

Barriers and enablers for up-scaling nature-based solutions in urban environment in the Baltic States

Summary report

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Table of Contents

Introduction	2
The methodology	2
Nature-based solutions in urban environment	3
Implementation of nature-based solutions in urban areas in the Baltic States	4
Examples of nature-based solutions in urban areas in the Baltic States	5
Main motivators for implementing nature-based solutions	8
The main barriers when implementing nature-based solutions	9
Cooperation between municipality and private landowners	13
Nature-based solutions and general public	14
Conclusions/recommendations	14
Annex 1. Interview questions	16
Annex 2. Additional materials	17

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Introduction

The objective of the research was to identify the main barriers and most efficient enablers for activating the application of nature-based solutions (NBS) for flood risk and stormwater management in urban environment by private landowners. Additionally, experience/possibilities in cooperation between private landowners and municipality representatives for enabling NBS in urban environment were investigated. The study focussed on the situation in the Baltic States - having similar climatic, geographic and political backgrounds.

The methodology

The report is mainly based on 8 interviews with relevant stakeholders having experience with NBS in urban environment in Estonia, Latvia and Lithuania (e.g., landscape architects, municipality representatives, researchers). The interview findings are accompanied by the short overview of existing examples of NBS on public and private land in urban environment in the region.

The interview questions are given in Annex 1. The interviews were carried out with 3 specialists from Estonia, 3 specialists from Latvia and 2 specialists from Lithuania.

Estonia:

- **Gen Mandre** is a landscape architect who has been actively promoting sustainable urban drainage systems (SUDS) in Estonia. He has been involved in several international projects related to SUDS ((D)rain for life, LIFE UrbanStorm, CleanStormWater) and he was one of the main persons involved in implementing nature-based stormwater solutions in Viimsi.
- **Alar Mik** has been working in Viimsi municipality for more than 10 years with construction and utility issues, currently he is the deputy head of Viimsi municipality. He considers stormwater management an important topic for the municipality and has a vision that Viimsi could be a learning and demonstration area for different stormwater solutions in future.
- **Mati Raamat** has been working in Tartu city planning for more than 20 years and has been involved in different stormwater management related projects (e.g., iWater).

Latvia:

- **Andris Ločmanis** is a city planner from Riga city and has thus been involved in several NBS projects (e.g., CleanStormWater, iWater).
- **Jurijs Kondratenko** has experience in sustainable stormwater management since 2012 and he is currently active in several organisations: Riga Technical University, Grupa93 Ltd., D-0 Ltd., Cleantech Latvia. He was involved in formulating recommendations on regulation changes to facilitate sustainable stormwater management in Latvia and developing guidance documents on SUDS implementation for municipalities and designers/landscape architects. He has acted as an expert on sustainable stormwater management in various urban planning and design projects internationally.
- **Ilze Rukšāne** is the owner of „Alps“ – a team of dedicated landscape architects creating healing landscapes. Their first project (Rūjiena culture house) with targeted design towards SUDS (not just a ditch) was implemented in 2013/2014. Since then, they have been involved in several stormwater management projects. Ilze has been involved in developing instructions and guidelines for SUDS.

Lithuania

- **Dr. Ričardas Skorupskas** from Vilnius University (Institute of Geosciences, Department of Geography and Landscaping) is an active scientist, geographer and spatial planning specialist. He has been involved in the preparation of several landscape plans in Lithuania (e.g., Landscape and Ecosystems part of the Comprehensive Plan of the Territory of the Republic of Lithuania, the National Landscape Management Plan).
- **Laura Baumilė** is the senior specialist at the Architecture and Spatial Planning Division in Plungė District Municipality where currently NBS for flood control are implemented.

Nature-based solutions in urban environment

The European Commission defines nature-based solutions as *“Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions.”*. Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services.¹

A part of NBS are Sustainable Urban Drainage Systems (SUDS) that are designed to manage stormwater runoff locally (as close to its source as possible), to mimic natural drainage and encourage its infiltration, attenuation and passive treatment. In urban environment they can be for example green roofs, rain gardens, bioswales, permeable pavement, ponds, detention basins.

Multifunctionality

While conventional urban drainage systems focus only on the stormwater quantity, SUDS pay attention to quantity and quality of stormwater runoff as well as to amenity and biodiversity offering a variety of additional benefits/ecosystem services besides flood control. Additional benefits for a private landowner could be:

- Nature-based solutions offer the diversity be it in the urban public space or private garden - plot/site is visually changing with seasons which makes it more interesting. Nature allows different solutions/features (plants, rocks etc.) and NBS can be solved differently. A pipe is just a pipe, while a swale can be ordinary or with grass, flowers, rocks etc, it can be part of a wetland, nature area. Nicer look also raises the value of the property.
- Playful effect provided by directing water and showing flowing water – e.g., cascades, fountains.
- Microclimate – lowering of temperature and reducing the impacts of heat-waves, healing effect of seeing water and greenery (proved by research), using rainwater as playground, being closer to nature, aesthetics.
- Money saving – NBS/SUDS can be cheaper than conventional drainage systems if you know how to build/maintain them. In theory green solutions are cheaper during the building phase, but their maintenance can be more expensive compared to conventional solutions. Rainwater harvesting and use for irrigation or domestic needs can also provide money saving. In the estimation of cost-effectiveness also the multiple benefits of SUDS should be counted.

¹ https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en

Challenges

Even though nature-based solutions provide many benefits, the question is how to equalise such multifunctionalities with monetary value? How much does for example visual beauty cost? If one could calculate the value of all benefits then the NBS would be much more efficient than conventional solutions.

Another challenge in the Baltic Sea Region (BSR) is related to changing climate. It is predicted that extreme weather conditions will be more frequent. On one hand due to climate change the BSR is facing more frequent and heavier rainfalls, most heavily affecting densely built and inhabited urban areas. Therefore, cities are in an emerging need to deal with the common challenge of stormwater flooding – a challenge that may lead to environmental degradation, infrastructure damage, risks to human safety and other adverse impacts on the urban environment. Such a challenge is not easily answered as it requires a holistic, comprehensive, and knowledge-based approach to stormwater management.² On the other hand, more often occurring extremely hot and dry periods make the selection of suitable plants for NBS more challenging.

It is also important to remember the winter season (snow) when designing NBS in summer. Latvia, Estonia and Finland are unique by having very many frosting/defrosting cycles that creates the need to think about overflows of SUDS and connection to the stormwater drainage. In winter the ground can be frozen, preventing rainwater from seeping into the ground, so instead of infiltrating the water will freeze and create a skatepark. Another issue in connection with the snowy season is related to the use of de-icing agents (salt) that is a problem for plants. Scandinavians have changed the de-icing methods – no salts are used but granite aggregates. Also, potassium chloride could be used for de-icing that is not as harmful to plants as sodium chloride. In the case of using sodium chloride, in order to minimise the effect on plants, filter strips before green techniques can be used. However, de-icing needs more studying. In conclusion, such challenges should be tackled in cooperation between countries with similar climatic conditions (e.g., Estonia, Latvia, Finland).

It should be also kept in mind that NBS/SUDS are teamwork - their development starts from collecting background information and creating the vision followed by stormwater calculations and hydraulic as well as landscape design (visual appearance) of SUDS. From another perspective - inside a municipality such a project goes through several departments covering their own part of the project, thus it is essential to have a project manager who has an overview of the whole project.

Implementation of nature-based solutions in urban areas in the Baltic States

Estonia

Estonia is a rather small country and in general the towns are green and with parks, however, keeping the green areas and not building grey infrastructure in them should be kept in mind. SUDS are legally favoured in Estonia as according to the Water Act they are the first solution to be considered. However, they are still a little unfamiliar and people are afraid to use them and tend to be too stuck to traditions (old and familiar ways/techniques are preferred). SUDS require broader thinking, taking into account more aspects, more work, however, the result is worth all of that. In general, Estonian

² Kondratenko, J., Kotoviča, N. & Reča M. (2021). Regional and national policy recommendations for implementing the integrated stormwater management in the Baltic Sea Region. Deliverable 4.4 of the BSR WATER project, co-funded by the European Development Fund. Riga City Council. www.bsrwater.eu/sites/bsrw/files/stormwater_report_v1.pdf

municipalities are in favour of new solutions but at the same time it can still be encountered that the thinking is based on numbers and not taking into account the added values of nature-based solutions. Younger people understand the added value and a new generation is coming. However, the tricky point can be that in municipalities older colleagues are training newcomers with old ideas. A change in thinking is needed! A drawback for Estonia is relatively cheap water, which means that water is not valued (e.g., rainwater harvesting).

Latvia

Even though there are several examples of nature-based stormwater solutions, it has taken a lot of effort and Latvia can still be considered to be in the starting phase. First showcases are working well and also awareness about multi-functionality of nature-based solutions is growing (benefits related to microclimate etc.) so at the moment the situation is favourable for SUDS (their use is growing rapidly).

The capital Riga is located by the Baltic Sea and large rain events are one of the main climate risks together with coastal floods. Thus, stormwater management is an important issue, however, currently the challenge is that different municipality organisations/departments are responsible for different parts of the stormwater management system. There is hope that the new SUDS example in Riga – Skanste park - will raise the awareness about SUDS and encourage different stakeholders to cooperate much more.

Lithuania

The implementation of nature-based solutions in Lithuania is taking its first steps. In recent years, a methodological legal framework has been developed but only one example of the application of these principles has been implemented or is still being implemented. There is a lack of integrated application of nature-based solutions in the management of the territory. However, in order to reduce the risk of surface water flooding and the negative impact on the environment and economy in Vilnius, the project “Management of Surface Wastewater Systems in Vilnius” is currently being implemented that integrates several NBS (e.g., rainwater storage pond in Šeškinė).³

Examples of nature-based solutions in urban areas in the Baltic States

Estonia

There are not so many examples – mainly small single objects but no complex SUDS solutions (SUDS as a chain of consequent stormwater management techniques)). In some cases such more comprehensive design solutions with beautiful landscaping have been rejected by the customers due to high construction and maintenance costs. However, there is a discussion about SUDS and some examples exist (e.g., Viimsi). A lot is depending on designers.

Examples:

- Viimsi:
 - Viimsi manor park – SUDS are used in the park to drain the soil in the territory of the park, protect the banks of the ditch that runs through the park from erosion by decreasing the flow rate in the ditch. Used elements – small waterfall, stepping stones, rapids, wooden platform, dam.

³ <https://www.apva.lt/pavirsiniu-nuoteku-sistemu-tvarkymas-vilniaus-mieste/>

- <https://urbanstorm.viimsivald.ee/viimsi-manor-park/?lang=en>
- Randvere tee parking lot – SUDS were used to prevent rainwater from reaching the sewage system too fast and to prevent floods. It features three areas with different types of pervious pavement, an infiltration bed and rain gardens.
- <https://urbanstorm.viimsivald.ee/randvere-tee-parking-lot/?lang=en>
- Rainwater harvesting and use system in Pärnamäe road 190 commercial building – rainwater is collected from the roof through the sieve into the tank (3000 l) from where it goes through the pump and filter into the toilets and the watering tap.
- Tartu:
 - Green roof on the main building of the University of Life Sciences (built in 2007) is Estonia's largest green roof - 1,600 square metres, the surface is covered by 8 cm of thick mixture of light gravel, clay and sand, or light humus. In such conditions *Sedum acre* and *Thymus* varieties can grow well.⁴
 - Rainwater harvesting and use system in Tartu, Vanemuise 45. The pillars of the building hide rainwater pipes, along which rainwater collected from the roof flows into a 13 cubic metre collection tank hidden under the house. The collected rainwater is used in toilets and washing machines of the house.
 - Kassisilma 2 UPS logistics centre (Tartu) - exemplary working detention pond and a ditch (by Inseneribüroo Urmas Nugin OÜ)
- Several projects are in implementation (e.g., Rapla central square where an attenuation storage tank is planned, Põhjaringi 2 production building in Tartu where a detention pond and a ditch with overflow are currently being built)

Latvia

SUDS are not very popular yet in Latvia. „Spice Home“ is considered to be the best example so far and Skanste park should be the next good example. There are also some other examples in Riga and outside, however, implementation of SUDS is still in the piloting stage. For example, other solutions in Riga are really small and not looking so nice – a few streets collect stormwater to soakaways, these are technical solutions and not visually attractive.

Examples:

- Riga:
 - “Spice Home” parking lot (built in 2016) is considered to be the best example so far in Latvia. Parking lot total area is ca 10 000 m² and includes green areas of 2 100 m². The bioswale is the first green infrastructure of such size and function in Riga. It performs well in different seasons and proved itself even in extreme weather events. The vegetation is strong and maintenance is relatively easy and not demanding.
 - <https://www.interregeurope.eu/policylearning/good-practices/item/3761/bioswale-at-the-spice-home-shopping-centre-parking-lot/>
 - Skanste park is a courageous and ambitious project that will be finalised this year. It is a public park that will be ready for different stormwater scenarios. The blue-green corridor serves an area of more than 100 ha and with local runoff restrictions has a potential to serve even greater area. This is considered to be one of the best SUDS laboratories for the next few years (by «BRD Projekts», «Veido vidi», «Grupa93»)
 - Other projects by private developers (e.g., bio-swailes/rain gardens and infiltration solutions in Bonava projects)

⁴ <http://aiandus.ee/loe.php?id=3315>

- Jelgava - ditches, ponds, permeable paving (by «3C» Ltd.)
- Kandava park with swales and pond cascade (by «3C» Ltd.)
- Rūjiena - (by «ALPS» and «3C» Ltd.)
 - 'dry river' and rain gardens near Rūjiena culture house - this is a stylish example. Huge amount of rainwater was coming from the roof of the culture house but there were no rainwater pipes so SUDS were a practical necessity. As river Ruja was close-by then rain water was directed there using sustainable techniques.
 - french drains near Rūjiena kindergarten – small but functional solution for flood control
- Ogre rain gardens, french drains and Krasta street promenade («dry rivers»)
- Nature-based solutions on the territory of the Salaspils secondary school (by «ALPS») - playground/ sportsground collecting and infiltrating water.
- Several green roofs; several are also in the design stage.
- Several projects in implementation (e.g., Sporta 2 in Riga where bioswales and rain gardens are planned, conceptual design for multimodal transport hub in Torņakalns with nature-based solutions)⁵

Lithuania

SUDS are not yet widely used in Lithuania and are the least developed urban engineering infrastructure. There are some examples of NBS, but they are still isolated. For example, the building of green roofs has only recently begun in Lithuania due to economic conditions, lack of information and climatic conditions and they are more popular in rural areas⁶. However, the concept of extensive maintenance of grasslands is being implemented in the management of Vilnius city greenery.

Examples:

- Vilnius –
 - The laboratory building of the Vilnius University Botanical Garden – during its reconstruction in 2016-2017, Paleko Studio added a roof garden (including trees and shrubs, annual and perennial herbaceous plants) with an open-air rooftop terrace and a green facade to the building.
<https://www.miesarch.com/work/3816>, <https://www.nssmag.com/en/art-design/13425/vu-botanical-garden-laboratory-the-greenest-side-of-vilnius>
 - Senvagė Valley in Šnipiškės - the former heavy transport storage site in the valley of the old river Neris was opened to urban communities.
<https://tricksfast.com/lithuania/new-place-to-visit-in-snipiskes-senvage-valley-landscape-opened-up-to-the-community-madeinvilnius-lt/>
 - Green roof on "Žali" service and shopping centre - the green roof created on the building, insulates heat inside the shopping centre in winter, does not let the sun rays heat the premise in summer, as well as allows avoiding the unpleasant smells from bitumen roofing.
<https://rautagroup.com/en/zali-true-green-shopping-center/>
 - Gulbinai district (in planning) - the main development priorities have become complex, sustainable spatial planning using flow, volume and sustainable pollution control and remediation systems, such as wetlands and ponds, infiltration, drainage systems, green boulevards, corridors, gutters, filter strips, etc.

⁵ https://erda-rte.eu/sites/default/files/documents/terra/1/6.Jurijs_2021-04-19%20Latvia%20GI%20projects.pdf

⁶ http://kurklit.lt/wp-content/uploads/2020/10/201230_ESAMOS-SITUACIJOS-ANALIZ%C4%96-1.pdf

- Rainwater storage pond - reconstruction of rainwater systems will soon begin in the 500 ha territory covering Šeškinė, Pašilaičiai and Fabijoniškės districts using the principles of green infrastructure and sustainable water management.⁷
- Pastauninkas Park (Kretinga) - a natural surface water collection and drainage system based on natural processes has been installed, performing both a utilitarian and aesthetic function.
- Plungė municipality - a shallow swampy ravine with aquatic plants is currently being installed in the intensive recreation area for the collection and accumulation of surface water from the recreation area. In the same area, nature-based surface water collection, utilisation, and infiltration facilities are installed next to the parking lots.
- The Creative Center in Tegra House (Subartėnai village, Elektrėnai municipality) consists of four buildings using harmonised design solutions completed in 2015. In order to integrate the buildings into the environment, the roofs of all buildings were planted using the company ZinCo intensive planting systems for flat and pitched roofs. <https://integra.house/en/spaces/>

Main motivators for implementing nature-based solutions

The following list of potential enablers applies in all three Baltic countries and could be used by municipalities for motivating themselves and private land owners to implement NBS in combination with or instead of conventional drainage systems:

- The main motivator is inability to do otherwise – you are forced to do something to avoid flooding. For example, in Riga developers are obliged to decrease run-off (earlier infiltration cassettes were used, now more natural solutions are favoured).
- The key is also social responsibility, the realisation that the application of such solutions directly or indirectly benefits every citizen. Implementation of nature-based solutions is a demonstration and development of personal, community and social responsibility.
- Examples of well-functioning and well-maintained NBS/SUDS are extremely important and the municipality has to set an example itself.
- Explaining the added values is important – e.g., using stormwater as irrigation water, visual attractiveness of SUDS. Beautiful environment is also a motivator.
- Using NBS makes public space greener, nicer, more inviting and more comfortable, which attracts people and brings them outside and being outside makes people more healthy (social, community and environmental benefits).
- Improved microclimate due to SUDS (e.g., green roofs on office buildings, rain gardens/flowing water) increases productivity.
- SUDS can improve safety – for example porous asphalt does not form an ice layer.
- Sustainable building certificates for commercial developers (e.g., BREEM/LEED) - certification requires sustainability and SUDS can be part of that (e.g., green roof on “Žali” service and shopping centre that is BREEM certified).
- SUDS can be part of corporate social responsibility — e.g., roof gardens for office building workers to use, bee hives on them – green roof as service (for example in Poland bee keeping is a service - you keep bees on roofs and charge money for that from the roof owners).
- Lack of infrastructure – if the city pipe system cannot handle the stormwater, then other solutions are needed, however, implementation of SUDS depends a lot on hydro-geological conditions – in some cases infiltration is not possible or is complicated.

⁷ <https://vilnius.lt/lt/2021/10/14/nauja-lietaus-vandens-talpykla-seskinės-seniunijoje-bus-pritaikyta-ir-rekreacijai/>

- From municipality's side there are several ways of motivating private land owners to implement SUDS:
 - Adding SUDS to regulations (for example, in Riga the aim is to integrate SUDS in all related municipality documents, e.g., SUDS are included in the 2nd Energy and Climate Plan and will be included in the sustainable development strategy that is currently under development). Good solution would be including SUDS into building regulation that would make considering SUDS obligatory for private landowners (e.g., like in Tartu (Estonia), however, Riga was not able to implement that).
 - „Green factor“ is also a good tool - it is a practical and user-friendly Excel-based tool for urban planning. It ensures sufficient green infrastructure when building new lots in a dense urban environment.⁸ Helsinki is advanced with that but Riga cannot find a way to implement it.
 - Stormwater tax - private land owners pay for stormwater runoff that is discharged from their property to the central system (e.g., in Riga) – that may motivate private land owners to consider implementing NBS to reduce the costs. On the other hand, municipalities may also motivate additionally by deducting the stormwater tax or exempting the landowner from tax if NBS are used.
 - Municipality may consider giving financial support for private landowners (prevention aspect, offering benefits, not forcing them to pay more) → the more water is retained at private land (at the source of stormwater runoff), the less of it ends up in the municipal central system (endpoint). Perhaps compensation would balance resolving/paying for problems later. Possible calculation method – how much stormwater runoff is coming from private land at the moment vs after application of NBS.

The main barriers when implementing nature-based solutions

Even though nature-based solutions provide a variety of benefits, the implementation of such solutions is often hindered by several barriers that are faced in all three Baltic countries.

a. *Cooperation with land owners*

Cooperation with land owners can be problematic. On the one hand, SUDS should be easier to implement on private land than for example asphalt – nice and lush rain gardens should be easier to negotiate. On the other hand, for instance Latvians are very private, so they do not want anyone to do anything on their land. This means that often private land has to be bought to finish some solution as by Latvian legislation a municipality cannot build on private land unless there is an agreement. So municipalities either build on their own land or buy land. However, more and more cities are having landscape architects who know the arguments for SUDS.

Often between the municipality and private landowner there is also a designer (municipality is communicating via designer with the land owners). For SUDS solutions the designer has to offer/propose these solutions to the landowner, as people may not be even aware of them. So the problem is the lack of knowledge of both, designers and private landowners, about SUDS and their benefits. However, the solution is providing the best

⁸ <http://www.integratedstormwater.eu/material/green-factor-tool>

examples. Reactive approach and cooperation are needed, so the key is communication about benefits that SUDS provide for all of us.

b. Conflict with heritage/nature protection

There can be conflict with both, heritage and nature protection. In case of heritage the difficulty is that historically SUDS have not been in that location and often there is no room for SUDS (e.g., the UNESCO protected old towns of Riga, Tallinn and Vilnius). In case of nature protection - SUDS can be designed in different ways and thus they can be fitted also to nature protection areas. SUDS are flexible and suit everywhere as long as the hydro-geological conditions are suitable. Additionally, there can be environmental conflicts in some locations – e.g., impervious soils, close to water bodies – so building of certain types of SUDS is not allowed.

Even though rules have to be followed, current times should be also taken into account, looking from another angle is helpful, not only black and white thinking. Not everything has to be preserved as it was, but actually exciting solutions can be added (e.g., adding boardwalk to a wetland and making it accessible to people).

c. Ecosystem „disservices“ – attraction of biodiversity undesirable for humans, e.g. ticks, mosquitoes, snakes

It is the thing with nature – there will be bugs as they are part of nature. The problem is that our contact with nature is decreasing, however, being in contact with nature increases immunity and provides better health. Thus, it is important to raise awareness about the benefits (e.g., pollinators are important for cities) to avoid public opposition to the implementation of NBS in urban areas due to the potential risks (e.g., the problem of rarely mown grasslands in Vilnius).

Standing water (e.g., in rain gardens) can encourage the reproduction of insects, so water must be kept flowing/circulating (e.g., cascade, fountain) to prevent mosquitos. Another relevant aspect is maintenance – if that is done correctly then the situation is better.

However, in general this is probably not such a problematic barrier even though the issue is often raised when designing NBS.

d. Low awareness

Low awareness can be considered the root of all problems, since the decision-making and selection of NBS depends on the level of awareness and currently the awareness is low at all levels (municipality, developer, designer, private land owner). This means that fostering and increasing awareness is crucial, this includes showcasing good examples and multiple benefits of SUDS. Private sector is not aware how this affects them but municipal examples will create interest - there is a need for practical examples that people can see and touch. Education is the key!

Another aspect is related to habits – why to change the existing practice? Why to make investments while not knowing if these are needed – if and when will the 100-year flood come? It is mainly a matter of will, awareness and readiness to take the risk of trying something new – and again the key is awareness raising because as awareness grows, so does the wish to make changes.

It has to be understood that the diameter of the pipes cannot be increased indefinitely but heavy rainfalls will happen more and more often. Wouldn't it be then easier to infiltrate some of the excess water? SUDS cannot replace conventional pipes; a city needs pipes but they should be the endpoint – before that SUDS should be used wherever possible. The most efficient solution in an urban environment is a combination of SUDS and piping. The main difference between pipe and SUDS is that when pipes are dealing with consequences and elimination of the problem (flooding), then NBS/SUDS help to prevent the problem. A good example is the Copenhagen case where there was a shift from elimination to prevention after the cloudburst events during 2010-2011. This shows that one big stormwater event can make a difference. Similarly, changes were made in Helsinki after large rain events.

Another issue is related to the quality of stormwater runoff. There are no standards on how to clean stormwater, especially in connection with oil pollution – even though SUDS clean stormwater, oil separators are still required. This means that rules need to be developed when and where separate cleaning is needed in case of SUDS and how to maintain.

Wise approach is to start with small projects, learn from them and make necessary changes. There is no need to take on the whole town at once, rather approach step by step that also allows seeing the change.

Awareness raising should start already at school level – establishing playing grounds with SUDS allows children to learn and makes it a normality for them that such solutions are used.

e. *Lack of skills and knowledge, lack of relevant service providers*

The skills of different stakeholders can be in general considered as weak. SUDS are still an unfamiliar topic for designers – e.g., they just write in the project that we will infiltrate without checking the infiltration capacity or the freezing depth. This has been the knowledge of specialists in a narrow field (hydro-geologists, water management specialists) that has not yet reached a wider circle of specialists. Often the beautiful visual appearance of SUDS is described but the necessary preparatory studies have not been carried out. Infiltration systems in our climate have to be frost resistant and definitely need an overflow. There are only a few landscape architects dealing with technical SUDS design (engineering part). There is also a lack of engineers who are able to perform stormwater calculations. For a designer it is easier to design conventional systems than SUDS.

There is also a lack of contractors who are able to build NBS professionally. Construction companies are sceptical about the implementation and installation of such measures. Thus, there is huge avoidance from constructors' side and it is extremely difficult to bring the idea to them. It is difficult to change their thought patterns as it seems that they do not think along. Reducing design supervision in order to save costs is also a problem.

It has to be kept in mind that in the case of NBS the key is cooperation – NBS are not one-man projects but cooperation is needed between different stakeholders.

New development areas are a good place to start – it is much simpler to plan/build from zero taking into account natural water cycle compared to trying to fit NBS into the existing urban environment. The key is quality and education.

f. Lack of vision, enthusiasm in municipalities

In general, the municipal level is lacking a longer perspective and bigger picture. It is often feared that SUDS are expensive, difficult to implement and with special rules. However, it is often up to the municipal authorities to prove the usefulness, necessity and practicality of such decisions. One possible solution to get things going is having at least one high-ranking/influential person (e.g., the mayor) who can state that it is an important topic. Another solution could be having a landscape architect on city payroll (e.g., Salaspils in Latvia) as they know the arguments for SUDS. If the municipality wants to create something new – the solution to initial scepticism is efficient communication at all levels of the municipality.

Another issue can be lack of legislation (e.g., old design rules). There are not many municipalities that have a stormwater management plan that includes sustainable solutions for stormwater management. Fortunately, there are some municipalities that show examples – e.g., Viimsi municipality (Estonia) has SUDS in 2 development documents (development plan and climate change adaptation plan), municipality management and council are involved and interested and SUDS are even included in the coalition agreement. Viimsi would like to be a learning and demonstration area for sustainable stormwater solutions in future – there could be a whole map explaining and guiding to different solutions. Showing the existing solutions to people is important to inspire and encourage them. There are not so many sample areas in Estonia and most people do not go to other countries to see best practice examples.

The lack of enthusiasm is often connected with costs – the selected solutions have to be realistic and useful for society. SUDS take public space (expensive), public money (special construction/solution) and their maintenance tends to be more expensive. Especially if natural conditions are unfavourable. Tartu (Estonia) has an idea to zone the city – where infiltration is reasonable and where not – as generalising data is pointless. One has to have a clearer picture of the city to decide in which areas implementation of NBS is reasonable. There is no point to say in the comprehensive plan that everyone has to infiltrate because infiltration is not possible everywhere (e.g., riverside, unsuitable geology). Specific knowledge is needed to be able to make decisions.

g. Costs

Costs are always an issue but the advantage of nature-based solutions is that the range of their implementation costs is very wide: from relatively expensive solutions to cost-effective or even cost-saving solutions. It all depends on the complexity of the selected solution/technique. For example, Viimsi (Estonia) embedded green islands (trees, bushes) in their parking lot SUDS but it can be also done without these. Also, a ditch can either have plants or not. In the case of „SPICE“ (Latvia) alternative reconstruction of urban sewer would have been very expensive so NBS was chosen because of a lower price. In summary - NBS can be done in a simple and cheaper way but if you want to make a very good and complex solution then it may be more expensive than just a pipe. However, these systems perform differently compared to conventional systems so it is difficult to compare. Problem is quite often rather lack of space as SUDS need space (although there are some SUDS solutions that can be fitted even in very tight conditions).

Maintenance is a different issue – it can be more expensive but again it depends on the selected solution. It should also not be forgotten that underground pipes also need maintenance (e.g., in case of leaks). Maintenance has to be thought through already in the design phase.

h. Improper installation or maintenance of SUDS can cause problems

You have to clearly identify the stakeholders involved in construction and maintenance of SUDS and educate them. With SUDS, the lack of maintenance quickly becomes apparent, which is not the case with pipes, however, pipes also have to be maintained.

In terms of construction skills, SUDS are easier to build than pipes (the pipe ends have to be tightened; the surface has to be tight where they are laid to avoid leaks underground) as requirements are higher compared to SUDS. However, the maintenance of SUDS requires special solutions (e.g., ditch banks, large wet areas, removal of litter). Maintenance is feared as maintenance companies do not have experience with SUDS but this can be solved by clear instructions for the maintenance team. Service providers have to read the maintenance guidance (compulsory part of the building project) and instruct their workers (e.g., pushing the snow in the right way according to the guide to avoid damaging SUDS or vegetation). Getting the maintenance right takes time.

Monitoring of SUDS solutions is another issue - guidance is needed as it is not clear when for example cleaning of SUDS is needed (e.g., changing the soil).

i. Lack of space

Nature-based solutions need space, so lack of space can be a problem in densely built urban areas. Another obstacle related to space is connected with heritage areas, for example the old towns of all three Baltic capitals that are UNESCO sites, where on the one hand there is no room and on the other hand there are special requirements.

A special barrier for Latvia is that there have been historically problems with green roofs (shopping mall green roof collapsed, 52 people dead) so green roofs are still considered dangerous – it is a mental barrier. However, a new project is in preparation where green roofs will be added and monitored and that will hopefully change the perceptions.

Cooperation between municipality and private landowners

It depends a lot on the perception/attitude of private landowners. There are more and more private landowners who would like to establish environmentally friendly solutions on their own initiative. Nevertheless, each step has to be explained to landowners and the experience shows that they need time to understand (e.g., an example of Latvian logistics centre that ca 7 years ago did not want SUDS but now is asking for such solutions). Also, Scandinavian investors operating in the Baltic States are more interested in green solutions.

The designer has to weigh all positive and negative aspects and bring out both the wins and losses from the client's perspective, but to be honest, mostly there is not much to lose. NBS raise the price of the real estate as they provide nice and enjoyable surroundings.

Municipalities adhere to standards so thinking outside of the box is needed, things are not just black and white and willingness to take a risk is needed. However, it depends on the municipality - e.g., Salaspils municipality in Latvia is very open and they have hired a municipal landscape architect.

Nature-based solutions and general public

General public does not know much about NBS and there are also not so many examples in the Baltic countries. Normal citizens do not see NBS but flooding is noticed. It tends to be a thing of a narrow speciality – how to drain the stormwater. Ordinary person does not pay attention what lamp is in the ceiling or what furniture is used – that is interesting for specialists. SUDS are in the orbit of interest of specialists/people that have experience with them.

Those who think favourably and accept NBS do not promote them actively enough. Those who do not accept blame proactive municipalities, designers and all those who support new ideas. Part of the public is quite strongly opposed to extensive management (rare mowing) of grasslands. They see a danger to their health (higher levels of dangerous insects, etc.).

In case of practical examples, it is important to communicate these solutions to the general public. In the case of Viimsi SUDS examples the communication was efficient and people know that the parking lot is a LIFE project area – information about that has spread everywhere, citizens talk about that proudly and there has been also praise and recognition in FaceBook. However, there has also been feedback on why it was all necessary. When Viimsi was planning a new parking lot with SUDS there was scepticism, however, when they saw from the plan how much greenery there would be then the attitude changed completely.

In the case of Latvia there has not been any project where public awareness was raised, however, the new Skanste park project would maybe change that.

People have to be made aware that the surroundings between home and work should also be enjoyable. Public space is very important!

Conclusions/recommendations

It can be concluded that applying nature-based solutions in urban environment for flood and stormwater control is not a mainstream topic in the Baltic States. There have been a few pilot examples in the frames of European projects and funding but these are linked to innovation in the region.

During the interviews a few issues related to NBS and SUDS can be highlighted and recommended to keep in mind when thinking about promotion of sustainable flood and stormwater management in urban areas:

- A change in thinking and planning is needed - SUDS require broader thinking, taking into account more aspects, more work, however, the result is worth all of that.
- In urban areas the combination of SUDS and pipes has been most effective so far.
- Start with small scale projects, learn from them and make necessary changes. Step-by-step approach also allows seeing the change.

- SUDS are important to consider especially for new projects/developments because it is more complicated to add them to already developed/built areas.
- The key to success lies in promoting best practice examples, quality of the solutions and education of different stakeholders!
- Planning of SUDS is teamwork: it involves engineers, designers, landscape architects, land owners (both municipality and private landowners), and citizens.
- Practical maintenance guides are needed for landowners and estate owners.
- Establishment of SUDS/NBS needs patience as they may not function right away (vegetation growth takes time).
- A pipe is just a pipe – nature-based solutions offer much more.
- „Pocket parks“ – small parks that are used a lot, for example in Copenhagen. Pocket parks can create new public spaces without the need for large-scale redevelopment. Although they are often too small for many space-intensive physical activities, pocket parks provide communities with greenery, a place to sit and rest, and an ecological foothold for urban wildlife.⁹
- Visualising is a good tool to raise awareness and increase acceptance to NBS – visualisation of scenarios would support decision making: the town without any greenery and then with greenery – what do you prefer? It is the question of fantasising and visualising.
- More cross-border cooperation is needed between countries with similar climate conditions (e.g., application of SUDS in cold climates).

⁹ https://en.wikipedia.org/wiki/Pocket_park

Annex 1. Interview questions

2. How would you assess the situation regarding the implementation of nature-based solutions in urban areas in your country?
3. What do you consider to be the most successful examples of NBS in urban areas in your country?
4. Reflecting on the multifunctionality of NBS - what do you consider to be the main benefits of NBS besides flood control?
5. What are/have been the main motivators for implementing NBS? (e.g., subsidies, property tax reliefs)
6. What are the main barriers when implementing NBS? Do you consider following barriers relevant for your county?
 - a. Cooperation with land owners – important but can be sometimes problematic
 - b. Conflict with heritage/nature protection
 - c. Ecosystem „disservices“ – attraction of biodiversity undesirable for humans, e.g. ticks, mosquitoes, snakes
 - d. Low awareness
 - e. Lack of skills and knowledge, lack of relevant service providers
 - f. Lack of vision, enthusiasm in municipalities
 - g. Costs
 - h. Improper installation or maintenance of SUDS can cause problemsIs something missing?
7. How has been the cooperation with municipality/private landowners?
8. How are nature-based solutions perceived by the public?

Annex 2. Additional materials

Additional reading:

EEA Report No 1/2021 „Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction“, <https://www.eea.europa.eu/publications/nature-based-solutions-in-europe>

„Regional and national policy recommendations for implementing the integrated stormwater management in the Baltic Sea Region“,
www.bsrwater.eu/sites/bsrw/files/stormwater_report_v1.pdf.

The European Natural Water Retention Measures (NWRM) Platform, <http://nwrn.eu/>

Baltic Smart Water Hub - <https://www.balticwaterhub.net/>

European Commission Knowledge Centre for Biodiversity on nature-based solutions, https://knowledge4policy.ec.europa.eu/biodiversity/topic/NBS_en

Projects addressing nature-based solutions for stormwater and flood control in the region:

LIFE UrbanStorm – Development of sustainable and climate resilient urban storm water management systems for Nordic municipalities (2018-2023), <https://urbanstorm.viimsivald.ee/?lang=en>

LIFE GOODWATER IP - Implementation of River Basin Management Plans of Latvia towards good surface water status (2020-2027), <https://goodwater.lv/en/home/>

LAND4FLOOD: Natural Flood Retention on Private Land (2017-2022), <https://www.land4flood.eu/>

BSR Water – Platform on Integrated Water Cooperation (2018-2021), <http://www.bsrwater.eu/>

CleanStormWater - Testing new storm water treatment solutions for reduction of hazardous substances and toxins inflows into the Baltic Sea (2020-2022), <https://cleanstormwater.viimsivald.ee/>

iWater – Integrated Storm Water Management (2015-2018), <http://www.integratedstormwater.eu/>

(D)rain for Life - Promoting Sustainable Urban Drainage Systems in Estonia - Latvia Cross-Border Area to Improve the Environment for Active and Sustainable Communities (2007-2013), <https://keep.eu/projects/9895/Promoting-Sustainable-Urban--EN/>