NO LONGER JUST A HOLE IN THE GROUND

The Adaptive Re-Use of Resource Depleted Quarries

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Abstract

A quarry is an area from which rocks such as marble, limestone, and granite are extracted for industrial use. Once depleted of their desired resources, quarries are frequently abandoned. The resulting gaping holes can fill with water and form dangerous quarry lakes while others are turned into unsightly landfills. When quarries are in close proximity to urban environments, inhabitants are subjected to pollution and noise, and the undeniable eyesore of an abandoned quarry remains long after excavation is completed.

Sustainable redevelopment has become a shining solution for these abandoned, resource-depleted quarries. Dozens of cities in America and abroad have undertaken adaptive re-use projects to transform quarries into a variety of public and private spaces. The potential new uses for these expanses of land include sites for research and education, aquaculture, recreational activities, storage, industry and housing.

The goal of my research is to encourage the rehabilitation of land disturbed by quarrying by making the areas suitable for new sustainable land uses. I will examine cases that successfully transformed resource-depleted quarries into commercial and residential communities, and will discuss how further to improve future redevelopment of quarries with greater consideration to environmental impact and biodiversity.

Introduction: Impacts of Quarrying

A quarry is an area from which resources such as marble, limestone, sand and granite are extracted for industrial use. Once depleted of their desired resources, quarries are frequently abandoned. The majority of quarries are located fairly close to urban environments due to the expense of transporting raw materials into the city for industrial use in buildings and roads. As a result, inhabitants of neighborhoods near quarries are subjected to air pollution from dust, noise pollution from trucks and machinery, and the destruction of what may have once been a beautiful landscape. Not only do quarries often negatively impact those who live nearby, but they often leave residual negative impacts on the environment. Runoff of chemical pollutants into bodies of water, loss of natural habitats, farmland, and vegetation, and natural resource exhaustion are among the most harmful environmental impacts.

While quarrying can be a negative industry for society and for the environment, the necessity of quarrying is undeniable. In order for human civilization to continue as it has since the industrial revolution, we need the retrieval of resources from quarries in order to create our homes' foundations, transportation structures with cement, concrete, asphalt, and crushed stone, and other industrial uses such as abrasives, binders, additives, and roofing. Millions of people worldwide are employed by quarrying practices, and therefore a removal of the quarrying industry would result in the loss of jobs for countless families. Therefore, in order to remedy the negative effects of quarrying, we must use the resource depleted spaces for other practices once the quarries cease being operational. The potential transformation of quarry sites into a variety of sustainable uses would not only remedy the negative effects of quarrying, but could create sites of greater social, environmental

Quarrying Activity in the United States and Abroad

The activity of quarrying reflects the spatial distribution of mineral deposits. There can be large cost differences between quarries, usually in relation to the depth at which deposits are found and if they are on land or at sea. The decision to mine can depend on commodity prices of the material, the environmental impact of mining, or the post-mining disposal of waste. A quarry's lifespan can range from under a decade to over 50 years' worth of resource supplying. In the United States alone, there are approximately 100 metal mines, 900 mines and quarries producing industrial minerals, and 3,320 quarries producing crushed rock such as sand and gravel.

Assuming a similar relationship in other countries, this would suggest approximately 25,000 mines in the world producing industrial minerals and 100,000 quarries producing aggregates for construction purposes. This is a difficult number to fathom. Global mining and quarrying is characterized by a small number of international enterprise groups that operate across continents in conjunction with smaller companies. With quarries reaching as deep as 200 feet below the surface, the number of gaping craters left after quarries are depleted of resources worldwide is shocking.

Since very few quarries are ever reclaimed after industrial depletion, certain questions are begged.

- Why are these gaping holes left with no intention of reclamation?
- Why aren't quarries excavated with a post-depletion plan in mind?
- Why is the adaptive re-use of these spaces such a seemingly rare practice?

Cases

The cases I have chosen to include each serve as examples of different methods that the successful adaptive re-use of quarries can follow. The five cases are each located in a different geographic location—three in the United States and two abroad—and vary in the time in which the projects were undertaken. The map below depicts the relative location of each case.

Case Study: Brownstone Park

1.1 Location and Purpose

- Located near in Portland, Connecticut, Brownstone Exploration and Discovery Park is a privately operated extreme adventure park built in a former quarry that opened in 2008.

1.2 Issues Prior to Redevelopment

- The limestone quarry was originally abandoned in the 1930's after flooding from the Connecticut River ended all operations. The quarry site was neglected and filled with water, forming what is known as a quarry lake. A quarry lake forms when a quarry site fills with water. Since the water in a quarry lake is stagnant, the water is incredibly cold and when reckless individuals choose to go swimming unattended, their bodies often go into shock. Approximately 30-40 people drown per year in quarry lakes due to reckless activity. All efforts to drain the flooded quarry were unsuccessful. As a result, the Brownstone Quarry was in need of monitoring in order to prevent such deaths.

1.3 Funding

- The quarry was leased by the Town of Portland in 2000, which receives a portion of gate receipts and is relieved of much of the maintenance as well as policing of the quarries. Originally, there was hope that opening the site as an adventure park for the public would raise awareness of the historic landmark and strengthen the local economy. Residents of the town of Portland receive entry to the park for half price. An estimated 50,000 visitors came in 2010, and even more in 2011 onward.

1.4 Features

- The quarry converted into an adventure park features a variety of outdoor activities, including cliff-jumping, rock climbing, swimming, kayaking, scuba diving, climbing and rappelling, wakeboarding, rope-swings, 750-foot zip-lining, a 100-foot water slide and inflatable water toys. Currently, construction is being undertaken to create a campground for visitors to stay at the site overnight. There are also plans to offer educational programs at the site, including scuba diving and wakeboarding.

Figure 1: A) Zip-Lining at Brownstone Park. B) Kayaking, water slide, and inflatable water toys at Brownstone Park.

Source: Brownstone Park Website & Wikimedia Commons

Case Study: Brownstone Park

1.5 Benefits

- Brownstone Park has successfully yielded high revenue for the city due to the increasing number of visitors that attend the park every year as well as a large number of employment opportunities. Monitoring of the area by park life guards and police officers has eliminated safety hazards posed by the quarry lake prior to redevelopment. The site has become a beloved activity site instead of an abandoned hazards and visitors range from locals to out-of-state tourists. Not only does the adventure park re-use the land, but it stimulates outdoor activities that bring people out of their homes and into nature. The park encourages healthy, enjoyable activities for all ages.

1.6 Drawbacks

- The only drawback that my research has provided is the cost of maintenance and monitoring of the park. However, since the quarry needed monitoring prior to redevelopment, the revenue brought in by visitors' gate fees has mostly outweighed the cost of such policing.

1.7 Public Response

- The response to Brownstone Exploration and Discovery Park has been incredibly positive. As mentioned previously, over 50,000 visitors enter the park each season. Citizens of Portland receive a discounted entrance to the park, and visitors come from all over to enjoy the activities offered. Similar projects include Three Oaks Recreation Area in Crystal Lake, IL, Independence Grove in Libertyville, IL, Quincy Quarries Reservation in Quincy, MA, and Gray's Lake Park in Des Moines, IA. Recreational uses for abandoned quarries have been successful in locations all over the United States.

Figure 1: A) Inflatable water toys at Brownstone Park. B) Wakeboarding at Brownstone Park.

Source: Brownstone Park Website & Wikimedia Commons

Case Study: Quarry Falls

2.1 Location and Purpose

- Located in the center of San Diego, California, this quarry had served as the major stone and concrete source for construction projects in the region for the last 70 years, including the downtown baseball stadium of the San Diego Padres and airport runways. As of 2008, when the quarry was depleted of its resources, developers proposed a plan to restore the site into a mixed-use housing district including multi-family housing units, retail shops and commercial office space, interchangeably referred to as Quarry Falls or Civita—a name that blends civic with vitality.

2.2 Issues Prior to Redevelopment

- The site of the quarry is located in the center of San Diego and there are several surrounding neighborhoods that are subjected to the noise, air, and water pollution as a result of the operational quarry. Since the quarry is unsightly for nearby residents, property values in the area are low and complaints are high. The land has allegedly sunken 200 feet from its original level.

2.3 Funding

- The large-scale plan was proposed and accepted in 2008, but due to the housing market crash, construction did not begin until 2010 and is projected to continue for the next 15 years. The adoption of the Quarry Falls specific plan by the San Diego City Council establishes the city's official development policy for Quarry Falls. The quarry has been owned by the Grant family since the late 1920s and was taken over by the Corky McMillin Companies of San Diego contracting company and the Sudberry Properties development agency. The budgeted $1.5 billion project is said to be financed from construction loans through local banks that had been lenders for Sudberry projects.

2.4 Features

- The Quarry Falls plan features a 225.0-acre planned development located within the city limits of the City of San Diego. Organized around an expansive system of terraced parks and urban open space, the Specific Plan's various land uses are combined to allow optimal integration of a variety of housing types; a mixed use area, with neighborhood, community and lifestyle retail commercial uses; and office/business parks linked together by a functional and efficient network of pedestrian trails and sidewalks, bicycle paths and vehicular circulation. Quarry Falls will include 37 acres of parks and trails, 4,780 living units, a self-sustaining community with an elementary school and shops, trolleys that connect to public transit, large waterfalls, and an emphasis on sustainability, energy efficiency and recycling.

Figure 1: Regional Map of Quarry Falls

Figure 2: Plan of the Quarry Falls Recreation Center.

Source: Quarry Falls Specific Plan 2008
http://www.sandiego.gov/planning/community/profiles/missionvalley/pdf/plans/quarryfallsspecificplan.pdf

Case Study: Quarry Falls

2.5 Benefits

- The benefits of Quarry Falls are only speculative at this time, but it is projected that, once completed, the project will turn the area into a thriving center of residential, retail, office and business space. The current living member of the Grant family was determined not to let the quarry, which is on the National Register of Historic Places, be turned into yet another shopping mall. This project has helped provide jobs to many of the construction workers who lost their jobs in the 2008 market crash, and will hopefully stimulate the local economy by attracting tourists and inspiring similar projects elsewhere. The desire to incorporate sustainable practices in the area is one to be admired and replicated.

2.6 Drawbacks

- The cost of the project is very high at $1.5 billion, and the project is a long-term endeavor that may cause discomfort and other unpleasant consequences for nearby residents who are subjected to construction drawbacks until completion. Since the quarry has dropped some 200 feet from its original level, there is also the issue of drainage from the district. However, with the creation of so employment opportunities, living and business spaces, as well as a remedy for the negative environmental and aesthetic impacts, the costs and temporary discomfort resulting from the project are soon to be outweighed.

2.7 Public Response

- The first housing units went up for sale in early 2012 and have had a very positive response. While living spaces are costly to purchase or lease, the district has been granted many awards for its creation of a smart energy community, including acknowledgments such as the 2010 Outstanding Planning, Leadership, and Service Award from the San Diego Chapter of the American Planning Association, as well as the 2009 Governor's Environmental and Economic Leadership Award given by Governor Arnold Schwarzenegger. As the project continues to grow and parks are completed, the public response is expected to be even more positive.

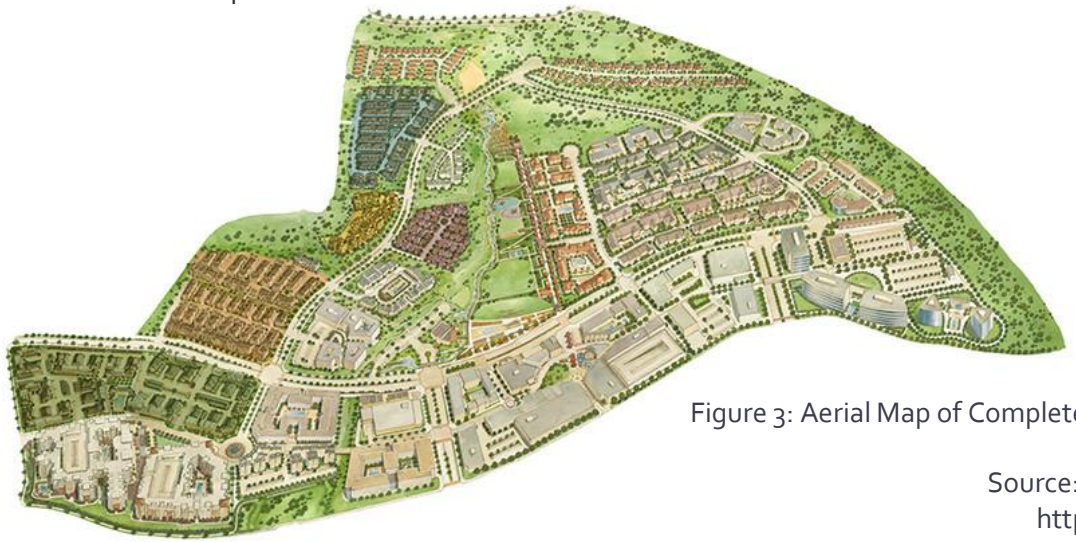

Figure 3: Aerial Map of Completed Plan for Quarry Falls

Source: Civita Project Website
http://www.civitalife.com/

Case Study: Bellwood Quarry

3.1 Location and Purpose

- Located in Atlanta, Georgia, the Bellwood Quarry is the proposed site for the creation a reservoir within the larger Atlanta Beltline Project, which is a large-scale redevelopment project, started in 1999, that seeks to combine greenspace, trails, transit, and new development along a 22 mile rail in Atlanta.

3.2 Issues Prior to Redevelopment

- The quarry provided gravel for the past 100 years to the region surrounding Atlanta and has recently stopped being operational due to resource depletion. The quarry was considered a huge nuisance by locals, who were subjected to noise from machinery and air pollution. The land was neglected and fenced off to prevent accidents. Atlanta has faced serious issues with water shortages and has considered building a new water storage system.

3.3 Funding

- The Atlanta Beltline Project is a $3 billion project that is receiving funding from the city of Atlanta. The architect of the plan, Ryan Gravel, a Georgia Tech architecture and urban planning master's student, envisioned the beltline as Atlanta's Emerald Necklace. Mayor Shirley Franklin commissioned a study to determine whether the Beltline could be financed with a tax allocation district (TAD) and found that the city would raise more than 60% of the total cost for the project in addition to an aggressive fundraising campaign that has brought in over $40 million. The Bellwood Quarry Reservoir will be funded from these sources.

3.4 Features

- The Bellwood Quarry was purchased in 2006 by the city of Atlanta for the construction of a potential reservoir within the Atlanta Beltline Project. This reservoir could hold 30-50 days' worth of water, an estimated 1.2 billion gallons of water.

Figure 1: Empty Bellwood Quarry poses an environmental and social hazard for Atlanta, GA.

Source: Sierra Club Georgia Website
http://georgia.sierraclub.org/centennial/Retrofit.htm

Figure 2: Aerial View of Empty Bellwood Quarry

Source: Alexander and Garvin Associates
http://www.tpl.org/our-work/parks-for-people/bellwood-quarrywestside-park

Case Study: Bellwood Quarry

3.5 Benefits

- Since the city of Atlanta has faced such issues with water shortages, the reclamation of this quarry into a reservoir will contribute to the remediation of the water shortage. The crater already exists, so it would be faster and cheaper to develop the site into a reservoir. Not only does the transformation provide a reduction in noise and air pollution, but it also resolves detrimental environmental issues involved in building a completely new reservoir for the city. The quarry is among the sites that are visited during the Atlanta Beltline Project's citizen tour. Currently, the quarry is blocked off due to the reckless activity of teenagers that have gone swimming in the quarry lake since it creased being operational. The transition into a practical water management site will prevent future hazards that result from an abandoned, water-filled quarry.

3.6 Drawbacks

- The drawbacks of transforming the Bellwood Quarry into a reservoir include the large expense as well as the pollution that accompany construction. However, once the project is complete, the benefits of a new reservoir of this magnitude will be unparalleled.

3.7 Public Response

- The public response has been incredibly positive towards the Atlanta Beltline Project and the transformation of the Bellwood Quarry into a reservoir. When tours are given along the railroad on which the project is being undertaken, visitors are astounded by the natural beauty of the quarry and the potential benefits and historic value it will provide for the city.

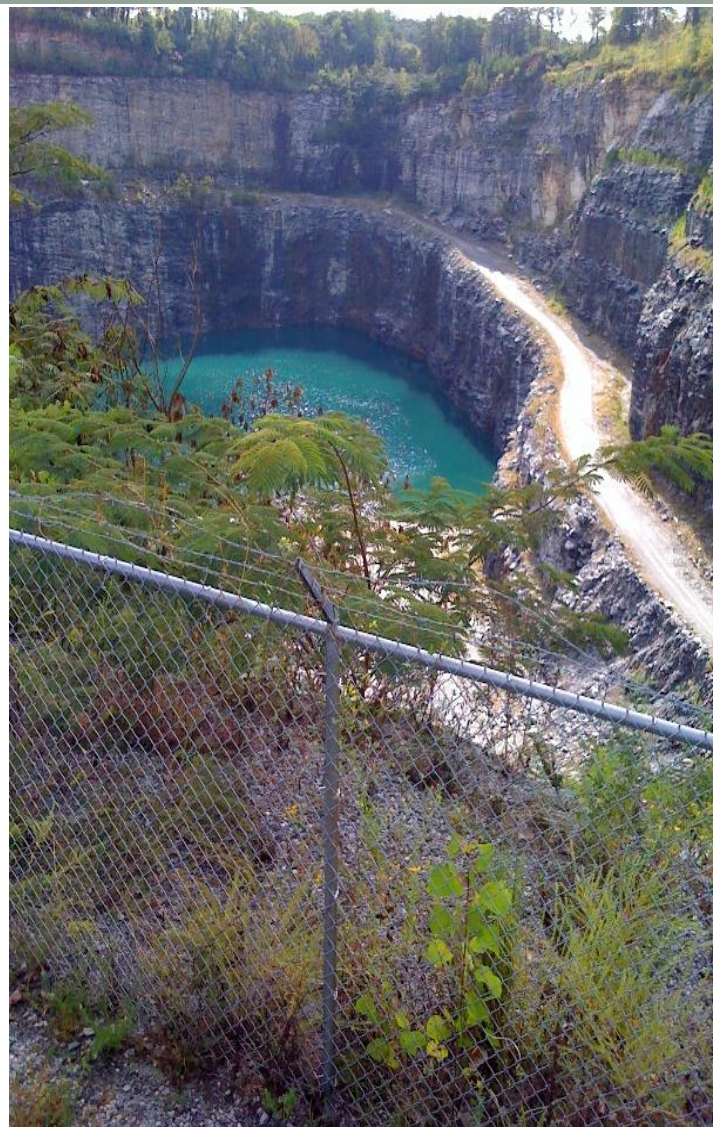

Figure 3: Fenced off Bellwood Quarry is a tourist attraction but also a hazard for reckless activity.

Source: Atlanta Beltline Tour http://www.lizlapiduspr.com/2011/tour-the-atlanta-beltline/

Case Study: Butchart Gardens

4.1 Location and Purpose

- Located near Victoria Canada on Vancouver Island, the Butchart Gardens are a group of floral display gardens made in an exhausted limestone quarry. Robert Butchart, a pioneer in the thriving North American cement industry, was attracted to Canada's West Coast by rich limestone deposits. In 1904, he developed a quarry and built a cement plant to satisfy the cement demand from San Francisco to Victoria, Canada. The Butcharts established the family home close to the quarry. As Mr. Butchart exhausted limestone deposits, his enterprising wife, Jennie, made plans to create something of beauty in the gigantic exhausted pit. Little by little, the quarry blossomed into the spectacular Sunken Garden by 1921, the ownership of which has been passed on for generations.

4.2 Issues Prior to Redevelopment

- Prior to redevelopment, the limestone quarry was a giant, hideous pit left near the Butchart family's home after the limestone was depleted.

4.3 Funding

- Initially, funding for the Butchart Gardens was granted by the Butchart family's success in the quarrying industry. However, through the generations, funding for the gardens has been generated primarily from the millions of visitors that enter the gardens each year.

4.4 Features

- The Butchart Gardens features a series of beautiful gardens—each of which have a different cultural theme—outdoor symphony concerts, a yearly Christmas light display and ice skating, greenhouses, firework shows, a children's carousel, a boat tour and family restaurants. The site even offers educational features, such as an ornamental bird collection for education and conservation. The gardens are dog friendly and feature a variety of reservation opportunities for weddings, birthdays, and other social events.

Figure 1: A) Site of the limestone quarry at Butchart Gardens. B) One of the main Butchart gardens in Spring.

Source: Butchart Gardens Website and Wikimedia Commons

Case Study: Butchart Gardens

4.5 Benefits

- The Butchart Gardens attracts over a million visitors each year and has been deemed a National Historic Site in Canada. The site attracts tourism for the region, creates job opportunities, re-uses resource-depleted land, and engages the community and provides family entertainment. The creation of such a site creates encourages visitors to interact with nature, engage with their families in outdoor activities, and bask in cultural entertainment such as the symphonies and other educational opportunities.

4.6 Drawbacks

- According to my research, the gardens' only drawback is the cost of maintenance of such a large national park. However, the revenue yielded from the millions of visitors is more than enough to cover the cost of maintaining the beloved park.

4.7 Public Response

- The public response is incredibly positive. As mentioned previously, the Butchart Gardens were deemed a National Historic Site in Canada and attract over a million visitors per year. With the incredible amount of family activities and community engagement, this re-use of this derelict quarry has been widely successful and beloved.

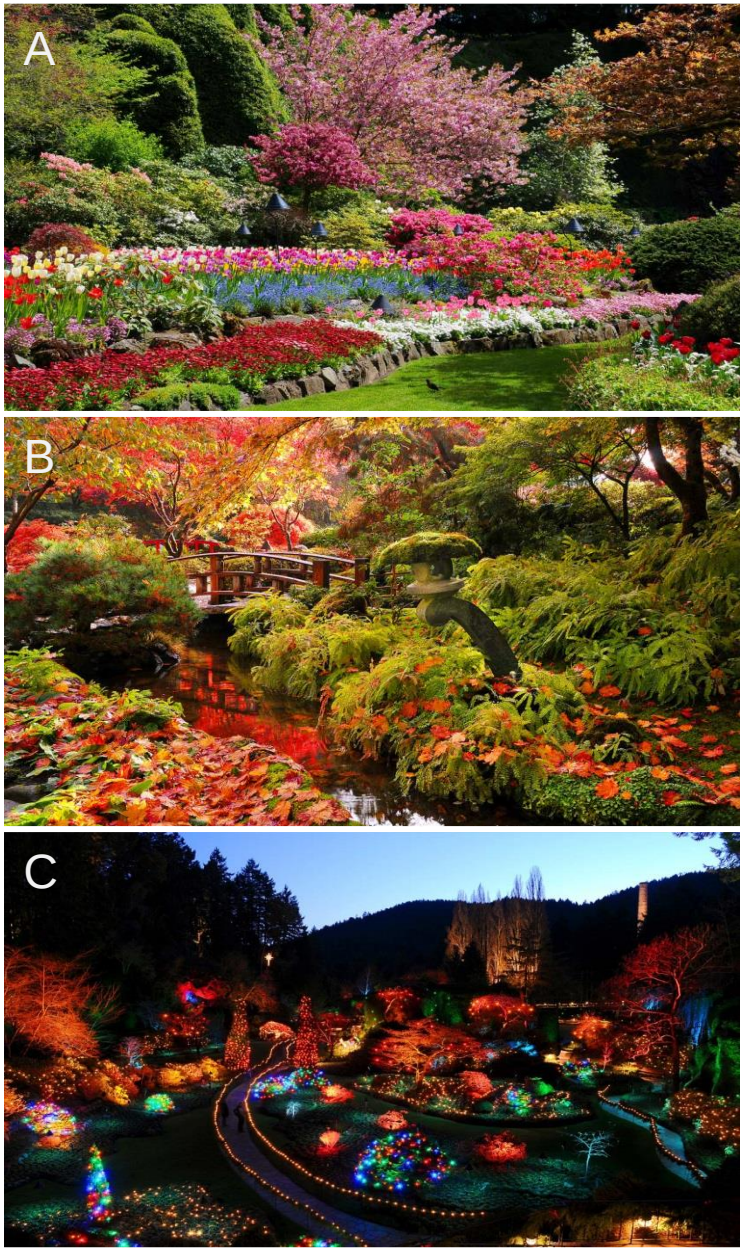

Figure 1: A) Gardens in Spring. B) Gardens in Autumn. C) Gardens at Christmas. Source: Butchart Gardens Website

Case Study: Groundscraper Hotel

5.1 Location and Purpose

- Located just 30 miles outside of Shanghai, China, the InterContinental Shimao Shanghai Wonderland Hotel, also referred to as the Groundscraper Hotel, is a proposed luxury resort that will have 16 floors below the surface of the earth—hence the coined phase "Groundscraper"—in an abandoned quarry at the foot of Tianmashan Mountain.

5.2 Issues Prior to Redevelopment

- The 100 meter, or 330 feet, deep crater was a source of industrial resources since the 1950s. The pit was initially abandoned in 2000, and the land was neglected, unsightly, and dangerous.

5.3 Funding

- Recently, a British engineering firm called Atkins proposed a plan to utilize the abandoned land into a tourist attraction in conjunction with developers in Shanghai. An estimated $555 million endeavor, the funding is most likely coming from the Shanghai Shimao Property Group and the city of Shanghai. However, my research could not confirm the funding source.

5.4 Features

- The Groundscraper Hotel features 380 rooms, a spa, an athletic complex for water sports at the basin of the quarry, an underwater restaurant, and a 32-feet deep aquarium. All features of the hotel will utilize sustainable practices, such as a green roof and an artificial lake to generate geothermal energy. Down the center of the hotel will be a 60-meter glass curtain, built to mimic a waterfall.

Figure 1: A) Quarry outside of Shanghai prior to redevelopment. B) Proposed exterior of the InterContinental Shimao Shanghai Wonderland Hotel.

Source: Architizer Website http://architizer.com/blog/construction-begins-on-shanghai-groundscraper-hotel/

Case Study: Groundscraper Hotel

5.5 Benefits

- The transformation from a resource-depleted quarry into a luxury hotel will generate a vast amount of job opportunities. It will also bring many tourists to the area, as the hotel is somewhat of a cross between a vacation spot and a theme park. The use of sustainable energy sources is also an incredible bonus of the hotel and will hopefully inspire similar energy practices in other projects in China.

5.6 Drawbacks

- The idea of creating a luxury hotel from a depleted quarry is somewhat ostentatious and only benefits an elite few. With hotel rooms starting at $320 per night, there is definitely a social class limitation by creating such an establishment. However, with such a lavish exterior and a re-use of the land, the issue of being a hazardous eyesore is eliminated and the revenue that will be generated will benefit the developers and workers.

5.7 Public Response

- The projected completion date is expected to be late 2014 or early 2015, but the public response thus far has been very positive. The beautifully rendered plans have evoked such amazement from the public and Atkins received the Gold Medal at last year's commercial real estate MIPIM Asia Awards. The most appealing aspect of the hotel is its use of green design and sustainable energy sources, as well as the illusion that the hotel is a part of nature.

Conclusion from Cases

These five cases serve as successful adaptations of resource depleted quarries into sites that promote community engagement, housing, and/or practical use of land. Brownstone Park and the Butchart Gardens seamlessly utilize the empty quarry sites into parks that have become beloved by locals and tourists. Quarry Falls and the Chinese Groundscraper Hotel, once completed, are projected to provide permanent and temporary housing that both yield sustainable practices. The Bellwood Quarry will be transformed into a practical reservoir that will assist in salvaging water for the entire city of Atlanta.

These cases are examples of how sustainable redevelopment is a solution for abandoned, resource-depleted quarries that benefits everyone. By encouraging the rehabilitation of land disturbed by quarrying, society can remedy the negative effects of anthropogenic industrial activity. The redevelopment of quarries can both benefit humans and lessen the environmental impact of quarrying without removing quarrying as a global and regional industry.

While the cases I presented depict a recreational park, a mixed-use housing district, a water management system, a National Park, and a luxury hotel, adaptive re-use projects can transform quarries into a variety of public and private spaces other than these uses. Such options include geological sites for research and education, nature preservation areas, training courses for rescue dogs, personnel, and the military, open-air theaters, museums on quarrying heritage, film sets, rock climbing, storage and warehouses, landfills, harbors, cooling water for industry, and industrial plants.

Looking Forward

My research points to the realization that a post-excavation plan should be implemented for each quarry, both old and new. Society cannot cease quarrying without surrendering materials necessary for a vast number of our industrial processes, but if we just abandon quarries when they are no longer operational, we are wasting land, polluting neighboring cities, and allowing for the deterioration of natural habitats.

The after-use of quarries is important because it increases public acceptance of quarrying and shows that former quarry sites are not merely degraded areas, but can give value added to the land and can even act as a catalyst for the development of a region, like that of Quarry Falls. Land rehabilitation is an essential part of quarrying and aims at making disturbed areas suitable for new sustainable land uses, and is it disappointing that such practices are not the norm.

Rehabilitation of quarries can yield so many positive social, economic, and environmental that it only makes sense that they should be reintroduced into society after their resources are depleted. Although remediation is a costly feat for most quarry sites, the benefits seen in the cases I have presented display how the costs will be outweighed by benefits, and adaptive re-use should be undertaken as measures to make our cities more ecologically healthy and aesthetically pleasing.

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