

Reopening of culverted streams and rivers

Réouverture de rivières et cours d'eau enterrés dans des villes norvégiennes

Øystein Rapp

Sweco Norge AS, Water and Sewage Department, Drammensveien 260 0212
Oslo Norway (corresponding author: oystein.rapp@sweco.no)

RÉSUMÉ

Depuis une bonne dizaine d'années les principales communes norvégiennes ont intégré dans leur stratégie de gestion des eaux de pluie la réouverture des rivières et cours d'eau précédemment dirigés vers des réseaux fermés. La réouverture des cours d'eau et rivières a montré la nécessité, dès la phase de projet, de se focaliser sur la structure du lit et des berges des rivières et cours d'eau. Une bonne connaissance des conditions géologiques ainsi que du niveau des eaux souterraines sont primordiaux pour une bonne prise de décision à propos de l'étanchéité du lit de l'ouvrage. Le projet détaillé des différents paramètres techniques tels que les pentes, la profondeur, les largeurs etc. de l'ouvrage sont nécessaires quant à un dimensionnement correct de l'enrochement utilisé en prévention de l'érosion. Afin de prévenir de nombreux problèmes, au cours de la phase de construction de tels ouvrages, dus principalement au manque d'expérience des entrepreneurs contractés, il est fortement recommandé que le suivi de chantier soit effectué, de façon rapprochée, par les ingénieurs et architectes paysagistes ayant été impliqués lors de la phase de projet. Cependant l'eau se fraye toujours un chemin ! C'est pourquoi il est fortement recommandé de budgéter des ressources au cours des trois à cinq premières années de la phase opérationnelle, et ce, bien qu'une attention particulière ait été portée lors de la phase de construction.

ABSTRACT

The reopening of culverted streams and rivers is a strategy which has been implemented in the main Norwegian municipalities over the past decade. The reopening of culverted streams and rivers has led to, already in project phase, to pay special attention to the structure of the stream and river bed, and banks. Good knowledge of the geological conditions but also groundwater level is crucial to take correct decisions about the bed sealing. Detailed design of different technical parameters such as slope, depths, width etc. is necessary to obtain the right stone dimension that can prevent erosion. Entrepreneurs have shown a lack of experience with such constructions. Therefore, to prevent problems in the operational phase, it is relevant to have a tight follow up from engineers and landscape architects during the building phase. Nevertheless, water always finds its way! This is why it is important to keep in mind that it is always necessary to spend some resources for repairs during the first three to five years of the operational phase, even though much attention that has been paid in the construction phase.

KEYWORDS

Construction, culvert, municipality, reopening, rainwater.

1 BACKGROUND AND RELEVANCE

Reopening of culverted streams and rivers is a strategy which has been implemented in Oslo and some other Norwegian cities over the past decade. In the masterplan proposal for the new “*Green plan in Oslo*”, Oslo municipality (2009) it is stated that “One of the plan-strategies in the “Green plan” is to develop the blue green structure. Reopening of culverted rivers and streams, which is of importance for the overall green structure, is a central element of this strategy.”

Sweco Norway AS has been working as a technical consultant in several bigger projects of this kind over the last five years. Sweco Norway AS has been responsible for different stages of those projects: prestudies including predesign, detailed design but also advising during the construction phase.

Sweco is proposing to give a feedback on the acquired experience through a short presentation of the built projects.

2 MATERIAL AND METHODES

Oslo municipality has developed a strategy on reopening culverted streams and rivers, both as projects which they run on their own, but also projects where private developers own the property. In both situations consultants do much of the pre-design and design.

One of the main challenges is the structure of the stream and riverbeds. In a natural stream or a river, the bed is constructed of natural elements that placed themselves over the years. The different fractions of stone, gravel, sand, silt and clay have been sorted and placed by the stream. This has led to a sealed bottom in close contact with groundwater.

On the contrary, in a newly constructed river or stream, there is often no contact with ground water. Therefore, the bed sealing is of great importance, assuring that the constructed stream does not disappear into the ground. Sealing can be done with natural clay and moraine, or with different membranes. The other main challenge is the resistance against the bed being transported away by the water / erosion.

During the design phase a lot of time should be spent on those challenges.

3 RESULTS

3.1 THREE DIFFERENT PROJECTS

3.1.1 *Bjerkedalen Park (Oslo municipality) – won the 2015 « Oslo municipality Architectural prize » and Julsbergbekken / Bygger'n (Oslo municipality)*

This project was about reopening a culverted stream together with reconstructing a park with a small stage, café and playground. The current of the stream is regulated thanks to an overflow principle. The manhole initially used for closed stream system has been maintained to lead overflowed stream giving control of the opened stream. This method does make the construction of the “bed of the river” easier.

3.1.2 *Hvalsbekken (Asker Municipality)*

This area suffered from important floods in 2016. A project regarding reconstruction of the original stream, which has then more capacity, has started. In this project 3D-models were created, and the stakeholders could get an overview of the “final results” before the construction had even started (see the pictures below).



Hvalsbekken project, flooding and 3D-model in pre-design phase

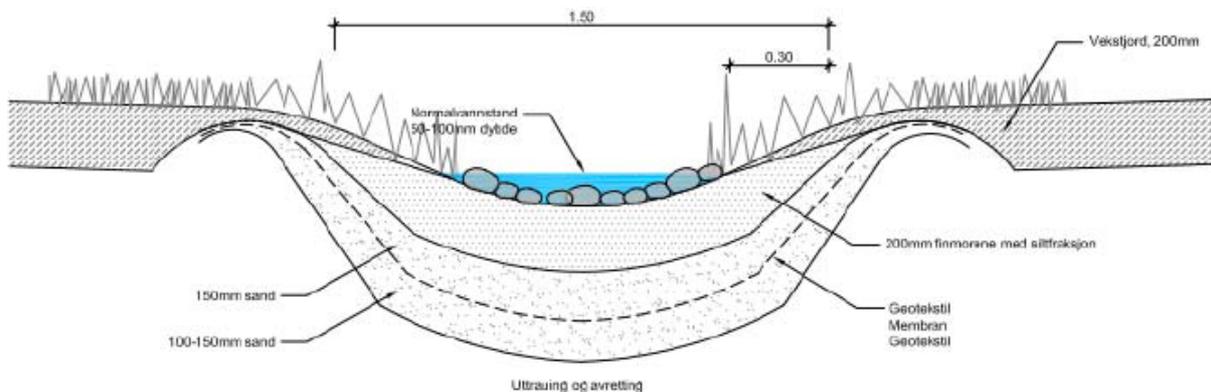
3.1.3 Skytterdalen (Bærum Municipality – Suburb of Oslo)

This project dealt with reopening of a culverted combined sewer stream (rainwater and sewage). Separation of sewage and rainwater was the main focus in this project together with designing a rainwater stream gathering water from the whole watershed. The experience from the other projects as Bjerkedalen Park mentioned above was used for the construction of bed of the river but also for the replanting of vegetation here.

3.2 GAINED EXPERIENCES / RECOMMENDATIONS

3.2.1 Construction of stream and river beds

In each of the four projects mentioned above the main river bed material was proposed to be built with natural glacial moraine materials (including clay and silt). The needed maximum stone-size both in the stream itself, in thresholds and constructed waterfalls were calculated. In figure (see below) the structure of the stream bed, and banks, from the Julsbekken-project is shown.



Structure of bank of the stream, Julsbekken project

3.2.2 Experience from the construction phase

This kind of projects is a new “subject” among entrepreneurs, and a lot of follow up in the construction phase is needed. Especially when it comes to the management of soil textures, vegetation, stone material and bottom-substratum. The construction of “thresholds” in the stream is another subject that requires follow-up. Thresholds are important for slowing down the water current and creating pools which can help with water retention. In water-ways where fishes are living, it is important to create the reopened streams so that fishes can migrate. It turned out in all three projects that it was impossible to get natural glacial moraine materials (including clay and silt) this because there were no open quarries delivering those during the construction phase. The “natural moraine” therefore had to be constructed by using a typical diagram and mixing different natural soils together to reach this match.



Construction of stream-bed and sealing of the stream-bed (FDP-membrane), Julsbekken project

3.2.3 Experience from the operational phase

Natural streams and rivers are constructed by water transport of sediments and washing out of different soils and stone-textures over the years, but constructed streams have not gone through these phases. So, it is necessary to spend some resources on the maintenance of erosion and replanting of vegetation the first three years. This, especially regarding the erosion of banks and bed at thresholds but also constructed waterfalls have to be paid attention to. In addition, other parts of the constructed streams, where water velocity is higher (narrow or steeper phases), had to be repaired. Experience from this has to be taken into account in new projects.

A common challenge is erosion but also algae-growth, and weed problems, see figures on next page.

In the Skytterdalen project a problem regarding disappearing water has occurred along stone walls. It is difficult to build such structures in a stream, especially in Nordic climate.



Erosion and weed problems, Julsbekken project

4 CONCLUSION

In addition to the technical aspects drafted above, it is important to point out the esthetical input that the reopening of streams and rivers lifts, and this in the heart of urban areas. It is also commonly accepted that this will help to reduce the oversaturated pipe networks. Such projects require a very high level of cooperation between the different engineering and architectural teams / fields as success criteria during projecting but also construction phases.

LIST OF REFERENCES

Oslo kommune, Plan og bygningssetaten, Avdeling for byutvikling (2009), *Grøntplan for Oslo*, Vedlegg 6, Lukkede vassdrag i Oslo aktuelle for gjenåpning.