

## 02.23 Flood Hazard and Flood Risk (Edition 2020)

### Overview

On October 23, 2007, Directive 2007/60/EC of the European Parliament and the Council on the assessment and management of flood risks (FRMD) was passed; it came into force on November 26, 2007. The 1<sup>st</sup> cycle to implement the FRMD was completed with the publication of the Flood Risk Management Plan (FRM Plan 2015) at the end of 2015. The 2<sup>nd</sup> cycle is to be implemented by 2021. Its first phase involved reviewing the flood risk assessment and the risk areas in Berlin in accordance with Section 73 of the Federal Water Act (WHG). This phase was completed by the publication on December 22, 2018 (SenUVK 2018). The second phase to implement the FRMD involves preparing flood hazard maps and flood risk maps. These form the basis for the subsequent update to the Flood Risk Management Plan to be completed by the end of 2021.

Pursuant to Article 74(1) of the Federal Water Act, the relevant authority of the State of Berlin prepares the flood hazard maps and the flood risk maps. According to Article 74(2) to (4) WHG, the contents of the maps must comply with the requirements of Article 6(5) FRMD. In order to produce maps that are largely uniform in terms of content and design, the German Working Group on Water Issues of the Federal States and the Federal Government (LAWA) has published “Recommendations for the establishment of flood hazard maps and flood risk maps” (LAWA 2018) for this purpose. They contain standardised minimum requirements defined in the FRMD applicable both to flood hazard and flood risk maps.

**Flood hazard maps** show flood extent and the water depth for different flood scenarios. The hazard maps illustrates flooding caused by high water levels of a body of water itself. Floods that are caused by sewage plants exceeding their capacity or groundwater surfacing, failure of dams installed for water-management purposes or heavy rainfall are not included in flood hazard maps. **Flood risk maps** indicate potential adverse consequences associated with floods with reference to the protected assets defined in the European FRMD (LAWA 2018).

In Berlin, flood hazard maps and flood risk maps are reviewed and, if necessary, updated based on the LAWA recommendations for the establishment of maps and criteria of significance (LAWA 2017, 2018) as well as the implementation concept of the River Basin Community Elbe (RBC) (FGG 2018). For a more detailed description of the methodological design and the steps involved, please refer to these two documents (LAWA 2018, FGG 2018). This was accompanied by a close bilateral collaboration between the State of Berlin and that of Brandenburg, as they share a state border. The flood risk assessment in accordance with Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks (FRMD) revealed that there is a **potential significant risk of flooding** in the following areas: Tegeler Fließ, Panke, Erpe, Lower Havel / Lower Spree and Müggelspree, including the Gosener Gewässer with the Seddinsee. These were therefore defined as risk areas in accordance with Section 73 WHG (see Figure 1). For these areas, flood hazard maps and flood risk maps were developed or updated by December 22, 2019.

The flood hazard maps and flood risk maps constitute a **preventive** tool for **flood protection** in Berlin that outlines the extent of flooding and its effects during specific flood events.

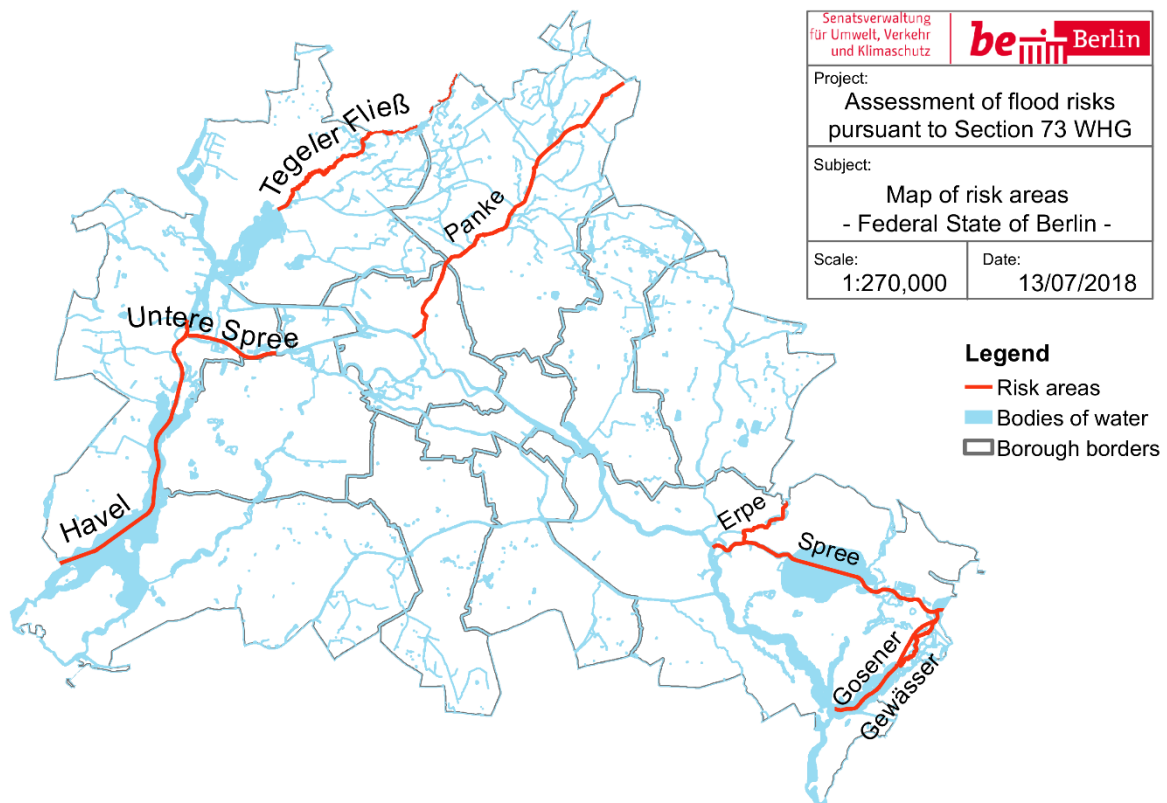


Fig. 1: Risk area locations in Berlin (SenUVK 2018)

## Statistical Base

The flood hazard maps and flood risk maps were developed based on the following sources:

- Water levels for flood events, incl. their associated probability of occurrence (IPS 2009, IWU 2014, 2015, Koenzen et al. 2011)
- ATKIS® DGM - Digitales Geländemodell (DTM, Digital Terrain Model) 2019 (SenStadt 2019a)
- Gewässerkarte (Map of Bodies of Water) 2017 (SenStadt 2017)
- Protected Areas by Nature Conservation Legislation (incl. Natura 2000) 2019 (SenStadt 2019b)
- Water Conservation Districts 2009 (SenStadt 2009)
- Denkmalbestandskartierung im Landesdenkmalamt Berlin (Monument inventory mapping by the Berlin Monument Authority) 2019 (SenStadt n.d.)
- 06.01 Actual Use of Built-Up Areas / 06.02 Inventory of Green and Open Spaces / 06.01.1 Actual Use / 06.02.1 Actual Use and Vegetation Cover (Edition 2016) (SenStadt 2016)
- Betroffene Einwohner (Affected inhabitants), December 31, 2018 (Amt für Statistik Berlin-Brandenburg (Statistical Office for Berlin Brandenburg) 2019)

## Methodology

By December 22, 2019, flood hazard maps and flood risk maps were developed or updated for areas for which flood risks had been identified in 2018. The flood hazard maps show which areas could be flooded according to different probabilities of occurrence. In Berlin, the following three flood scenarios are considered based on the FRMD:

1. flood with a low probability or extreme event (rare event,  $HQ_{\text{selten}}$  /  $HQ_{\text{extrem}}$ )
2. flood with a medium probability (medium event,  $HQ_{\text{mittel}}$ )
3. flood with a high probability (frequent event,  $HQ_{\text{häufig}}$ ).

Table 1 defines the flood events and flood scenarios according to the definitions by the River Basin Community Elbe.

Tab. 1: Flood event/ flood scenario definitions	
Event	Description
Rare event ( $HQ_{selten}/HQ_{extrem}$ )	$HQ_{selten}$ or $HQ_{extrem}$ events are statistically very rare. Extreme events are incidents caused by the failure of flood control facilities, an unfavourable combination of rare flood events or an unfavourable combination of rare flood events and discharge impairments due to structural or other reasons. For areas along river Elbe with flood control facilities in place, the extreme event caused by the failure of flood control facilities is shown by default. $HQ_{200}$ , which statistically occurs every 200 years, is used to represent flooded areas. In areas without flood control facilities, $HQ_{200}$ is also displayed.
Medium event ( $HQ_{mittel}$ )	As defined by the European FRMD, $HQ_{mittel}$ represents a flood event that statistically occurs every 100 years ( $HQ_{100}$ ). This does not rule out, however, that such an event may occur multiple times in a hundred years. According to German water law, $HQ_{100}$ is used to define flood areas.
Frequent event ( $HQ_{häufig}$ )	$HQ_{häufig}$ is a flood event that statistically occurs much more frequently than once in a hundred years. The probability of $HQ_{häufig}$ to recur at waters in the RBC Elbe is regarded to be either 5, 10 or 20 years.

HQ: Abbreviation of “high” and the discharge coefficient Q.

**Tab. 1: Flood event/ flood scenario definitions**

In Berlin, several methods were used to determine the flood hazard maps for the different flood scenarios. This required, on the one hand, a joint approach with the State of Brandenburg, as the bodies of water flow from Brandenburg into Berlin and as the Havel flows back from Berlin into Brandenburg. On the other hand, this involved adapting the methodology to suit the natural conditions and data availability. The chapter on the [methodology for deriving flood areas](#) (SenStadt 2019c) and relevant studies (IPS 2009, IWU 2014, 2015, Koenzen et al. 2011) outline the methodological approaches taken.

## Map Description

The flood hazard maps show the flood extent of and the water depth of flood events with a high, medium and low probability (cf. Fig. 2). For Berlin, the maps present floods caused by river flooding. Floods caused by sewage plants exceeding their capacity or groundwater surfacing, failure of dams installed for water-management purposes or heavy rainfall are not shown on the maps.

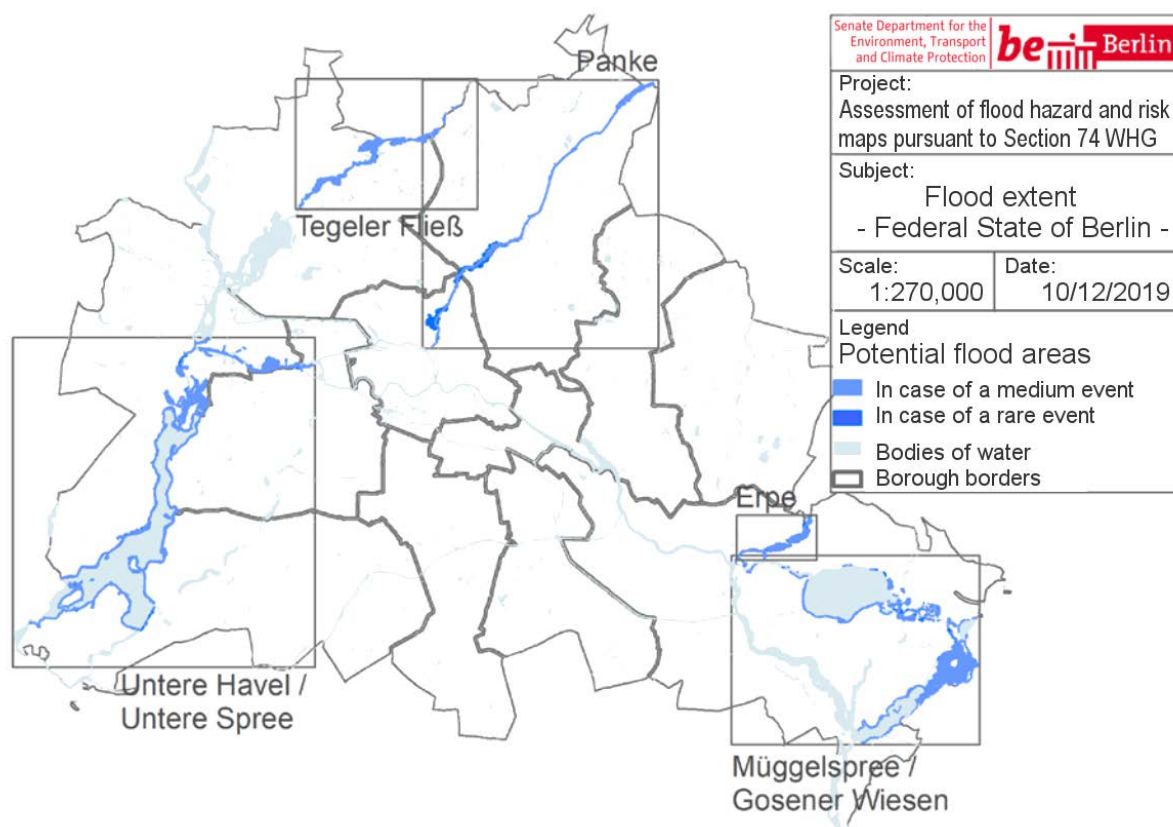


Fig. 2: Flood hazard map locations and extent of flooding

The flood risk maps display the potential flood damage for three flood scenarios with a high, medium or low probability. They provide information on:

- the number of inhabitants that are potentially affected per risk area,
- adverse consequences to economic activity and land use of the affected areas
- adverse consequences to UNESCO World Heritage Sites and
- conservation districts that may be affected, e.g. drinking water protection areas and Natura 2000 areas.

The flood hazard maps and flood risk maps constitute an important tool in flood prevention and flood protection. On the one hand, they are intended for internal use by the authorities. They provide the basis for deriving measures as part of the Flood Risk Management Plan. In Berlin, [flood areas](#) are defined based on the flood hazard maps (SenStadt 2019c). In flood areas, building restrictions apply ([Law and Ordinance Gazette p. 658ff](#), only in German), which then impact on planning and land use. Outside their application in flood areas, flood hazard maps represent the spatial backdrop for “risk areas” (cf. Article 78b para. 1 sentence 1 WHG). Relevant restrictions for fuel oil consumer installations also apply here.

On the other hand, flood hazard maps and flood risk maps serve to inform the public and to illustrate potential hazards and risks. They can be used as a basis to implement one’s own individual precautionary measures. The detailed hazard and risk maps can be accessed by the public via the “map presentation” in the Geoportal Berlin.

The map application “[National flood hazard maps and risk maps](#)” (only in German) is provided by the German Federal Institute of Hydrology (BfG) (BfG 2019a). It represents the national interface for hazard and risk maps throughout Germany according to the FRMD. In addition, the BfG provides a further map application on nationwide flood scenarios (BfG 2019b).

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