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Decision Consequence Analysis (DCA) of Intervention Alternatives on Landfills Wandir I and II, Volta Redonda (RJ)

José Carlos Rocha Gouvêa Júnior
Project Manager - Environmental Liabilities
Companhia Siderúrgica Nacional

Introduction

1. **Decision Consequence Analysis (DCA)**
    - Application of a formalized decision making process;
    - Employs Decision Theory, probability and statistics;
    - A decision is addressed by disaggregating uncertainties and predicting positive and negative outcomes of possible management approaches;
2. **Advantages**
    - Provides a structured model for mapping and evaluating possible outcomes and risks for a decision;
    - Decision support system for management of environmental liabilities to assist the decision maker in choosing best management alternatives.
3. **Case Study**
    - Implementation of a Intervention Plan for landfills Wandir I and II, that's received steelmaking wastes between 1995 and 1997, in a area of almost 140,000m2;
    - In accordance with local guidelines (CONAMA 420), after several soil and groundwater investigation, the area was classified as contaminated site due the presence of metals and PAH above the standards and SSTL's for groundwater ingestion;

Objectives

Select an alternative for intervention and site closure of Landfills Wandir I and II.

The **DCA Methodology** was applied to ensure that:

- **All possible alternatives** were considered;
- **Uncertainties** were listed, quantified and addressed;
- Possible **outcomes were understood** and summarized;
- **Subjective beliefs** about alternatives were mostly eliminated from the analysis

Protection

Ensure protection of human health under any scenario of future land use, including occupation by residences, commerce and industry;

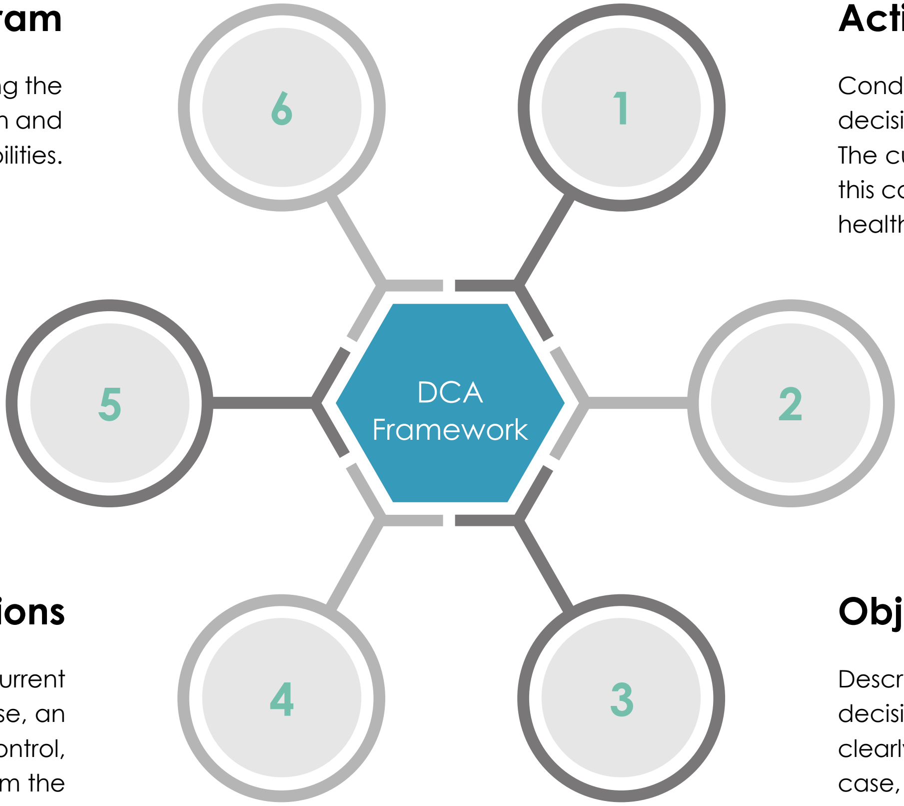
Longstanding Effectiveness

The adopted alternative must have longstanding effectiveness;

Minimize Risks

The adopted alternative must be environmentally sustainable and minimal risk od collateral damage during implementation

Methodology



Action Triggers

Conditions that create the need for a decision;
The current undesired state of nature, in this case, the contamination, posing health risk for hypothetical occupants

Problem Statement

Is the diagnostic of unacceptable conditions. A robust understanding of the problem changes both the objectives and the alternatives for reaching them.

Objectives

Describe the desired state of nature after decisions are implemented; they need to be clearly defined, concise and measurable. In this case, the objectives chosen were the ones described in the previous section

Primary Decisions

Are the actions necessary to change from the current state of nature to the desired one. For this case, an extensive list of measures of institutional control, engineering and remediation was drawn from the literature.

Performance Metrics

Every alternative must be evaluated according to the defined performance metrics, which measure attainment of the objectives. For that, it is necessary to map the interaction between decisions and uncertainties.

Decision Diagram

Generally in a tree format, describing the possible outcomes of each decision and their probabilities.

Results

Problem description: the main boundary conditions described for the site, based on the data collected, were groundwater flow velocity is low; wastes are buried at a maximum depth of 7m, and average depth between 3 and 4m; and the main risk pathway of concern is groundwater consumption. Therefore, the adopted alternative should prevent direct contact with groundwater for future occupants on the landfill area or reduce the contamination to acceptable risk levels.

1

Groundwater withdrawal restriction

Already in effect due to a municipal law

2

Landfill Cap

3

Excavation and soil/steelmaking wastes disposal

4

Combination of alternatives 1 and 2

Landfill cap and groundwater withdraw restriction.

Combined Alternatives

2,6%
Chance of failing of geomembrane in the first10 years

10YRS
Horizon with low risk of collateral damage

50%
Cost in comparison with soil excavation and disposal

Landfill Cap

Groundwater withdraw restriction

Landfill cap aims to **block the main routes of exposure** that may offer risks.

Additionally, by delaying the leaching of contaminants into the aquifer, it **prevents the already unlikely migration of contaminants out of the site through groundwater**.

A **conservative estimate** of the probability of success is that the geomembrane has a **2.6% chance of failing in the first 10 years. The risks associated with its implementation are significantly lower than** those associated with **excavation and soil disposal.**

Restricting groundwater withdrawal in conjunction with landfill cap increases the likelihood of success, especially by reducing the likelihood of damages to the geomembrane due to well drilling. In addition, in the event of geomembrane failure, the restriction will continue to block the main exposure pathways.

Conclusion

- The application of DCA techniques allowed a comprehensive evaluation of the alternatives for intervention and site closure of landfills Wandir I and II by describing the boundary conditions, defining objectives and evaluating the effectiveness and likelihood of success of each alternative in a systematic way.

- Due to the characteristics of the contaminants and the hydrogeology of the site, the risk of migration of contaminants reaching the receptors outside the landfill through groundwater is practically non-existent in the medium term.

- The risks to human health occur only in scenarios that are hypothetical, unrelated to the current occupation.

- The combined alternatives of geotechnical confinement and restriction to groundwater abstraction would eliminate the risks to human health satisfactorily over a 10-year horizon, with a low risk of collateral damage during its implementation.

- The alternative of soil removal and re-disposal, while equally effective in eliminating risks to human health, would create risks of accident and contamination during its implementation and would cost at least twice as much as the landfill cap.

Acknowledgments