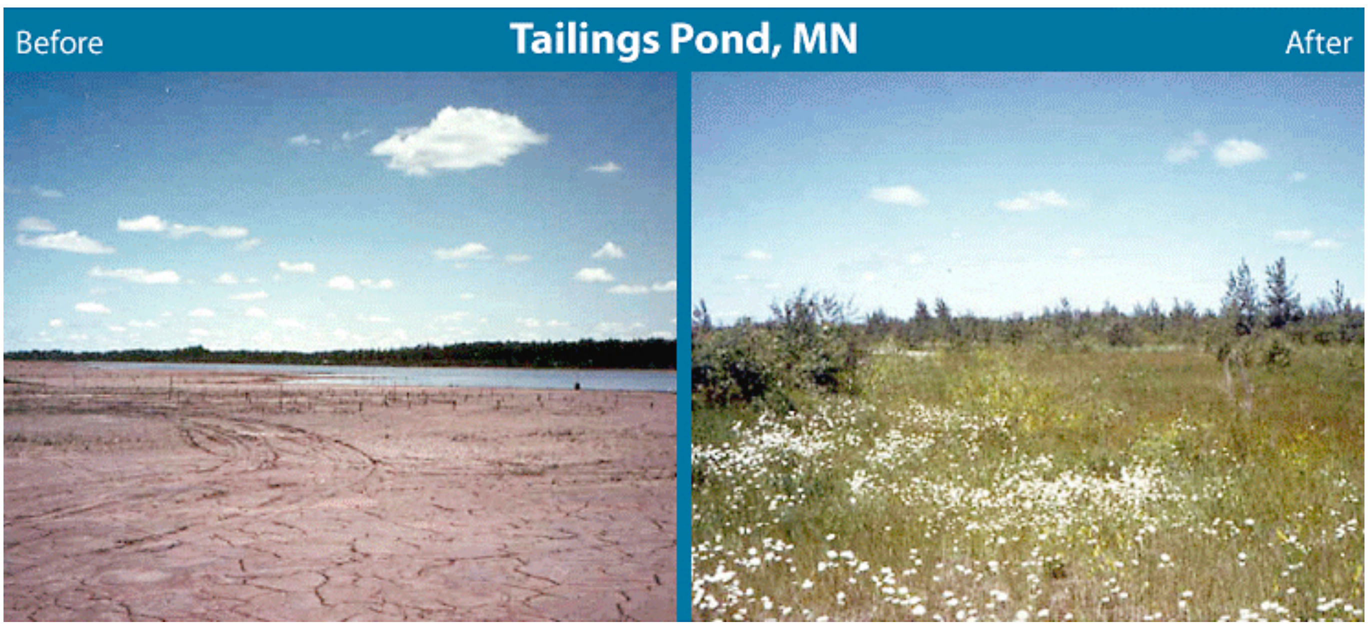
# Mining Waste
# Treatment Technology Selection

## Introduction

Mining is essential to the economy of the United States, but historical mining practices and the absence of routine mined-land reclamation, remediation, and restoration have led to legacy sites with significant environmental and human health impacts. New mining operations continue to have severe waste issues that must be addressed during and after the actual mining operation. Some new operations occur in areas with legacy environmental sites where the actual material contains sufficient residual mineralization such that further development, remining, and subsequent reclamation of the waste are economically viable. Some current operations even have the infrastructure in place to co-manage the cleanup of legacy waste while in operation. Understanding and addressing potential impacts at many of these sites are often complex, involving multiple environmental media spread over large areas. Remedial solutions are often lengthy, expensive, and unacceptable to the regulated and regulatory communities, as well as to the public.




This Web-based Mining Waste Technology Selection site assists project managers in selecting an applicable technology, or suite of technologies, which can be used to remediate mine waste–contaminated sites. The site consists of decision trees, overviews of applicable technologies, case studies where these technologies have been implemented, and regulatory challenges. The decision trees, through a series of questions, guide users to a set of treatment technologies that may be applicable to that particular site situation. Each technology is described, along with a summary of the applicability, advantages, limitations, performance, stakeholder and regulatory considerations, and lessons learned. The technology overviews include information to help project managers decide how well the technology may fit their particular site and remedial/reclamation goals. These technology overviews are not meant to be technical design manuals – this information can be found in other resources (ADTI, GARD Guide). Each technology overview links to case studies where the technology has been implemented.

The first question which must be answered in the decision tree is if a technology is needed which can be implemented immediately. Immediately, in this case, means within a year or two. The implementation time criterion is loosely based on a Superfund removal project. Those situations where a technology must be implemented immediately generally involve mitigating an existing human health or ecological exposure. In some cases, the technology implemented may be a permanent solution to the problem. In other cases, the technology may be an intermediate step, taken to protect public health or the environment, in a longer-term process. In this situation, it is understood that additional, more permanent technologies must be implemented to protect public health and the environment.

Regardless of whether a technology must be implemented immediately or not, the next question presented in the decision tree is whether a technology is needed to address solid mining waste or mining-influenced water. Solid mining waste may present a risk from direct contact with human or ecological receptors. In historic mining areas, there is often little separation between the mining areas and residential areas; thus, people living in these areas are exposed to mining waste on a regular basis. Additionally, solid mine wastes have been used as a product in a variety of ways, including as a building material, for road construction, for driveway construction, as a landscaping material, as soil or agricultural amendments and in numerous other ways. These uses increase the potential for exposure to waste materials. Children or adults may be exposed through their daily activities to mine wastes that have been used for driveway fill, as a landscaping material, or for other uses in residential areas. Additionally, mine wastes that have been brought into residential areas or other areas frequented by people can be carried indoors through tracking. Once mine wastes have been brought indoors, the potential for children to be exposed increases. Removal of the waste material is the preferred technology, generally through removal of carpeting and other soft surfaces and vacuuming hard-surface flooring with HEPA vacuums. For this type of removal to be effective, there should be a strong health education component for residents.

While removal of solid mine wastes in residential yards is generally feasible, that is generally not the case in source areas such as waste piles or ponds because of the volume of waste material. Exposure to waste materials may still occur in these areas, as they are often used as recreational areas. Where removal is not feasible, exposure to the material may be reduced by treating the waste to reduce bioavailability or mobility, using physical barriers, or using administrative and engineering controls. Solid mining waste may also present a risk as the source of contamination in mining-influenced water.

When addressing a mining waste environmental problem, it is important to understand the relationships between mining-influenced water and solid mining waste. Mining-influenced water may be a source of drinking water for humans as well as habitat or an attractive nuisance for ecological receptors. One option for treating mining-influenced water is treating the source, which is often solid mine waste. Because of the physical size of the area covered by solid mine waste or because of the volume of solid mine waste present, it may be impracticable to treat mining-influenced water by remediating the solid mining waste source. In these cases, it may be preferable to treat mining-influenced water on site, as it leaves a site, or at the human or ecological receptor. The decision on where to treat mining-influenced water will vary, based on characteristics of the site, the potential for exposure, and the availability of infrastructure. In situations where mining-influenced water is readily accessible to human and ecological receptors and exposure does occur, it may be preferable to treat the water at either the source of contamination or as it leaves the site. If mining-influenced water is used as a source of drinking water, it may be necessary, possibly on a short-term basis, to treat the water at the point of contact with the human receptor. That means installing a water treatment system, either on a public water system or at individual taps or wellheads for private or small community drinking water wells.

When remediating sites, it is generally preferable to use a technology which provides a permanent solution. However, this may not always be possible. Even technologies which are considered permanent may require some form of long-term monitoring. In some cases, a technology which is considered to be temporary may suffice. Temporary technologies may also be used as an interim measure to reduce exposure while a more permanent remedy is put in place.

Another aspect to be considered when implementing a technology to treat mining-influenced water is the amount of infrastructure, materials, energy, and manpower necessary to implement a technology. There is often a preference or a need for technologies that require less of these inputs for remote sites or sites in long-term operation and maintenance. However, this is not always possible. A thorough discussion of this topic can be found in the International Network for Acid Prevention (INAP)'s Global Acid Rock Drainage (GARD) Guide.

Because of the size, complexity and number of media affected in any given mine waste site, it may be necessary to go through the decision trees several times to select appropriate technologies to address the issues presented in a site.

Prevention (INAP)'s Global Acid Rock Drainage (GARD, 2009) Guide defines “passive treatment” as follows:

“Passive treatment refers to processes that do not requires regular human intervention, operations, or maintenances. It should typically employ natural constriction material, (e.g., soils, clays, and broken rock), natural materials (e.g., plant residues such as straw, wood chips, manure, and compost) and promote growth of natural vegetation. Passive treatment systems use gravity flow for water movement. In some arid climates, it might also included use of evaporation or infiltration (e.g., soil amelioration and neutralization) of small volumes of ARD.”

The GARD Guide 2009 goes on to define “active treatment” as follows:

“Active treatment refers to technologies requiring ongoing human operations, maintenance, and monitoring based on external sources of energy (electrical power) using infrastructure and engineered systems.”

Active and passive treatment has always stirred controversy because any definition is wrought with subjectivity. This guidance is no exception and prefers to recognize the inherent gray area between active and passive by inferring that some technologies are simply more passive than others. Our recommendation is to look carefully at all the technologies available to treat surface water and allow the site access and cost guide your decisions. This guidance is not a substitute for careful thought and an understanding of your site characteristics.

Situations such as contaminated sediments in a surface-saturated environment are not uncommon at mine sites. In as much as contaminated sediments are not restricted to mine waste sites, ITRC has contaminated sediment guidance (completion date June 2011), emphasizing the potential assessment of bioavailability and describing the process of assessing exposure through the human and multiple ecological pathways. If the contamination is not in a saturated “contaminated sediment” environment the soil, sediment or dust may require treatment or removal from the indoor environment. Often dust and yard soils have accumulated over the years and provide significant human exposure.

Mine spoils and other mine waste may require complete removal and disposal to prevent further human exposure or to prevent it from impacting the surface and or groundwater. In other instances the mine solid waste may be treated in place or controlled using barriers to isolate the mine solid waste from producing future exposure or impacting water flowing through the site. In still other instances the characteristics of the mine waste, the volume of the mine waste, or even the landmass covered by the mine waste requires that exposure be controlled using access controls to the site. Administrative and engineering controls are certainly not the preferred alternative; however, cost and sometimes public pressure to preserve the historic nature of the local mining culture dictate that the waste remain as it was and access be restricted to protect those nearby.

***Click Here*** for a Dynamic/Interactive Periodic Table of the elements