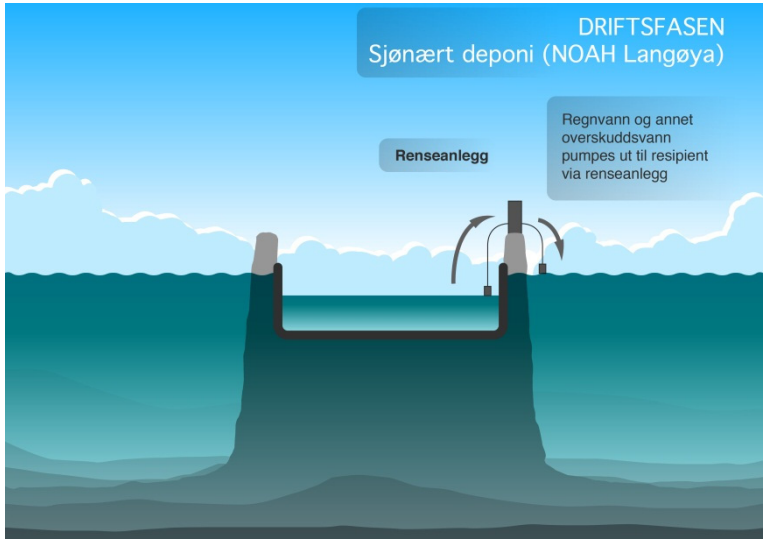

Postgirobygget - ca 200 000 m^3

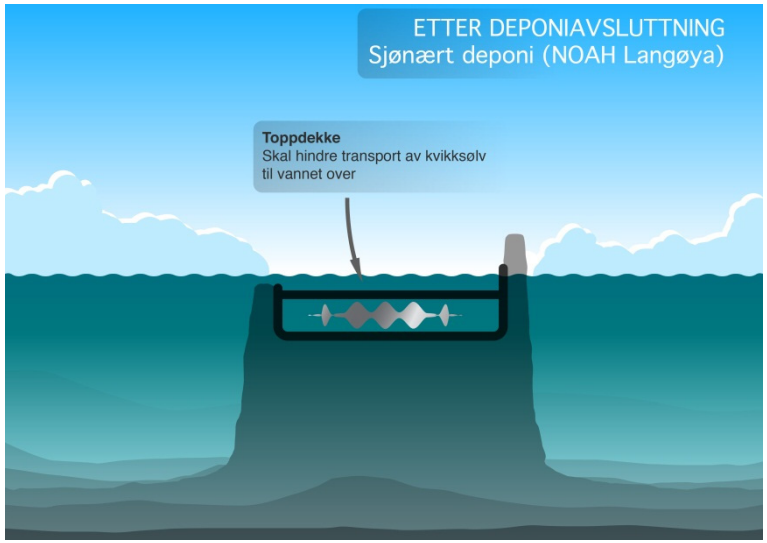
Transport and treatment of recovered materials
Alternatives: 2, 3, 4A and 4B

Potential locations:

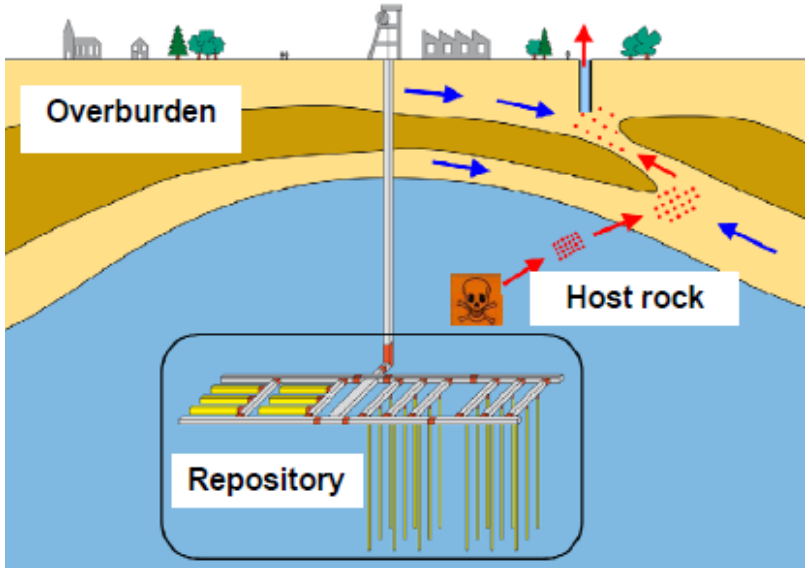
- Hanøytangen (Bergen)/ Vats (Stavanger) for cleaning/preparation
- Langøya (Oslo fjord) / Germany for storage

Land storage e.g. Langøya
- today used for storage of dangerous materials





Land storage e.g. Salt mine Germany

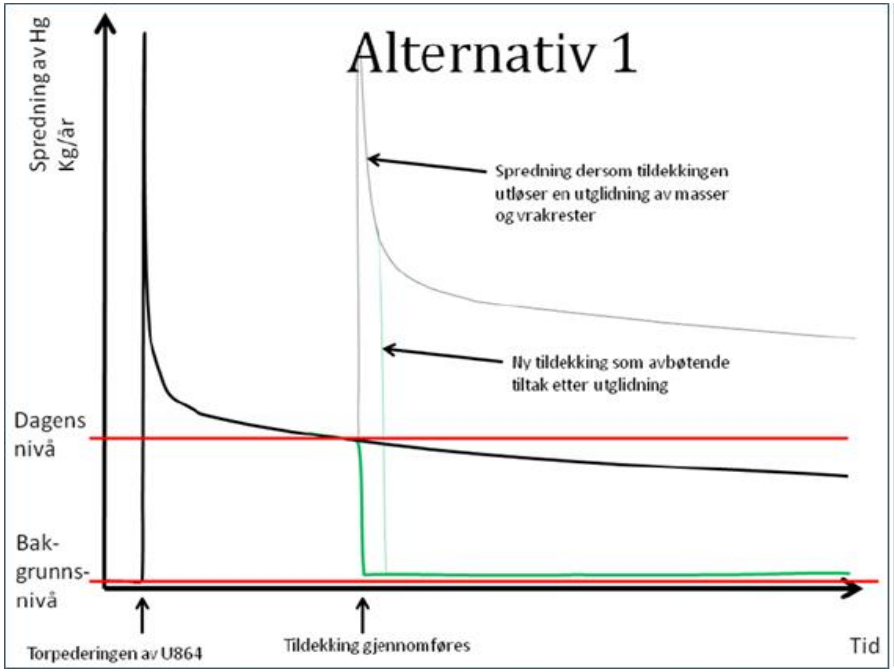


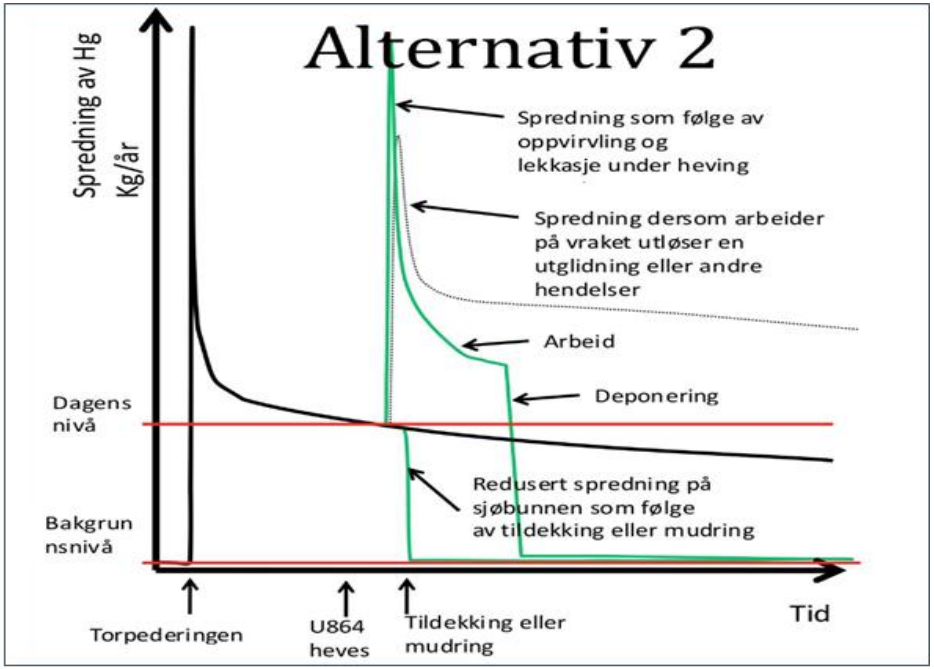
Benchmarking

Project	Country	Year	Comment	Water depth	Relevance
Turingen lake	Sweden	2003	Metallic Mercury covered	- 5m	Positive
København havn	Denmark	2004	Mercury++ dredging and cover	Harbour	Positive
Palos Verdes, California	USA	2000	Contaminated: DDT/PCB. Pilot-study	40 – 60m	Only cover / rock dumping
Eagle Harbor	USA	2003	Mercury++ Covered by sand	Harbour	Positive
Log Pond Bellingham Bay	USA	2000	Mercury++ Covered by sand	Harbour	Positive
Hamilton Harbor	Canada	1995	PCB, Mercury++	Harbour	Ongoing
Port of Seattle	USA	1994	Mercury++	Harbour	Positive
Minamata Bay	Japan	1977/88	Metyl Mercury	Harbour	Positive
Odda	Norway	1992	Metallic Mercury	Harbour	Source not stopped

Risk assesment – Independent assesments

- Risk assessment – focus on following main objectives
  - Environmental risk, short term
  - Environmental risk, long term
  - Operational risk during execution of project
  - Cost risk during execution of project
- Risk analysis
  - Specification of all assessed risk elements
  - Elements given order of probability and impact
- Environmental Risk Analysis - focus on:
  - Risk of spreading of Hg
  - Ecological risk
  - Human risk
- Geotechnical assessments
- Risk analysis on cost

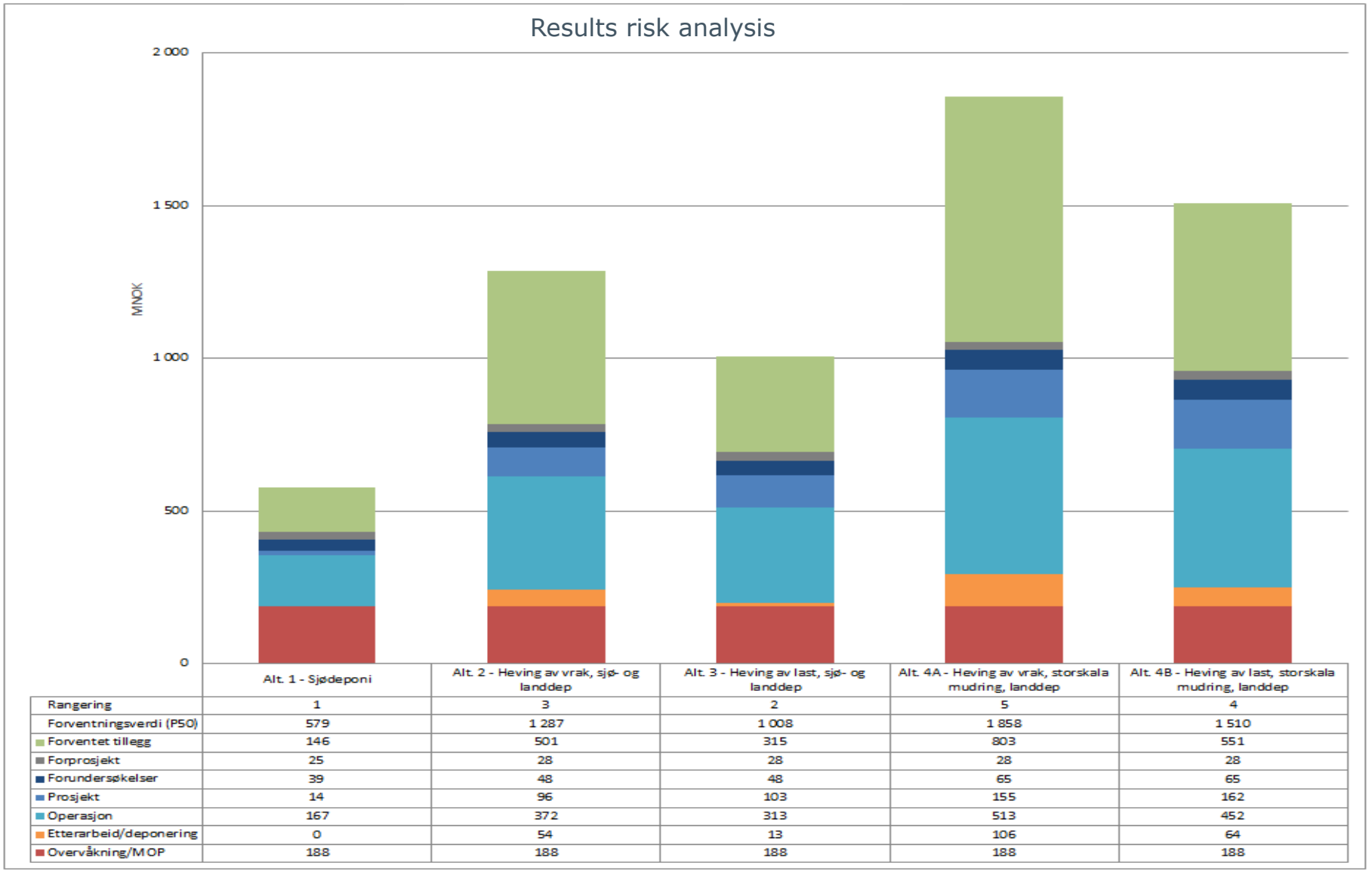




Potential incidents

- "collapse of sea-bed during operation"
- "Explosions"
- "Leakage of Mercury when raised"
- "Problems during transportation"
- "Spreading of contaminated soil from operation"
- "Leakage of Mercury when handling the wreckage between vessels/land/etc."
- "Explosions on Vessels/land»

Cost estimates (expected value– MNOK)



	Alt. 1 - Sjødeponi	Alt. 2 - Heving av vrak, sjø- og landdep	Alt. 3 - Heving av last, sjø- og landdep	Alt. 4A - Heving av vrak, storskala mudring, landdep	Alt. 4B - Heving av last, storskala mudring, landdep
Rangering	1	3	2	5	4
Forventningsverdi (P50)	579	1 287	1 008	1 858	1 510
Forventet tillegg	146	501	315	803	551
Forprosjekt	25	28	28	28	28
Forundersøkelser	39	48	48	65	65
Prosjekt	14	96	103	155	162
Operasjon	167	372	313	513	452
Etterarbeid/deponering	0	54	13	106	64
Overvåkning/MOP	188	188	188	188	188

Rankings and recommendation

MAIN CRITERIA	Alt. 1	Alt. 2	Alt. 3	Alt. 4A	Alt. 4B
Short term environmental risk	(÷)	÷÷÷	÷÷	÷÷÷÷	÷÷÷
Long term environmental risk	+++	+++	+++	+++	+++
Cost	580	1290	1010	1860	1510
Rank	**1**	**3**	**2**	**5**	**4**

- Different short term environmental risk, all show reach objectives on long term.
- Ranking based on the cost of achieving the environmental objectives.
- If Alt.1 is not feasible due to political reasons , then alt. 2 and 3 may not be feasible either.
- The recovery of the wreck (Alt. 2 and 4A) is assessed to be unfeasible. This is because recovery of Mercury (Alt. 3 and 4B) seem to be better alternatives, based on both environmental and cost assessments.
- The recommendation is based on a very thorough analysis. Continued assessments are not advised.

Summary – Major Challenges

- Stakeholder management
- Communication
- Infinity perspective – how to define the requirements of the project whilst trying to balance these needs against potential similar demands other places in Norway.
- Reasoning versus feelings!!