

Bauxite Mine Tailings and Alumina Refinery Residue Storage

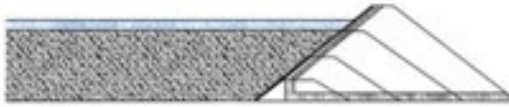
Alcoa Corporation (“Alcoa”) manages a global inventory of impoundment facilities used to store bauxite mine tailings and alumina refinery residue. These include active, inactive and closed sites wholly or majority-owned and managed by Alcoa, as well as joint-venture facilities in which Alcoa holds a minority interest. The types of material maintained in these impoundments generally falls into two categories:

- **Bauxite Mine Tailings:** mud-like residue remaining after bauxite is washed at mine sites.
- **Alumina Refinery Residue:** refinery process byproducts, such as bauxite residue and sand, remaining after extraction of alumina from bauxite in refineries.

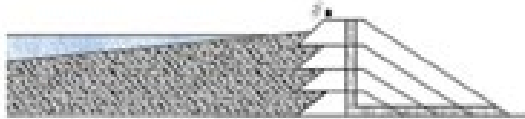
Construction and Design

Typically, both mine tailings and alumina refinery residue storage facilities are constructed of earthen embankments, or dikes, forming an enclosure. The mine and refinery by-products are deposited into the enclosure in a slurry form and dried over time. Some impoundments are kept at their original height, with the perimeter embankment constructed to full height before deposition begins. Others are raised over time by methods described below, with the design of the raising governed by the type of tailings or residue being stored, and the method of deposition used. The methods for raising bauxite tailings and alumina residue storage dikes usually fall into one of the following categories:

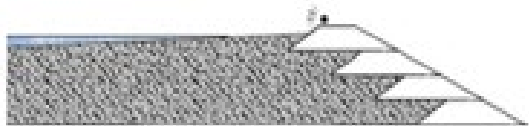
- **Downstream:** This method raises the impoundment height downstream from the initial dike which is built from borrowed fill materials.



- **Centre line:** Successive raising occurs in such a way that the axis of the dike remains in the initial position and coincides with the initial dike axis.



- **Upstream:** Successive levels of the containment dike are founded on the tailings or slurry previously discharged and impounded.



Tailings Dams and RSA Management

Alcoa is an industry leader in the management of tailings and residue storage. We have rigorous protocols in place to supervise the design, construction, operation and closure of storage impoundments that have been developed over decades of safe operating practice. Active, inactive and closed facilities are managed through a governance structure with global oversight, independent third-

party inspections as required by regulation, long-term management plans including capital needs and clearly defined location, BU and Corporate responsibilities.

Our protocols also require use of suitable measures to prioritize our activities based on potential risks and consequences and, where appropriate, the development of effective emergency response plans. And, of course, Alcoa's corporate culture encourages and values transparency and reporting.

Aligned with our commitment to safe, sustainable operations, Alcoa has also led new industry and company improvements in the management of impoundments. Some examples include:

- Storage of bauxite tailings within the mined footprint to reduce disturbance of land;
- Progressively moving from traditional wet storage to solar drying and stacking, where practical, which significantly reduces the potential for impacts on the surrounding environment (alumina refinery residue only);
- Bauxite residue storage areas are typically engineered embankments and are either clay/bentonite lined or have a synthetic liner, or both;
- Underdrainage systems to reduce the water pressure on the embankments; and
- Residue filtration technology, like at our Kwinana refinery in Australia, which reduces the moisture content of alumina refinery residue sufficiently to allow for more conventional ways to handle materials, like using conveyors and stacking.

Consequence Ratings

In each region in which we operate, we apply consequence ratings system as guided by either local regulations or internal Alcoa requirements. For instance, in Brazil, we use the Brazilian National Mining Agency (ANM) standards, which replaced the previous National Department of Mineral Production (DNPM) standards, and in Australia, we use the consequence rating system developed by the Australian National Commission on Large Dams (ANCOLD).

However, for consistency in reporting on this page, we have chosen to apply an internal rating system for consequence ratings across all of Alcoa's impoundments in order to allow for comparative assessment across our portfolio of impoundments.

In each case, it is important to note that the applicable rating system provides a classification of the potential *consequences* of a catastrophic failure, not the *likelihood* of failure.

Sustainability and Future Land Use

As a sustainability leader, Alcoa is focused on progressively closing and rehabilitating inactive storage areas. Installation of an appropriate closure (cover) system, effective management of water post-closure, and residue consolidation over time, substantially reduce the risk of instability resulting from continued water infiltration.

Alcoa is committed to rehabilitating inactive storage areas and the outer embankments of the storage areas as they are progressively raised. The aim of our rehabilitation is to generate a self-sustaining ecosystem.

In addition, Alcoa has a public long-term goal to reduce bauxite residue land requirements per metric ton of alumina produced by 15 percent by 2030, from a 2015 baseline. Through year-end 2018, we achieved a 5.8 percent reduction. (For more information, see [Alcoa's Sustainability Report](#).)



Vegetation established on the outer slopes of a residue dry stacking area

Field trials and fundamental research on residue rehabilitation is undertaken at many of our locations. This research aims to better understand water-nutrient-plant-residue sand dynamics as a means of optimizing the rehabilitation prescription and identifying potential residue area closure strategies.

Our current closure strategy incorporates the following three main objectives:

- Final land use for bauxite residue storage areas should be consistent with the aesthetic, environmental, and social values of the surrounding land.
- Rehabilitation and closure should achieve a stable and sustainable condition which does not significantly impact the surrounding environment and does not deteriorate substantially over time.
- Rehabilitation, closure and post closure land use plans consider external stakeholder requirements.

An example of returning residue storage areas to productive land use is the current use of Alcoa's early residue storage areas at the Kwinana refinery. The land on which these early storage areas are located was made available by the State Government for this purpose under the Alumina Refinery Agreement Act 1961 (WA). Parts of the area were handed back to Landcorp in 2000 and have since been incorporated into the Motorplex site, which was opened in December 2000. Since opening, there have not been any issues related to managing the site in the context of it being a former residue storage area.



Motor Sports Complex built partially over the original residue storage areas.

Download information on our facilities

An inventory of our bauxite mine tailings and alumina residue storage facilities is available for download. The list is subject to change as facilities are developed, closed, or otherwise move through their lifecycle, and will be updated periodically as warranted.

Link to the spreadsheet [here](#).