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# **MANAGEMENT OF POPs CONTAMINATED SITES IN MOLDOVA: CISMICHIOI LANDFILL**

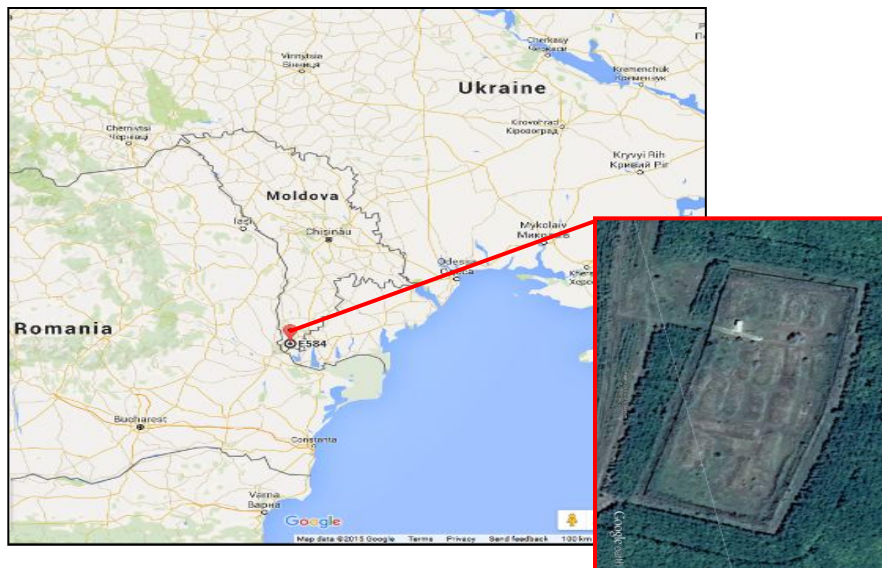
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## *\*Origins of the problem*

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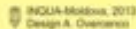
- Intensive use of chemicals in Moldovan agriculture in the soviet period;
- 560,000 tons of pesticides imported in Moldova between the 1950 and 1990 to a total area of the country less than 35 thousand km<sup>2</sup>;
- Improper pesticides management strategy and accumulation of big amount of banned and useless pesticides over the years in storage facilities;
- The first attempt to solve the problem in 1970s - construction of a landfill for obsolete pesticides;
- Unsuitable technical and ecologically unsustainable solution for the construction of the landfill, probably due to lack of financial resources and clear environmental requirements at that time.
- Inadequate management of the waste storage process, inaccurate recording of the quantities and type of chemicals stored and improper subsequent retention of records.

# General Description of the Site



- Situated in the south of Moldova, 5 km apart from the Ukrainian border and about 10 km apart from the surface waters related with Danube delta;
- The nearest village of Cișmichioi [Chishmikiy] is approx. 7 km distant from the landfill;
- Built in 1975-1977 and put into operation in 1978;
- Located in a closed area of approx. 2.3 ha with 14 waste storage pits (3 concrete pits and 11 ground pits);
- Protected by a fence made of concrete slabs with the height of approx. 2.5 m and guarded by security guards - State Enterprise "Guard services";
- Current management - the National Agency for Food Security.

## Arrangement of 14 pits with buried pesticides



## ***General Description of the Site***



- The size of concrete pits is approx. 30m x 10m x 4m;
- The size of ground repositories is 29-43m x 12.5m-16.5m x 5m.;
- Total volume of 14 pits is about 26,000 m<sup>3</sup>;
- The quantity of buried waste - 4,000 tons (according to available documents);
- The estimated quantity of waste - over 16,000 tons.

### **Regular monitoring at landfill 1999-2014:**

- Institute "Acvaproiect";
- National Agency for Geology "AGeoM";
- State Hyrometeorological Service;
- Center of Ecological Investigations "ECOS";
- Public Association "INQUA-Moldova".



# *The Chismichioi OP Landfill*

## **Situation regarding the landfill in 2014:**

- **Uncertainties regarding the amounts of pesticide waste stored;**
- **Insufficient knowledge of the degree and type of soil and groundwater contamination in the landfill area;**
- **Degradation of the protective upper layer of the stored waste pits and landfill infrastructure;**
- **Growing concerns of area residents regarding the landfill's negative environmental and health impacts.**

## **Necessary measures to be taken:**

- **Site investigations and feasibility study to determine more accurately the quantities and categories of waste stored, the most appropriate method of remediation, to estimate costs, technical and equipment needs, etc.**
- **Practical remedial works at the Cismichioi landfill.**



## **Project “*Reduction of the risks associated with hazardous waste landfill in Cismichioi*”:**

- **Financed by the Czech Development Agency;**
- **Works carried out by the Company Dekonta a.s., Czech Republic;**
- **Coordinated by POPs Sustainable Management PMT within the Ministry of Environment of Moldova and the National Agency for Food Safety;**
- **Period of implementation: 2016-2018.**

### **Project stages:**

- **Site investigation;**
- **Risk assessment;**
- **Analysis of mitigation measures and recommendations;**
- **Feasibility study;**
- **Rehabilitation works on site.**

# *Site investigation*

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□ ***Aim of investigation work*** - to determine the amount of waste stored, the nature of stored substances and degree of contamination, and included the following activities:

- geophysical investigation,
- investigation of the unsaturated zone,
- investigation of the saturated zone,
- sampling of all the matrices,
- laboratory analyses of samples collected,
- waste identification and inventory,
- surveying,
- data evaluation.



# *Site investigation*

## *Conclusions:*

- The material within the area of the landfill is contaminated with heavy metals (As, Cr<sub>tot</sub>, Cu, Zn), pesticides (2,4-D, atrazine, simazine), organochloride pesticides (4,4'-DDT; 4,4'-DDE; 4,4'-DDD; 2,4-DDT; 2,4-DDE; 2,4-DDD; HCH alpha, HCH beta, HCH gamma), oil products (C<sub>10</sub>-C<sub>40</sub>) and PAH's (naphthalene and benzo(a)anthracene);
- In the most of pits the contaminated depth interval reaches up the depth 5-6 m (below to tops of the mounds).
- The top strata of the mounds (up to approx. 2,4 m b.t.) shows relatively low level of contamination.
- The rough estimation, based on the analyses results and the knowledge of the mounds dimensions, is that in the landfill there is approx. 37,600 m<sup>3</sup> of contaminated waste/soil;
- there is only a very limited contaminant migration from the waste deposits;
- no contamination in the building structure, bottom sediment and surface water.

# ***Risk Assessment***

***Main objective of the RA*** - to assess significant human health and environmental risks related to existing soil and groundwater impact and determine appropriate mitigation measures:

## ***Summary of Total Risk:***

- The soil contamination beyond the waste mounds had dominantly a point character and it is almost exclusively related to the top soil strata;
- The extent of soil impact indicates an inability of contaminants to significantly migrate through the unsaturated zone to groundwater;
- No groundwater contamination was detected;
- No unacceptable risks were identified for on-site workers and off-site farmers for any quantified exposure scenario;
- ***Considering that the landfill in Cismichioi represents the potential serious contamination source which requires the permanent control.***

## ***Recommendations of mitigation measures***

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### ***The objectives of the mitigation measures defined:***

- **Permanent control of the landfill presenting a potential serious contamination source;**
- **To eliminate any potential for the release of the deposited material from the landfill to the surrounding environmental media;**
- **To complete the groundwater monitoring network by additional monitoring well located southwest the landfill in the anticipated groundwater flow direction;**
- **Monitoring of groundwater quality should be conducted with the aim to verify the results of the performed site investigation;**
- **No changes should be made to the current land use of the subject property.**

## ***Recommendations of mitigation measures***

### ***Three options of mitigation measures proposed:***

- ▣ ***Option 1. No action.*** No remedial action at the site, the site remains as it is. This option does not eliminate the potential any future release of the deposited material from the landfill to the surrounding environmental media. It was considered that *No Action option is not acceptable* for the Cismichioi landfill.
- ▣ ***Option 2. Upgrade of landfill containment*** comprises a capping of a landfill as a complex or of the individual waste repositories with compacted landfill surface, geocomposite bentonite mat, covered with HDPE 2 mm thick foil, geotextile a granular drainage layer and a vegetative support layer, and further upgrade of the existing drainage system.
- ▣ ***Option 3. Removal of landfill*** comprises the removal of topsoil and waste by excavation and further disposal of the excavated materials on the off-site landfill for hazardous waste or its treatment by one of the existing methods. This option allows the complete removal of the landfill, but it also has negative sides, such as complicated technologies, large amounts of waste treated, requires a long time and high costs.

# ***Feasibility Study***

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***The objective of feasibility study*** - to specify the optimal solution for the improvement of the landfill containment including the precise estimate of the respective costs.

***Criteria*** considered during the *screening of remedial technologies*:

- Overall protection of human health and the environment;
- Regulatory compliance;
- Effectiveness and performance;
- Long term maintenance issues;
- Reductions in toxicity, mobility, and/or volume of contaminants;
- Implementability;
- Costs.

# ***Feasibility Study***

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***Four remediation alternatives*** consistent with the scope of work of the Feasibility Study:

***Alternative 1:*** Capping of hazardous landfill in Cismichioi;

***Alternative 2:*** Excavation of dumped pesticides waste and contaminated soil with their disposal in an incinerator;

***Alternative 3:*** Excavation of dumped pesticides waste and contaminated soil with on-site treatment of waste using Gas Phase Chemical Reduction and treatment of soil by biodegradation;

***Alternative 4:*** Excavation of dumped pesticides waste and contaminated soil with on-site waste treatment using Base Catalysed Decomposition and treatment of soil by biodegradation.

***The criteria for evaluating the remedial alternatives*** are technical, institutional, and economic considerations that decision-makers will take into account in selecting the remedial actions.



# Feasibility Study

## Conclusions:

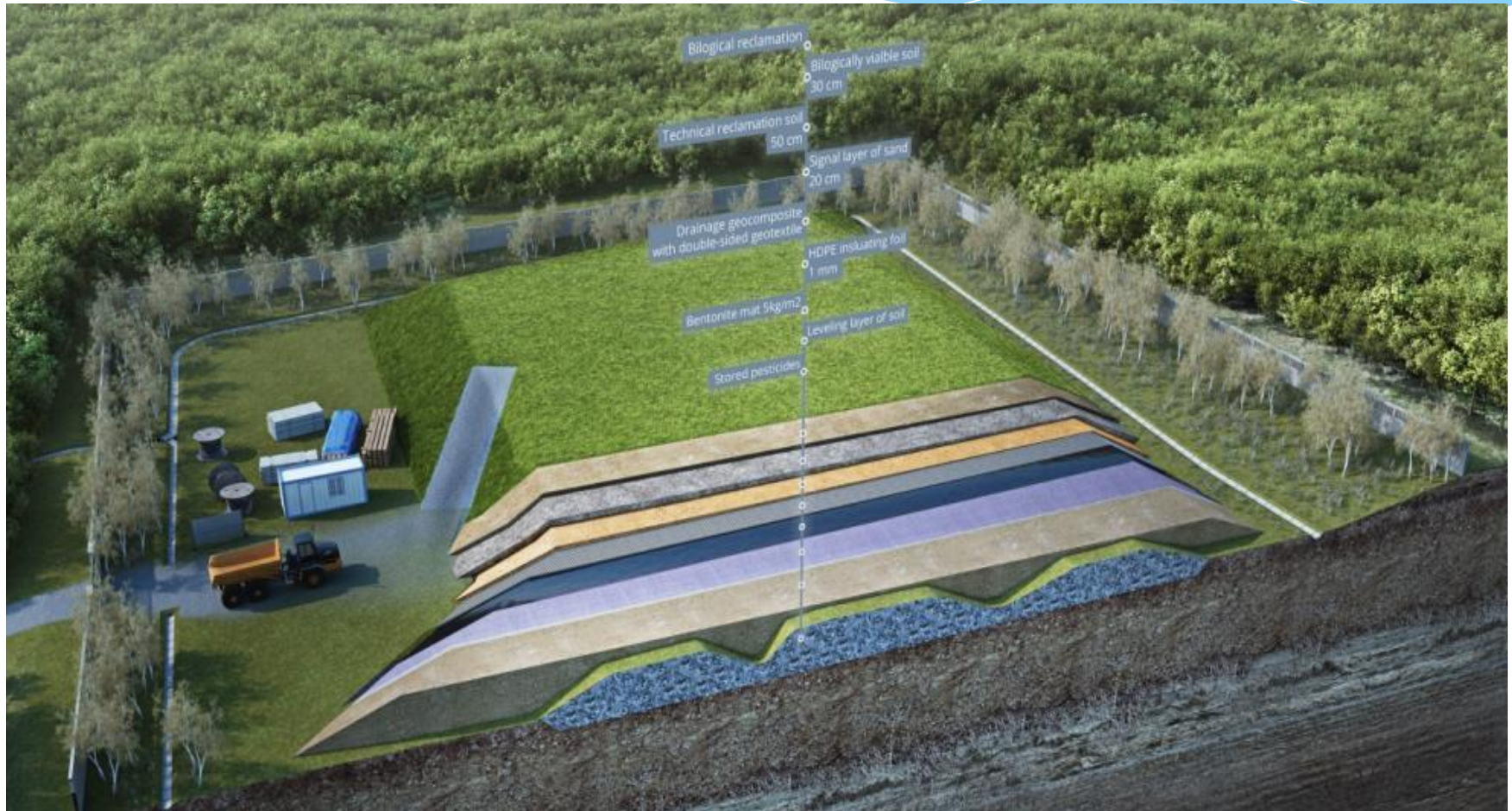
- There are ***no significant differences*** between individual alternatives with regards to protection of human health and the environment, and to long-term effectiveness. All alternatives were judged technically feasible.
- The difference was made by ***the costs***:
  - ***Alternative 1*** considering capping is relatively cheap (approx. 1 million Euro);
  - Costs for alternatives considering removal of waste and contaminated soil range reach about 60 million Euro (***Alt. 2***), 21 million Euro (***Alt. 3***) and 38 million Euro (***Alt.4***). Removal of waste and contaminated soil cannot be justified on an economic basis.
- ***In sum, Alternative 1 was recommended for further considerations mainly due to relatively short time needed for achieving acceptable reduction of existing risks, relatively low exposure to hazardous substances during remedial action and low cost in comparison to other alternatives.***

## *Rehabilitation works*

The technical solution for the reclamation of the hazardous waste landfill in Cismichioi included several stages of construction works and facilities:

- *Landscape design and reconstruction* included strengthening the surface of the landfill and the circumferential slopes along the perimeter of the landfill;
- *Technical remediation* on the area of 11,830 m<sup>2</sup>;
- *Drainage* represented by a trench 0.8 m deep and 1.0 m wide;
- *Biological remediation* by a vegetative cover planted with a mixture of fast-growing grasses;
- *Monitoring* - the system for monitoring groundwater and atmospheric air quality parameters was reconstructed.

# Rehabilitation works



Cross-section of the reclaimed landfill in Cismichioi

# *Rehabilitation works*

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## *Conclusions:*

- ❑ The landfill body was restored in situ and integrated into the landscape;
- ❑ The rehabilitation was designed and executed in accordance with the current legislation and took into account the results of investigation and monitoring of ground and surface waters;
- ❑ Thanks to landfill rehabilitation, a significant improvement in the safety of stockpiled pesticides and other chemicals has been achieved in order to prevent environmental pollution (soil, groundwater) in the future;
- ❑ Ensuring the safety of the landfill will reduce the risks to public health;
- ❑ The main goal of the rehabilitation, which was to conserve the landfill and limit its impact on the environment, has been achieved.

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**THANK YOU FOR YOUR ATTENTION !**

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