

Ridgeway Mine Fairfield County, South Carolina, US



The extensive water management system at Ridgeway channels all water across the site to the open pits. When full, these pits have the potential to be a sustainable potable water source.

The journey

The Ridgeway mine was an open pit precious metal mine that produced a doré bar composed of approximately 60 percent gold and 40 percent silver. It operated from 1988 through to 1999, employing more than 180 people, and produced 1.5 million ounces of gold and 0.9 million ounces of silver.

The mine was a very low-grade ore body and, with gold prices being relatively low, it was operated at a loss in its latter years in order to fulfil the conditions of the mining permit and facilitate closure of the tailings cover.

The exploration and feasibility stages were conducted by Amselco Exploration, but the mine was operated and closed by Kennecott Ridgeway Minerals Company, a wholly owned subsidiary of Rio Tinto. There was a very vocal minority who opposed the mine from the outset. Their opposition, prior to Rio Tinto's ownership, was very aggressive and challenging to manage.

The mining property is 2000 acres of mostly forested land; 903 acres of which were disturbed. The operations produced approximately 60 million tons

The Ridgeway gold mine is an excellent illustration of responsible mining and reclamation practices that serves as example to regulators, the mining industry and communities impacted by mining alike.

of tailings and 40 million tons of waste rock, much of which is prone to acid rock drainage (ARD) and required careful management. There are two open pits with sulphide-bearing rock exposed on the pit walls.

The \$30 million reclamation process focused on tailings impoundment stabilisation, overburden storage removal, dismantling and disposal of process facilities, the development of the open pit lakes and an adjoining wetland system.

Right:
The South Pit
stockpile in 1999.



The transformation

The site today consists of two 100-acre freshwater lakes, numerous wetlands and a 380-acre tailings storage facility, now transformed into a tall grass prairie hosting numerous bird and other wildlife species. By 2002, the revegetation of all previously disturbed and subsequently restored land surfaces was completed and less than 10 acres of the original 903 remain disturbed.

The South Pit is almost at capacity and, although the filling of the North Pit is not as advanced, the water quality there is also evolving in a very favourable trajectory. Indications are that Ridgeway will be able to discharge water from the site without treatment when the pit lakes are full. These lakes are a potential long-term sustainable potable water source for the surrounding community.

By 2002, the revegetation of all previously disturbed and subsequently restored land surfaces was completed and less than 10 acres of the original 903 remain disturbed.

Ridgeway is a world-class reclamation project providing valuable training opportunities in ecology, biology, and mine reclamation. To date, students from Clemson and Winthrop University and environmental regulators from the state of South Carolina have been able to take important lessons from the work applied to the site's two open pits (now freshwater lakes), tailings facility and surrounding mine property.

Whilst all processing facilities have been removed, the administration and maintenance buildings have been retained to provide a base from which to operate any educational programmes. Site tours, presentations and visiting lectures are regularly hosted for all educational levels.

Technical innovation

The closure strategy involved managing each of the potential ARD contaminant sources on site to minimise the potential for long term ARD generation. 18 million tons of acid-generating waste rock were placed in the bottom of the pits and rapidly flooded with runoff water collected from around the site. This flooding is covering the pyrite-bearing waste and pit walls with water, limiting the supply of oxygen and controlling the release of acid rock drainage. Lime is also being added to maintain a neutral pH in the north pit.

The objective of the flooding is to create ecologically sustainable pit lakes that support a healthy aquatic community and allow good quality water to be discharged off site without treatment. Detailed chemical, physical and biological monitoring of the pit lake is allowing active management of the flooding to enhance water quality and ecosystem function.

The remainder of the waste rock was used to construct the embankment for the tailings impoundment. An innovative closure strategy was developed for this area; benign, deeply weathered, fine-grained rock was fed through the mill and discharged as slurry over the top of the potentially acid-generating tailings. This has created a 3-6 foot cap of material that supports a healthy vegetation community, preserves runoff water quality and maintains saturated conditions in the underlying pyrite-bearing tailings, effectively controlling ARD formation.

The management of these closure techniques applied to the sulphide-bearing pits and the tailings facility was particularly challenging due to the amount of rainfall in the sub-tropical environment typical of the south eastern US. To address these challenges the tailings closure cover was designed to be capable of withstanding a probable maximum precipitation rain event of 44 inches in 24 hours.

*The South Pit
stockpile in 2004.*



The height of the tailings impoundment perimeter crest was increased and a new spillway was designed and constructed to handle the huge water flows that were calculated to be produced during such an unlikely event. This was connected to a further series of spillways and a wetlands area downstream of the impoundment, leading to one or both pit lakes. The wetlands linking the two lakes both provide storm water runoff surge capacity and enhance the overall aesthetics and biodiversity of the site.

The end result was an extensive water management system on site, which can withstand statistically significant rainfall events and transfer water in a controlled manner to one or both pit lakes. There is only a single permitted control point where any water from the site leaves the property.

The development of both the pit lakes and tailings closure strategy was completed following consultation with internal and external experts as well as state regulatory agencies. Once the reclamation model had been developed and accepted by the company and Agency it was presented to the community through media and direct public meetings.

Highlights

Ridgeway is an excellent success story in responsible mining. Through very extensive research, followed by thorough and fundamentally sound engineering practices, Ridgeway incorporated minimal operational impacts, concurrent reclamation practices and a robust closure plan.

Since the mine closed, Ridgeway has been formally recognised by the South Carolina Department of Health and Environmental Control, the Interstate Mining Compact Commission, and the US Department of the Interior for best practices and sustainability in the reclamation of the site's two open pits, tailings facility, and surrounding mine property.

A new approach to tailings management, using a hydraulically placed cover, is providing an important case study in effective reclamation techniques for regulators and the mining industry. The cover is proving to be very effective in controlling saturation in the tailings mass and ARD reactions. An additional benefit of this method was that it reduced the cover construction costs from \$28m to \$6m!

The successful implementation of the site's closure strategy has also led to the revegetation of the disturbed areas on site and protected runoff and groundwater ecosystems. The reclaimed land, wetlands and pit lakes on the site are already able to support a vibrant wildlife community.

Through very extensive research, followed by thorough and fundamentally sound engineering practices, Ridgeway incorporated minimal operational impacts, concurrent reclamation practices and a robust closure plan.

Relations with the local community have gone from openly hostile in the early exploration days through to warmly supportive of the reclamation project and the company's environmental stewardship record.

The reclamation process has provided significant contributions to the knowledge base within the state regulatory community. The long-standing professional working relationship with state regulators and the community has made the site, and Rio Tinto, a standard bearer for successful mining and reclamation in South Carolina.

*Hen harrier over
the revegetated
prairie grasslands
on the tailings dam.*

Lessons learnt

- Detailed closure planning at the outset would have given more realistic costs of the reclamation process. The feasibility report had very little about reclamation in it and only \$1.5m was provided for at the time the permit was issued, prior to Rio Tinto's ownership.
- This oversight was addressed by incorporating closure planning into the operations as soon as mining began, so that mining and reclamation developed alongside one another.
- Early and transparent community engagement is vital. The opposition group were aggressive and radical to start with but a more open approach from senior management at the mine in the mid 90's, led to improved relations and, ultimately, some of the group speaking on Rio Tinto's behalf.
- Delivering on community commitments was an essential element in the development of trust.
- It was important that their input was valued throughout the process of developing sustainable options for future uses of the site.
- Taking pre-emptive measures helps avoid potential problems. Rio Tinto are not obliged to bring State regulators in to inspect everything that is done on site now but they are always contacted to ensure that major decisions regarding reclamation have been reached through consultation and advice.



- The mining and reclamation methods developed at Ridgeway provide important lessons for regulators, the mining industry and communities impacted by mining.
- The techniques developed for ARD management, tailings closure and open pit lakes closure, as well as a successful communities strategy, continue to be communicated widely through conference papers, community, industry, regulatory, and university presentations, and field trips.

*A wetland area
beside the
revegetated
tailings dam.*



Our Vision

We aim to ensure that our legacy sites are made safe, that all problem areas are addressed cost-effectively, and that there is a sustainable socio-economic future for the community together with a minimised aftercare burden.
