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Is There an Ideal Model for Effective Stormwater Management in Norway?

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Introduction

Climate changes in Norway deals with increased amount of precipitation and an elevation of temperature. Increased urbanization with more dense surfaces provides even more flooding risks, which is and has been the reality many places for some years now (Hanssen-Bauer, I. et al 2015).

Use of stormwater as a resource was the main topic in Norsk Vann rapport 162/2008. (Lindholm et.al.2008), made as a guideline for climate adapted stormwater management in Norway. The report addresses water engineers, planners and landscape architects working to solve the increased amount of stormwater due to climate changes. Additional water management has to provide values to the environment, such as aesthetics, experience, recreational and social values related to the total entity. We need to know how the practical work is performed. Is there an ideal method for stormwater management, a kind of best practice model that is possible to identify? How are the interdisciplinarity challenges solved?

This paper is based on an ongoing research project funded by the Norwegian Research Council and Asplan Viak AS. It is named in English "Stormwater as a resource. Increased use of stormwater as environmentally creating element in urban areas", led by Asplan Viak AS in Norway (Vasseljen et al., in progress).

Through evaluation of case studies of ten different stormwater management projects in two major cities in Norway, Oslo and Trondheim, we got some interesting findings during our evaluations. The six Oslo cases are discussed and evaluated here. Stormwater will in this study, embrace both rainwater and surface water in urban reopening projects of creeks and small rivers much influenced by heavy rain events, since they are so closely connected.

Background and literature review

Urbanization and increased precipitation combined with old sewer systems entails challenges of handling urban stormwater. The urban waterways and stormwater management should be treated as one entity (Lindholm et al., 2008). Catchment plans should include stormwater management and flooding from creaks and small rivers in open solutions. The three step strategy in the

same report (Lindholm et al. 2008) introduces the stormwater management plan as a tool for the municipalities, planners and designers. First step is to capture and infiltrate small rain events, mainly on site and close to the source. Step two is retention and delay of medium rain, and the third and last step is safe diversion of large rain to avoid flooding. The three step strategy is adopted as a national stormwater strategy from the governments new report (NOU 2015:16), and adopted by the municipality of Oslo in their stormwater management strategy. The concept for the three-step strategy is that stormwater is a resource rather than a problem, and managed holistically. Another example is Malmö, a major city in Sweden, which has developed a basic idea for stormwater policy where the quantity issues (flows and volumes), quality issues (pollutants) and various social aspects (amenity and multiple use) should be dealt with in one overall plan (Stahre, 2008).

Presenting a new stormwater management technique, Echols and Pennypacker (2008) introduce the new concept "artful rainwater design" (ARD), to point to the importance of managing stormwater runoff close to the source as new design opportunities. Northern European countries, such as Denmark and Norway, parts of Germany and the Netherlands are all working with the challenges of adapting cities to climate change (Beckhaus & Fryd 2013). Design practice is still searching for appropriate aesthetics on landscape-based stormwater management systems. Open water in rivers, creeks and stormwater measures provides several benefits to the quality of the water like more oxygen and sunlight. As water moves through vegetation, sand and gravel, it is filtrated for contaminated particles (Paus et al., 2014).

Goals and objectives

The research aim is through interdisciplinary collaboration, to develop good processes and procedures for planning and design of modern stormwater management. The purpose is to increase the use of stormwater as a resource in urban areas, and to identify a model for best practice in the field. We searched for the driving forces behind the stormwater management projects today, if there are guidelines and restrictions made by the government or municipalities to follow. Furthermore,we looked into what we could expect from the already made stormwater projects, and if the stormwater is handled properly in order to avoid flood as well as creating additional values.

Method

We wanted to identify both national and local guidelines, handbooks and legislations for planning and engineering stormwater management projects. To find out how the municipalities work with the topic, and if this is handled

similarly throughout the country. By reading the municipalities` websites about the topic, and go deeper into it by interviewing main persons in the municipality about their attitudes and goals.

Criteria for identifying cases was done by choosing projects finished within the last ten years, located in two different parts of Norway in order to obtain as wide range as possible. There should be public spaces of a certain size, placed in an urban context with multifunctional green structure. The selection was influenced by pre-existing knowledge and recommendations from peers (Beckhaus & Fryd 2013). The examination of the cases is done as empirical observations and normative assessment of the visual appearance.

The case studies took place in September 2014 as an on-site examination by a group of 2-3 landscape architects, one architect and one water engineer. The studies were based on observations, semi-structured interviews on-site and afterwards with designers, stakeholders and persons in charge of maintenance. Photographs and review of papers, maps and drawings were examined.

Only three out of ten research cases are based on just stormwater. The other seven are all connected to rivers to be partly reopened, together with managing stormwater on site. The cases were examined through four main topics; hydrology, ecology, experience value (aesthetical, recreational & social) and maintenance. Before examination of the cases, the research team developed a list of criteria to use in the evaluation of the cases. The evaluation form of built facilities identifies what kind of stormwater management solutions were used.

Results

After having examined the websites of a few selected cities in Norway, we identified that open stormwater management was included in the guidelines in the municipal development plans. However, the focus on stormwater management varied considerably. One city had implemented an overall stormwater management plan while one city barely mentioned it. We also interviewed the head of water and sewerage agency in the three biggest cities, Oslo, Bergen and Trondheim. Oslo was best in class due to use of stormwater as a resource. Since around year 2000 they have had a strong focus on informing every property owner to take care of stormwater on their own sight. Restrictions do not allow them to bring water directly into the municipal sewage network because of the limited pipeline capacity. The other cities have not implemented such an overall legislation, only certain areas of the cities have similar plans of action. Our research shows that in Oslo the biggest obstacle for open stormwater measures being built is lack of knowledge, not in the municipality, but among developers, engineers, landscape architects and

constructors. In Bergen and Trondheim there was lack of knowledge among all actors. All three municipalities mentioned that stormwater measures are area demanding.

In this paper we focus on the six cases in the Oslo area, four re-opening of creeks and rivers (two in Hovinbekken and two in River Alna) and two only with stormwater management (Nansenparken and Pilestredet Park). As earlier mentioned we examined four main topics; hydrology, ecology, experience value and maintenance. The hydrology is the main element that will be described here because that was critical to all the other topics. Everything depend on the hydrology input as a determining factor. The three other topics will partly be mentioned when appropriate.

Stormwater management is directly related to calculating the quantity of water moving through a given system. The results from the case studies shows it is a challenge to make measures with suitable dimensions. Several cases still used large storage tanks for delay of the stormwater rather than using the water as a resource on surface areas. However, the storage tanks should rather be the last resort, and not the first as an example from Pilestrede Park showed us (figure 1 and 3). Here, a large open stormwater measure, with the possibility to store huge amount of stormwater, barely gets any stormwater at all, because all the water ends up in the tank. The area seems to be over-dimensioned.

The quality of the water is also an important factor connected to the importance of blue and green areas as additional values. Two main rivers in Oslo, Hovinbekken and River Alna have been partly reopened over the last ten to fifteen years as part of a big political program related to improved living conditions in the area of Groruddalen. Since the beginning of the 1900, most of the rivers and creeks in urban Oslo were closed and routed into pipes, mostly due to poor water quality. Since around year 2000, this changed and rivers and creeks started to be partly reopen. One reason is again the quality of the water, however this time the water quality has improved substantially. During the period of closed rivers, numerous pipes were connected to the main river pipe system. This brought various types of pollution from industry, roads and even black water into the pipe system. As the city has grown, big challenges in reopening rivers occur as buildings and constructions are covering the old river areas. Open rivers need more space than closed ones, and that is why the rivers reopens in parts.

For three of the reopening cases, we could demonstrate that most of the water during a heavy rainfall still goes in pipes below the open river (figure 3). We discovered this by studying the plans and drawings, and discussing with the

planners, engineers and landscape architects. The need to understand the flow of water in every case study, forced us to find a way of showing it, as shown in the example from Bjerkedalen Park reopening project in Hovinbekken (fig. 2)

Figure 1. Detention area. Possible to collect a big amount of stormwater runoff

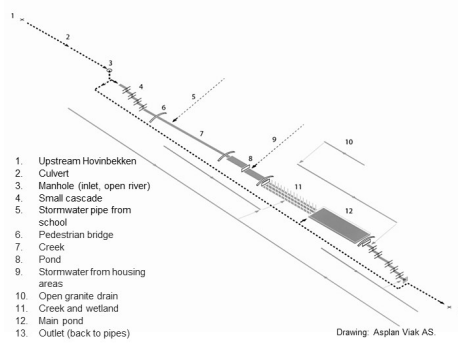

Figure 2. Bjerkedalen Park. Principle drawing of the waterways through the project

The lack of water in dry periods has in some places, damaged the bottom of the rivers. In these kind of projects the river is constructed with a dense bottom, and the result is an uplifted river. The need of supplying fresh water increases, mostly to avoid leakage of water. In the two Hovinbekken projects, Bjerkedalen and Tiedemannparken, the original river flows much deeper in the ground, hence the uplifted river (figure 3). The area around is filled up with soil several meters high, and a connection to the original water stream is not possible. The same two cases has limited connection to the stormwater from the housing areas nearby which exclude a big part of water that could have supplied both the green areas and the river with sufficient fresh water. Stormwater from roofs and green areas are important because it is defined as clean, and therefor an important contribution to the river. In the new housing areas nearby Tiedemannparken stormwater is retained in tanks underneath the parking cellars as an unused resource, before entering the effluent pipe system.

In the case of River Alna, the study at Hølaløkka and Grorud Park, shows different natural ways of cleaning the water connected to the reopened river, which increase the ecological values. Aeration and purification of stormwater from roads, parking lots and sports facilities are used in vegetated wetlands, natural designed creeks and in urban concrete channels. Measures connects to waterfalls, and have sediment basins before the outlet into the river. Nansenparken is not connected to any river. It is constructed as a water concept based on several natural processes and supplied with fresh water in the

dry season. The water connects to the groundwater, and is pumped and reused for the water facilities, which gives important experience values to the park.

Project	Kind of project	Hydrology	Other factors
Bjerkedalen Park	Reopening part of Hovinbekken	Uplifted river. Piped original river. Piped stormwater from houses	Big green park between existing housing area
Tiedemannparken	Reopening part of Hovinbekken	Uplifted river. Piped original river. Stormwater in tanks at residences	Narrow dense park in new urban housing area
Grorud Park	Reopening part of River Alna	Not piped river. Stormwater natural based cleaning processes	Big green park in existing river valley
Hølaløkka	Reopening part of River Alna	Uplifted river. Piped original river. Natural based cleaning processes	Quite big river park in housing and industry area
Pilestredet Park	Based on just stormwater	Stormwater collected in big storage tanks. Dry surface solutions	Narrow and dense urban park in housing area
Nansenparken	Based on just stormwater	Recycling stormwater & natural based cleaning processes	Big green park connected to housing area

Figure 3. Case study shows how the water are treated

Discussion

The new NOU 2015:16 about stormwater in urban and suburban areas, has uncovered that the national guidelines for managing stormwater in Norway is inconsistent in many ways. It points out the need to coordinate the stormwater- and watercourse measures within each catchments, which means that everyone involved must work together interdisciplinary. While the water engineers are doing calculations in relation to climate change, it seems that the planners job in the municipalities has changed the last ten years. They more frequently make arrangements for the private developers, and let the private actors do the planning (NOU 2015:16). This may differ a lot in different municipalities, but it seems to be a tendency. This can explain some of the results from our case study, where we raise the question if they do enough to avoid floods. When private developers are responsible for the planning without clear guidelines about how to relate to the whole catchment area, the municipalities have no control of how properly the stormwater actually is being managed.

Catchment-based planning is an important control for managing the stormwater properly. Instead of managing stormwater on every property, it should be based on catchment analyses (Ødegård et al., 2013) and (Thorén 2014). In catchment-based landscape analyses, it is possible to make plans to manage stormwater as a resource in every part of the catchment area. Such measures can take action upstream to avoid flooding downstream (Bioforsk). The important result is to identify available areas for local stormwater managements (Ødegård et al., 2013), and to develop an interdisciplinary understanding in how and where the water flows both on surface and in pipes as well as know about the groundwater level. By connecting the stormwater

management to small catchment areas rather than for every single property, calculations for total precipitation and runoff is easier to calculate and manage.

The case studies shows that it seems to be equally important to create additional values in addition to managing the stormwater in Norway.

Conclusion

Future planning and design of open stormwater management must define the ambitions at an early stage at every level working interdisciplinary. Do catchment-based landscape analyses to identify possible areas for open stormwater measures. Do not trust that every single developer can do it properly by their own. The government need to have the overall control over the catchment. Choose measures that have actual hydrological and ecological effects, based on the climate today and in the future, as well as providing additional values. Success criteria will be to increase the knowledge in every level from planning to maintenance. Make general plans, which set the premises for managing stormwater in the catchments. Give stormwater measures enough space. Use nature as a model.

References

Backhaus, A. & Fryd, O. (2013) The aesthetic performance of urban landscape-based stormwater management systems: a review of twenty projects in Northern Europe. *Journal of Landscape Architecture*, 8:2, 52-63

Bioforsk. (Downloaded 2016) ExFlood - Extreme weather in small catchments: new method for flood protection. Available at: http://www.bioforsk.no/ikbViewer/page/prosjekt/hovedtema?p_dimension_id=22783&p_menu_id=22793&p_sub_id=22784&p_dim2=22785

Echols, S. & Pennypacker, E. (2008) From Stormwater Management to Artful Rainwater Design. *Landscape Journal*, 27:2-08

Hanssen-Bauer, I. et al (2015) NCCS report no. 2, Klima i Norge. *Miljødirektoratet*

Lindholm, O., Endresen, S., Thorulfsson, S., Sægrov, S., Jakobsen, G., Aaby, L. (2008). Veiledning i klimatilpasset overvannshåndtering. Norsk Vann rapport 162-2008

NOU 2015:16. Overvann i byer og tettsteder. Som problem og ressurs. Klima- og Miljødepartementet (Official Norwegian Report)

Paus, K. H., Morgan, J., Gulliver, J. S., Leiknes, T. & Hozalski, R. M. (2014). Assessment of the Hydraulic and Toxic Metal Removal Capacities of Bioretention Cells After 2 to 8 Years of Service. *Water, Air, and Soil Pollution*, 225.

Stahre, P. (2008) Blue-green fingerprints in the city of Malmö, Sweden. Malmö ´s way towards a sustainable urban drainage. VA SYD

Thorén, K.H. (2014) Bærekraftig byutvikling? Blågrønne strukturer og klimaforandringene. *Arkitektur* N, 5: 82-89 (English abstract)

Vasseljen, S., Overvann som ressurs. Økt bruk av overvann som miljøskapende element i byer og tettsteder (translated to English -Stormwater as a resource. Increased use of stormwater as environmentally creating element in urban areas"), *Asplan Viak AS in Norway* (in progress)

Ødegård, I.M., Clewing, C.S., Thorén, K.H. (2013) Urban overflatevannhåndtering. Erfaringer fra Institutt for landskapsplanlegging. *Kart og Plan*, Vol 73, pp. 382-392 (English abstract)