

APPENDIX 1 - STRATEGY LIBRARY

Appendix attached to Master Thesis:
“A New Planning Approach”
in Sustainable Urban Design, LTH, Lund University

Astrid Steen, May 2019

STRATEGY LIBRARY

The purpose behind this library is to compile a list of methods on how to deal with water in case of flooding.

The list is split into different categories; methods of how to deal with flooding due to sea level rise

- in the sea,
- by the coast,
- up on land,
- with architecture,

methods of how to deal with flooding due to cloudbursts

- through the landscape,
- with architecture.

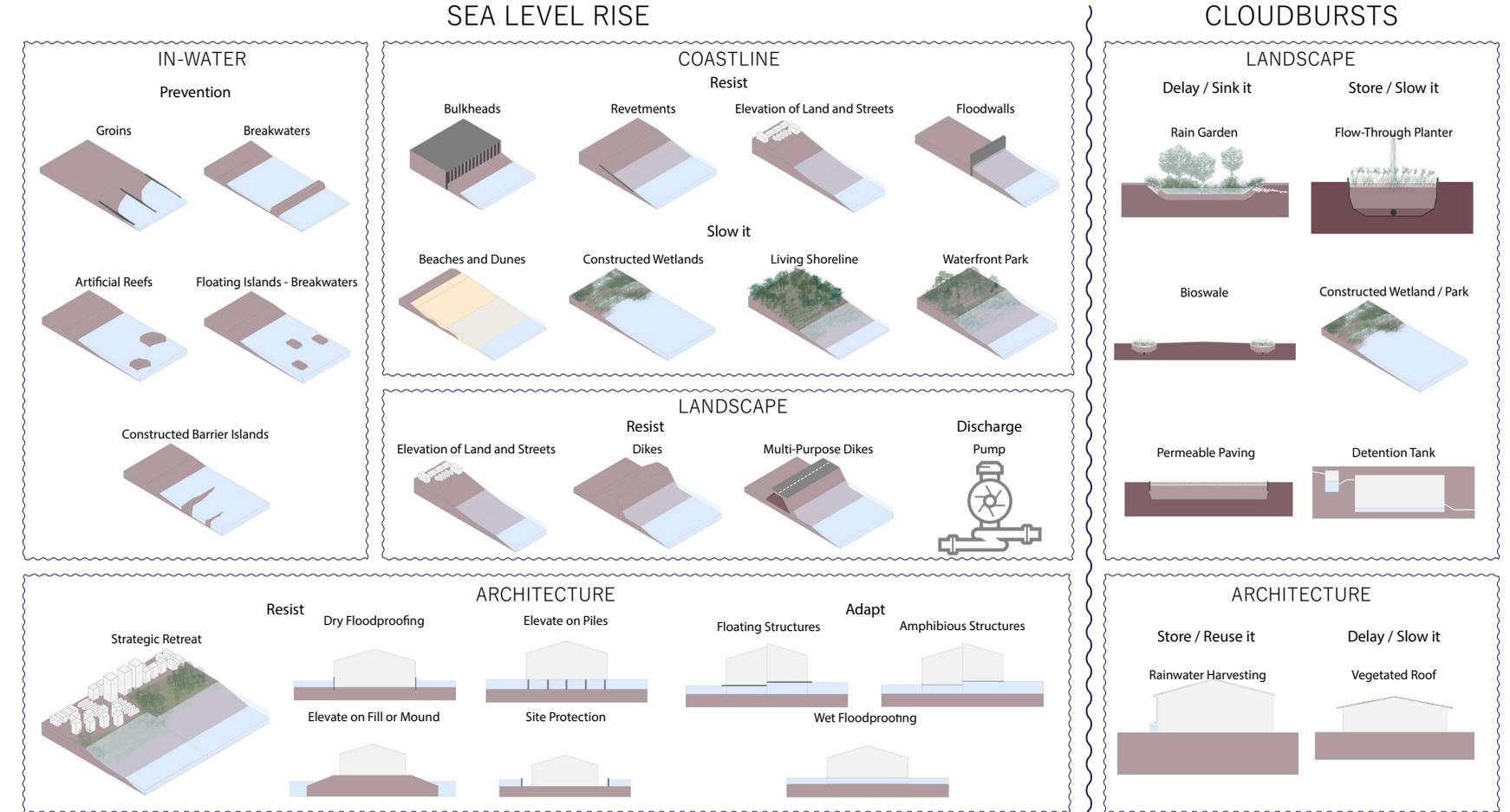
These methods can either be classed as:

- preventive; aiming to stop a flood from occurring / have an effect on land.
- resisting; putting up a defense to prevent a flood from affecting the built environment.
- slowing it down; letting green structures deal with the water naturally, protecting the built environment.
- discharging; moving the water from one place to another with technical equipment.
- adaptive; architecture that embrace the floods.

- delaying; taking up some water, letting any excess move along further, while treating it along the way.
- sinking it; slowly letting the water soak in or run on.
- storing; keeping the water contained until it can be let out elsewhere or is needed.
- reusing it; collecting the water and putting it to use.

These methods will be used in the larger strategic summary in the thesis. Together with the reading of the city core of Malmö they present a solution for how Malmö could deal with floods on a city scale in the future.

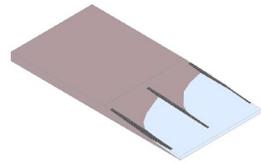
A shorter compilation of the methods can be found in the main document.



SEA LEVEL RISE

IN-WATER - PREVENTION

Groins

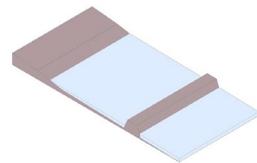


Are (usually) stone piers built out into the sea from a beach with the purpose of protecting the beaches from erosion or trap sand from drifting.

They are protecting the shoreline from diminishing and closing in on any nearby structures.

<https://www.britannica.com/technology/groin>

Breakwaters

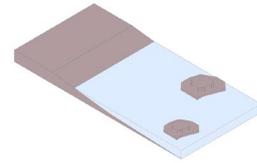


Are offshore structures protecting land areas from waves and their effects.

Just like groins they protect the shoreline from diminishing, however, this will not prevent erosion completely.

<https://www.britannica.com/technology/breakwater>

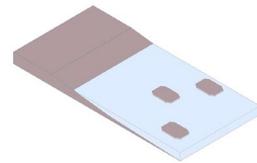
Artificial Reefs



Work just like breakwaters but also have the potential to be a positive addition for marine life.

https://en.wikipedia.org/wiki/Artificial_reef

Floating Islands

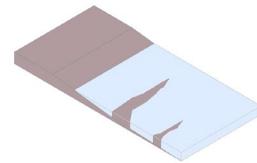


Could work similarly to the artificial reefs but with a focus on the possible positive ecological effects on land.

There is also the possibility of working these into some kind of aquatic habitation.

https://en.wikipedia.org/wiki/Floating_island

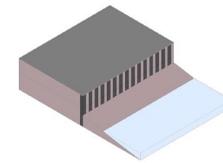
Constructed Barrier Islands



Are a type of dunes that lie parallel to the mainland. They have similar effects on coastal protection as breakwaters but as they also create protected waters can be a contributor in shaping intermediate wetlands between the barrier islands and the mainland.

https://en.wikipedia.org/wiki/Barrier_island

Bulkheads



Protect from erosion. They are reinforcements of the coastline in the form of walls.

These are best used when a clear distinction should be made between sea and land.

<http://www.coastalwiki.org/wiki/Bulkheads>

Revetments

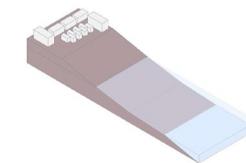


Are designed to absorb the energy from incoming water to protect against erosion.

They are constructed on slopes and are supposed to keep the coastline open and accessible to users.

<http://www.coastalwiki.org/wiki/Revetments>

Elevation of Land and Streets



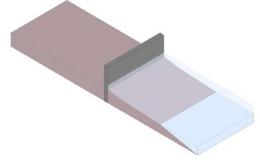
Protects the built environment from floods through land-fill.

A very expensive method that doesn't look at natural ways of dealing with water and floods but rather a protective retreat.

Only possible with new development areas.

COASTLINE - RESIST

Floodwalls



Can be fixed or deployable. Fixed walls are an easier option as they don't need and manoeuvring, however they also create a permanent barrier between the built environment and the sea.

Deployable walls are more expensive and need technical equipment but doesn't create a barrier.

COASTLINE - SLOW IT

Beaches and Dunes

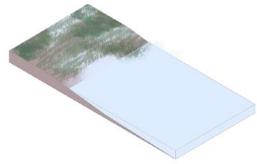


Naturally occur along the coastline and provide flood and erosion control. As they are dynamic environments they change over time and need space to do so in order not to disappear.

Therefore the all-ready existing beaches and dunes of Malmö are important to protect from infringement.

<http://nrcregionsolutions.org/beaches-and-dunes/>

Constructed Wetlands

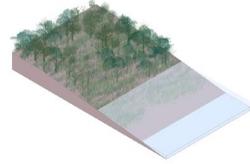


Man-made but built to simulate a natural wetland and how it deals with rainwater or floods of the sea. It stores, treats and reduces stormwater run-off through its plants.

A wetland is an ecosystem of great biodiversity and although large in scale is adaptable in shape and size depending on the site.

8 Shades of Green Infrastructure

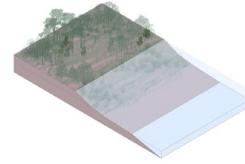
Living Shoreline



Uses the growth of living things (such as plants or oyster reefs) to help hold off erosion. Compared to constructed erosion control systems, that can negatively affect other portions of the coastline, the living shoreline has further positive effects apart from protecting from erosion, such as increasing biodiversity and cleaning the environment.

<https://phys.org/news/2017-03-coastline.html>
<http://www.oyster-restoration.org/living-shorelines/>

Waterfront Park



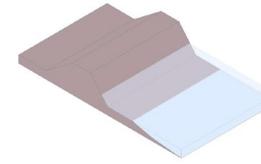
Combines the benefits of having a space designed for flooding (trapping, storing, taking up the water), protecting the shoreline from erosion and offering recreational space in dry periods.

Can be created by the coast or along a river.

<http://nrcregionsolutions.org/waterfront-parks/>

LANDSCAPE - RESIST

Dikes

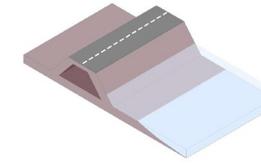


Works like a barrier wall; protecting low-lying areas from flooding, resisting both water and wave action. They make it possible to develop land that even lie below sea level.

Can vary in size, length and design.

<https://www.coastal-management.eu/measure/sea-dikes>

Multi-Purpose Dikes



Works the same way as the regular dikes but the design is more intricate, for example combining: dike, piping tunnel and road.

LANDSCAPE - DISCHARGE

Pump

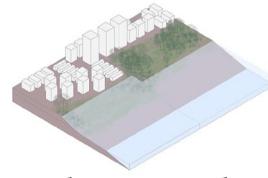


Removes water from spaces that are not able to handle the water on its own.

A must for spaces that, for example, are meeting points between sea level rise protection (dikes, floodwalls etc.) and low points that gather cloudburst runoff.

ARCHITECTURE - RESIST

Strategic Retreat



Is a last resort when trying to maintain the built environment but when other types of flood protection isn't working.

It could also be a strategic decision to continue a city's development further from the shoreline to avoid a future need for coastal city protection.

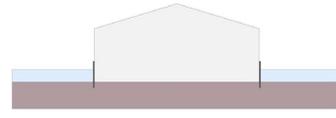
Elevate on Fill or Mound



Raises building out of harms way from flooding.

A good option if the floods aren't expected to be longlasting, as this would create little house islands with difficulties with transportation (except for boats).

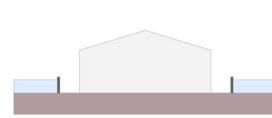
Dry Floodproofing



A technical solution protecting the building from the negative effects of the water.

A good option for short-lasting floods, seeing as entering/exiting the house would be difficult while the water is still there.

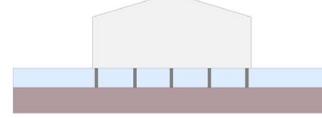
Site Protection



Protects not only the building but also the immediate yard.

Just like with the elevated mounds - a good option if the floods aren't expected to be longlasting, as this would create low-lying house islands with difficulties with transportation (except for boats).

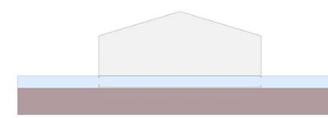
Elevate on Piles



Raises the building out of harms way from flooding.

A solution suitable for areas where reaccuring floods are expected and everyday life is adjusted to living with the floods.

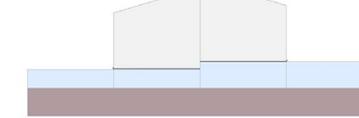
Wet Floodproofing



Allows for and is prepared for floods to enter/pass through the building.

Just like the buildings that are elevated on piles this is a solution suitable for areas where reaccuring floods are expected and everyday life is adjusted to living with the floods.

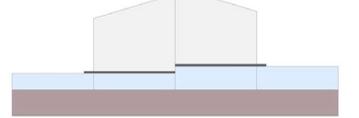
Amphibious Structures



Are meant to be situated in water bodies. The structure is secured to the ground via poles and rises and falls along these as the water levels fluctuate. This means that the building can be on the ground from time to time as well.

ARCHITECTURE - ADAPT

Floating Structures

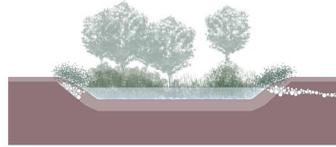


Are meant to be situated in water bodies. The structure rests on a flotation device, which means that it is designed to always rest on water. It also allows the structure to be resilient towards floods, easily rising and falling with the water levels.

CLOUDBURST - 8 Shades of Green Infrastructure

LANDSCAPE - DELAY / SINK IT

Rain Garden



Collects stormwater from surrounding, impervious surfaces in a dip where the water may be absorbed into the ground or by the plants in the garden.

Rain gardens are adaptable in terms of scale and therefore an excellent complement in areas with impervious surfaces in need of water management on site. However, the site needs to be relatively flat or the garden needs to be placed in a low area.

Bioswale



Collects stormwater from surrounding, impervious surfaces in a ditch with plants where the water may be absorbed into the ground, by the plants or be led elsewhere.

Bioswales are a suitable supportive systems next to roads due to their physical shape (narrow and long).

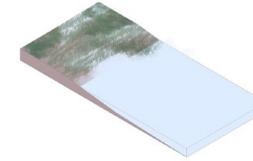
Permeable Paving



Works as a substitute for traditional impervious paving. It allows water to pass through its surface, avoiding excess run-off, where the soil can absorb the water.

Works best in flat sites, with limited or slow traffic and with soil of high permeability.

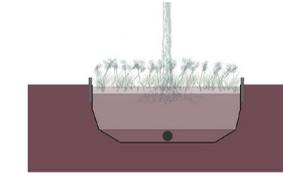
Constructed Wetland / Park



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Flow-Through Planter



Allows water to flow through vegetation and different soil compounds to filter the water, water the plants and any excess water evaporates.

Since the flow-through planter deals with the water on site it is a good solution for areas lacking drainage and with contaminated soils.

LANDSCAPE - STORE / SLOW IT

Detention Tank

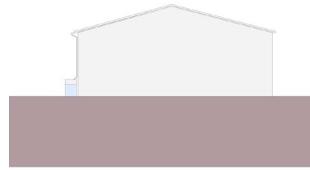


Temporarily stores excess wastewater and stormwater before releasing it for downstream treatment.

Necessary to avoid combined sewer discharge when floods occur. However, it is simply a container and doesn't help in any other way.

ARCHITECTURE - STORE / REUSE IT

Rainwater Harvesting



Collects and stores storm-water for later use in for example irrigation or toilet flushing. (Not for drinking.)

It's an easily managed, above-ground storage with great potential for public and private use.

ARCHITECTURE - DELAY / SLOW IT

Vegetated Roof



Is covered in vegetation that drinks the rain water, decreasing run-off and dealing with the water immediately on site.

Needs rather flat roof structures (5-20 °) and good structural support of the building.

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