Augustenborg, Malmö: Retrofitting SUDS in an urban regeneration area

Climate change impacts addressed	Urban flooding
Spatial scale	Neighbourhood
Response type	Delivery of physical infrastructure
Core drivers	Response to current climate Quality of life and attractiveness of place
Good practice	Leadership / championship External collaboration Public engagement Cohesive delivery of multiple benefits

Summary

The neighbourhood of Augustenborg (Malmö, Sweden) has experienced periods of socio-economic decline in recent decades, and frequently suffered from floods caused by overflowing drainage systems. Augustenborg underwent a significant regeneration between 1998 and 2002. The main drivers for this regeneration initiative were the difficult social and economic situation in the neighbourhood, flood risk management, waste management and biodiversity improvement. Significant physical changes in infrastructure took place as a result, focusing on the creation of sustainable urban drainage systems, including ditches, retention ponds, green roofs and green spaces. The project was carried out collaboratively by the city council and a social housing company, with extensive participation of the residents in Augustenborg. The project has resulted in a successful outcome as the rainwater runoff rates have decreased by half, and the increase in green space has improved the image of the area.

Case study location

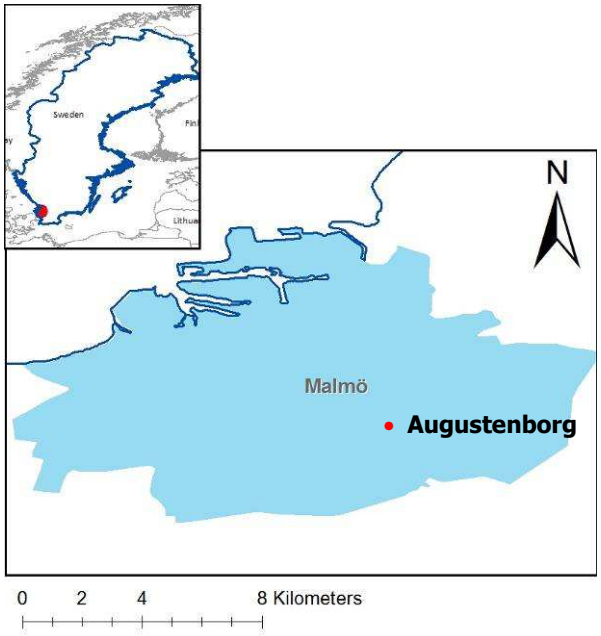

Figure 1. Location of Augustenborg

Malmö is located in the south of Sweden and is the country's third-largest city, with a population of 286,000. Malmö used to be a successful industrial city. However, the oil crisis in the 1970s caused closures of shipyards and textile industries generating severe unemployment. Since the 1980s Malmö has reinvented itself as an eco-friendly, multi-cultural and knowledge-based city [(1)].

The Augustenborg neighbourhood, located in the Fosie district (Figure 1), is about 32 ha in size and contains 1,800 apartments, 1,600 of which are rented from the Malmö Municipal Housing Company (Malmö Kommunala Bostadsbolag - MKB) [(2), (3)]. Most of the multi-family houses are 3 stories high, some houses are 7 stories. The neighbourhood is home to 3,000 residents. It was built in the 1950s as one of the first housing estates delivered under Sweden's social housing policy, and was initially considered to be a highly successful mixture of housing, employment and social facilities. However, by the 1970s the neighbourhood fell into decline, impacted on by

economic difficulties at the city level. The estate suffered a spiral of decline as more people moved out, flats remained unoccupied, and the residual population became marginalised with high levels of unemployment [(2)]. Augustenborg has also been challenged by high levels of resident turnover and a high percentage of immigrants who started arriving in the 1990s [(4)]. Problems with the built environment included damp, inefficient insulation and poor appearance. Most importantly, the neighbourhood suffered from flooding from the sewage and drainage system, the capacity of which was exceeded during heavy rainfall events. The in-migration to Malmö in the 1980s and 1990s brought cultural diversity to the neighbourhood. The regeneration efforts in Augustenborg started in the 1990s, and developed into the Ekostaden Augustenborg project.

Malmö has a mild, oceanic climate, despite its northern location. In summer average high temperatures reach 18-21°C and low temperatures are around 10-12 °C, but temperatures do sometimes exceed 25°C and occasional heat waves occur. Winters are cold, with temperatures steady between −3-4°C, rarely dropping below −10°C [(5)]. Rainfall is light to moderate throughout the year, with an average of 169 wet days and 600mm rainfall per year. The second half of the year is the wettest, with November having an average of 60mm precipitation. The months from January to June normally have less than 50mm precipitation and the driest month, is February with an average of 30mm [(3)]. Snowfall occurs mainly in December through to March, but snow covers do not usually remain for a long time, and some winters are virtually free of snow.

Prior to regeneration, Augustenborg was prone to annual flooding caused by the old sewage drainage system being unable to cope with the combination of rainwater run-off, household waste water and pressure from other parts of the city. Resulting flooding was leading to damage to underground garages and basements, and restricted access to local roads and footpaths. Untreated sewage also often entered watercourses as a result of increasing pressure on the sewage treatment works [(2)].

Future climate projections for Malmo developed by the Swedish Commission on Climate and Vulnerability [(6)], estimate an increase in average January temperature of 2°C by the 2020s and 6°C by the 2080s. The summer (July) increase in the temperature is projected at 2°C by the 2020s and 4°C by the 2080s. The number of days in the summer with a maximum temperature above 20°C could increase to 10 in 2020s and to over 50 in 2080s. The precipitation patterns will also change with wetter winters and drier summers. Summer precipitation is likely to fall by 30mm per month. The precipitation in January is likely to increase by 30mm in 2020s and 50mm in 2080s compared to the 1961-1990 baseline. The number of heavy downpours in autumn and winter are projected to increase, with up to 8 days with over 10mm of precipitation possible by 2080s. This is likely to exacerbate the problems associated with rain water runoff management in urban areas.

Development of the initiative

Key aims

'Ekostaden Augustenborg' is the name for the regeneration initiative of Augustenborg neighbourhood in Malmö. The key aim of the initiative was to create a more socially, economically, and environmentally sustainable neighbourhood. The City of Malmö and MKB set the initial scope of the Ekostaden Augustenborg project, which focused on combating flooding, waste management and enhancing biodiversity. In order to minimise flood risk, rainwater from roof tops and other impervious surfaces is now collected and channelled through canals, ditches, ponds and wetlands before finally draining into a traditional closed sub-surface storm water system (Figure 2).

Themes driving the initiative

The main driver behind the initiative was the regeneration of the neighbourhood with firm focus on innovative environmental improvements, including reduction in flooding, improved waste

management, and biodiversity enhancement [2]. The direction and focus of the urban regeneration initiative was partly dictated by the changes at the city level, which was pursuing policies relating to moving from post-industrial to environmentally sustainable city [1]. While adaptation to climate change was not an explicit driver, the project aimed to address the issue of urban flooding, which is one of the climate change effects that is likely to be exacerbated in the future in this area. Measures addressing urban flooding were combined with those aiming at reduction in CO_2 emissions, and at improved waste management.

Figure 2. Sustainable urban drainage system in Augustenborg (Photograph: GRaBS)

Details of the initiative

The introduction of a Sustainable Urban Drainage Systems (SUDS) was part of the broader regeneration project, Ekostaden Augustenborg. This project also involved initiatives aiming at improvement of energy efficiency and energy production, electric public transport and car pooling, and recycling [2]. Due to recurring flooding problems it was proposed that stormwater from Augustenborg should be disconnected from the existing combined sewer, and drained by means of an open system. The main intention was to reduce flooding by 70%, eliminating combined sewer overflow completely, by both lowering the total volume of stormwater reaching pipes and reducing the peak flow rates. This has been achieved by reducing the impervious areas and the associated runoff, preserving and enhancing green spaces, and managing stormwater to reduce total runoff [3].

The stormwater management system created in cooperation with MKB, the Water Department, landscape designers, and local residents in Augustenborg interested in water management issues, now includes a total of 6km of canals and water channels and ten retention ponds [2]. Rainfall is collected in natural ditches and reservoirs before directing it into a conventional sewer system. The rainwater from various roofs, roads and car parks is channelled through visible trenches, ditches, ponds and wetlands (Figure 3). These landscape features are integrated into the townscape within 30 courtyard areas, which also provide recreational green spaces for the area's residents [1]. Whilst green spaces were increased in size and number, the specific style of the 1950's was maintained

so as not to compromise the aesthetics of the area [2]. Some of the green spaces can be temporarily flooded, which helps to manage water by slowing its entry into the conventional storm water system.

In addition, green roofs have been installed on all developments built post 1998. Some buildings existing prior to 1998, such as garages that have been reused as offices, have also been fitted with green roofs. Altogether, there are 30 green roofs in the neighbourhood and 2,100 m^2 of green roofs are provided on MKB houses. In addition, a Botanical Roof Garden, which covers 9,500m^2 of an old industrial roof, was developed between 1999 and 2001, and remains the largest green roof in Scandinavia [2].

The alternative option of reducing flooding via a conventional separated stormwater system for Augustenborg would have meant major earthworks. This approach could also have caused problems further along the stormwater drainage network, such as bottlenecks where the system joins with older pipes. Moreover, the receiving areas could have suffered increased flood risk, erosion or water quality degradation [3]. Therefore, the implementation of the open stormwater system described above was considered to be the most sustainable option aligning with the vision of the regeneration initiative Ekostaden Augustenborg.

Figure 3. Sustainable urban drainage system in Augustenborg (Photograph: GRaBS)

Implementation of the initiative

The project was started in 1997, and ran between 1998 and 2002. The work on the SUDS infrastructure began in December 1999, and finished in the summer of 2000. The system has been operational since May 2001 [3]. The implementation of the initiative was co-managed by the City of Malmö and the MKB social housing company. Close cooperation between these bodies allowed negotiation of management responsibilities, which are crucial for maintaining the initiative in the long term. The MKB and the City of Malmö agreed a joint management contract for the waste, water and green space systems, which is said to be working effectively [2].

The project involved retrofitting SUDS within existing development and infrastructure, and with residents in situ, which presented a challenging task. Specific challenges associated with the design of a system that was functional, did not damage existing buildings and infrastructure, and was acceptable to local residents, are listed in Box 1. These problems were solved by redesigning, re-siting and in some cases not implementing certain elements of the system, utilising technological solutions, and extensive consultation with local residents (see the section on stakeholder participation). Other problems associated with the project were the unavoidable noise

and dust during construction, which caused complaints from local residents [3]. In addition, the retention ponds were prone to algae growth, and a technical solution was designed to solve this problem [2].

Box 1. Design challenges to implementation of sustainable urban drainage systems in Augustenborg [3]

- Finding physical space to incorporate the SUDS into the already existing development:
  - The SUDS had to be fitted around existing electricity, water, heating and telephone infrastructure;
  - Access for emergency vehicles had to be maintained;
  - Many residents were concerned that large percentage of the accessible green space was not suitable for recreation, and that some trees were removed.
- Buildings could not be damaged by water. Thus, all SUDS were underlain with geotextile, removing the possibility for increased deep percolation and limiting the system's function to water retention rather than infiltration.
- Health and safety issues had to be solved. The SUDS were located within and in close proximity to school grounds, and concerns were raised about the drainage channels posing obstacles to elderly and disabled.
- Aesthetics were more important to many residents than the functioning of the system.

Sources of funding

The total sum invested in the physical improvements in Augustenborg and related projects was around SEK 200M. Around half of the sum was invested by MKB. Remaining funding mainly came from the local authorities, principally the City of Malmö, in addition to several other sources which included [2]:

- The Swedish government's Local Investments Programme for Ecological Conversion and Eco-Cycle Programme (SEK 24M);
- The Swedish Department of the Environment (SEK 4M) and EU programme LIFE (SEK 6M) provided funds for the creation of the Botanical Roof Garden;
- EU URBAN programme also supported the regeneration of Augustenborg.

Management work is jointly funded through the housing company, which incorporates costs into rents, the water board through the water rates, and the city council's standard maintenance budgets.

Stakeholder engagement

Collaboration with key stakeholders

The key actors involved in the regeneration of Augustenborg were the MKB housing company and the City of Malmö, represented by the Fosie district and the Service Department [2]. However, several individuals were particularly important to the success of the project. The process of creation of Ekostaden Augustenborg began in 1997, and was started by discussions about closing down a nearby industrial area. Peter Lindhqvist from The Service Department, City of Malmö, suggested that an eco-friendly industrial park opened in the area. At the same time Bertil Nilsson, former headmaster at the school in Augustenborg, had become one of the co-ordinators of the Swedish Urban Program in Malmö. He contacted Christer Sandgren at MKB who was their housing manager for Augustenborg and had the mission to renew the area. The three men gathered a

group of senior officers, colleagues and active residents in the area who all wanted to turn the area into a sustainable district of Malmö. A project leader, Trevor Graham with experience from Groundwork in England, was hired in 1998 [(2)]. As the project progressed, local businesses, schools and the industrial estate became involved. The Botanical Roof Garden was developed in a partnership with several universities and private companies.

Engaging the public

One of the main objectives of Ekostaden Augustenborg was to enable residents to play a significant role in the planning and implementation of the initiative. The Augustenborg project incorporated extensive public consultation. This included regular meetings, community workshops, and informal gatherings at sports and cultural events. The approach became increasingly open and consultative [(2)].

While some claim that involvement of local residents was low for a variety of reasons ranging from apathy to language barriers [(3)], approximately one fifth of the tenants in the area have participated in dialogue meetings about the project, and some have become very active in the development of the area [(2)]. Residents and people working in Augustenborg were involved in the design of the outdoor environment. A special needs advisor and local access and mobility group worked with the design team throughout the project [(2)]. Constant communication and in-depth community involvement enabled the project to accommodate residents' concerns and preferences regarding the design of the stormwater system. Consequently, the project encountered little opposition.

Augustenborg school pupils were involved in a number of local developments, for example with the planning of a new community/school garden, rainwater collection pond/ice rink, a musical playground, and sustainable building projects incorporating green roofs and solar energy panels [(4)].

The greatest challenge in involving the public was maintaining continuity, which involved keeping a steady focus on the environmental awareness of the residents and informing the newcomers to the area about what had been done. He also observed that in order for people to become involved they need to have more control over the project outcomes, and the authorities therefore have to accept that things do not always happen exactly as they were planned [(2)].

Can it have an impact?

Scope of adaptation

It is estimated that 90 % of the stormwater from roofs and other impervious surfaces is led into the open storm-water system in the housing area [(2)]. The open stormwater system is now able to handle runoff volumes locally. The implementation of an open stormwater system at Augustenborg has improved not only stormwater management in the area, but also the performance of the combined sewer system that serves the surrounding area. The volume of stormwater draining into the combined system is now negligible, and this system now drains almost only wastewater [(3)].

In addition, modelling work has shown that the total annual runoff volume is reduced by about 20% compared to the conventional system. This is due to evapotranspiration from channels and retention ponds between the rain events. Also, the runoff peak flows are delayed and attenuated [(3)].

The partnership involved in the design of the project was aware that climate change is projected to worsen still further flooding problems in the city. While no climate change analysis was carried out on the open storm water system, it was designed to accommodate a 15 year rainfall event as the baseline. Significantly, there have not been any floods in the area since the open stormwater

system was installed [2]. Moreover, a 50 year rainfall event was experienced in the summer of 2007, which cut most of Malmö off from rest of Sweden. Augustenborg was not affected by this event, suggesting the design of the storm water system is performing better than conventional design standards and that Augustenborg is well prepared for more intense rainfall events in the future.

That the functions of the SUDS in Augustenborg have nevertheless been to some extent compromised by the need to adjust the design to suit the residents' needs. In order to reduce the total flow volume, the storage capacity between storms should be maximised and the surface area of storage areas should be as large as possible to encourage evapotranspiration. However, the residents were concerned about their courtyards being turned into unusable areas of open water. The conflict between people's preferences and the requirements of an efficient stormwater drainage system were to some extent solved by the development of green roofs, which utilised previously unused space [3].

The green roofs in Augustenborg intercept around a half of the total rainwater runoff over the course of a year (the amount absorbed at any time varies according to the saturation level of the roof surface). In addition, the roofs have a significant cooling effect in the summer when compared with standard black bitumen roofs. Consequently, their presence (and that of more open water and green space) will help the area to adapt to projected heatwaves and higher temperatures associated with climate change.

Additional benefits

There is a range of benefits additional to adaptation to more extreme rainfall events that stem from the comprehensive regeneration of the Augustenborg area:

- Reconfiguration of public spaces between housing blocks has given residents opportunities to grow their own food in small allotments, and has created places for leisure and attractive areas for children to play.
- Biodiversity in the area has increased by 50%. The green roofs, predominantly the Botanical Roof Garden, have attracted birds and insects, and the open storm water system provides better environment for the local plants and wildlife. In addition, flowering perennials, native trees and fruit trees were planted, and bat and bird boxes were installed.
- The environmental impact of the area (measured as carbon emissions and waste generation) decreased by 20%.
- The participatory character of the project sparked interest in renewable energy and in sustainable transport among residents, after they heard about similar plans for other areas.
- Between 1998 and 2002 the following social changes have occurred:
  - Turnover of tenancies decreased by 50%;
  - Unemployment fell from 30% to 6% (to Malmö's average);
  - Participation in elections increased from 54 % to 79%.
- As a direct result of the project, three new local companies have started: Watreco AB (set up by local resident and amateur water enthusiast), the Green Roof Institute, and the car pool established in 2000, which uses ethanol hybrid cars to further reduce environmental impacts [2].

To summarise, the environmental improvements, enhancement of the built environment and empowerment of the local community have resulted in Augustenborg becoming an attractive, multicultural neighbourhood. Augustenborg is now seen in a positive light by most residents in Malmö and the Ekostaden project is considered to be one of the most far reaching sustainable urban regeneration initiatives in Sweden [7] and provides learning and inspiration for other areas [8] (Box 2).

Box 2. Augustenborg as an inspiration for other areas

The adaptations at Ekostaden Augustenborg are now being replicated in a number of projects in Malmö:

- The redevelopment of a hospital site in the city is building on lessons learned, and is designing a 100% 'storm water neutral' system, which will manage all storm water within the site's boundaries.
- A project relating to sustainable regeneration of post war housing is analysing what has worked (and not worked) in Augustenborg when it comes to facade renovation, storm water handling and involvement of residents.

In addition, around 15,000 visitors have come to the area, including Augustenborg´s Botanical Roof Garden, from all over the world since the start of the project. There is a constant interest, both local and international, to learn from the example of Augustenborg and global media interest is still strong.

Key messages

- The initiative and enthusiasm of the Service Department in Malmö and housing company MKB. Strong leadership by individuals from these organisations and their professional networks allowed the development of a comprehensive project. In turn, this leadership was only possible due to decentralisation of power from the city to the district level.

- The collaborative character of the project enabled joint management of related issues.

- Participative character of the project. Involvement of the residents in the design phase meant that there was little opposition to the project, and resulted in sense of ownership, empowerment and raised awareness among the residents.

- Extensive funding provided by the local authorities and the housing company.

Contact organisation

www.Malmö.se/sustainablecity

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