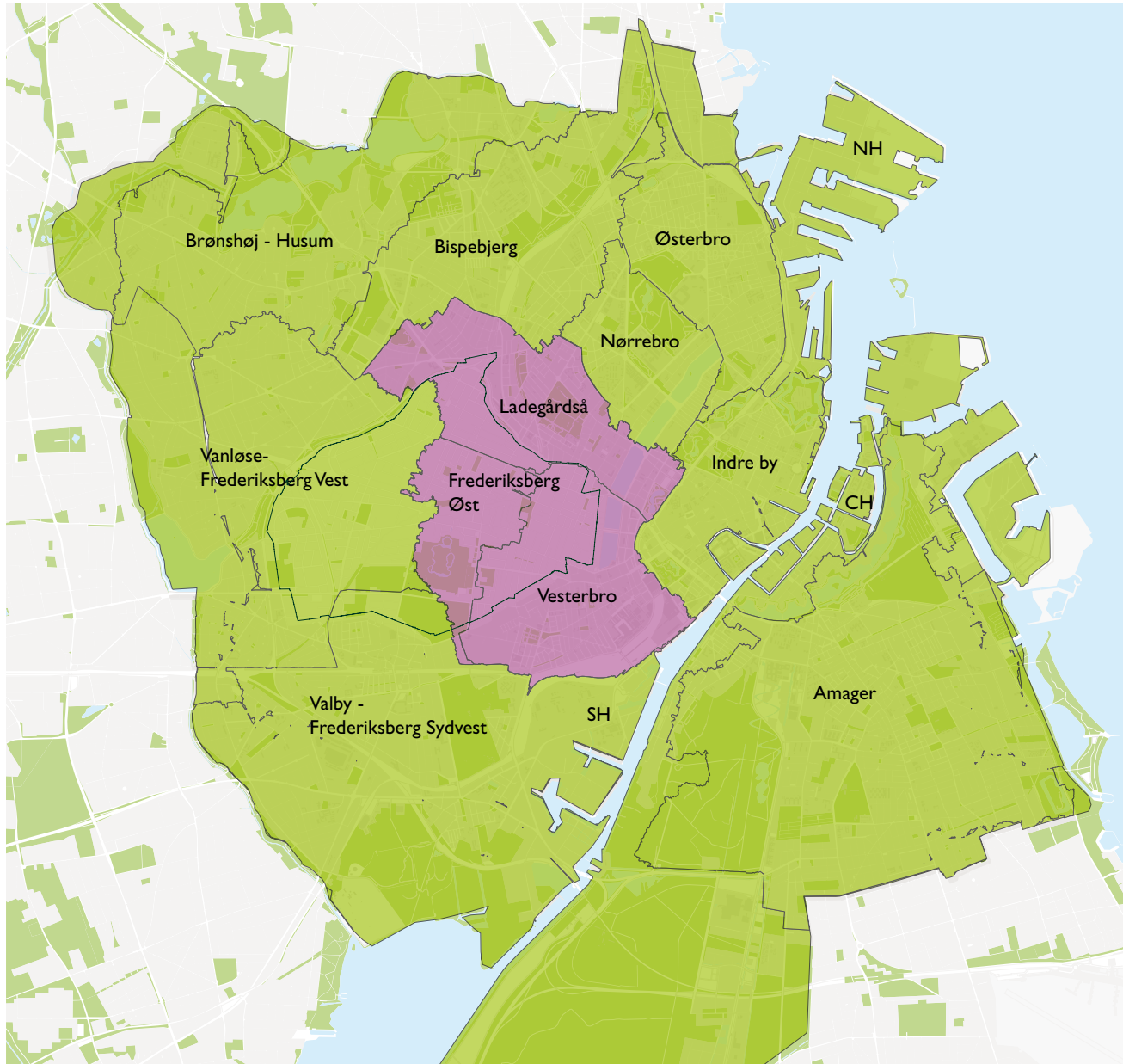


SUMMARY

# CLOUDBURST MASTERPLAN FOR LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO







## CLOUDBURST CATCHMENTS

The very severe cloudburst hitting Copenhagen the 2nd of July 2011 caused flooding in large portions of the city. The flooding caused significant problems for the infrastructure in the inner parts of Copenhagen and Frederiksberg. In certain places up to half a meter of water covered the street and several houses and shops had suffered serious damages.

The serious consequences following the cloudburst on July 2nd 2011 and other minor cloudbursts have led the municipalities of Copenhagen and Frederiksberg to initiate this project, which aims to highlight potential initiatives effective in mitigating flooding and reducing damages related to cloudbursts in the future.

The cloudburst solutions presented here cover the catchments of Ladegårdså, Frederiksberg East & Vesterbro. The proposed solutions for cloudburst management comply with the service level for cloudbursts in Copenhagen and Frederiksberg, ie. a maximum of 10 cm of water on terrain during a 100-year storm event. Additionally, in accordance with the intentions and visions set out in the Cloudburst Plan for Copenhagen and Frederiksberg from 2012, proposed solutions are sought developed to include added value and elements, which contribute to making the city more green, more blue, more attractive and more liveable.

The cloudburst catchments are prioritized based on an assessment of the flood risks in the individual catchments. Along with the Inner City (Indre by) & Østerbro, the Ladegårdså, Frederiksberg East & Vesterbro catchment belongs to catchments of highest priority.

The catchment area of Frederiksberg East is included in the concretization of the masterplan for this part of Copenhagen, since stormwater detention on this relatively high lying area is of high importance for the solutions in the lower lying areas of Ladegårdså and Vesterbro.

# CLOUDBURST CATCHMENTS OF LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO

LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO

## BACKGROUND AND CHALLENGES

The cloudburst catchment area of Ladegårdså, consists of the northern part of Frederiksberg and the southern tip of Bispebjerg and Nørrebro, bordering the main traffic corridor, Åboulevarden. The cloudburst catchment of Vesterbro consists of all of the neighborhood of Vesterbro and the southern part of Frederiksberg. Additional to the two cloudburst catchments is the strip east of the inner lakes between Nørre and Vester Søgade and Nørre and Vester Farimagsgade.

The two catchments were amongst the most affected areas under the cloudburst July 2nd 2011. At several locations in the catchments additional flooding on other occasions has been reported during the last years, including august 2010. Since the catchments are also covering the more densely built and populated area of the city, the annual risk associated with cloudbursts is very high. The catchments are therefore of high priority.

The two catchment areas are closely linked to the cloudburst catchment area called Frederiksberg East in the Cloudburst Management Plan for Copenhagen. This catchment covers the central part of Frederiksberg and is equally included in this project.

The initial analysis include area characteristic, mapping of existing plans and infrastructure, terrain-based analysis and calculations of run-off. Based on the initial analysis, the area covering the three catchment areas is merged and subsequently divided into four sub-catchments: *Bispeengbuen*, *Assistens Kirkegård*, *Vodroffsvej og Frederiksberg Allé* and *Sønder Boulevard*.

The area is marked by the cross-cutting traffic connections to/from the inner city: Nørrebrogade, Åboulevard, Gammel Kongevej, Vesterbrogade and Istedgade. These roads also make up, Åboulevarden excluded, the main shopping stretches in the area. Between and parallel to these stretches and traffic corridors are several roads characterized by more local traffic and shopping. These smaller roads help connect the neighborhoods and include amongst other Rantzausgade, Rolighedsvej-Rosenørns Allé, Frederiksberg Allé and Sønder Boulevard.

In general, the terrain slopes from West to East, where water has previously drained towards the inner lakes and the stream of Vodroffså-Rosenåen to Kalvebod Strand and the harbor. The drainage has also passed through the stream of Ladegårdså, which is now piped under the Åboulevard with outlet to Peblinge Sø.

The continued urban development has by a large extent change the natural drainage of the area. The sewer built out of Copenhagen and Frederiksberg has reduced the need for terrain-based drainage. New infrastructure such as the metro line and the elevated railways constitute barriers in the city along with the inner lakes.

The combination of increased densification, increases in rain intensity and a desire for a higher service level for the citizens creates a need for terrain-based solutions, which are integrated into ongoing planning of the city. Focus is on blue-green infrastructure, which can add value to the city not only through hydraulic functions for flood mitigation, but also in terms of recreational, environmental, social and economic values.



Sub-catchments delineated based on cloudburst structure and area characteristics



## THE OVERALL CHALLENGE IN THE NEIGHBORHOOD

The overarching need is to safeguard larger areas from cloudbursts, which are relatively lower than the surrounding terrain. This is especially important around Bispeengbuen, parts of inner Nørrebro, around Vodroffsvej and large parts of the central Vesterbro. These areas are all characterized by constituting local low points, whose natural drainage opportunities have been limited by the urban development.

### BISPEENGBUEN

The area around the Bispeengbuen is a natural lowlying area. In the former meadow, the Bispeengen, the two streams Ladegårdså and Grøndals Å merge and continue as Ladegårdså to the lake of Peblinge Sø. During cloudbursts, large amounts of water collect in the area, especially where Nordre Fasanvej run underneath Bispeengbuen. The water both stem from stormwater runoff on terrain from Borups Allé and Hillerødgade and sewer backup from the sewer system in the municipality of Copenhagen.

### ASSISTENS KIRKEGÅRD

Inner Nørrebro has two areas which are especially overloaded during cloudbursts: the area north of the Assistens cemetery and the area around Korsgade and Blågårdsgade. The Peblinge Dosering pose a barrier towards the lake thereby preventing runoff during cloudbursts to reach the lake, when the sewer system is overloaded. The water from the area between Nørrebrogade and Åboulevard instead collects in Blågårdsgade and Korsgade. The area around the Ørstedspark could drain to the lake in the park, which should be coordinated with solutions planned for the Inner City.

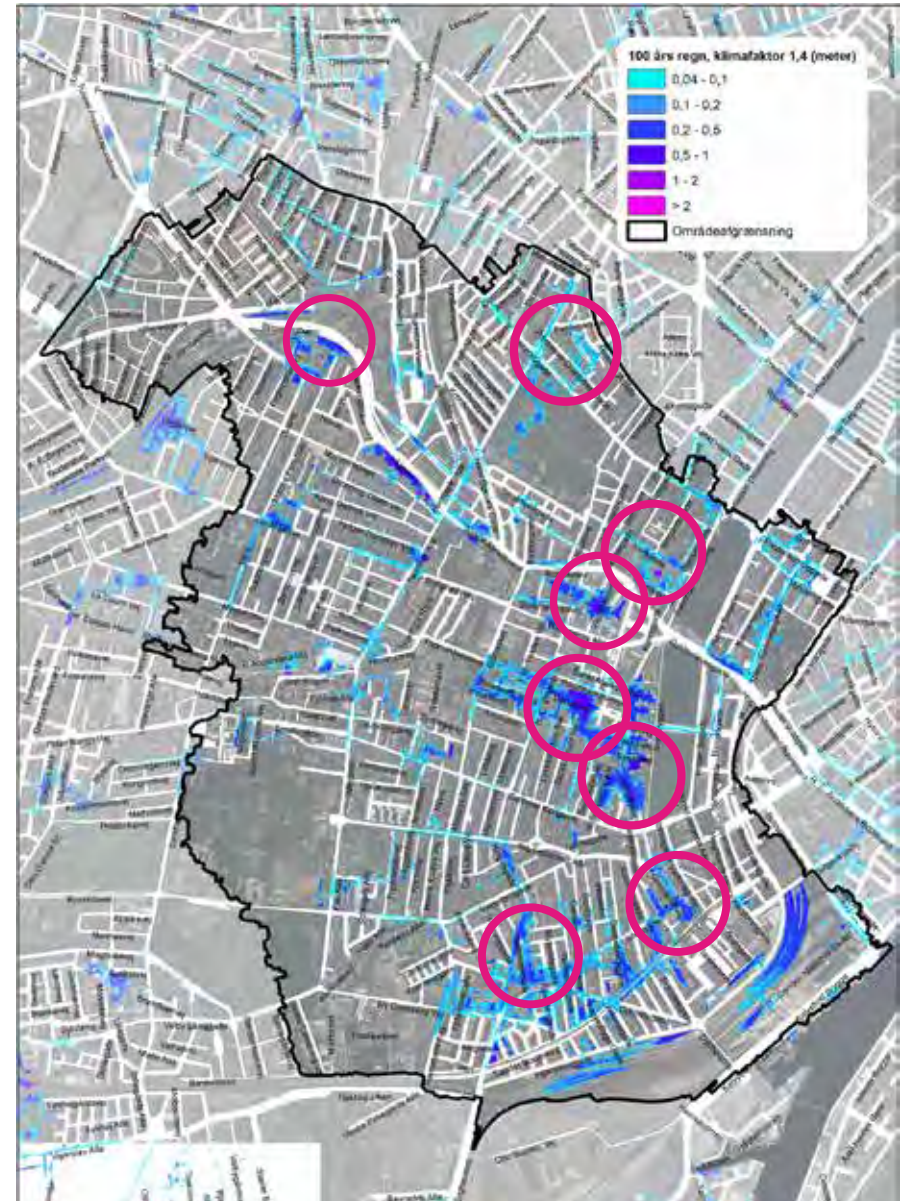
### FREDERIKSBERG ALLÉ OG VODROFFSVEJ

In the area around Vodroffsvej- the lowest points are Danasvej, Worsaaesvej and Vodroffsvej itself. The low points in the area are located under the level for the stream of Ladegårdså piped below the Åboulevard preventing the stream to function as drainage corridor under cloudbursts. The terrain from central Frederiksberg slopes towards the Vodroffsvej area causing runoff to drain on terrain to this area during cloudbursts. The Vodroffsvej area does not have a natural drainage opportunity, since large areas lie below the water table of the inner lakes. Especially Gammel Kongevej makes up a significant barrier in relation to previous natural drainage paths towards the south to the area where Gasværksvej and Sønder Boulevard lie today.

### SØNDER BOULEVARD

Sønder Boulevard constitute approximately the former shoreline. From here Copenhagen has been expanded southeast through landfill. During cloudbursts the flooding in the area from the overloaded sewer systems is exacerbated by overland runoff to the lowlying streets, which have no natural drainage possibilities. As an examples, water is lead from Vesterbrogade and Frederiksberg Allé via Kingosgade to the low point on Enghavevej while Istedgade and Sønder Boulevard convey water to the low point in Gasværksvej. Ingerslevsgade constitutes an artificial ridge through the area, preventing runoff to reach the harbor.

## LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO



Modeled flooding before implementation for cloudburst solutions. The lowlying areas most badly affected are marked by pink circles.

# PRINCIPLES FOR ADAPTATION

*For the concretization of the cloudburst management plans for the catchments of Ladegårdså, Frederiksberg East and Vesterbro 2 different masterplans are proposed including 3 overall alternate proposals.*

The overall principle for cloudburst management in the prioritized catchments is, that as much stormwater as possible should be detained in the upstream areas, while robust cloudburst roads are implemented downstream connecting to the recipients. Cloudburst roads should not only serve during cloudbursts, but also function to decouple everyday rain from the sewer system. That way, the sewer system will be able to handle the increased precipitation under future climate conditions.

Both masterplans are based on a finger structure, where cloudburst roads make up the fingers in between main traffic and retail corridors. The cloudburst roads will secure that runoff is conveyed out of the area in an effective and robust way. The locations of the fingers of the cloudburst network is practically identical in the two masterplans. The primary differences between the masterplans are described below.

## MASTERPLAN 1

In Masterplan 1 stormwater is conveyed from the majority of the subcatchments of Bispengbuen and Vodroffsvej to the Saint Jørgen Lake during cloudburst. Since the water table in the lake today (+5,8 m) is above street level (+3,4 m) for large parts of the area it is suggested, that the water table in the southern part of the lake is lowered (to approx. +2,8 m). and that water and landscape architecture is implemented in the area, through eg. a park towards the lake enhancing public access to the waterfront.

If the water table in the lake is lowered as suggested, an estimated 40.000 m<sup>3</sup> buffer volume is created. The needed volume for the area of Vodroffsvej is around 50.000-70.000 m<sup>3</sup>. In combination with local detention in and around the cloudburst road, the volume accumulating in the area during a 100-year cloudburst event is nearly accommodated. Excess stormwater will overflow into the cloudburst pipe planned to drain Vesterbro to the harbor. From the subcatchment of Assistens Kirkegård the stormwater is conveyed to the Peblinge lake, which is possible with the current water table. To maintain a good water quality in the lakes, stormwater runoff will be cleaned before discharge.

In Masterplan 1 everyday rain from the subcatchment of Assistens Kirkegård is conveyed through gravitation to eg. the Peblinge lake. From the subcatchments of Bispengbuen and Vodroffsvej everyday rain will possibly be conveyed to the Saint Jørgens Lake, where the majority of the water will be used for recreation..

## MASTERPLAN 2

In Masterplan 2 stormwater is not conveyed to the inner lakes, but through a large cloudburst tunnel with a diameter of 4-5 meter to the harbor. The cloudburst tunnel could supplement or replace the detention bassins planned for Sydhavn as a means to reduce combined sewer overflows to the harbor. In Masterplan 2 all everyday rain decoupled from the sewer system and conveyed through the cloudburst roads will be pumped from the cloudburst tunnel to the harbor.

## MASTERPLAN I

## LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO



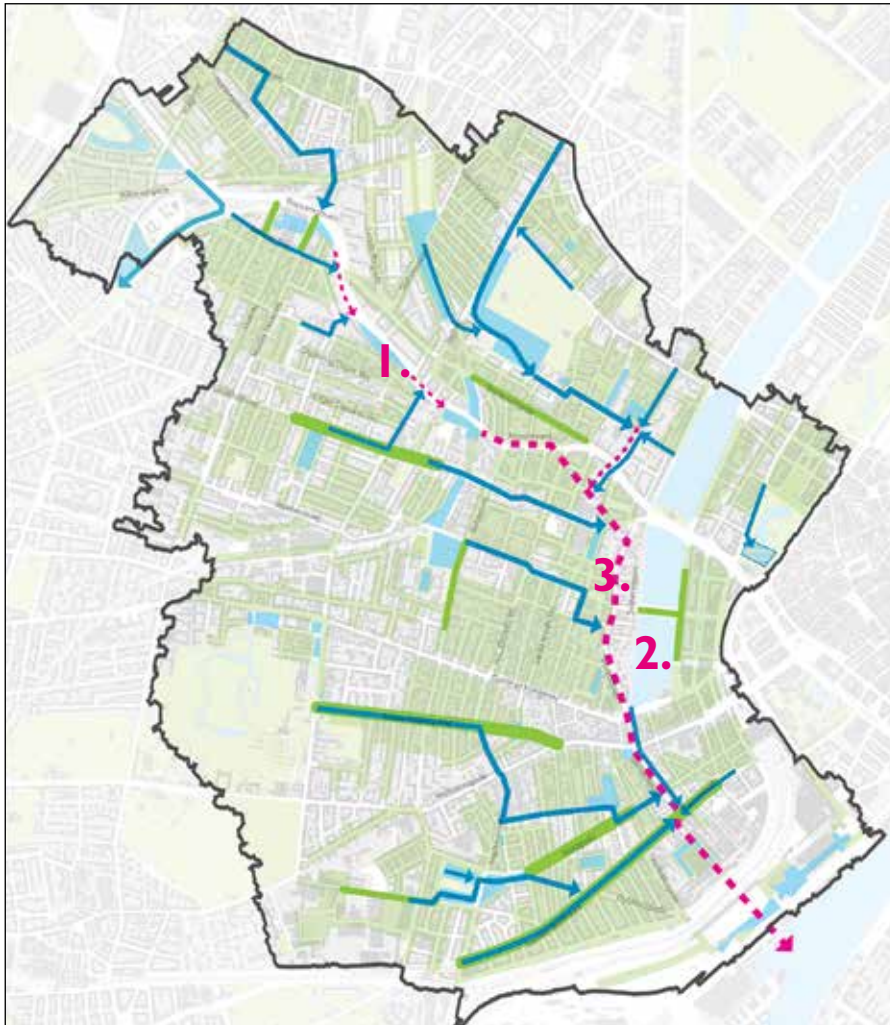
### PROS

- The city is made cloudburst resilient through mainly blue-green infrastructure
- Open solutions with high flexibility and robustness
- Possibility to create a new large recreational and landscape architectural element of international class at Saint Jørgens lake

### CONS

- Risk of reduced water quality in the inner lakes following cloudbursts
- Cloudburst and green roads causes increased maintenance and reduced access locally
- Lowering the water table of Saint Jørgens lake will change the character of the lake, which goes against the current conservation and protection





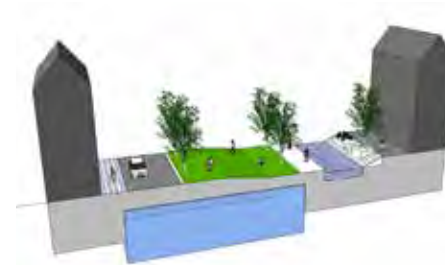
**PROS**

- The city is made cloudburst resilient through mainly blue-green infrastructure
- No risk of negative impact on the inner lakes
- Cloudburst tunnel can replace need for detention basins in Sydhavn

**CONS**

- Large cost for implementation of cloudburst tunnel, which does not contribute with blue-green elements
- All everyday rain will be pumped if synergy to detention basins is to be utilized
- Cloudburst and green roads causes increased maintenance and reduced access locally

ALTERNATE PROPOSALS



**1. ÅBOULEVARD**

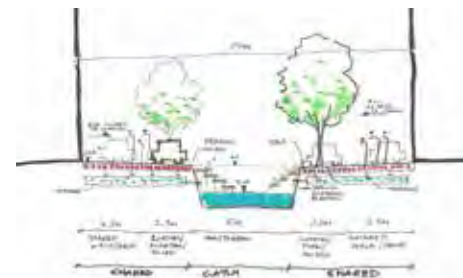
The traffic in the Åboulevard is conveyed to a tunnel, while cloudburst runoff is conveyed and detained in blue-green elements implemented in the previous road profile. Additionally, one of the tunnels could function as detention basin in cloudburst situations. The alternate proposal is mainly to be considered as a traffic project and thus is not elaborated further in this plan.



**2. SAINT JØRGENS LAKE**

The water table in both parts of Saint Jørgens lake is lowered. By lowering the water table less, but in both lakes, the same detention volume is created or, by lowering both lakes to the proposed level a larger detention volume is created, up to 80.000 m<sup>3</sup>.

This proposal is relevant for Masterplan 1.



**3. VODROFFSVEJ**

A canal street is created in Vodroffsvej conveying water through the entirety of Vodroffsvej and Gasværksvej following inspiration from Amsterdam. This alternative give the possibility of conveying water on Dette giver mulighed for at aflede vandet på overfladen fra størstedelen af området netthe way to Vesterbro without affecting the inner lakes.

This proposal is relevant for Masterplan 2.

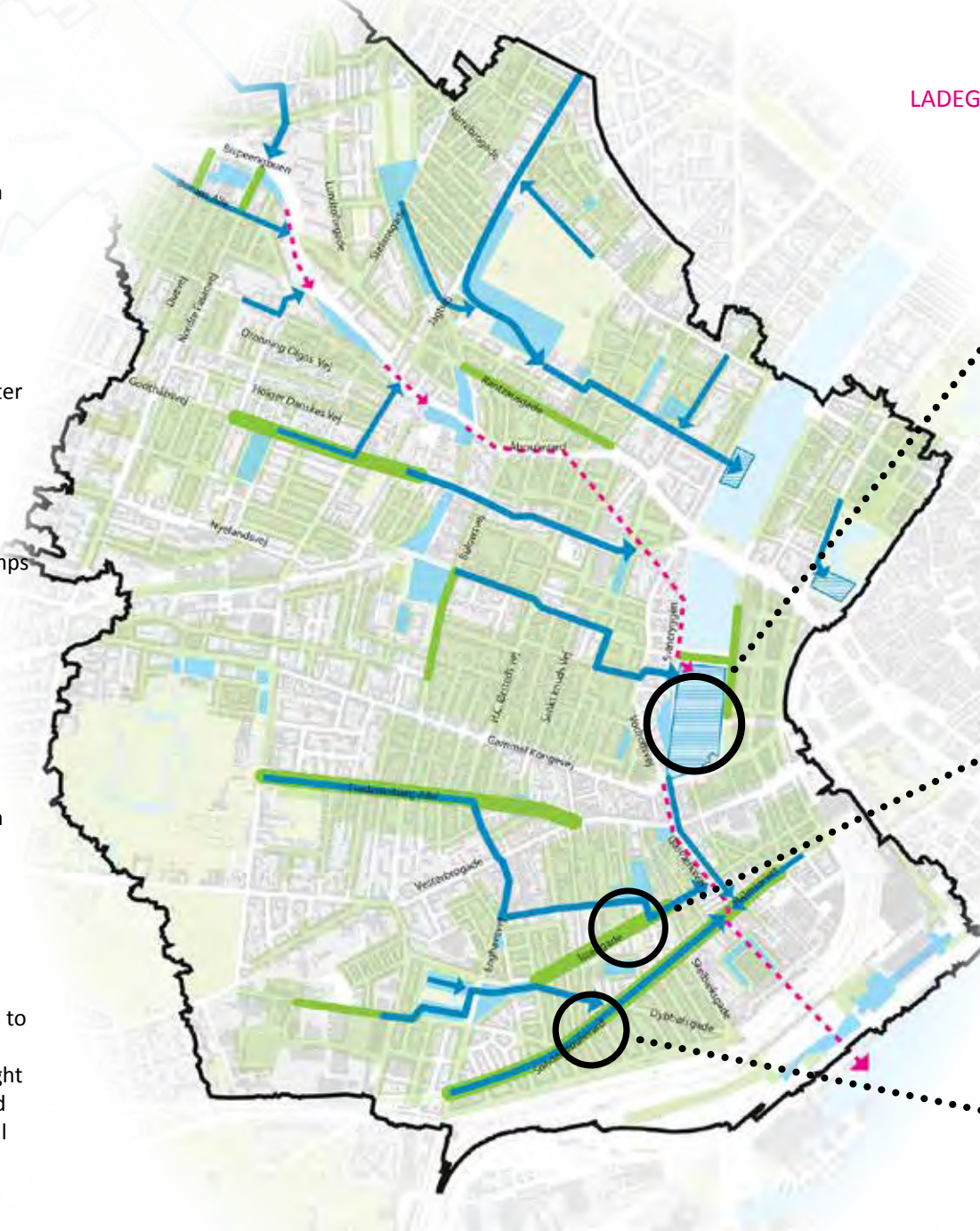


**DESCRIPTION**

The masterplan are developed based on a principle made up of 4 overall elements:

- Cloudburst roads conveying water towards recipients through v-profile, super profile, trenches or hollow sidewalks. Many cloudburst roads are supplemented with separate stormwater piping for everyday rain.
- Detention roads and green roads detaining water before conveyance to cloudburst roads. Detention through roadbeds, permeable paving, road bumps or in trenches with weirs.
- Central detention detaining water in plazas or parks in order to reduce capacity and sizes of downstream cloudburst roads to reduce effect on especially accessibility and parking.
- Cloudburst piping conveying water on traditionally.

The cloudburst roads will by an large be designed to collect everyday rain as well as to convey cloudburst water. Roofs and roads with below 5000 annual daily cars will sought disconnected. Everyday rain will be cleaned before discharge to recipients. Cleaning will primarily consist of filtering through a combination of mold, chalk and sedimentation.



**SAINT JØRGENS LAKE**  
Central retention



**ISTEDGADE**  
Cloudburst road



**SØNDER BOULEVARD**  
Green road and detention





# SAINT JØRGENS LAKE

LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO



## DESCRIPTION

Saint Jørgens lake can be designed as a greener low lying area in the neighborhood similar to the historic profile of the lake before it was converted to a water reservoir. The water table could be lowered in one end of the lake or alternatively a smaller lowering both in both parts of the lake. By using the lake for detention, the cloudburst tunnel described in Masterplan 2 can be avoided.

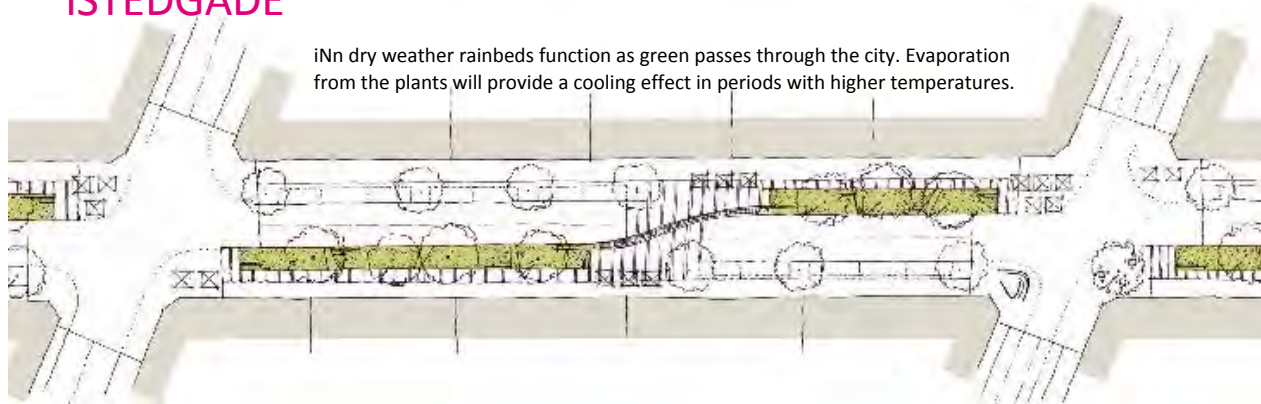
A lowered water table will open possibilities for new recreational park areas around the lake, which can help improve access to the water. The water park will pose a new attractive and active urban space for the citizens of Copenhagen and Frederiksberg with water as unifying theme.

On the other hand, lowering the water table might have consequences for the biodiversity of the lake and the possibility to meet current goals set out in the water frameworks. Costs and benefits in using the lake for cloudburst management need to be further analysed.

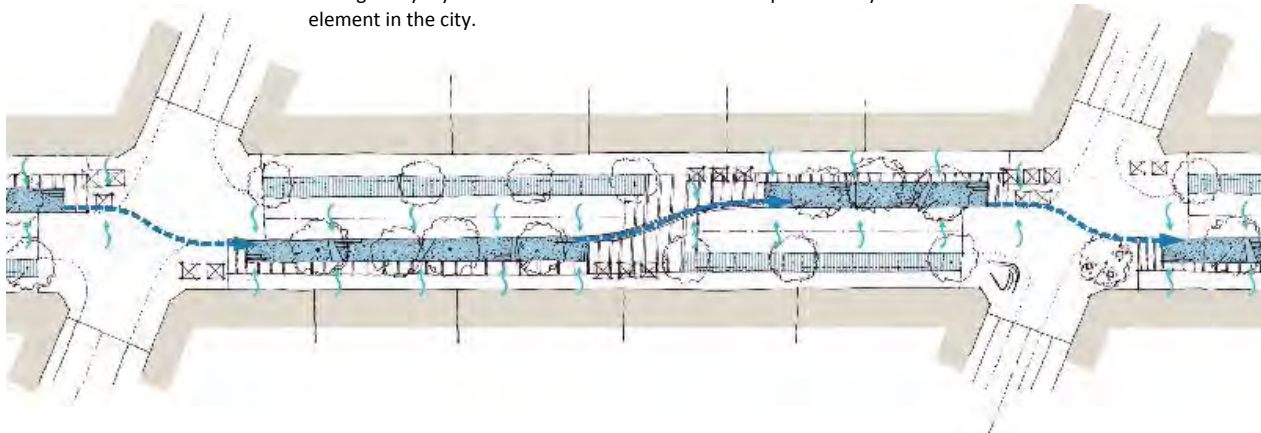


## ISTEDGADE

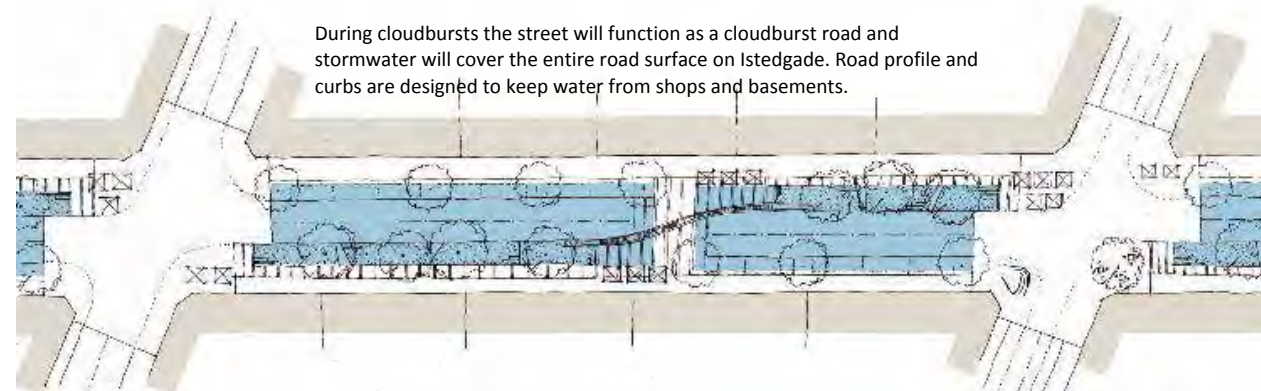
In dry weather rainbeds function as green passes through the city. Evaporation from the plants will provide a cooling effect in periods with higher temperatures.



During everyday rain the trenches fill with water and provide a dynamic blue element in the city.



During cloudbursts the street will function as a cloudburst road and stormwater will cover the entire road surface on Istedgade. Road profile and curbs are designed to keep water from shops and basements.



## LADEGÅRDSÅ, FREDERIKSBURG EAST & VESTERBRO



DRY WEATHER



EVERYDAY RAIN



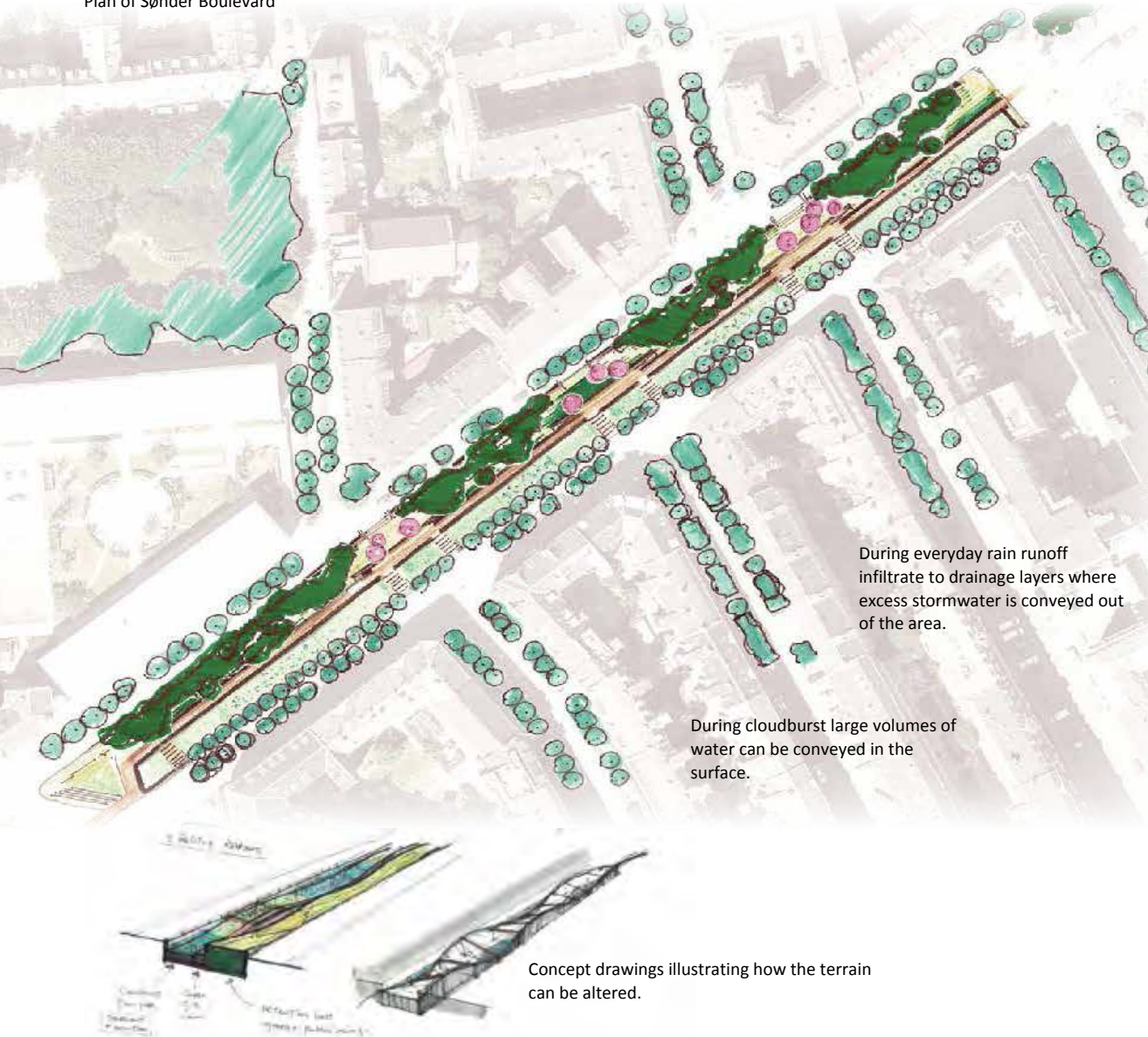
CLOUDBURST



# SØNDER BOULEVARD

LADEGÅRDSÅ, FREDERIKSBURG EAST & VESTERBRO

Plan of Sønder Boulevard



Under dry weather conditions the road function as a green recreational park.

During everyday rain runoff infiltrate to drainage layers where excess stormwater is conveyed out of the area.

During cloudburst large volumes of water can be conveyed in the surface.

Concept drawings illustrating how the terrain can be altered.





# CONSTRUCTION COSTS

In assessing the overall construction costs for the proposed solutions the service level of a maximum of 10 cm of water on terrain during a 100-year cloudburst event is used as design criteria. Planting and fitting is also included.

The economy is expressed in a 2013 price level including design, new piping, construction site and contingencies appropriate for current level of detail. In the detailed estimate the projects are split in terrain-based solutions and traditional piping solutions. In the construction costs it is assumed, that the utility will cover 75% of costs associated with terrain-based solutions and 100% of traditional piping solutions. The economy is divided according to the subcatchments in which they are implemented. As an example, flooding issued around Bispeengbuen will be addressed through projects located in the subcatchments of Assistens Kirkegård and Vodroffsvej.

## MASTERPLAN 1

SUBCATCHMENT:	MUNICIPALITY	UTILITY
BISPEENGBUEN	50 MIO DKK	175 MIO DKK
ASSISTENS KIRKEGÅRD	100 MIO DKK	400 MIO DKK
VODROFFSVEJ OG FREDERIKSBERG ALLÉ	100 MIO DKK	450 MIO DKK
VESTERBRO	175 MIO DKK	725 MIO DKK
IN TOTAL	425 MIO DKK	1.700 MIO DKK

A basic version of Masterplan 1 would be possible if only the very overall cloudburst roads are implemented:

1. Cloudburst pipe from Bispeengbuen to Saint Jørgens lake
2. Cloudburst pipe from saint Jørgens lake to the harbor
3. Saint Jørgens lake
4. Danas Vej and Niels Ebbesens Vej
5. Sønder Boulevard
6. Matthæusgade and Skydebanehaven
7. Hans Tavsens Plads, Korsgade and stormwater cleaning to Peblinge lake

This head structure would be able to be implemented for ca. 950 Mio DKK.

## LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO

## MASTERPLAN 2

SUBCATCHMENT:	MUNICIPALITY	UTILITY
BISPEENGBUEN	50 MIO DKK	175 MIO DKK
ASSISTENS KIRKEGÅRD	100 MIO DKK	400 MIO DKK
VODROFFSVEJ OG FREDERIKSBERG ALLÉ	75 MIO DKK	850 MIO DKK
VESTERBRO	175 MIO DKK	1.050 MIO DKK
IN TOTAL	425 MIO DKK	2.500 MIO DKK

A basic version of Masterplan 2 would be possible if only the very overall cloudburst roads are implemented:

1. Cloudburst pipe from Bispeengbuen to the harbor
2. Danas Vej and Niels Ebbesens Vej
3. Sønder Boulevard
4. Matthæusgade and Skydebanehaven
5. Hans Tavsens Plads, Korsgade and stormwater cleaning to Peblinge lake

This head structure would be able to be implemented for ca. 1.400 Mio DKK.

## GREEN ROADS AND LOCAL DETENTION ON ROADS

The possibility for synergy with SUDS in form of green roads etc. is very similar for the two masterplans. In total 75 km of road has been identified with potential for decoupling of stormwater and detention in green streets with possibility of coupling to cloudburst roads. A rough estimate suggests that these 75 km road can be implemented for approx. 750 Mio DKK, not including private investments in internal patios and potential refund connection fees to the sewer system.

If a basic version of either masterplan is selected, a substantial amount of additional green streets, central detention or tradition sewer built out will need to be implemented in the long run.

# OPERATIONAL COSTS

In assessing the operation costs it is assumed, that the operation of parks and plazas increases as a result of redesigns and that potential conservation might change for certain areas. Unit prices for operation of pocket parks is derived from the municipality of Copenhagen. The average increase in annual operational cost is assessed to 40 DKK/m<sup>2</sup>.

It is assumed, that the v-profiling of roads and that roads with one-sided slope can be operated at similar unit pricing as top profiled streets, therefore no additional operational costs are included. Additional costs might occur during wear layer coating or winter maintenance, which is assumed outweighed by the reduced amounts of manholes/catch basins.

Operation of canal streets, green corridors, etc. is monetized using on experience based data from eg. Ørestad Syd, where annual operational costs for green corridors and small canals make up approx. 200 DKK/running meter. It is assumed, that the utility company covers approx. 25 % of these costs corresponding to the operational costs associated with traditional sewer system.

The annual operational costs for piping is assessed using experience based data from operational activities from HOFOR for pipes, pumping stations and basins. A pump station for draining and a rinsing system is assumed for the cloudburst tunnel, but not an actual overflow pump station. The latter could become necessary at a general sea level rise of more than 0,5 m.

Below the increase in operational costs per year is presented divided between municipality and utility. Operational costs associated with green roads are not included.

## MASTERPLAN 1

	MUNICIPALITY	UTILITY
NEW GREEN AREAS ON ROADS	10 MIO. DKK	10 MIO. DKK
NEW GREEN AREAS ON PLAZAS	2 MIO. DKK	
ALTERED LANDUSE OF RECREATIONAL AREAS	10 MIO. DKK	4 MIO. DKK
TRENCHES, CANAL STREETS, ETC.	2 MIO. DKK	1 MIO. DKK
PIPES AND PUMPING STATIONS		2 MIO. DKK
IN TOTAL	24 MIO. DKK	17 MIO. DKK

## MASTERPLAN 2

	MUNICIPALITY	UTILITY
NEW GREEN AREAS ON ROADS	10 MIO. DKK	10 MIO. DKK
NEW GREEN AREAS ON PLAZAS	2 MIO. DKK	
ALTERED LANDUSE OF RECREATIONAL AREAS	4 MIO. DKK	4 MIO. DKK
TRENCHES, CANAL STREETS, ETC.	2 MIO. DKK	1 MIO. DKK
PIPES AND PUMPING STATIONS		5 MIO. DKK
IN TOTAL	18 MIO. DKK	20 MIO. DKK

The net present value of the operational costs with a life span of 50 years will make up roughly 1.500 Mio. DKK for Masterplan 1 and 1.600 Mio. DKK for Masterplan 2. Substantial uncertainties are associated with these figures, partly in relation to type of park and solutions and partly in relation to the selected discount rate used for the calculations.

The implementation of the cloudburst solutions will furthermore lead to savings and socio-economic benefits. The municipality of Copenhagen has conducted analysis showing the positive effect of eg. green areas on real estate prices and public health, etc.

The alternative to the implementation of the cloudburst roads will be to implement supplementing traditional piping and pumping stations, which also includes additional operation for the utility. In addition, a large annual volume of stormwater will be treated and discharged locally as part of the decoupling. This will reduce the load on the wastewater treatment plant Lynetten, thereby saving fees associated with treatment at the facility and as well as fees for discharging to Øresund.



## CONTRIBUTION TO CITY STRATEGIES

Both masterplans seek to create synergies in a broader perspective to other strategies and planning efforts in the city, in addition to the primary focus of meeting the service levels set forth in the cloudburst management plans.

The broader perspective becomes visible at a city level, where both masterplan for concretization of the cloudburst management plans follows and supports the existing city plans and structures. The cloudburst roads will help lift the quality and urban life in a number of important local stretches of the city.

In relation to increased greening and increased biodiversity, the masterplans will help convert sealed surfaces to blue-green elements and areas, which in a large extent will be laid out as corridor connecting existing recreative areas.

The masterplans provide an opportunity to strengthen bicycling by located cloudburst and detention roads on stretches in need of or already planned to be upgraded for soft road users. This is the case for eg. Rantzausgade, Bülowsvej, Vodroffsvej, Gasværksvej and Istedgade. The cloudburst roads could potentially be implemented in connecting to bike lane projects or even help facilitate the conversation of selected road to dedicated bike roads.

It is also the intention, that a large portion of the solutions with green areas and recreative usage are planned in an area, where potential linkages to urban renewal and neighborhood improvements is likely, eg. in the area of Nordre Fasanvej with green roads, retrofitting the plaza at Blågård's Plads, green cloudburst roads in the area of Vodroffsvej and retrofitting the plaza at Litauens Plads.

Through the development of the masterplans focus has further more been on establishing signature projects in Copenhagen and Frederiksberg with landscape architecture in international class, which can help strengthen the brand of the city. This could for instance be the project relating to Saint Jørgens lake, which also lies on the border between the two municipalities and thereby also visualizes the transverse cooperation necessary in addressing future climate change induced challenges. Also the proposed conversions of Sønder Boulevard and Frederiksberg Allé could be highlighted as potential examples of signature projects. Sønder Boulevard with increased support of activities and øget Frederiksberg Allé with more classical landscape architecture.

## ASSESSMENT

LADEGÅRDSÅ, FREDERIKSBERG EAST & VESTERBRO

Based on the work with the concretization of the cloudburst management plans the city administrations have conducted an assessment of the two proposed masterplans. Below the criteria for assessment are presented. The assessment is qualitative and based on input from technical, economic and planning experts with a thorough knowledge and understanding of the masterplans.

	MASTERPLAN 1	MASTERPLAN 2
HIGH SYNERGY WITH CITY STRATEGY	●●●●●○	●●●●●○
HIGH VISIBILITY	●●●●●●	●●●●●○
HIGH MULTIFUNCTIONALITY	●●●●○●	●●●●●○
HIGH SYNERGY WITH OTHER PLANNING EFFORTS	●●●●●○	●●●●○●
FEASIBILITY	●●○○○○	●●●○○○
HIGH ROBUSTNESS TOWARDS CHANGING CLIMATE PREDICTIONS	●●●●●○	●●●○○○
ADDED VALUE AND LIVEABILITY	●●●●●○	●●●●●○
LOW ENVIRONMENTAL EFFECT	●●●●○●	●●●●●○
LOW COSTS	●●●●●○	●●○○○○
REASONING	<p>The masterplan is robust towards changes, easy to implement in phases and includes highest possible level of blue-green solutions.</p> <p>This plan presents the largest transformation of the city and the largest recreational potential. The plan is the least costly. The plan includes comprehensive administrative and authoritative barriers in form of existing conservations plans.</p>	<p>The masterplan is simple to dimension and plan. The plan includes possibilities of multi-functionality in form of double use of cloudburst pipes for traditional wastewater basin. The plan is assessed to be relatively simple to pass current authorities. Construction costs will be substantially higher than for masterplan 1, though including possibility for saving on traditional detention basin.</p>
	Both masterplans include substantial synergy to city strategies and other ongoing planning efforts. Both masterplans fulfill the service levels outlined in the cloudburst management plans.	

## **EXPLANATION OF CRITERIA FOR ASSESSMENT**

### **SYNERGY WITH CITY STRATEGY**

The degree of synergy with other related strategies in the city of Copenhagen, eg. Miljømetropol, Metropol for People, the Copenhagen Biking Strategy 2011-2025.

### **VISIBILITY**

The degree to which the cloudburst solutions are visible.

### **MULTIFUNCTIONALITY**

Assessments of the degree to which the solutions provide possibility to solve other challenges in the city or provide additional functions.

### **SYNERGY WITH OTHER PLANNING EFFORTS**

The degree to which the solution supports other plans in the municipality, eg. green plans, etc.

### **FEASIBILITY**

The degree to which the solution can easily be implemented and integrated into the city.

### **HIGH ROBUSTNESS TOWARDS CHANGING CLIMATE PREDICTIONS**

The degree to which the solution can be amended in case climate assumptions change.

### **LOW ENVIRONMENTAL EFFECT**

The degree to which the external water environment is affected.

### **LOW COSTS**

The total construction and operational costs.

In the assessment no compensation for potential value adding factors provided by the solutions is included.