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*Help Instruction File:*

# Sampling Module Overview

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Provided by the Office of Surface Mining Reclamation and Enforcement (OSMRE), the Pennsylvania Department of Protection (PADEP), the U.S. Geological Survey's (USGS) and the West Virginia Department of Environmental Protection (WVDEP).

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# 1.0 Objective

In the AMDTreat program, the Sampling module is considered a project component of a mine drainage treatment system. A sampling plan may or may not be required as part of planning and operating a treatment system but is highly recommended in order to monitor the performance and ensure that the treatment components are obtaining the objectives for treatment of the mine drainage. For mine drainage where a responsible entity and a National Pollutant Discharge Elimination System (NPDES) permit exist, the applicable regulatory authority directs the permittee (responsible entity) where the sampling is to be performed, parameters to be monitored and reported, and the frequency in which the samples must be collected. The NPDES permit may also require the permittee to conduct monitoring of the water body receiving the treatment system outfall upstream and downstream of the discharge location, also referred to as Hydrologic sampling locations. While there are minor capital costs associated with the Sampling module, the module was included in AMDTreat in order to capture the annual costs associated with the labor and laboratory costs to monitor the locations at a mine drainage treatment system required as part of an NPDES permit.

The objectives of the overview are to (1) Provide an understanding for the application of the Sampling module for capturing the associated costs for a mine drainage treatment system and (2) Provide an overview of the Sampling module to guide users in developing a cost estimate for this project component. The information is presented in two sections, **Overview and Application** and **Sampling Module Overview**.

## 2.0 Overview and Application

A basic understanding of the application, labor, permit conditions and equipment requirements for the sampling component of an entire treatment system is required to develop an accurate cost estimate using the AMDTreat software. These topics are discussed below before discussing the Sampling module interface and functionality to provide the necessary context. The Overview and Application section is organized into two parts: (1) Functions and (2) Configuration & Application.

### 2.1 Functions

As mentioned in Section 1.0, the Sampling module is intended to capture the annual costs associated with the water monitoring required as part of an NPDES permit that may exist for the final outfall from the treatment system to a receiving stream. The NPDES permit may also require hydrologic samples as well, which typically include sampling the receiving stream both upstream and downstream of the treatment system outfall. The following is a list of the items to consider as part of a treatment system sampling plan:

1. Is there an NPDES permit associated with the mine drainage source(s) to be treated? If so, how many monitoring/collection locations are required and what is the monitoring frequency?
2. Are hydrologic monitoring locations included as part of the NPDES permit requirements and if so how many monitoring locations and what frequency is required for those locations?
3. If there is no NPDES permit in place, then the project manager must determine if regular monitoring of water quality is required to ensure the treatment system is achieving the desired goals of the project. The number and locations of monitoring (water sampling) including the

parameters to be measured and the desired frequency should be determined to provide an approximate annual cost for sampling and monitoring the system or any of the components.

## 2.2 Configuration & Application

Requirements as set forth in an applicable NPDES permit that has been applied to a mine drainage source will dictate the primary inputs the user must include in order to consider the Sampling module for an entire treatment system as an annual cost component. The number of NPDES sampling points, sample frequency, and the approximate lab cost per sample, based on the parameters set forth in the NPDES permit (e.g., Dissolved Iron), allow the user to input this information into the module. It is often a good idea to generate a schematic plan (map) of the applicable treatment system in order to illustrate the proposed sampling locations, both those required as part of an NPDES permit if applicable and those for which the operator wishes to monitor for the raw water and individual components. If hydrologic monitoring is necessary as part of an NPDES permit, these sample locations can also be shown on the schematic plan since they are typically located in the receiving stream upstream and downstream of the treatment system outfall.

For treatment systems where there is no applicable NPDES permit, the need for sampling and monitoring is still recommended in order to monitor the effectiveness of the treatment system and to ensure that the system is achieving the restoration goals in the receiving stream(s).


## 3.0 Sampling Module Overview

This section focuses on describing the specifics of the AMDTreat Sampling module.


### 3.1 Layout and Workflow

In general, inputs are on the left-hand side of the module and calculated outputs are on the right side. The module inputs on the left-hand side are generally arranged into two sections: (1) Properties and (2) Costs. The workflow for users is to begin at the top left-hand side (Properties) and continue down on the left-hand side entering all the appropriate input parameters.

Module output is provided on the right-hand side of the module. Module outputs are arranged into three sections: (1) Capital Cost, (2) Annual Cost, and (3) Net Present Value (NPV). The estimated cost to conduct sampling is provided under the Capital Cost and Annual Cost headings. The final output section includes the NPV analysis. This section provides an estimate of the total cost to conduct sampling of a mine drainage treatment system for a defined time period.


A general overview of the module input and output sections is presented below, however, users are directed to the numerous tool tips located within the module that provide additional detailed information, such as definitions of terminology. In most cases, the tool tips are accessed by clicking on the information icon (  ) in each of the subheadings in the module.

### 3.2 Module Inputs

**3.2.1 Properties:** The user can select or de-select Round Trip Travel Time (hrs) and Round Trip Mileage (mi). There are also entries for NPDES Monitoring and Hydrologic Monitoring. The descriptions of the items can be found in the tool tip for this section. Click on the information icon (  ) on the right side of the Sampling heading.

*3.2.1.1 NPDES Monitoring:* This section has entries for the Number of Sample Points (each), Collection Time Per Sample (hrs), and Sample Frequency [Ev (Events)/month], related to the requirements set forth in an NPDES permit.

*3.2.1.2 Hydrologic Monitoring:* This section has entries for the Number of Sample Points (each), Collection Time Per Sample (hrs), and Sample Frequency [Ev (Events)/month], related to the general hydrologic monitoring, which may or may not be related to an NPDES permit.

**3.2.2 Costs:** The user can select or de-select Flow and Sampling Equipment Cost (\$). There are also entries for Labor Unit Cost, Mileage Rate, and Lab Costs. The descriptions of the items can be found in the tool tip for this section. Click on the information icon (  ) on the right side of the Sampling heading.

*3.2.2.1 Flow and Sampling Equipment Cost:* The user can enter the capital cost for Flow and Sampling Equipment needed to conduct the sampling/monitoring of the treatment system. Sampling equipment may consist of such items as a pH meter, field alkalinity kit, etc.

*3.2.2.2 Labor Unit Cost:* This user input represents the unit cost of labor (\$/hr).

*3.2.2.3 Lab Cost per NPDES Sample:* This user input represents the lab cost for all of the analyses required for each NPDES sample (\$/sample). If the operator wishes to obtain additional parameters beyond what is required by the NPDES permit, they should verify the costs and include it in this unit cost.

*3.2.2.4 Lab Cost per Hydrologic Sample:* This user input represents the lab cost for all of the analyses required for each hydrologic sample (\$/sample). If the operator wishes to obtain additional parameters beyond what may be required by an NPDES permit, they should verify the costs and include it in this unit cost.

*3.2.2.5 Mileage Rate:* This user input represents the approximate gas and maintenance cost for each mile driven (\$/mile).

## 3.3 Module Outputs

This section goes over the module outputs (costs) for the items associated with estimating the sampling cost of a mine drainage treatment facility. The default values are based on prior experience of the AMDTreat team; however, these can and should be adjusted according to specific site conditions and current rates of each item.

**3.3.1 Capital Cost:** This capital cost comes directly from selecting and entering the Flow and Sampling Equipment Cost.

**3.3.2 Annual Cost:** This annual cost can come from the Calculated selection, which includes Labor Cost, Lab Cost, and Mileage Cost, or from a User Specified cost. The User Specified cost may be used where an existing system is in place with known sampling costs.

*3.3.2.1 Labor Cost:* The Labor Cost is calculated using several of the variables specified by the user in order to calculate an annual cost for the labor effort required to conduct the necessary sampling for the treatment system.

**3.3.2.2 Lab Cost:** The Lab Cost is calculated using several of the variables specified by the user in order to calculate an annual cost for the lab analysis required for the sampling of the treatment system including any hydrologic samples.

**3.3.2.3 Mileage Cost:** The Mileage Cost is calculated using some of the variables specified by the user in order to calculate an annual cost for the mileage driving to and from the treatment site for the laborer conducting the sampling efforts.

**3.3.2.4 User Specified Cost:** Determined by the user, if necessary for including a known annual cost for the sampling of a treatment system.

**3.3.3 Net Present Value:** The NPV section determines the cost to operate a treatment system component over a specified time period. The NPV calculates the present-day financial investment required to generate the income to pay for future operation and equipment/materials replacement costs. Both **Financial Variables** and **Cost Categories** are required to calculate the NPV.

**3.3.3.1 Financial Variables:** The Term of Analysis, Inflation Rate, and Rate of Return are three variables used in the NPV calculations. The default values for these terms are shown under the Net Present Value section of each module. Users must access the Net Present Value menu at the top of the main user interface to change the default values as they would apply to all modules used for an entire treatment system. While NPV is determined for each AMDTreat module activated by the user, the goal is to determine a total NPV for an entire mine drainage treatment system project (a collection of cost estimates for individual modules creates a treatment system project in AMDTreat). Therefore, a single value for Term of Analysis, Rate of Return, and Inflation Rate is applied to all modules and cannot vary between modules.

- **Term of Analysis:** The time period used by the NPV calculation to determine the financial investment required to pay for all future costs of the treatment system.
- **Inflation Rate:** Represents the average price increase of goods and services over time. AMDTreat uses the inflation rate to calculate the future cost of the annual operation and maintenance (O&M) and recapitalization items.
- **Rate of Return:** Describes the expected profit on an investment.

**3.3.3.2 Cost Categories:** For each treatment module, AMDTreat provides a default list of recommended equipment and materials that require recapitalization. In addition, AMDTreat provides recommendations (default values) for life cycle and replacement percentage. Users can click on the default values for *Life Cycle* or *Replacement Percentage* and use the +/- buttons to change the default values. In addition, users can select *Custom Cost* and enter a new cost to represent the current cost of the equipment. Users can add new recapitalization items or deactivate/delete existing items for calculating the NPV.

- **Annual Operation and Maintenance Cost:** By default, AMDTreat transcribes the annual O&M cost from the Annual Cost section to the Net Present Value section. The program assumes the module is being used to estimate the annual cost for a treatment system component, so it automatically transcribes the annual cost to the NPV section.

If this is not the case or the user wants to use some other annual cost, the “Use Custom” box can be selected to allow the user input of a different annual cost to utilize in the NPV calculation.

- Recapitalization Cost: Certain treatment system components, especially mechanical and water conveyance equipment, require periodic replacement. The recapitalization cost of an item is an estimate of the amount of money required to pay for future replacement costs for the item. In addition to the Financial Variables described above, three additional values are required to calculate the NPV of recapitalization costs, the present-Day Equipment Cost, the life cycle, and the replacement percentage.
- Default Cost: This represents the current cost to purchase the equipment or material.
- Life Cycle: The time frame between equipment or material replacement is its life cycle. Some equipment manufacturers provide recommended life cycles for their equipment to provide consumers with an estimate of how long the equipment is expected to be operational. Some life cycles, such as those used for treatment media (limestone), are based on best professional judgement. Some operators prefer to periodically purchase and replace equipment/materials before failure to preserve the continuity of operations, while others wait until failure to replace an item.
- Replacement Percentage: The replacement percentage is an adjustment factor to the default cost to accommodate situations where the entire piece of equipment or all of the material does not require recapitalization.

*3.3.3.3 Rationale for Recapitalization Recommendations*: Recapitalization recommendations are based on professional experience of the AMDTreat Team and may not apply to all situations. Users are encouraged to customize the recapitalization assumptions to their treatment scenario. AMDTreat Team members are located in Pennsylvania and West Virginia and have collective experience in design, funding, and/or operation/maintenance for over 100 passive treatment systems. Users may have different experience and opinions than those listed.

By default, AMDTreat includes two recapitalization items for the Sampling module: Sampling Equipment and Annual O&M. There is also a custom cost field. Users can delete or modify any of the default recapitalization items by either deselecting the item or by setting the replacement % to zero. If the item is deselected the total cost for the item will still be shown but the cost will be subtracted from the NPV cost, shown in the NPV heading. Users are free to fully customize the replacement items, including adding new items or deleting default items.

**Sampling Equipment**: The default life cycle of sampling equipment is set at 5 years and the default replacement percentage is 50 percent (50%), meaning half of the sampling equipment will need replaced every 5 years. The user can adjust these default values as appropriate or specify a custom cost if known for the sampling equipment.