

RECLAIMING BJØRNTVET

- A Sustainable Afterlife for a Hard Rock Quarry

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DISCLAIMER

As a student of landscape architecture I'm trained as a designer and not a scientist, and I consider this report an addendum rather than the main part of my submission - which is the set of large exhibition boards (the report was made simply because it seemed mandatory, and is probably lacking in comparison with a scientific report of proper format). I have also made and submitted as another addendum a digital presentation that is easier to review on a computer screen than the boards, but again, I must emphasize that the boards represent the main body of my submitted project. This report however together with the digital presentation do well in complementing the boards, as well as provide bits of information that may be lacking on the boards.

ABSTRACT

The project sets out to present a flexible design scheme for assuring a sustainable afterlife for the Bjørntvet limestone quarry. Through multiple layers of design interventions the project proposes a public future for the site - rich both in biodiversity and social programming. The project culminates in a master plan for the site, with a number of design interventions that in conjunction secures 4 existing valuable biotopes on the site, introduces 9 new biotopes plus 4 new ecotones, provides a plethora of new public amenities (recreational infrastructure, cross country skiing circuits, climbing centre, educational centre, cafe, canoeing lake, bat cave excursion, educational installations, vista points, a 25m high ascendable mine tailing and more), improves connectivity and introduces a sustainable strategy for managing the contaminated city-snow.

INTRODUCTION

It is no longer possible to ignore the devastating impact of destruction that the modern, human civilization has inflicted on the ecology of the planet. Affecting global climate change, biodiversity loss, air-, soil- and water contamination; the current, unprecedented rate of land-use change across the world constitutes the greatest environmental concern of humanity today (Ellis, 2011).

In 2008, for the first time in history, half the world's population were living in towns or cities (Urbanization: A Majority in Cities, 2007). This trend seems prone to continue as the world population is estimated to grow toward 9 billion before 2050 and 10.1 billion by the end 21st century (Global population, 2011), and global giants such as China and India progressively become more urbanized. Already today humanity's ecological footprint far exceeds the biocapacity of the Earth, and conservative estimates describe a footprint back in 2005 concurrent with a biocapacity of almost 1.5 Earths (The Worldwatch Institute, 2010). The resolution is long overdue and humanity needs to step up and derail this trend.

In the field of landscape architecture and urban design, the term “land reclamation” has in recent years emerged as a design-/planning concept that seeks to deal with the environmentally sustainable reuse of post-industrial land. Often referred to as ‘urban wastelands’ or ‘brownfields’ (depending on the circumstances) these sites typically exhibit certain negative properties, such as being under-utilized, derelict and/or contaminated; and therefore harbour distinct potential for being put to better use. *The United States Environmental Protection Agency* [USEPA] defines brownfields as “abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.” (Brownfields and Land, n.d.). “Land reclamation” concerns the clean-up (where needed) and re-utilization of such sites (typically post-industrial landscapes such as landfills, contaminated urban rivers, military facilities, mineral extraction sites, etc.) within a framework of environmental- and social sustainability.

OBJECTIVES

In the United States alone an estimated >600,000 abandoned and contaminated waste sites have been identified since 1990 (Berger, 2006), and in Norway alone around 450 military sites with ground contamination have been registered since January 2010 (Grunn- og sedimentforurensning, n.d.). I think these numbers predict a staggeringly high total estimate for the number of brownfield-sites on a global scale, that probably amounts to many millions. This means that an immense amount of untapped potential for improved land-use lies dormant across the world, and that the competence to properly deal with land reclamation projects becomes an immensely important trait.

Quoting the Italian architect and editor Stefano Boeri: “It is necessary to find a development model no longer linked to perpetual horizontal expansion, which has not only devoured vast areas of agricultural land but also swept aside the living space of animals and plants.” (Boeri, 2010). Alan Berger from P-REX and MIT approaches land reclamation through what he has coined “systemic design”. This outlook “implies that there are larger scale forces in the built and natural environment that, if properly understood, will lead to more intelligent project scenarios as opposed to superficial cosmetics or post-rationalized form.” (Berger, 2009).

“Clearly the problem of man and nature is not one of providing a decorative background for the human play, or even ameliorating the grim city: it is the necessity of sustaining nature as a source of life, milieu, teacher, sanctum, challenge and, most of all, of rediscovering nature’s corollary of the unknown in the self, the source of meaning.” (McHarg, 1967).

With these ideas and concepts in mind; the project seeks to reclaim the Bjørntvet limestone quarry, ensuring a sustainable afterlife for the site that benefits; the local environment and biodiversity (red list-species, valuable nature types etc.); the global environment by securing the site for an ecologically sensitive after-use, arguing through the project that a ‘sustainable’ reclamation design is an appropriate fate for the afterlife of quarries and other industrial sites; and benefits the growing city of Porsgrunn and its inhabitants by providing a new city sanctuary for recreation, health, awareness-raising/education, a new local “green” network of connectivity/mobility, and more. The project seeks to set a precedent in the field of urban planning and design; for diverse, site-specific and ecologically sensitive land reclamation, conceived at the interface of biology/ecology and landscape architecture. The project deals with how the site can be utilized after mineral extraction in the quarry has come to an end.

BACKGROUND INFORMATION, SITE DESCRIPTION

Much of the research on the site and its context was completed before March 2012, and is summarized in the following paragraphs. Bjørntvet is a limestone quarry located in Norway, in the county of Telemark, and the municipality of Porsgrunn. It is situated in Bjørntvetåsen, a forested hill in the middle of Porsgrunn city surrounded largely by residential areas, with some industrial development and intensive agriculture. The project site is defined to include the woodlands around the quarry. The actual extraction site covers an area of about 0.5 km². The very first test hole was drilled at Bjørntvet by *Norsk Hydro* in 1946, followed by a series of drills in 1949-50 carried out by *Dalen Portland Cementfabrikk*. The extraction of limestone was initiated in 1955 and is ongoing.



Image: Photograph from site visit in December, 2011.

The limestone deposits on which the site is located belong to *Steinsfjordformasjonen*, which is a part of the larger geologic formation known as *Oslofeltet*. The rock was originally deposited in a shallow oceanic area under a tropical climate, and dates back approximately 425 million years to the latter part of the cambrio-silurian period, around the time when the first vascular land plants emerged on the planet. Limestone geology is very rare in the south of Norway, and the alkaline, calcium-rich soils it provides, support some of the most endangered nature types in Norway. Mineral extraction has shaped a topography of 10 meters high- and wide terraces that descend as much as 90 meters into the hill (measured from the highest- to the lowest point).

The quarry belongs to the *Leirkup* watershed of almost 70 km². Because the quarry in essence is a hole in the middle of a hill surrounded by lower land, the water that reaches the site comes mainly as stormwater from precipitation (ground-water is not a factor). After the mineral extraction recently reached down deeper than level +40 meters, the stormwater - that up until then had been drained naturally by a small creek - has had to be pumped out of the quarry mechanically; and the company is now expecting to pump out approximately 460,000 m³ of water on a yearly basis.

The woodlands around the quarry largely consist of mixed deciduous and coniferous forest, with occurrences of the red-listed nature types of calcareous lime- and calcareous pine forest (Norwegian Red List for Nature Types, 2011). Several red-list species have been registered on the site, and many more are expected live there. A report commissioned by the municipality of Porsgrunn in 2003 to assess its environmental status, concluded that; the extraction site is a “very important area for biodiversity, with a high degree of landscape value”, that the woodlands surrounding it has “great potential for biodiversity, with a very high degree of landscape- and recreational value”, and that the whole project site including the quarry and the surrounding woodlands holds “great potential for biodiversity” due to the rare limestone geology on which it is located (Grønn Plakat, 2003). Additionally, three smaller areas within are deemed “very important” by the Norwegian Directorate for Nature Management; a small patch of calcareous lime forest, a set of terraces that provide hatching grounds for stock doves and an area of calcareous pine forest.

METHODS

RESEARCH

The first phase of the project was all about retrieving massive amounts of data about the site and its context, in an effort to establish a solid framework of factual information inside which sensible plans for the site's future could be conceived. The methods for gathering this data was manifold and includes: Opportunistic internet searches, reading reports on various subjects, browsing specific organizations' websites, email-correspondence with different organizations etc., reading literature on relevant subjects, site visit, study trip, gathering information from various online databases, collecting map data through the use of Geographic Information System [GIS] computer software, rendering text- and numerical information into illustrations, consultation and reviews with project supervisors and more.

CONCEPTUALIZATION

The information gathered and organized in the research phase created a necessary foundation for creative thinking about what to do with the site. The conceptualization phase saw methods such as rearrangement of data, visualization through sketching and a digital 3D terrain-model, as well as consultations and reviews of ideas with supervisors and other students. The end goal for this work was to define a set of solid strategies and concepts (in broad strokes), that would offer a point of departure for the specific design interventions concluding the project. This phase also saw a lot of work with the layout of text and graphics on the boards that were to become the end product of the project.

DESIGN

The strategies from the conceptualization phase already set up many of the design interventions I wanted to plan on the site, but the decisions on exactly how and where to implement them were still to a large extent undecided. More detailed and geographically correct visualizations followed, which gradually metamorphosed into the final renderings of a master plan. Other illustrations were made to confirm- and convey the appropriateness of a few of the key design interventions.

RESULTS – PLANNED ACTIONS/DESIGN INTERVENTIONS

The following list of design interventions is not ordered by priority level, but coincides with the final master plan illustrated on the board *D. Design* in the main project presentation/exhibition.

1. CALCAREOUS WETLAND: The wetland is planned established on a large area of the quarry floor (in the northern part) with the natural accumulation of stormwater. Besides ensuring a quantitatively immense boost to the local biodiversity, the special lime-enriched conditions on the site also present a qualitatively interesting outlook on biodiversity. The bed of the wetland should be shaped with a variety of depths to support a greater diversity of life.

2. CALCAREOUS LAKE (size>25,000 m²): This biotope is proposed established due to the natural water-containing properties of the quarry that invites the idea of establishing a high-biodiversity lake- and wetland system on the site. Calcareous lake is one of the rarest and most valuable red-listed nature types in Norway, and the possibility of utilizing the rare limestone-geology of the quarry for the establishment of a new entity of this nature presents a unique opportunity. Calcareous lakes are home to endangered species such as the ancient and exceedingly endangered algae of the genus *Chara*.

3. CALCAREOUS POND (size<25,000 m²): Similar to the Calcareous lake but smaller in size, this kind of water body supports a different spectrum of life than the larger lake, and is therefore considered a different endangered nature type.

4. SNOW-REMEDICATION FACILITY: The snow that is currently dumped untreated into the city river (Porsgrunnselva) every winter, is instead relocated to a part of the quarry where a small facility is set up to receive the snow from the regular truck, melt it, remove trash debris and partially clean the contaminated snow.

5. SNOW-REMEDICATION TERRACES: After the snow has passed through the snow-cleaning facility the water is released into a constructed snow-remediation system consisting of 4 treatment cells. Here the melted snow-water undergoes several stages of aeration, sedimentation and phyto-remediation, before its released into the new limestone-wetlands of the quarry. This is illustrated in text and illustration on the board *D. Design*, as well as explained in the additional digital presentation.

6. WATERFALL: After the snow has passed through the snow-cleaning facility and the treatment cells a 20 meter high waterfall releases the treated melt-water into the wetland system of the quarry. The waterfall functions as a final act of aeration for the water, as well as an attraction connected to the new infrastructural network on the site.

7. BAT CAVE: Bats represent some of the most endangered animals in the world, and in the context of Norway, 9 out of the 13 bat species registered in the country are red-listed. Telemark and adjacent counties have some of the highest frequencies of bat-observations in the country. The cave is proposed dug out in the north-western corner of the quarry where the large new calcareous lake will reside, and will provide a well-suited habitat for various bat species (bats also thrive in wetland biotopes). The cave doubles as a concealed site for regulating the water level between the wetland-lake system and the pipe and hydro-power generator that will carry any excess water out of the quarry, as well as a visual monument for visitors of the site, and destination for people canoeing on the lake.

8. BAT CAVE OBSERVATORY: On an island in the middle of the calcareous lake a platform/tower is constructed for monitoring/observing bat activity in the cave and wetland.

9. CANOEING DOCK: In the southern end of the calcareous lake canoes can be rented for lake canoeing and possibly bat cave excursions.

10. EDUCATION CENTRE AND CAFE: As an initiative to establish a common ground where the children from the many different kindergartens and schools can congregate - normally existing in separate, closed systems - an education centre is planned in the quarry where the children's institutions of the city can bring the children together for regular educational events. The quarry could be a fitting place for this common ground, being central both relative to the city centre as well as between the different kindergartens and schools, and having in mind all the other design interventions that is planned for the site. The building also functions as a café for visitors of the quarry, with a large wooden deck overlooking the calcareous lake.

11. QUARRYSCAPE: A dry quarryscape-area is planned to fill the southern end of the quarry floor. This area is shaped to slope upwards away from the wetland to ensure runoff of stormwater and achieve dry conditions that will support a completely different spectrum of life than the adjacent wetland system.

12. QUARRYSCAPE MINE TAILINGS: Large mine tailings (gravel mounds) are shaped on the quarryscape - raised as forceful symbols of the site's industrial history. In time they might provide interesting edges and levels for life to inhabit.

13. WETLAND MINE TAILINGS: These will provide a different aesthetic emerging from the wetland rather than dry quarryscape, and the edges where the wetland biotope meets the tailings can provide interesting ecotones.

14. ASCENDABLE MINE TAILING: One of the tailings - 75 meter wide and 25 high - is constructed with a walkway spiralling up to an outlook point on the top, that offers a 360 degree view of the new landscape.

15. QUARRY ENTRANCE SWALE: A large, curving corridor is the main gate to the now public site and connects the southern end of the quarry to the city.

16. ROCK CLIMBING CENTRE: Limestone rock is highly sought after by rock climbers across the world. The project proposes a climbing centre that is sliced into a set of terraces facing the morning sun (to ensure that the main walls dry up quickly after the moist night air). With a small 5 meter wall on top of the climbing centre building, a 10 meter wall on the opposite side of a "courtyard", and a massive 25 meter wall in the middle; the Bjørntvet climbing facilities cater to climbers of many skill levels.

17. BIRD TERRACES EXTENSION: The terraces that currently facilitate hatching grounds for Stock Dove are to be secured, and furthermore extended (se yellow gradient on master plan) to provide a larger area where more birds can enjoy the sun-exposed terraces. The extension initiatives consist of preparing the terraces and general area to promote bird habitation, as well as restricting accessibility to the extension-zone.

18. CALCAREOUS LIME FOREST EXPANSION: The existing patch of calcareous lime forest on the north-western edge of the project site is to be secured and, measures initiated to promote the expansion of it into the surrounding woodlands.

19. CALCAREOUS PINE FOREST EXPANSION:: The existing area of calcareous pine forest in the south-eastern part of the project site is to be secured and, measures initiated to promote the expansion of it into the surrounding woodlands.

20. BUILDING RECLAIMED AS WILDLIFE SANCTUARY: The massive industrial building on the eastern part of the site is modified with wall perforations, large structural cuts and possibly prepared with soil to help establish a prosperous new ecology. The reclaimed building is set up as a refuge to whatever wildlife that would inhabit it.

21. RAILROAD TRACKS RACLAIMED AS PATHWAY: The railway-sidetrack and the connected building (currently used for loading extraction minerals onto train wagons for transport off the site) are reclaimed as a pathway and monument as part of the new infrastructural network on the site.

22. EXISTING SKI-CIRCUIT EXTENSION: The backbone of the new circulation network will be an illuminated gravel road that connects to- and extends an existing illuminated cross country skiing-trail just south of the site. Other 'lighter' mobility infrastructures will deviate from this backbone, connecting to strategic places where the primary, illuminated road system will not reach.

DISCUSSION

Addressed in the municipality plan for 2007-2020, the city of Porsgrunn is experiencing strong pressures on its green areas due to growth-induced urban sprawl. The plan emphasizes a need for securing core areas for agriculture, cultural landscape and protected nature; for developing continuous green structures that provide good accessibility along and across the urban fabric. The project complies with this vision by securing existing nature and green structures and promoting the

addition of more; and in making the quarry publicly accessible with the new multileveled pathway network, that permeates the project site and connects to strategic points in the city.

The remarkably central location of the site and the large green structures enveloping the extraction area - which represent a large portion of the city's total green structure - suggest that the site could play a major role in the "green" future of Porsgrunn. And I think the biggest con with the proposal would probably be of a financial nature for the company, that could possibly sell the site to developers with very different values and ideas in mind.

All in all the plan secures 4 existing valuable biotopes on the site, introduces 9 new biotopes plus 4 new ecotones, provides a plethora of new public amenities (recreational infrastructure, cross country skiing circuits, climbing centre, educational centre, cafe, canoeing lake, bat cave excursion, educational installations, vista points, a 25m high ascendable mine tailing and more), improves connectivity and introduces a sustainable strategy for managing the contaminated city-snow. I believe the project would provide a massive amount of added value for both biodiversity and society, and it could serve the company well in terms of public goodwill for fronting high ethical standards and setting a whole new industry standard that would benefit the whole world.

CONCLUSIONS

I believe the chances for success in implementing the ideas proposed in the project are very high, seeing that the interventions are so deeply rooted in the natural properties of the site and its context, and the many benefits for the immediate- and extended environment and society are quite unambiguous. Furthermore the proposed master plan is flexible and adaptive in the way that a complete implementation of all the design interventions is not necessary for assuring its functionality. Some of the proposed interventions could readily be discarded if necessary without hurting the integrity of the master plan; and different interventions could be applied at various time intervals, and even be modified if the situation changes.

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