# A Net Ecosystem Services Analysis of Remedial Alternatives for a Surface Impoundment in the Southwest


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## Introduction

A surface impoundment at a manufacturing facility in the Southwest is currently dry. Part of the impoundment has 1-foot of soil and vegetation covering hazardous substances released by the manufacturing facility, while the remainder of the impoundment has no soil cover or vegetation. The state regulatory agency wants the partial soil cover and vegetation removed and then the entire impoundment covered with 3-feet of soil and seeded vegetation. The company prefers to leave the partial soil cover and vegetation in place, and then put 1-foot of soil cover with seeded vegetation over the remainder of the surface impoundment. An intermediate remedial alternative would be to remove the partial soil cover and vegetation and put a 2-foot soil cover with seeded vegetation over the entire surface impoundment.

A Net Ecosystem Services Analysis (NESA) is being considered to rank the remedial alternatives from best to worst from an ecosystem services perspective. Specifically, a NESA uses Habitat Equivalency Analysis (HEA) to estimate the aggregate, net ecosystem services over time provided by each remedial alternative, and the remedial alternative with the greatest aggregate, net ecosystem services is the preferred alternative. Alternatives with negative net ecosystem services should not be implemented, because they do more harm than good. The costs of the remedial alternatives play no role in a NESA.

There will be five main steps in the NESA. The first step will be to identify the ecosystem services provided by the vegetation on the partial soil cover on the surface impoundment and the vegetation on the borrow areas where the soil for the cover of the remainder of the surface impoundment will be obtained. Then, in the second step a representative ecosystem service for the vegetation will be selected or an index of several ecosystem services will be developed. The third step will be to estimate the proportion of the selected ecosystem service/index relative to the maximum possible ecosystem service/index for the next 50 years for each remedial alternative for both the surface impoundment and borrow areas. In the fourth step, the timepaths of the relative ecosystem services for each remedial alternative will be converted into their present-value equivalent using a 3% discount rate and then will be summed. The final step will be to rank the remedial alternatives from best to worst using the magnitude of the present-value-equivalent, aggregate, net ecosystem services.

### Step 1: Identify Relevant Ecosystem Services

↓ Vegetation on Surface Impoundment and Vegetation on Borrow Area

### Step 2: Select Ecosystem Service Metric

↓ Choose Representative Ecosystem Service or Develop Ecosystem Service Index

### Step 3: Multiply Relative Ecosystem Services by Acreage Affected for Each Remedial Alternative

↓

$$\frac{(\text{Expected Ecosystem Services})_{\text{Year}}}{(\text{Maximum Ecosytem Services})_{\text{Year}}} \times \text{Acres}$$

↓

Surface Impoundment
Borrow Area

### Step 4: Convert Annual Service-Acres for Each Remedial Alternative into Their Present-Value Equivalents

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### Step 5: Rank Remedial Alternatives from Best to Worst

[A]

[B]

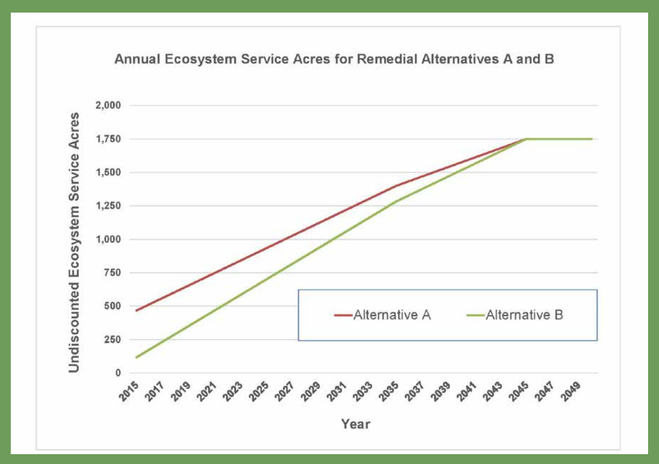
Tailing Ponds - Revegetated [A] and Active[B]

| Ecosystem Services of Impacted Habitat | Ecosystem Service Metric |
|---|---|
| 1. Regulation of Water Percolation Through the Soil<br>2. Air Quality / Dust Regulation<br>3. Greenhouse Gas Sequestration and Emissions.<br>4. Wildlife Support<br>5. Aesthetic Value | Stem Density Per Acre |

### Characteristics of Remedial Alternatives

| Remedial Alternative | Depth of Soil Cover (Feet) | Slope of Soil Cover | Acreage of Soil Cover |
|---|---|---|---|
| A | 1 | 0.5% | 700 |
| B | 2 | 0.5% | 700 |
| C | 3 | 0.5% | 700 |
| D | 3 | 1% | 700 |
| E | 3 | 1% | 1,050 |

### Comparison of Annual Ecosystem Services Gains from Remedial Alternatives A and B

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