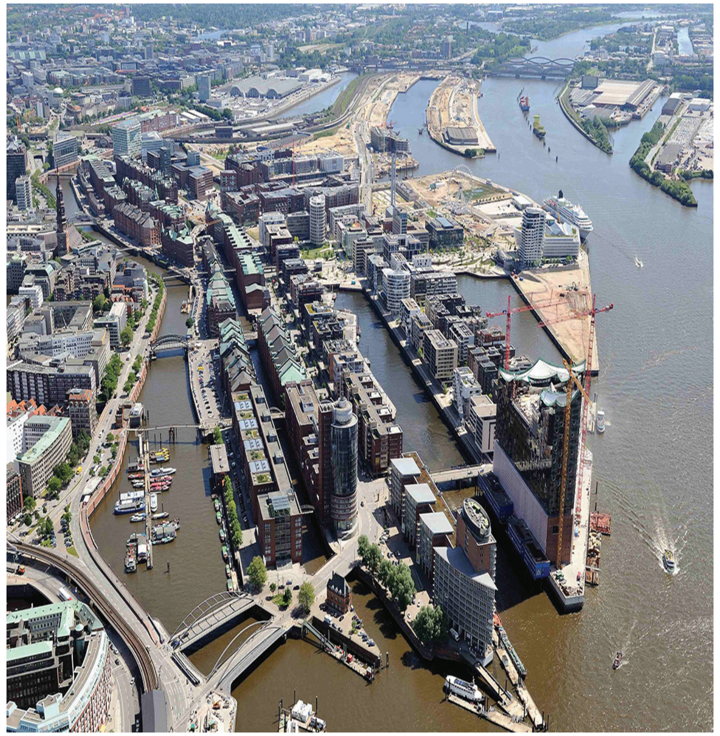
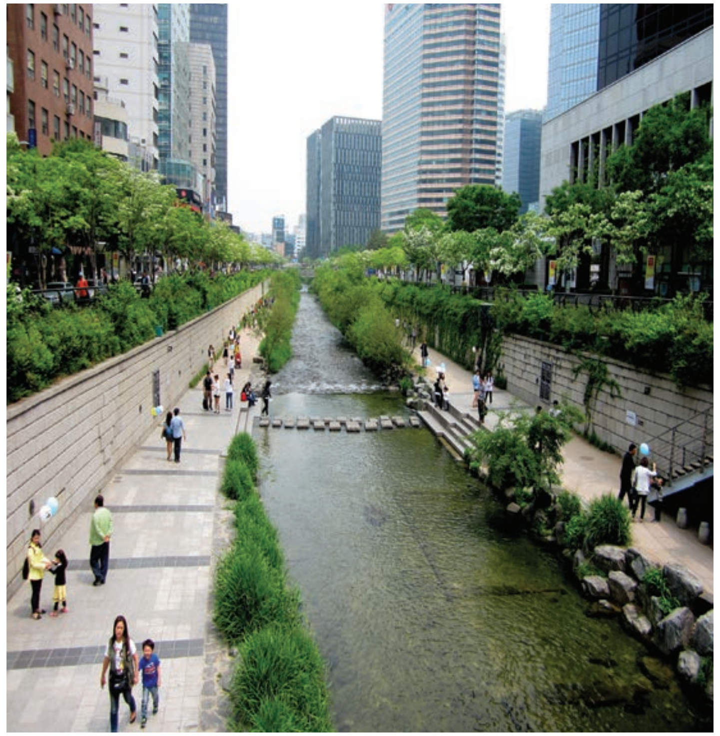




Strategies

ADAPTATION | MITIGATION
LEARNING FROM EXPERIENCES ABROAD AND AT HOME

The South Florida Region represents one of numerous sites around the world addressing the prospect of present and future inundation. In the United States and abroad, exemplary projects have been designed –and in many instances completed and operational-- to address the protection, retrofit and ultimate resilience of vulnerable urban areas. They employ a range of strategies for adaptation, mitigation and, where possible, prevention.

Hard Infrastructure Strategies rely primarily on technologically sophisticated approaches to a broad range of environmental problems. While these have proven tremendously effective, system failure can have devastating effects. Soft Infrastructure Strategies work in concert with natural systems rather than in opposition to them. These accept and value the presence of water, opting to manage rather than prevent the effects of environmental forces. Hybrid Strategies combine elements of soft and hard infrastructure solutions for multiple levels of protection and maximum effectiveness, employing aspects of each approach in proportion to the particular need of a given place.

Some of the many extraordinary ideas in place and under consideration around the world can be seen here. Drawing upon Dutch expertise in water management, four projects are located in The Netherlands: The technologically sophisticated Delta Works Projects, and two recent Room for the River projects that incorporate and celebrate the presence of water in the urban realm. In the United Kingdom: Cleveley's Coastal Defense and the Thames River Barrier, the latter recently celebrated its 30th anniversary. In Germany: The suite of remarkable sustainability initiatives designed and constructed as part of HafenCity. In Seoul, South Korea: The Cheonggyecheon Project, which restored flow along an urban river covered for over half a century by a highway that bisected the city.

In the United States, a number of speculative and commissioned projects have been produced for the New York | New Jersey area in recent years. 'Rising Currents: Projects for New York's Waterfront', was created in 2010 for the New York Museum of Modern Art. In the aftermath of Superstorm Sandy, the U.S. Department of Housing and Urban Development funded 'Rebuild by Design', the recently completed competition for projects that advance resilience along the New York and New Jersey coasts. Finally, closer to home, the Seven|50 Prosperity Plan of the Southeast Florida Regional Partnership represents the beginning of a broadly based planning process --one of many necessary steps that will result in a truly resilient region.

SOUTH FLORIDA'S RISING SEAS
FIU SCHOOL OF JOURNALISM + MASS COMMUNICATION

1937
Studies conducted by Rijkwaterstaat, showed that parts of the Netherlands were not safe in case of either storm or sea level rise.

1950
The first solution was to close the mouths of all the rivers: The Western Schelde, the Eastern Schelde, the Haringvilet and the Browershavense Gat. This proposal was named 'The Deltaplan'.

1953
Flood of 1953. The flood prevented 'The Deltaplan' from completion as originally intended. As a result, 2,000 people died and more than 150,000 hectares were flooded. 20 days after the flood, the Delta Commission was open. Its role was to advise regarding the complete execution of the Delta Plan. Its component parts:

1. Storm surge barrier in the Hollandse Ijssel
2. Damming the Zandkreek
3. Damming the Veerse Gat
4. Damming the Grevelingen
5. Damming the Volkerak
6. Damming the Haringvliet
7. Damming the Brouwershavense Gat
8. Damming the Eastern Schelde
9. Flood-control dam and lock in the Oude Maas

1958
The first of the Delta Works became operational. It was the storm barrier in the River Hollandse Ijssel. The Hollandse Ijssel Storm Barrier: The Hollandse Ijssel Barrier consists of a pair of enormous doors measuring 80 meters in width. These doors can be moved up and down vertically to control water.

1961
Two more mouths were closed: The Veerse Gat and the Zandkreek. With salt water kept out, water in between the barriers became fresh. Named the Veerse Meer (lake of Veere), it was also known as the Three-Island Plan because it connected three islands.

1969
Volkerak Dam: Construction started in 1957. It was a secondary dam, built to construct other dams –specifically, the Oosterschelde Barrier and the Brouwerdam. Volkerak Dam is 6 kilometers in length.

1971
Brouwers dam was completed. The construction of the Brouwers Dam was a good exercise for the even more complex Oosterschelde Barrier. Haringvliet Dam was completed, 14 years after construction began. At 4.5 kilometers in length, the dam serves two functions.

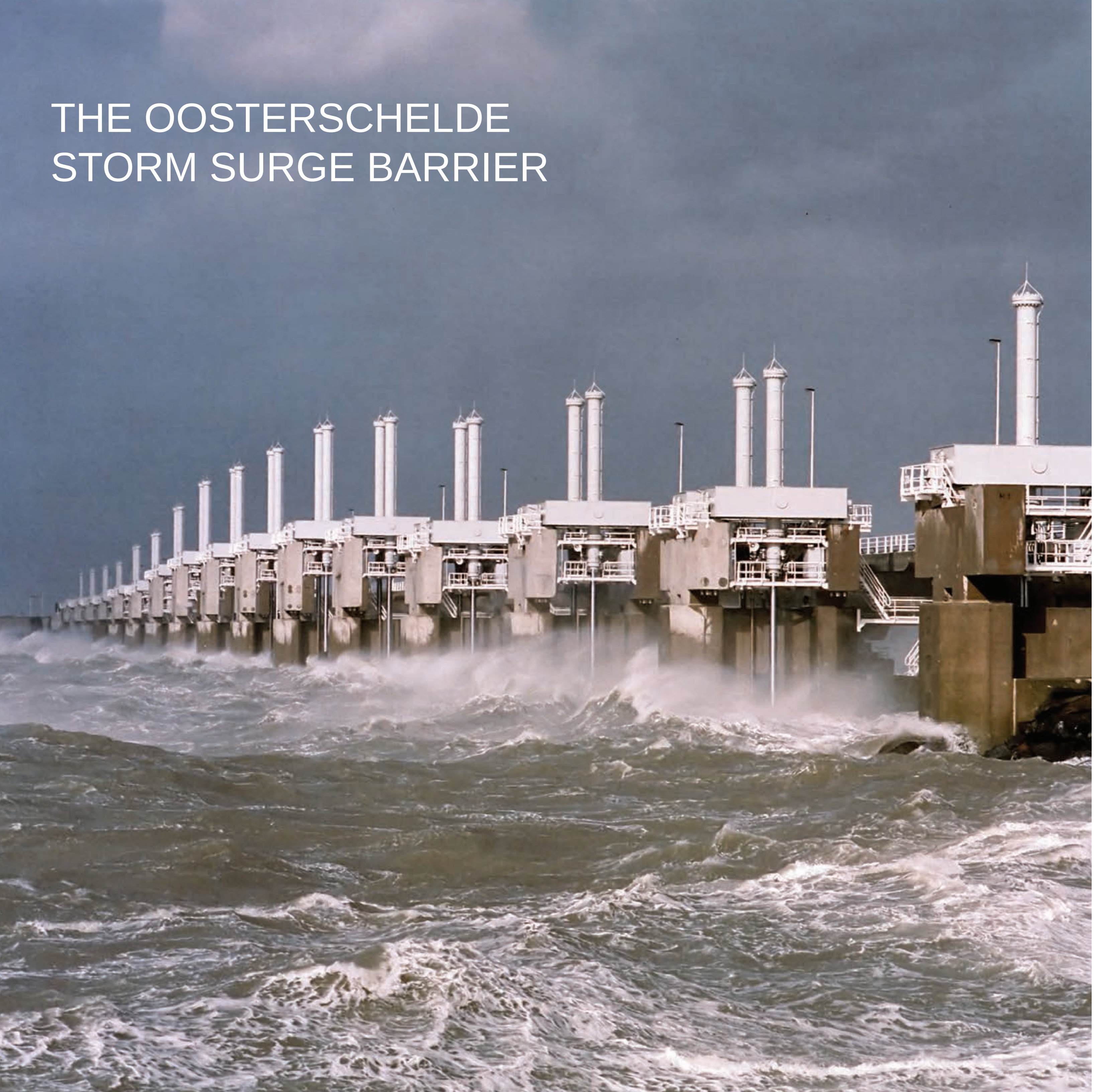
First: Protection against a potential flood. Second: Manage the drainage of water from the Rhine and the Maas Rivers into the North Sea.

1972
Grevelingen Dam took 7 years to build, and is 6 kilometers in length. Caissons were not suitable for the construction of the Grevelinger Dam, so a revolutionary technique was used to build one part of the dam: Cableways were used to plunge large blocks of stone into the water. As with the Volkerak Dam, the Grevelingen Dam was designed to facilitate the construction of the Haringvliet Dam, the Brouwers Dam, and the Oosterschelde Barrier.

1986
Osterscheldede Storm Surge Barrier: This most complex of the Delta Worksprojects constructed to date cost 2.5 billion Euros. It was officially opened by Queen Beatrix on October 4th 1986, and decreased the chance of another flood to once per 4,000 years.

1997
Maeslant Barrier: The most important element in the design was that the barrier should not hinder shipping and maritime traffic under normal conditions. The barrier should only be closed under exceptional circumstances: No more than once or twice every ten

THE OOSTERSCHELDE STORM SURGE BARRIER



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The Oosterschelde was the eighth barrier constructed in the network of dams and barriersin the Delta Works System. This is the largest and most complex project of all. The cost of the project, which extends for 3 kilometers, was 2.5 billion
Euros. Queen Beatrix officially inaugurated the project in 1986.The original proposal for the barrier was to be fully closed to the ocean. However people who lived in the area, as well as biologists, agreed that a permanently closed dam would damage the unique existing ecosystem of the region. The variety of animals and plants that live in the area are not found anywhere else in the world. There are more than 70 types of fish, 140 types of water plants and algae, 350 types of marine species and between 500 to 600 types of land in the region. Although the overriding priority was public national safety, preserving the natural surroundings was a close second. Moreover, altering the existing ecosystem was seen as a threat to the economy of the area, since many residents made a living from fishing.
In 1975 it was agreed by the cabinet committee that the Oosterschelde would be an open barrier. The new infrastructure would consist of piers distributed along the dam, connected by sliders that would open and close as needed. The proposal of a barrier that would not remain permanently closed represented a conceptual turning point in the Dutch definition of protection.

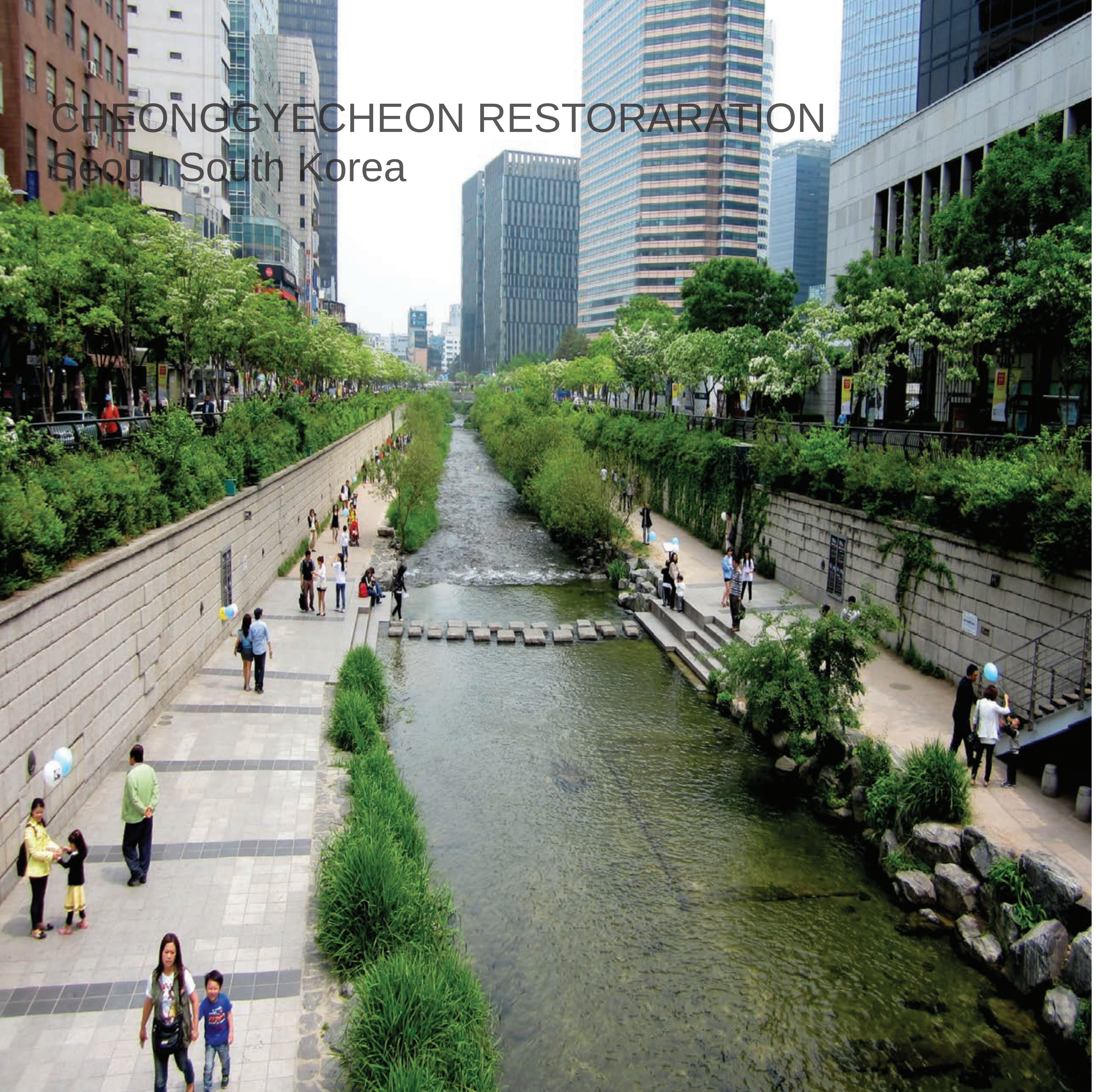
Construction Process

The Oosterschelde Dam would run over three channels: the ‘Hammen’, the ‘Schaar van Roggeplaat’ and the ‘Roompot’. It would consist of 65 prefabricated concrete piers and 62 steel sliders. This slider would maintain 75% of the original tidal
density. This would be enough to maintain the desired ecosystem of the area. The strategy for constructing this monumental structure was to prefabricate the component parts on one of the islands close to the site. Here, other materials for construction would be stored as well –including tubes, stone, and mats. This approach would have two primary benefits: It would serve to increase
tidal movement and it would preserve the safety of the workers.

One of the primary concerns during the construction process was the solidity and density of the soil that would support the Barrier. After researching and analyzing the composition of the land, it was concluded that it would not be able to sustain the requisite load.
A few adjustments would have to be made in order for the soil to support the new structure. Several strategies were implemented in the foundation of the barrier. Among them was the insertion of vibration pipes into the subsoil. The vibration would
compress and compact the subsurface sand to 15 meters of depth.

In a subsequent process, synthetic mats were placed over the soils and covered with concrete blocks. This approach proved insufficient to support the barrier. As a result, additional support was provided. A new set of mats was fabricated in the mainland to work as mattress, which would be fitted with sand and gravel.

One of the most important steps in the construction process of the barrier was the creation of the piers. The piers were fabricated in excavation sites on dry land with a depth of 15.2 below sea level. Each pier was composed of 450,000 cubic
meters of concrete and took one and a half year to finish. A new one was started every two weeks. The third element that played an important role in the function of this barrier was the slide
system, which consisted of tubes placed on top of the pier, which housed the mechanical equipment responsible for the operation of the slides. The moving steel planes were steel sheets attached to these tubes. Hydraulic cylinders moved them. The depths of the slides



SOUTH FLORIDA'S RISING SEAS
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THE CHALLANGE
The old elevated highway and concrete base looking down on the Cheonggyecheon stream caused safety issues and needed to be redesigned structurally or to be removed. The government however wanted to create a connection between the city's north and south sides, which the highway divides. "Transportation experts were concerned that removing the elevated highway would increase traffic congestion in the northern end of the city since it carried 169,000 vehicles per day." (Removing Freeways) The thought of removing the highway also met cooperation from many local business owners. The proposed stream restoration presented challenges. Water is not found in the Cheonggyecheon stream for most of the year except during the summer which is their rainy season, making it di cult to create a constant flow of water. See detail A below for how the pumps that store the water to allow for this to work..

SOLUTION
The Seoul Metropolitan Government decided to demo the elevated highway and concrete base over the stream. "To improve north-south linkages, 22 bridges-12 pedestrian bridges and 10 for automobiles and pedestrians were proposed to connect the two sides of the Cheonggyecheon." (Removing Freeways) To reduce the traffic congestion, car use was not influenced car use was not recommended in the city center, new bus lines are added, and new loading and unloading systems were implemented. "To address business owners' concerns, the Seoul Metropolitan Government held over 4,200 meetings to build consensus. Economic support was given to businesses and special agreements were made with vendors who had to move due to project construction." (Removing Freeways) "To focus on the low water flow of the Cheonggyecheon stream, water from the Han River and several pump stations is treated and pumped to create a consistent flow with an average depth of 40 centimeters in the Cheonggyecheon." (Cheonggyecheon Restoration Project) See Detail A

BENEFITS
"Increased overall biodiversity by 639% between the pre-restoration work in 2003 and the end of 2008 with the number of plant species increasing from 62 to 308, fish species from 4 to 25, bird species from 6 to 36, aquatic invertebrate species from 5 to 53, insect species from 15 to 192, mammals from 2 to 4, and amphibians from 4 to 8.

Reduces the urban heat island effect with temperatures along the stream 3.3° to 5.9°C cooler than on a parallel road 4-7 blocks away. This results from the removal of the paved expressway, the cooling effect of the stream, increased vegetation, reduction in auto trips, and a 2.2-7.8% increase in wind speeds moving through the corridor.

Increased the price of land by 30-50% for properties within 50 meters of the restoration project. This is double the rate of property increases in other areas of Seoul.

The stream attracts an average of 64,000 visitors daily. Of those, 1,408 are reign tourists who contribute up to 2.1 billion won ($1.9 million USD) in visitor spending to the Seoul economy.

Reduced small-particle air pollution by 35% from 74 to 48 micrograms per cubic meter. Before the restoration, residents of the area were more than twice as likely to summer from respiratory disease as those in other parts of the city.

Contributed to 15.1% increase in bus ridership and 3.3% in subway ridership in Seoul between 2003 and the end of 2008.

Increased number of businesses by 3.5% in Cheonggyecheon area during 2002-2003, which was double the rate of business growth in downtown Seoul; increased the number of working people in the Cheonggyecheon area by 0.8%, versus a decrease in downtown Seoul of 2.6%." (Cheonggyecheon Restoration Project)

A
ess the variable flow of the Cheonggyecheon, water from the Han River and several subway ations is treated ànd púmped to create a consistent flow with an average depth of 40

HAFEN CITY, ADAPTIVE URBAN DEVELOPMENT

SOUTH FLORIDA'S RISING SEAS
FIU SCHOOL OF JOURNALISM + MASS COMMUNICATION

THE CHALLANGE
During the 1990s, industrial activities in the Port of Hamburg declined. The city recognized the opportunity to reuse the industrial ports to expand development inside the city instead of developing outlying agricultural land. Since then, Hafen City ("Harbor City") has become the largest single development project (by acreage) in Europe. Since Hafen City is located on the banks of the Elbe River outside the protection of Hamburg's dike system, developers saw the risk of severe flooding as a design opportunity. The challenge was to design Hafen City as a model for post-industrial, transit oriented development within a floodplain. The master plan fort he project was the result of studies beginning in 1996, a design competition held in 1999, and approvals granted in 2000.

PROCESS
Flood-resilient design and sustainable architecture are the intended hallmarks of the project. The design team considered constructing a new dike to manage flood risks, but determined that associated time and costs were prohibitive. People also hoped to maintain the district's proximity and visual connection to the Elbe River, which a levee would have obscured. Instead of a dike, existing land was elevated with large constructed mounds called warften. Buildings and roads were strategically constructed on the high points, beyond the reach of the floodplain, allowing lower areas to flood periodically. Additionally, a robust public transit system consisting of underground rail, over ground buses, ferries and bicycles, supports the growth of the city. An elevated system of raised bicycle and pedestrian paths and bridges interconnects the city.

THE RESULT
Currently under construction, Hafen City is intended to represent an example of new, relatively dense, transit-oriented, flood resilient development. While historic properties in the area are maintained at their original elevations, new buildings and passageways are elevated up to 30 feet, while plazas and promenades remain at 15 feet, closer to the river.40 Small floodgates guard the connection between Hafen City and older portions of Hamburg. Unstable soils required all development to be built on structural piles. These piles offered the opportunity to create ample parking within the warften, relieving surface parking and vehicular congestion.
In addition, dense, transit-oriented development increases the district's walkability and decreases overall carbon dioxide emissions. The design of a network of enerous and interconnected public spaces and plazas add to the quality of life in HafenCity. Permitting requirements ensure new development meets the design standards and socioeconomic goals of the project. Energy sources favor solar, geothermal, biomethane fuel cell and heat pump sources.

HOW?
By elevating the buildings on plinths made of mounds of compacted fll it has been possible to connect Hafen City with the existing city area and develop it incrementally. All new buildings stand on artificial bases eight meters above sea level - out of reach of the most extreme flooding. On the exposed windward sides, such as the southern sides of Strandkai and Überseequartier, the external perimeter will actually lie at 8.3 to 8.6 meters above sea level.
It is the responsibility of the private developers of buildings to put these artificial compacted bases in place, so the number of these bases is growing as the number of buildings increases. This has dispensed with any need for financing of flood-protection measures years ahead of the sale or habitation of the sites concerned.