Clim INVEST

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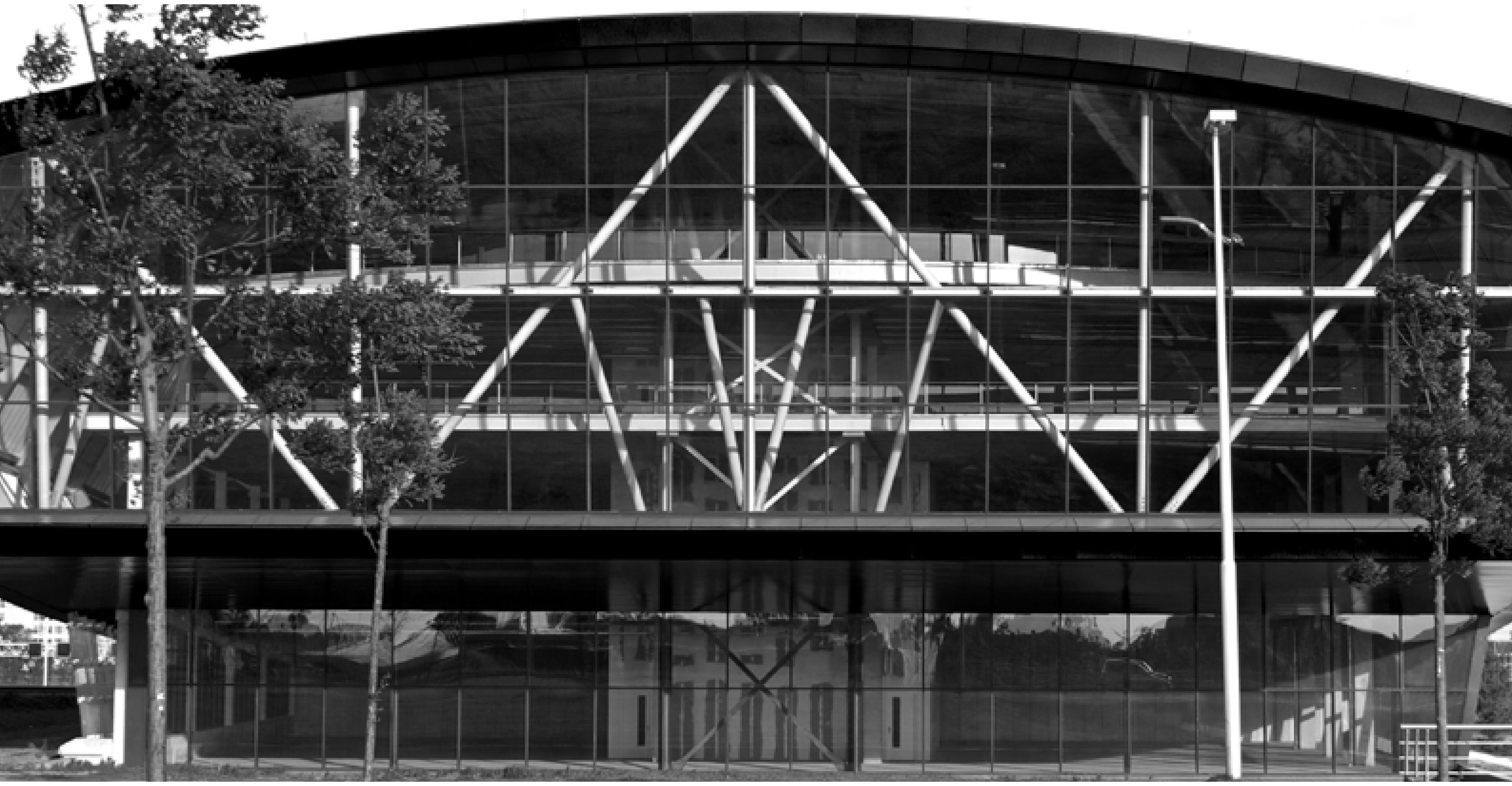
Climate Risk Assessment at the Asset Level
The Wall, Utrecht



There is an existing and growing body of scientific evidence demonstrating the financial implications that climate hazards like rising sea levels, flooding, extreme storms, and heat waves have for the real estate sector.

This case study — The Wall, a shopping centre in Utrecht, the Netherlands — demonstrates a high-level physical climate risk screening and considerations that should be taken into account for a real estate asset. We assess The Wall's exposure and vulnerability to four climate hazards to demonstrate what data is available and what is not for these type of assets. This will allow to start a discussion with asset managers and owners about what science can and cannot do within the realm of climate change adaptation.

With a climate risk assessment, better decisions can be taken on construction materials, installation of technologies, or even how the retail sector, logistics and food sector can invest in adaptation measures in shopping centres. The climate risk scores in this study (low/medium/high) are based on expert judgement of dimensions of physical climate risk (hazards, exposure and vulnerability).

Photo: Pim van Weelde

Case study asset: The Wall

The Wall is a 65 000m2 shopping centre in Utrecht, the Netherlands. The shopping centre sits by the A2 highway, the most important north-south connection in the Netherlands, vital for connecting the Amsterdam metropole to other European markets.

The exposure of the shopping centre depends on the location of the building, as well as the probability and frequency of hazards. Assessing the vulnerability of the shopping centre to climate hazards depends on factors such as elevation and placement of access routes, as well as technical characteristics of the building. Assessing vulnerability may be more challenging because of limited data on the latter including construction materials, energy performance and design, rainwater catchment systems and insurance coverage.

Figure 3. A simulation of the potential flooding following a 2 hour downpour of 70 mm per hour shows that the main access roads to The Wall and part of the A2 highway can be flooded and be inaccessible. Inundation depth is estimated between 20 - 30 cm, potentially damaging the buildings foundation, grid infrastructure or sewer systems, depending on threshold heights of the construction. Source: ClimINVEST, 2019; KNMI, 2014.

Climate risk assessment: Climate hazards, exposure and vulnerability

River flooding: low risk

Fluvial flooding – or river flooding – occurs when excessive rainfall, heavy snow melt or ice jams cause a river to exceed its capacity. Since The Wall is situated in low lying areas around Utrecht, between 20 to 60 km from the rivers Nederrijn-Lek, Eemmeer and Eem, it is highly exposed to the effects of increased magnitude and frequency of rainfall events. However, a combination of infrastructure design and policy reduces its vulnerability to these hazards (Delta Programme, 2019).

Figure 1. The Wall shopping centre in Utrecht, the Netherlands. Source: ClimINVEST, 2019

Regularly maintained dikes alongside the rivers have proven to be a cost-effective solution for flood management and help prevent local flooding around The Wall. Simulations conducted by the Dutch Delta Programme show 'worst case' examples of multiple dike failures at various locations. The climate-related flood assessment for the area around Utrecht and The Wall shows that the maximum estimated flood depth from the Climate Impact Atlas is less than 0.5m. The occurrence of this type of flooding as a result of a dike breach is estimated at once every 1000 – 10,000 years towards 2050.

Recent policies reinforce the protection afforded by climate-smart infrastructure design. Effective January 1st 2017, a new flood risk management policy linked protection levels to both the probability and the impact of the flooding. Higher protection levels apply in areas where flooding may cause major damage (economic loss, vital infrastructure and large number of victims).

The Wall is highly exposed to fluvial flooding but is not overly vulnerable to it because dike design keep levels of fluvial flooding low (less than 0.5m) and policies provide affected assets with protection.

Surface flooding: moderate risk

Surface or pluvial floods occur when intense rainfall cannot be drained away quickly enough through sewers, rivers, or other rainwater catchment systems. Currently 10% of all buildings within the Netherlands are at risk of surface flooding in the event of an extreme downpour (a so called 1 - 1000 year event) (klimaateffectatlas.nl).

Figure 2. Example of fluvial flooding risks: High water events in 1995 and in 2005 caused a major dike burst near the city of Den Bosch (30 km south of Utrecht), causing the highway A2 to be flooded for multiple weeks. Source: Dutch Ministry of Infrastructure and Water Management, 2005.

Although it has not yet been severely impacted by pluvial flooding, The Wall is located in a flood zone on highway A2 and surrounding infrastructure has not been sufficiently reinforced with pluvial flood management systems. The highway is part of a road system that has demonstrable difficulty draining during periods of intense rainfall (*Bles, et.al., 2012*). This can disrupt consumer and supplier access to the shopping centre, as well as cause physical damage to the building and merchandise.

In the case of pluvial flood risk, an extreme rainfall event of 70mm in 2 hours has a probability of occurrence of around once every 100 years. Climate change is likely to double this risk to once every 50 years by the end of the century. Less severe rainfall events will occur more frequently and temporarily disrupt the traffic flow on the A2 highway, thereby potentially affecting business at The Wall. Road network and sustainable urban drainage systems should be well maintained and where possible upgraded, e.g. installation of local bioswales for stormwater drainage to manage vulnerability. The Wall is highly exposed to pluvial flooding. It's vulnerability is partially mitigated by policies that provide affected assets with protection, as well as urban drainage systems.

Drought: low risk

Droughts can cause damage to buildings over long periods of time in the form of fissures in the external structures and façades. Likewise, soil subsidence and erosion triggered by droughts can cause uneven settling and foundation damages. Beside the direct effect of shifting ground levels, dried out soil also has reduced capacity to absorb water, which increases the risk of flooding.

Water authorities in the Netherlands are managing the groundwater levels to minimize soil subsidence triggered by drought. In 2016, the National Soil Subsidence Knowledge Programme was launched to support projects and initiatives around climate, water and soil subsidence (NKB, 2018). National measurements are showing an average yearly subsidence of 2 mm/yr for the area around The Wall in Utrecht (Bodemdalingskaart, 2018).

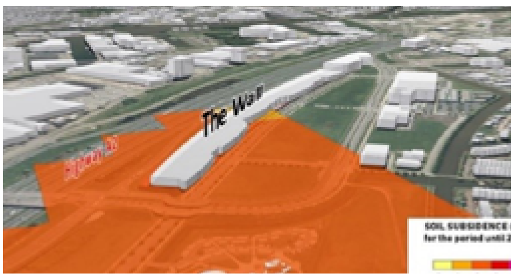


Figure 4. The expected total soil subsidence (in cm) when no adaptation measures are being taken for the period until 2050. For the area around The Wall, an additional 25% of the subsidence (5-10 cm) subsidence may occur as a result of climate change under all KNMI14 climate change scenario's. Source: ClimINVEST 2019; KNMI, 2014.

Although the foundation of The Wall itself is firmly anchored on concrete piles 30 meters deep, the surrounding infrastructure may subside, which means increased maintenance costs and a risk of deterioration of the rainwater drainage system. The northern part of the study area may be affected by moderate rates of soil subsidence. However, the asset itself is firmly founded on piles, hence this risk is deemed low.

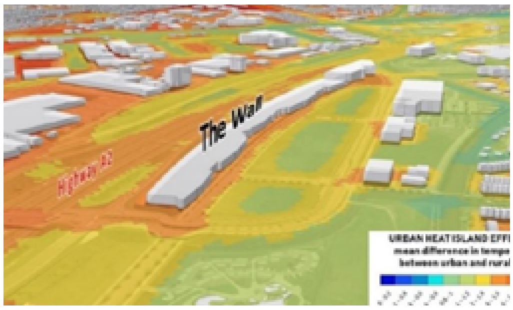
Heat stress: high risk

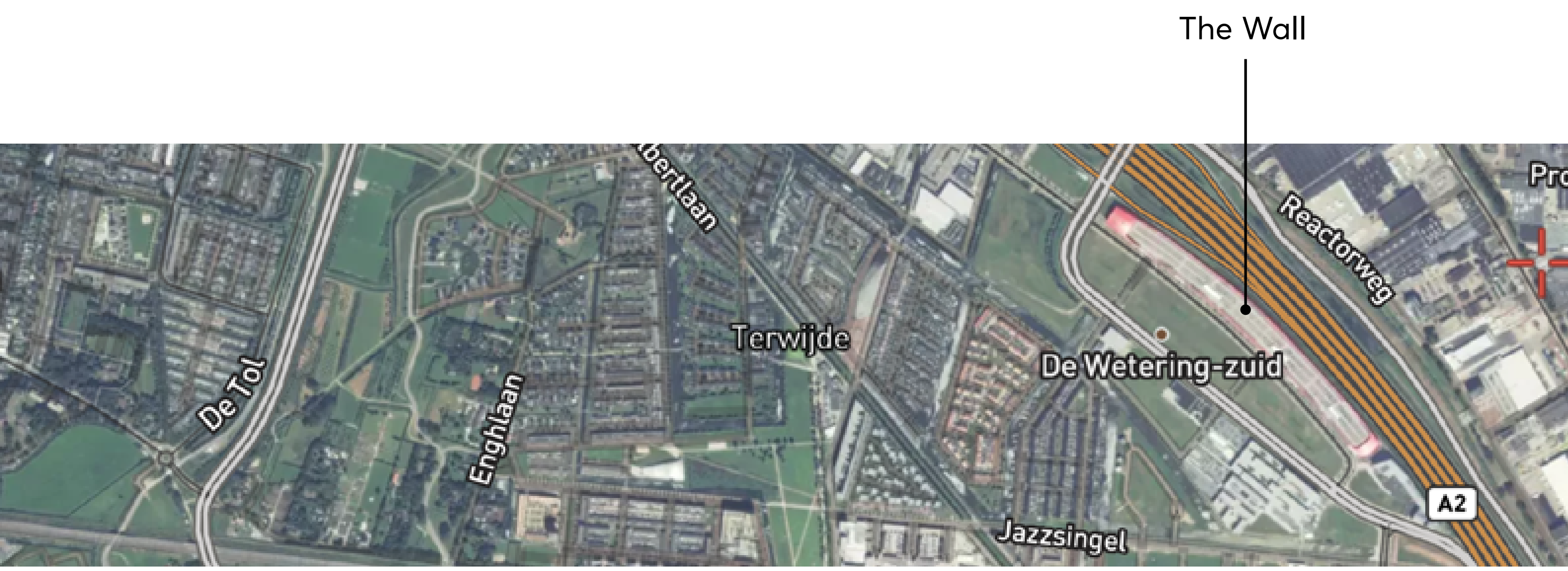
Prolonged periods of excessively high temperatures can impact building structures, electricity use, and water distribution networks of shopping centres. Heat stress can cause cracking and accelerated aging of concrete parts. Increased use of air conditioning during heatwaves increases electricity and water use and can put undue burden on the distribution networks.

In fourteen climate change scenarios focused on the Netherlands (KNMI, 2015), the number of days above 30 degrees is likely to increase from around 4 days on average per year to up to 13 days by 2050 and 21 days by the end of the century. Energy use for air conditioners in The Wall is therefore likely to increase over time, which represents higher operating costs and potentially higher greenhouse gas emissions.

A few measures were taken during the building phase of The Wall to maximize energy efficiency of the building or keep energy costs down, but these are not enough to adapt to warmer temperatures. Currently, there are plans to introduce solar panels on the parking deck for future energy consumption. There are significant opportunities for The Wall to reduce temperature fluctuation of internal spaces, ranging from cross ventilation, insulation, and green roofs to on-site shading with vegetation.

Figure 5. The local urban heat island effect in °C around the area of The Wall with the shopping centre is clearly visible (Klimaateffectatlas, 2019 and KNMI 2014). With its concrete roof top and 14000 parking spots, The Wall is clearly not able to absorb the radiation, creating a local island of heat to the city-level heat island effect of around 1.5 degrees Celsius. Source: ClimINVEST, 2019; KNMI, 2014.





Credit: Google maps/copernicus.

Summary and conclusions

From this case study in the Netherlands, it was found that climate risks are very complex and local by nature. The data used for this climate risk assessment, is publicly available at the Climate Impact Atlas for the Netherlands website (www.klimaateffectatlas.nl). Since physical climate risks have a direct impact on assets at a local level, a tailor-made approach was considered to examine the specific geographic and climatic conditions of The Wall's area.

The climate risk assessment of The Wall shopping centre gave a first indication of possible climate risks at an asset level. This case study provided a better understanding of the implications of different climate risks scenarios, and as a next step intents to stimulate the real estate sector, asset managers and owners to plan better investment strategies towards climate adaptation.

Climate adaptation investments that are set in place at an early stage through precautionary action may reduce the frequency of future interventions in assets. For instance, building flexibility into the design of shopping centres to allow for the unexpected could make investment decisions resilient to most possible changes in climate conditions. This may include no-regret strategies that bring benefits even in the absence of future climate change.

Infrastructure and policy measures can help reduce vulnerabilities for buildings in disaster-prone areas. In the case of The Wall shopping centre, climate-smart infrastructure and upgraded policies on flood risk management are protecting not only the building itself, but also the whole region against fluvial flooding. At the same time, the area of The Wall has not yet been sufficiently reinforced with pluvial flood management systems, having difficulties on draining stormwater during periods of intense rainfall. Revitalization and retrofitting of existing shopping center's infrastructure could help to prevent future asset losses due to climate impacts.

Real estate assets can increase their resilience to drought and heat stress by adapting to appropriate building codes or apply building regulations depending on the local climatic conditions. For instance, shopping centres have the potential to use water- and/or drought-resistant construction materials. Likewise, The Wall shopping centre has the opportunity to invest in green infrastructure within and around the building by making architectural adjustments and technical solutions that could integrate nature in the building. This way, the co-benefits offered by such green infrastructure could help reduce drought and heat stress risks. In the Netherlands, many real estate developers are complying to the new building regulations on "Nature Inclusive Design", which aims to include more biodiversity in the city and stimulate real estate sustainable projects.

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ClimINVEST

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