

The background of the cover is a photograph of a cityscape. In the foreground, there are several residential roofs with red and grey tiles. In the background, there are modern skyscrapers, including a prominent one with a curved facade and another with a blue and red facade. The sky is blue with white clouds. A large orange diagonal shape covers the bottom right portion of the image, containing the title text.

FLOOD RISK DUTCH MORTGAGE INVESTMENTS

Introduction

Investing in Dutch residential mortgages is a reliable long-term investment. Nevertheless, there are also risks involved in investing in mortgages. In general, risk analyses are focused on 'classic' risks such as credit and prepayment risk. In recent years, discussions in board rooms of institutional investors have increasingly focused on ESG risks such as climate change. DMFCO would like to contribute to the further understanding of these risks within mortgages.

Houses are at risk of partial or full flooding due to water from rivers, sewers or the sea. In this white paper DMFCO discusses the flood risk run by investing in Dutch mortgages. In doing so, the flood risk is made concrete by quantifying the probability of flooding, the financial damage in case of flooding and the expected loss of the investor. Followed by the steps an investor could take to limit flood risk in the portfolio.

How likely are floods in the Netherlands?

About a quarter of the Netherlands is below sea level and about half of the land area is at - very small to large - risk of flooding. In addition to the areas along the major rivers, the densely populated west and the two northern provinces of the country are vulnerable because of their low elevation (Figure 1).

The flood probabilities in Figure 1 originate from the *Climate Effect Atlas*, a project of Climate Adaptation Services (CAS). The atlas provides insight into the effects of climate change, such as flooding, water nuisance, drought and heat. For future flood probabilities, important factors are the degree of temperature increase and the changes in air currents that can cause more or less precipitation. The future scenario used by CAS assumes the most negative scenarios for both factors.

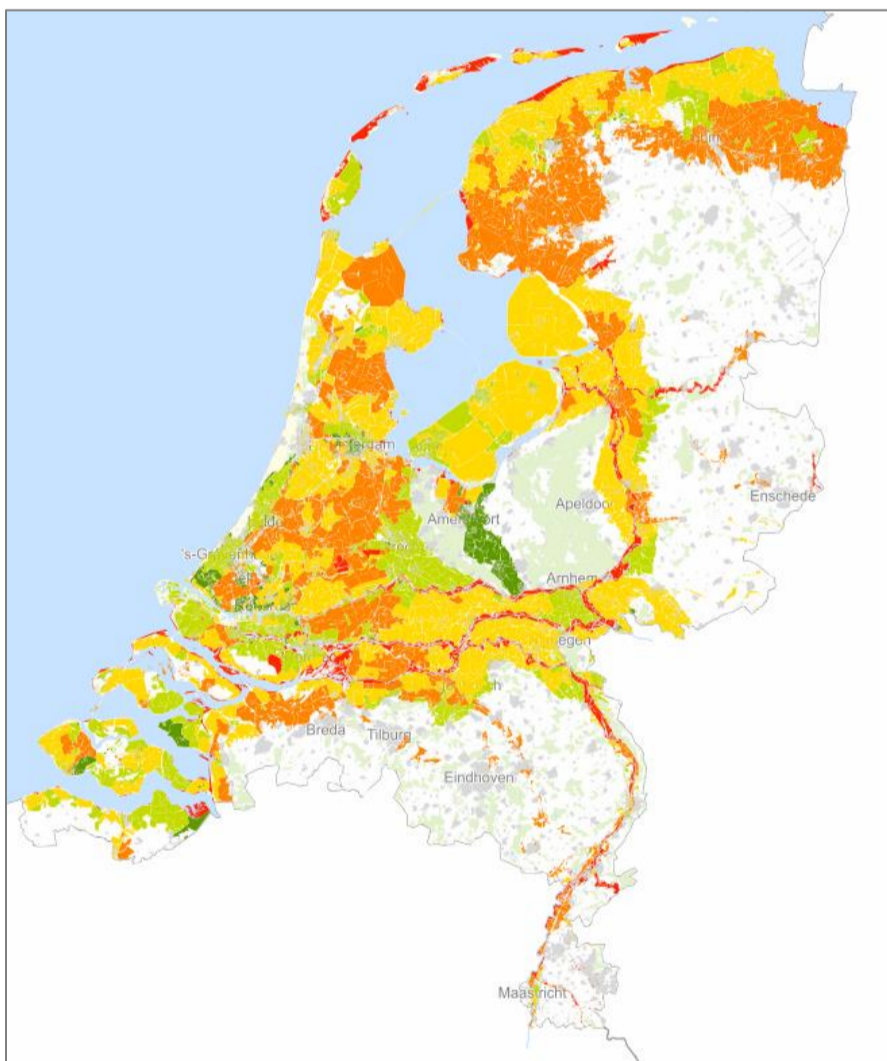


Figure 1: Flood probabilities 2050. Source: Climate Effect Atlas

The areas with the highest population density below sea level are protected by dykes. These form an important protection for many Dutch people, which is why the government has always regarded the maintenance of dykes as a priority. Already planned and future improvements will ensure

further strengthening. This will further reduce the likelihood of a dyke breach and thus a flood. These improvements are included in the analysis of CAS.

Despite nearly half of the Netherlands being at risk of flooding, the probability of a house in the Netherlands flooding once in the next 30 years is less than 5% in most areas. In a number of particularly vulnerable areas this probability can be considerably higher, sometimes even more than 50% (red areas in Figure 1). These areas are generally uninhabited because of the high probability of flooding. The risk to the investor is therefore limited.

Damage caused by flooding

When an area actually floods, the consequences depend on a number of factors. The potential damage to flooded houses depends mainly on the height of the water during a flood. A flood does not always have to be a major problem for the property itself, as long as the water level remains relatively low. In populated areas with high probability of flooding, houses are expected to flood less than half a meter. The value of the building is then expected to decrease by less than 5%¹. In addition to the value of the building, the value of the collateral consists of the value of the land. However, this land value does not have to be impacted negatively by a flooding.

If financial damage to homes occurs, it may be compensated by insurers or, in extreme cases, by the government. If, for example, the water comes from flooded sewers due to heavy precipitation, the damage is usually covered by the compulsory building insurance. In contrast, flooding from rivers is generally not covered by insurance.

There is currently an active public discussion about whether and to what extent flood damage is insurable. Flood damage is not always covered as the terms and conditions of coverage vary between insurance companies and are often unclear to consumers. This is evident from a report by the Dutch Authority for the Financial Markets (AFM)².

A large-scale flood can be classified as a disaster by the government. Victims can then receive compensation through a law: the *Wet tegemoetkoming schade (Wts, Law for compensation of damage)*. This law is meant for damages suffered that are not covered by insurance. This means that in many cases the insurance companies and the government jointly cover all damage to the building.

Flood risk for investments in mortgages

In the Netherlands, around 4 million homes are located in areas prone to flooding. One in three of these is a privately owned home with a mortgage. Flood risk is important for an investor with a mortgage portfolio, because the value of the collateral may decrease and thus increase the likelihood of non-repayment of residual debt.

Investment risk is generally expressed as an annual expected loss in relation to the total investment. For this purpose, the probability of default is multiplied by the loss given default. This principle can also be applied to flood risk: the expected loss is equal to the probability of flooding multiplied by the impact for the investor in the event of flooding. The result is the expected loss.

Floods occur only rarely, so the probability of flooding cannot be derived from historical data. In addition, we still do not know exactly what effect climate change will have. The consequences of a flood are also not universally predictable: some residents will sell their homes while others will stay in their homes and continue to pay the mortgage. As a result, estimating flood risk from an investor's perspective contains a great deal of uncertainty.

Despite the behavioural uncertainty it is possible to gain insight into the flood risk in mortgage portfolios. For this purpose DMFCO has developed a model based on available data from the *Climate Effect Atlas* and the Department of Public Works, among others, that can be used to approximate the expected loss in a mortgage portfolio. This involves estimating the risk run by an investor in Dutch residential mortgages. For this purpose, the probability that the home will be flooded at a certain water level is examined for each individual home. This includes taking into

¹ Standard method SSM-2017, Rijksoverheid (Department of Public Works)

² De invloed van klimaatverandering op schadeverzekeringen – Aandachtspunten voor consumenten en ondernemers, AFM 2021

account the change in flood probabilities over the next 30 years. For each possible flood height, this probability is multiplied by the expected damage for the investor in the event of a flood. The consequences in the event of flooding depend on the expected flood damage to the collateral on the one hand and the remaining outstanding mortgage amount at the time of the flooding on the other. Based on this model, a newly issued residential mortgage suffers, on average, less than half a basis point per year in flood losses and is therefore expected to be at limited risk. It should be emphasised again that this prediction is uncertain due to the reasons mentioned above. Nevertheless, it gives an indication of the order of magnitude that investors in Dutch residential mortgages can expect in terms of flood risk.

In exceptional cases, a large-scale flood may affect a large number of homes, as a result of which the actual loss at portfolio level may be higher than the predicted expected loss ('tail risk'). To make this risk transparent, a theoretical scenario in which a large river breaks its banks can be devised. In such a scenario thousands of homes are completely destroyed. To put this in perspective: this is many times larger in scale than the recent (July 2021) floods in Limburg. If we assume here that the damage is not covered by insurance or Wts and the residents can no longer repay the mortgage debt, the risk for the investor materialises. This very extreme scenario can result in an actual loss of tens of basis points.

DNB, the central bank in the Netherlands, simulated an even more extreme stress test in a recent report³. In doing so, DNB did not take into account local flooding, but the scenario that all areas at risk of flooding from rivers or the sea are flooded at the same time. In this most extreme scenario, all vulnerable areas in the Netherlands (all coloured areas in Figure 1) would be simultaneously flooded by 5 meters. However, this is a completely theoretical scenario: in reality, floods generally occur locally, for example from a flooding river or a breached dyke after a storm surge. The resulting flood may hit a large number of houses, but, in the opinion of DMFCO, the probability of the whole of the Netherlands being hit at once is negligible.

Identifying flood risk

Investors in Dutch residential mortgages can take several measures to manage flood risk.

Monitoring the risk

Based on the aforementioned modelling, flood risk is not a material risk from the perspective of a residential mortgage investor according to our current state of knowledge. In a real flood scenario, a limited area floods and thus only a limited part of the portfolio is affected. However, it is important to continuously monitor flood risk - just like any other potential investment risk. Climate change is a dynamic risk. Therefore, it is essential to improve existing models on an ongoing basis.

Should a risk premium be charged?

Homes located in vulnerable areas are at risk of flooding. As noted earlier, this concerns more than half of the houses in the Netherlands. The question here is whether lenders should apply a specific risk premium when financing such homes.

Houses in the Netherlands can be divided into two groups: those with a flood risk and those without significant risk. For the higher risk group, DMFCO's flood risk model can be used to estimate the expected loss and to allocate the resulting risk premium. Ultimately, this results in a maximum premium of about one basis point. In other words, people living in areas vulnerable to flooding would, in theory, have to pay an additional 0.01% on their mortgage interest. This order of magnitude of risk premium is not material enough to apply in practice in the first place. Also, the risk differs within the different vulnerable areas in the Netherlands: a house in an area outside the dykes just next to the banks of the Meuse, for example, is significantly more at risk than a house behind the dunes in The Hague.

Can vulnerable homes be excluded?

Another conceivable option is not to finance the house next to the Meuse in the above example. The problem with this, however, is that the site-specific probability of serious flooding is relatively small even for this house. Even though it is almost certain that an investor in Dutch residential mortgages will have to deal with flooded collateral at some point within

the next thirty years, it is not possible to predict exactly which areas will be affected. If the mortgage lender does not want to exclude homes from financing on a large scale, there is no way to identify specific houses in advance.

In addition, there are obvious ethical caveats and the regulator does not allow for selection based on location.

What to do as an investor?

In the sections above, we mainly discussed ways to measure and possibly price flood risk. However, there are concrete measures that an investor can take to actually reduce the risk.

Making homes more sustainable

Making collateralised properties more sustainable reduces CO2 emissions from energy use, inhibits climate change and reduces the likelihood of severe weather events. Mortgage lenders can play an important role in this, for example by promoting the sustainability of homes. In practice, this means for example that the mortgage lender makes it easy to borrow extra money for energy-saving measures.

Making homes more sustainable reduces the transition risk in particular, which is the risk related to the transition to a green economy. Making collateral more sustainable has no direct short-term effect on flood risk, but CO2 reduction is the only way to reduce physical climate risks - including flood risk - in the long term.

Helping affected people proactively

Flood risk materialises for the investor not when the home is literally flooded, but when the mortgagor sells the home and potentially incurs residual debt. Partly for this reason, it is important to give the residents of affected homes space to repair their damaged homes. For example, mortgage lenders can help residents who find themselves in financial difficulty because of the damage by offering a payment break. In addition to offering a payment break, a personal and proactive approach is important in such a process. Experience from DMFCO's portfolio at the time of the Corona pandemic shows that customers appreciate this and it helps customers improve their situation. Sometimes customers use help in the form of a budget coach or career counsellor. In a large majority of cases, the mortgage is now again reinstated.

In the event of a flood, in all likelihood only a small portion of the portfolio will be affected. This creates scope to help affected consumers by approaching them individually and offering tailored solutions.

Case: The recent floods in Limburg

By monitoring flood risks, investors gain insight into the effects of the changing climate at the portfolio level. Therefore, since 2019, DMFCO has been providing investors with monthly insights into the probability of flooding, the expected damage per flood, and thus the expected loss on the mortgage portfolio. When a flood actually occurs, additional actions are essential to identify and ultimately mitigate the damage.

Heavy precipitation caused parts of the Dutch province of Limburg and surrounding areas in Germany and Belgium to flood in July 2021. Many houses were damaged as a result, including houses with a MUNT mortgage. Following the flood, the possible impact on residents and investors was mapped out and the affected residents were actively approached to offer help.

Mapping out the potential impact

In the first days after homes flooded, there was a lack of clarity about the affected areas. Therefore, it was important to identify all loans that may have been affected by the flooding. An extensive analysis of various local and national news sources that reported on the flooding was the basis for DMFCO's estimate.

DMFCO then conducted an analysis of vulnerability by individual collateral, taking into account risk factors such as proximity to a river, location relative to sea level, and the Loan-to-Value (LTV) ratio of the mortgage. Figure 2 shows the properties financed by MUNT Mortgages in the affected areas.

³ Flood risk and financial stability: Evidence from a stress test for the Netherlands (DNB, 2021).

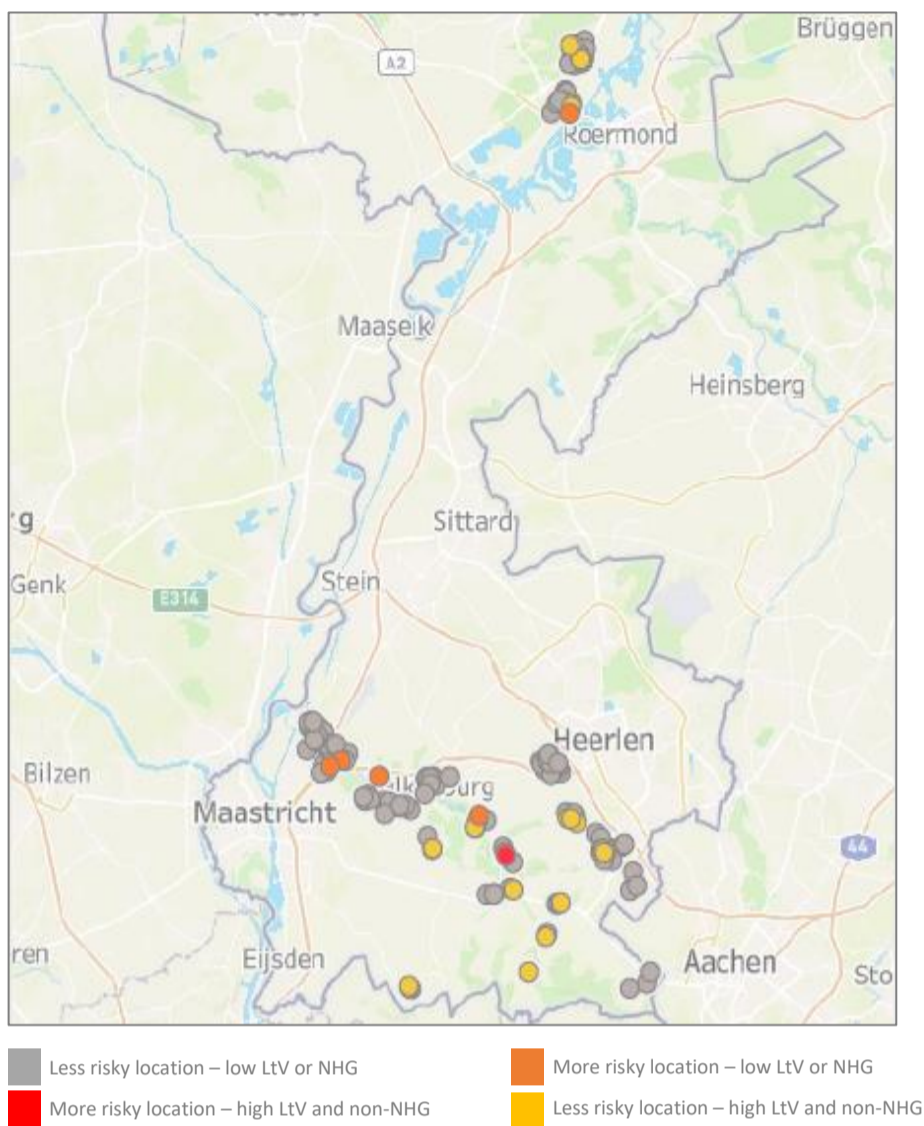


Figure 2: MUNT Mortgages-funded homes in areas affected by the floods in July 2021. The risk profile of a location was determined by DMFCO's flood risk model.

Helping affected people

After mapping the flooded locations and potentially affected collateral, residents were approached to offer assistance. In the case of the flooding in Limburg, DMFCO's Special Servicing department proactively sought to contact residents whose homes might have been flooded - this was about 0.2% of the mortgages in the portfolio. In addition to practical help on the most pressing questions, such as mortgage implications or double charges due to a temporary stay elsewhere, this was deliberately also to provide a listening ear at this difficult time for DMFCO's affected customers. Eventually, one household reported damage to the collateral. This damage has since been repaired and the costs were fully covered by the building insurance.

Conclusion

Identifying and understanding climate risks and mitigating measures is becoming increasingly important. For investors in Dutch residential mortgages, physical climate risks are important, among other things, because they can reduce the value of the collateral. In the Netherlands, it is particularly important to manage flood risk, as we will almost certainly experience more frequent flooding in the coming decades.

Based on the analyses in this white paper, we can state that the impact of floods for mortgage investors is limited. This is because:

- Relatively few homes are located in areas that have a high probability of frequent flooding, such as floodplains;
- In most circumstances, there are no significant negative impacts on collateral values; and
- Any costs for repairing damage are in many cases borne by insurers and/or government agencies.

Direct measures, such as charging a risk premium or excluding vulnerable homes, are limited in materiality or not allowed by law. DMFCO's recommendation is to continue to monitor risk, to continue to develop existing flood models, and to respond quickly after an actual flood to provide the best and most personal assistance to injured parties.



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