EVENT

FLOOD DISASTER

TEAM: MAX GROOS, HELENA SCHENAVSKY, EMMA SCHWARZ

LOCATION: AHRWEILER REGION, GERMANY
COORDINATES: 50.32° N, 7.06° E
ALTITUDE: 100M TO 300M ABOVE SEA LEVEL

Ahrweiler Region, Germany.

In mid-July 2021, the Ahrweiler region in Germany experienced a catastrophic flood event. Over a period of 24 hours, the area was inundated with 100 to 150 liters of rain per square meter. This unprecedented rainfall led to severe flash floods, causing the Ahr River to swell to historic levels. The floodwaters wreaked havoc on the region, with the narrow valleys and steep hills exacerbating the severity of the flooding. The event not only impacted Germany but also extended to Belgium, France, the Netherlands, and Luxembourg, highlighting the widespread and devastating nature of this natural disaster.

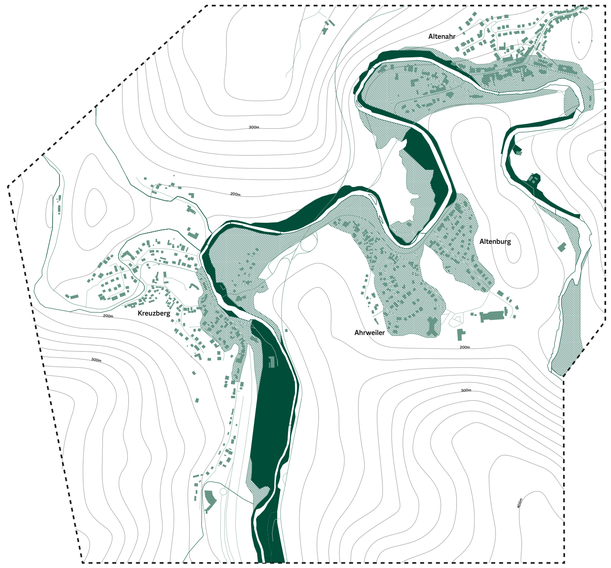
Condition before the flood disaster.

Condition before the flood disaster.

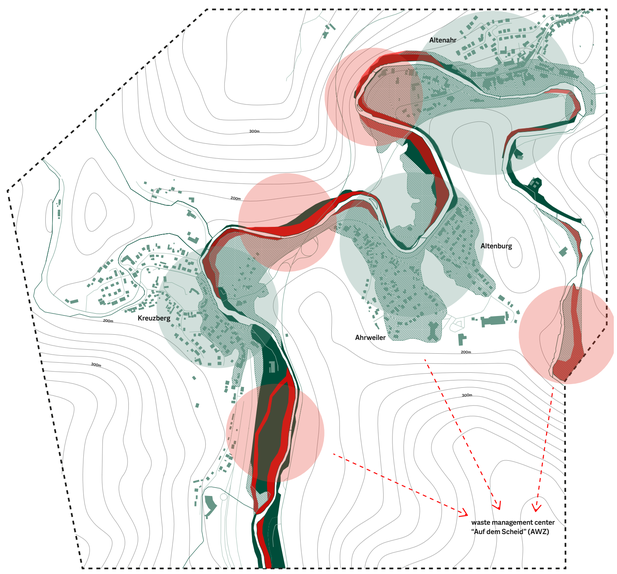
Condition during the flood disaster.

Condition after the flood disaster.

Condition after the flood disaster.



Flood area Flood trace



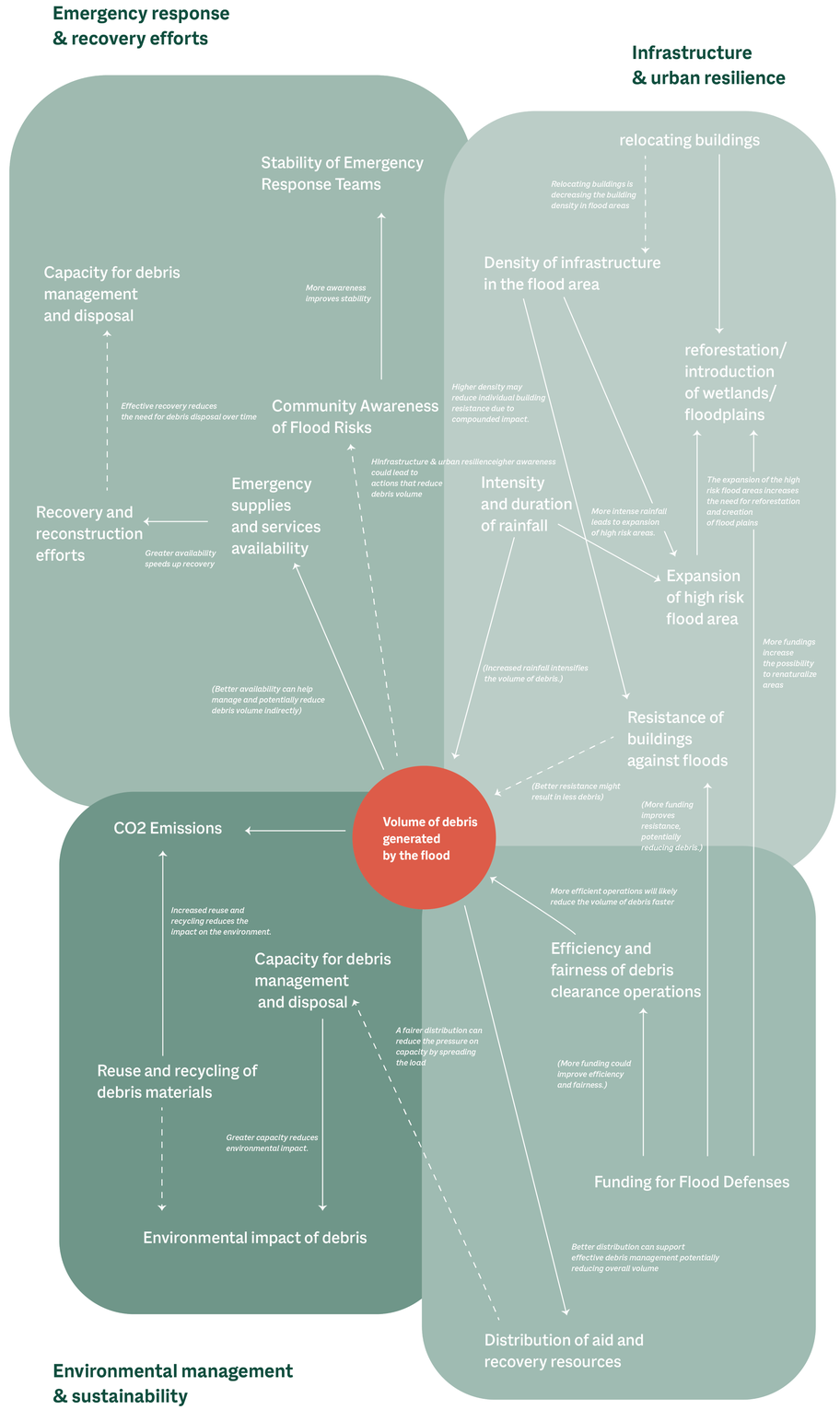
Widening the river Deepening of summer bed Mobile protective walls

The mid-July 2021 flood in Ahrweiler was marked by intense rainfall, which caused rapid and severe flash floods. The Ahr River reached unprecedented heights, significantly exceeding the normal levels and causing extensive damage. The deluge led to over 180 fatalities and displaced countless residents. The floodwaters destroyed critical infrastructure, including railways, roads, and bridges, and disrupted essential services such as gas, electricity, and water supplies. The strong floods ravaged a 40-kilometer stretch in the Ahrtal, inflicting severe infrastructural damage.

The geographical vulnerability of the Ahrweiler region, characterized by its narrow valleys and steep hills, exacerbated the flooding. Historically, the Ahrtal has faced significant flood damage, with notable floods recorded in 1910, 1804, 1719, and 1601. Modern infrastructural changes, such as ground sealing and river straightening, compounded the problem, as there had been little interest in funding prevention plans.

In response to the disaster, the Technical Relief Organization (THW) deployed around 4,000 helpers daily to assist with rescue operations, cleanup efforts, and the rebuilding of infrastructure. Thousands of volunteers from across Germany and abroad also contributed to the recovery efforts. In August 2021, a joint fund for reconstruction aid was established, amounting to a total of 30 billion euros. However, the reconstruction efforts have faced criticism for inadequate flood safety measures and the removal of natural flood control features. Rebuilding has focused primarily on urban areas, often neglecting ecological integration, and the use of heavy machinery has caused environmental damage, increasing future flood risks. Environmental concerns were initially overlooked, and there was a lack of input from ecological experts, leading to the destruction of biotopes during the process.

Despite the severe risks, many residents did not relocate from the flood-prone areas. This can be attributed to a psychological phenomenon known as „flood dementia," where people tend to underestimate the likelihood and potential impact of future floods, leading them to remain in vulnerable locations. This phenomenon underscores the need for better education and awareness regarding flood risks and the importance of implementing comprehensive flood prevention and mitigation strategies to safeguard communities in the future.



Flood disaster, System Map.

CASE STUDY 01

MOBILE FLOOD PROTECTION

FIRM: AQUABURG GMBH, MÜNSTER

LOCATION OF THE CASE STUDY: NRW, GERMANY
COORDINATES: 50.32° N, 7.06° E
ALTITUDE: 100M TO 300M ABOVE SEA LEVEL

The AquaWand is a mobile flood protection system designed to safeguard urban and rural areas from the devastating effects of flooding. Offering a more streamlined and faster solution compared to traditional options like sandbags or steel flood gates, the mobile flood protection wall could be a standard solution for private and public use in the Ahrtal region.

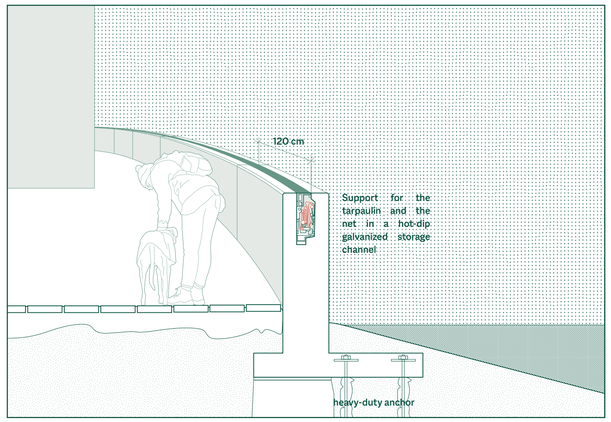
This system comprises modular components made from steel poles, a strengthening net, and a plastic tarp. Its design allows for flexibility and adaptability, as it can be fully retracted into the ground after use, making it suitable for various terrains and flood scenarios. The protection wall can be rapidly transported and set up by a small team, providing immediate protection in emergency situations.

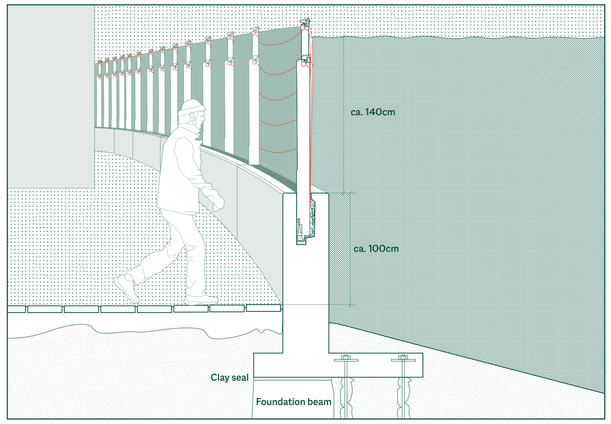
The AquaWand has been deployed in several flood-prone areas across Germany. While specific use in the Ahrtal flood has not been documented, the AquaWand is already widely used throughout the country. It could be a key solution for protecting the inhabitants of that region against future floods.

Aquawand in its folded state.

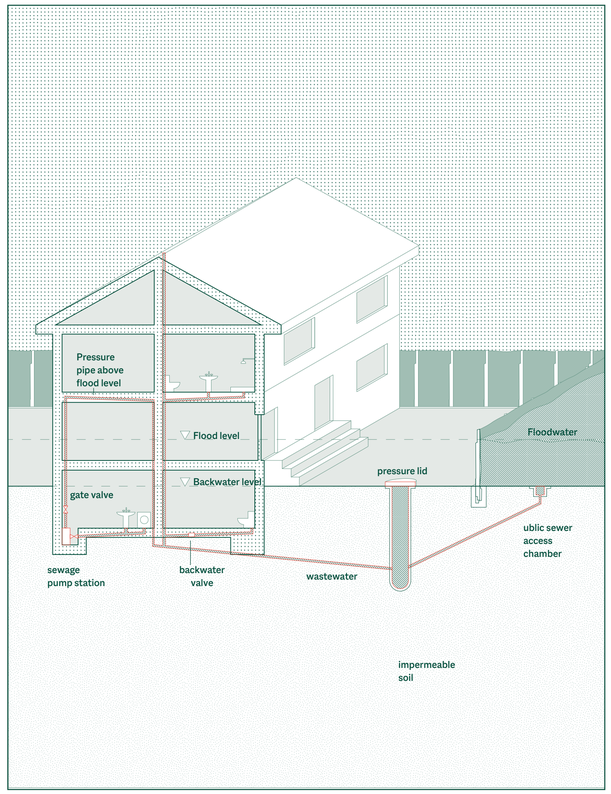
Aquawand in its built up state.

Testing of the application.





Detailed Section of application into a wall.



Possible scenario around a house.

Various wall heights: from 60 cm to 400 cm possible
Assembly with experienced team = 1 m^2 AquaWall / 1 pers.-minute
Less CO2 emissions than traditional aluminum flood barriers during production and assembly/disassembly (factor of 10)

Despite its flexible design and proven effectiveness in various flood-prone regions, the flood protection wall still encounters some challenges and considerations that merit attention.

One significant consideration is the initial investment cost. Implementing a modular flood protection system involves upfront expenses that may exceed those of traditional methods. While the AquaWand's durability and reusability can potentially offset these costs over time, convincing budget-conscious municipalities or organizations of its long-term benefits remains a challenge.

Terrain suitability is another crucial factor affecting the AquaWand's effectiveness. The system's ability to anchor securely into different types of ground—especially in rocky or uneven terrain—can impact its reliability during deployment. Ensuring compatibility with diverse landscapes and soil conditions is essential to maximize its utility across various flood scenarios.

Deployment logistics, while streamlined for rapid setup by a small team, require careful coordination and preparedness during emergency situations. Factors such as transportation to the site, personnel training for correct installation, and ensuring timely deployment can influence the system's effectiveness under real-world conditions.

Environmental impact, while minimized through the system's durability and potential for recycling materials, remains a consideration. The production and eventual disposal of steel and plastic components require sustainable management practices to mitigate ecological consequences. However, efforts to optimize material use and enhance recycling capabilities can further reduce environmental footprint over the system's lifecycle.

circular strategies

CASE STUDY 02

WASTE MANAGEMENT

ARCHITECT: THINKING CIRCULAR ACADEMY, NIEDERZISSEN

LOCATION OF THE CASE STUDY: AHRTAL, GERMANY
COORDINATES: 50.32° N, 7.06° E
ALTITUDE: 100M TO 300M ABOVE SEA LEVEL

The waste management center "Auf dem Scheid" (AWZ) above Niederzissen has been an integral part of the waste management concept of the district of Ahrweiler and makes a significant contribution to waste collection and recycling in the district. At 5.3 hectares in size, the plant in the Scheid industrial area in Niederzissen is the largest waste disposal facility in the district. While waste used to be disposed of in landfill sites in the Ahrweiler district, the focus today is no longer on dumping the delivered waste, but on returning raw materials from the waste to the economic cycle or using them in other ways. For this reason, the facility includes a recycling center for individual deliveries, a waste transfer station, a building materials collection point, a hazardous waste collection point and a collection point for electronic and electrical waste. At the composting site, green waste and other compostable materials are processed into compost, which can be collected free of charge by all citizens. The waste management center played a central role in dealing with the volumes of waste generated by the flood disaster in the Ahr valley on 14/15 July 2021. It was used as an emergency interim storage facility to deal with the enormous quantities of waste generated by the flood.

Bulky waste phase.

Construction waste phase.

Soil/mineral phase.

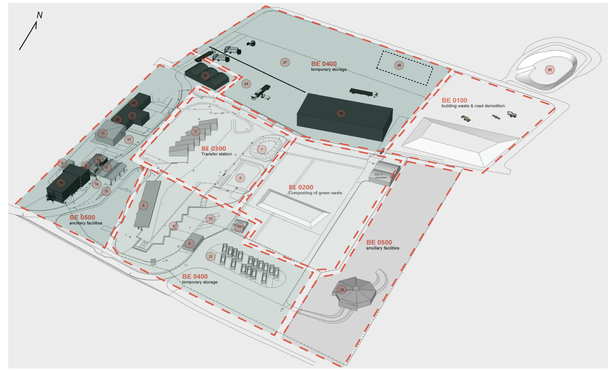
The quantities of temporarily stored waste varied:
Bulky waste phase (as of 19/08/2021): approx. 55,000 Mg
Construction waste phase (as of 28.10.2021): approx. 40,000 Mg

One of the final major tasks after the flood disaster was processing the flood silt. For months, the silt had been drying and was then fed into large trommel screens for cleaning. This process removed unwanted materials like wood, large stones and trash, leaving behind clean soil that could be reused, provided it was not contaminated. In total, over 226,000 tons of silt were processed.

In addition to the silt, construction debris from numerous demolished buildings also remained a significant issue. The cleanup of this debris took months. Across six different waste management sites, approximately 200,000 tons of construction debris were eventually removed from one site alone. This massive volume presented a significant challenge. The debris was recycled: workers first sorted out the trash, then the debris was crushed.

The resulting aggregate was washed to remove contaminants and used directly in the reconstruction effort, such as for filling basements or temporary road construction. Residents could collect this material for free.

The key innovation was that instead of transporting building materials into the Ahr Valley at great expense, the supposed waste was processed and reused on-site. This exemplified modern recycling and circular economy practices.



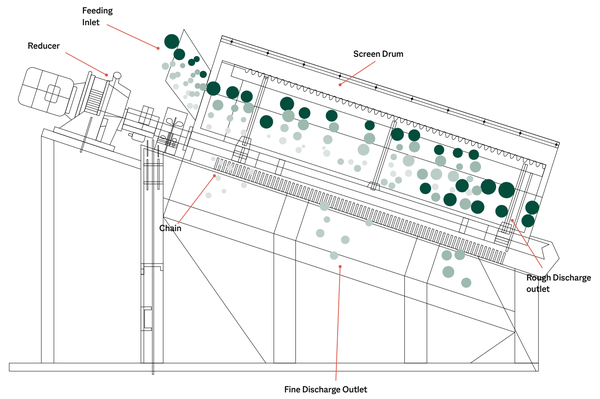
Operating units
BE 0100 building waste & road demolition
BE 0200 Composting of green waste
BE 0300 Transfer station
BE 0400 Temporary storage
BE 0500 Ancillary facilities

1998 Existing buildings
01 Operating building A
02 Scale roofing
03 Transhipment hall H-part 1-6
04 Unloading roof
05 Traformer house
06 Leachate basin
07 Rainwater retention basin

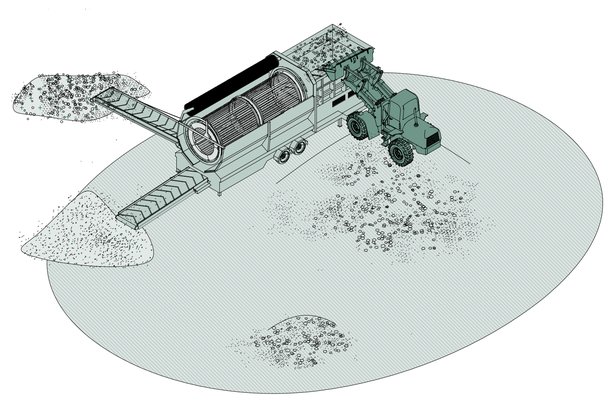
2009 Addition
08 Retaining wall
09 Problem waste acceptance
10 Container storage space electric
11 Drying hall (will be relocated)
12 Interim container storage
13 Garage/ Workshop
14 Company building extension
15 Weighing room 2
16 Environmental learning school
17 Heating system / local heating network

2017 Renovation
18 Operating building B
19 Weighing house 1
20 Wood chip storage
21 Vehicle/container washing point
22 Warehouse 1 (Hall 10)
23 Warehouse 2 Barrel Storage (Hall 11)
24 Average area
25 Rainwater retention basin 2
26 Loading hall (Hall 12)
27 Container provision/disposition area
28 Special interim storage for non-water-polluting, non-soluble waste

Expansion of the "Auf dem Scheid" waste management center in Niederzissen in 2017



How does a trommel screen work?



Sorting by conveyor belt of different waste that is previously sieved in the trommel.

CASE STUDY 03

ROOM FOR THE RIVER

ARCHITECT: RIJKSWATERSTAAT, UTRECHT

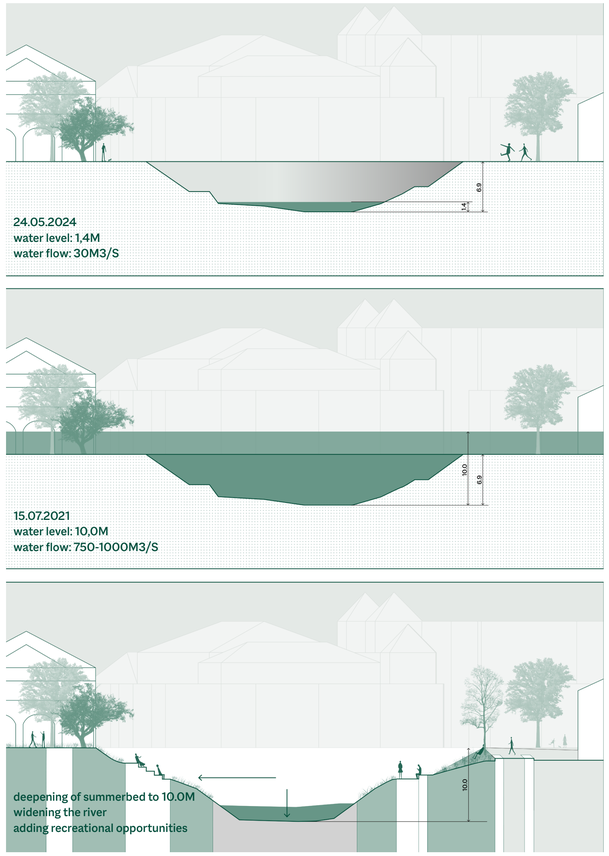
LOCATION OF THE CASE STUDY: NIJMEGEN, THE NETHERLANDS
COORDINATES: 52.08° N, 5.13° E
ALTITUDE: 29M

With the increasing frequency and severity of extreme weather events, including heavy rainfall, the risk of floods in the Netherlands is steadily growing. Consequently, in 2007, the Netherlands initiated the project “Room for the River,” where nature-based measures were taken at more than 30 locations.
The project embraces a multi-level governance approach involving NGOs, private stakeholders from different disciplines, and authorities at national, regional, and local levels. The aim was to manage higher water levels by providing more space for the rivers and simultaneously improve the spatial quality in the affected areas. Measures included, for example, the flood by-passes, excavation of flood plains, dyke relocation, and lowering of groynes. In contrast to traditional flood defenses, such as dikes and dams, the project relies on a nature-based approach with ecosystems and natural processes being part of the solution. The project represents a multifunctional design that not only increases flood safety but also adds cultural and environmental values at the same time, with increasing biodiversity and added recreational opportunities along the riverbanks.

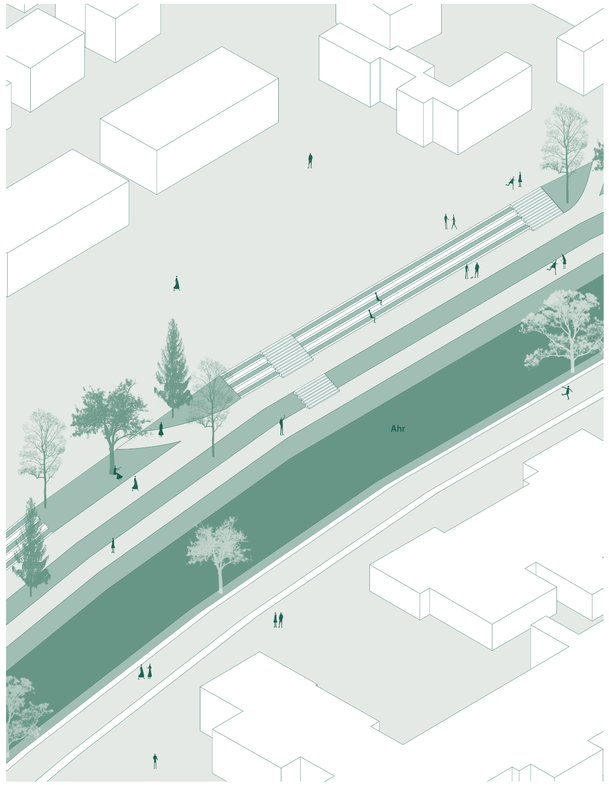
Condition before the measures.

Construction of a new channel.

Condition after the measures.



Bad Neuenahr - Ahrweiler, Section. Pathways Green Spaces Ahr River



Bad Neuenahr - Ahrweiler, Axonometry. Pathways Green Spaces Ahr River

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adaptive flood risk management, multi-level-governance, spatial planning, room for the river

The “Room for the River” project exemplifies a multi-level governance approach, where national, regional, and local government agencies collaborate with various stakeholders to find solutions. This includes active participation from the public, entrepreneurs, and interest groups in the decision-making process. While engaging diverse stakeholders offers many benefits, concerns about their involvement remain. The natural resource management often entails conflicts and negotiations. With diverse groups participating in the decision-making process, finding a solution that aligns with all stakeholders’ objectives while considering land and other natural characteristics becomes challenging.

The relocation of the dikes, one of the project’s most significant measures, also impacts numerous households residing in the floodplain, resulting in the prevention of construction projects or the relocation of residents. The presence of densely populated areas throughout the affected region could hinder the expansion of the floodplain due to high costs and socially unacceptable circumstances. Several dike relocations required the demolition of multiple houses and a significant reduction in farming households. Ideally, this occurred through voluntary sales as farmers chose to leave the polder.

Additionally, the Netherlands is likely to continue developing more flood management strategies. Although expanding river space is crucial, achieving climate resilience remains challenging, as flood risks persist despite efforts to reduce them. Future flood management plans may combine traditional methods like improving dikes with innovative approaches seen in projects like Room for the River.