Background to the PFRA European Overview - UC9810.5b

The individual Member State Reports reflect the situation as reported by the Member States to the European Commission in 2012. The situation in the MSs may have altered since then.

Assessment of data and information reported by Member States on their Preliminary Flood Risk Assessments and identification of Areas of Potentially Significant Flood Risk under the Floods Directive

Member State Report: SE - Sweden

The main outcomes of the assessment were:

1. Article 4 has been applied. It appears that Articles 13.1(a) and 13.1(b) have not been applied but there are no explicit statements to confirm this. Only fluvial floods are included in the assessment of the risk of flooding under Article 4. Sweden has subsequently indicated that the assessment was limited to fluvial floods because the majority of historical floods are of this type. Pluvial floods do not seem to be included but might be expected. Sea water and artificial water-bearng infrastructure floods are not included but will be included in the next reporting cycle.

2. The consequences of floods have not been quantified, only qualitatively assessed as to whether or not there are impacts on various aspects of human health, environment, cultural heritage and economic activity.

3. There are 9 criteria used to define historical significant floods, which include adverse impacts on human health, the environment, cultural heritage and the economy.

4. Hydrodynamic models including natural water retention capacity in lakes and wetlands were used to assess the extent of areas flooded for a 100 years flood and a 10,000 year flood. Sweden has also indicated that flood inundation maps have been produced for two different discharges.

5. Climate change has not been fully considered in this first PFRA/APSFR reporting, but will be done in the next cycle. Sweden has subsequently indicated that climate change has been considered in the flood hazard maps. The 100 year flood for 2098 has been calculated and the flood risk maps for the 100 year flood include the projected future climate for the APSFRs. For other long term developments (e.g. population, land use) no information was found.

Question 0: Contextual information regarding the Member State.

Sweden has 5 major national RBDs (SE1, SE2, SE3, SE4, SE5) that are the UoMs for the Floods Directive (FD), as well as for the WFD. In addition there are several small international RBDs for the waters shared with Norway and Finland. The areas shared with Norway are situated in the mountainous region between the two countries. Only the international RBD SE1TO sharing the border River Torne with Finland has been included in the Flood Directive reporting.

There is a strong national approach to the FD implementation, although the different regional and local conditions are taken into account. The SE4 is only reported for Article 5
(APSFR), while the other RBDs are reported for both Articles 4 (PFRA) and 5 (APSFR). The reason is that all historic floods have been used to identify APSFR, while only floods with consequences for all four focus areas (human health, environment, economic activity and cultural heritage) have been reported as PFRA areas, according to supplementary information in letter from SE to DG ENV. This is not a valid justification, as Article 5 required the identification of APSFR to be based on the PFRA. Sweden has subsequently indicated that the PFRA has been performed for the whole of Sweden.

### Table 1  The application of Articles, 4, 13.1.a and 13.1.b in the Units of Management of Sweden

Source: WISE Flood aggregation report “FD 1.1 Specific Areas to which each Article has been applied”

<table>
<thead>
<tr>
<th>Member State</th>
<th>Article 4</th>
<th>Article 13.1.a</th>
<th>Article 13.1.b</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note if the Articles have not been applied to or reported for any specific area, it is assumed that they have been applied to the entire UoM. In which case the values in the “drilldown to UoM” table will equate to 1, and the values in the Member State level table will equate to the number of UoMs in the Member State. Values of zero for any Article or UoM indicate that the Article has not been applied to that UoM.

### Drilldown to UoM:

<table>
<thead>
<tr>
<th>Member State</th>
<th>UoM</th>
<th>Article 4</th>
<th>Article 13.1.a</th>
<th>Article 13.1.b</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>SE1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SE</td>
<td>SE1TO</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SE</td>
<td>SE2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SE</td>
<td>SE3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SE</td>
<td>SE4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>SE5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 2  Specific types of floods to which Article 4, 13.1.a and 13.1.b have been applied

Source: WISE Flood aggregation report: “FD 1.2 Types of flood to which each Article has been applied”

<table>
<thead>
<tr>
<th>Member State</th>
<th>Article</th>
<th>UoM</th>
<th>Source</th>
<th>Mechanism</th>
<th>Characteristic</th>
<th>No Data</th>
</tr>
</thead>
</table>
**Question 1: Are all the types of flood that might be reasonably expected in the Member State included in the assessment of the risk of flooding under Article 4, Article 13.1(a) or Article 13.1(b)?**

*Note: One of the following options was selected to answer the question for each row*

- Yes
- No
- Not Clear (Included and Not Included Only)

<table>
<thead>
<tr>
<th>Source</th>
<th>Included</th>
<th>Not included but might be expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluvial</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Pluvial</td>
<td>Not clear</td>
<td>Yes</td>
</tr>
<tr>
<td>Groundwater</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Sea water</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Artificial water-baring infrastructure</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Other <em>(provide details in the summary below)</em></td>
<td>Not clear</td>
<td>No</td>
</tr>
</tbody>
</table>

**Summary assessment**

The only flood type included in this first PFRA is fluvial floods in rivers and lakes. Sweden has subsequently indicated that the assessment was limited to fluvial floods because the majority of historical floods are of this type. Pluvial floods have not been included due to their spatial and temporal unpredictability and the lack of analytical methods at national level (FD4.3). On the other hand, the national PFRA report available at [https://www.msb.se/Upload/Nyheter_press/Pressmeddelanden/Slutrapport_PFRA_MSB.pdf](https://www.msb.se/Upload/Nyheter_press/Pressmeddelanden/Slutrapport_PFRA_MSB.pdf) says in section 8.4, p. 30 that the current PFRA has taken pluvial floods into account based on the information reported by RBD authorities (länsstyrelserna). Thus it was unclear whether pluvial floods are included in the PFRA. Sweden has subsequently indicated that pluvial floods are part of the background information for the occurred...
historic floods. For sea water and artificial water-bearing infrastructure it is said that these are not included in this first report, but will be included in the next reporting cycle. For the groundwater flood type these do not occur as a separate flood type in Sweden according to the national PFRA report, p. 30.

Table 3  
**Time period covered by different types of historic flood events**

Source: WISE Flood aggregation report: “FD 2.0 Time period covered by historic flood events”

<table>
<thead>
<tr>
<th>Member State</th>
<th>Source</th>
<th>Total flood events</th>
<th>Range of years</th>
<th>2000 onwards</th>
<th>1950 to 1999</th>
<th>1900 to 1949</th>
<th>1800s</th>
<th>Before 1800</th>
</tr>
</thead>
</table>

(No data have been reported to WISE for this topic. Sweden has subsequently indicated that information was applied as descriptive text, but this was not extracted for assessment.)
### Table 4  Types of historical significant flood events and types of reported consequences

Source: WISE Flood aggregation report: “FD 2.1 Types of historical significant flood events”

<table>
<thead>
<tr>
<th>Member State</th>
<th>Article</th>
<th>Source</th>
<th>Mechanism</th>
<th>Characteristics</th>
<th>Number of Historical floods</th>
<th>Number of flood events with no data</th>
<th>Number with reported consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Human Health</td>
</tr>
</tbody>
</table>

(No data have been reported to WISE for this topic)

### Table 5  Types of potential future significant flood events and types of consequences

Source: WISE Flood aggregation report: “FD 3.1 Types of potential future significant flood events”

<table>
<thead>
<tr>
<th>Member State</th>
<th>Article</th>
<th>Source</th>
<th>Mechanism</th>
<th>Characteristics</th>
<th>Number of Potential Future floods</th>
<th>Number of flood events with no data</th>
<th>Number with reported consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Human Health</td>
</tr>
</tbody>
</table>

(No data have been reported to WISE for this topic)
**Question 2a:** What aspects required by Article 4 were not considered in the application of Article 4?

**Has Article 4 been applied?**

Yes, information has been reported on this aspect

**Summary assessment**

Most aspects of Article 4 mentioned for historic and future floods have been used in the PFRA, except climate change (see reply to Q12 for more info). Furthermore, no information is available on the effectiveness of flood defence structures. The consequences of floods have not been quantified, only qualitatively assessed as to whether or not there are impacts on various aspects of human health, environment, cultural heritage and economic activity (WISE FD4.3). The main gaps are that only fluvial floods are considered. Sweden has subsequently indicated that the assessment was limited to fluvial floods as these represent the majority of historical flood events. The focus has been on urban areas, because only three areas outside of urban areas were found to have significant impacts of floods on all the four types of consequences (human health, economic activity, environment and cultural heritage). See national PFRA report refered to in Q1. There is no information from Sweden in the WISE reports FD2.1, 2.2, 3.1, 3.2, 4.1 and 4.2.

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**Question 2b:** What aspects required by Article 4 were not considered when producing an assessment of the risk of flooding under Article 13.1(a)?

**Has Article 13.1(a) been applied?**

Not clear, no information reported on these elements

**Summary assessment**

There is no information reported on Article 13, only on Article 4, but I have not found any explicit statement that this article has not been applied anywhere in the WISE FD reports, nor in the national report cited in FD4.3: [https://www.msb.se/Upload/Nyheter_press/Pressmeddelanden/Slutrapport_PFRA_MSB.pdf](https://www.msb.se/Upload/Nyheter_press/Pressmeddelanden/Slutrapport_PFRA_MSB.pdf). There is no supplementary information concerning Article 13 in the document area.

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**Question 3:** What aspects required by Article 4 were not considered when producing Flood Hazard Maps and flood risk maps, and Flood Risk Management Plans under Article 13.1(b)?

**Has Article 13.1(b) been applied?**

Not clear, no information reported on these elements

**Summary assessment**

see reply to Q 2b.
Question 4: What are the types of floods considered/not considered within the auspices of the Floods Directive?

Summary assessment

See reply to Q1 above. The only information reported to WISE of those FD reports mentioned in the instructions above are FD4.3 and 4.10. Further info is available in the national report: https://www.msb.se/Upload/Nyheter_press/Pressmeddelanden/Slutrapport_PFRA_MSK.pdf

Question 5: What were the criteria used to define the historical significant floods and what were the reasons for not including some types of flood that occurred in the past?

Summary assessment

The only information available is in FD4.3, 4.4 and in the national PFRA report. A significant historical flood should be perceived as a crisis situation affecting many people, large parts of the community or basic values and functions. To cope with a significant flood should require resources beyond those normally available. The definition should be based on information relating to the following 9 criteria:

1) which water bodies are affected;
2) the expanse of the flooded areas;
3) the date and duration of the flood;
4) whether the area had been flooded before and which year;
5) adverse effects on human health, in terms of numbers of fatalities, injured, evacuated and people with further health consequences;
6) adverse environmental impacts, describing what was damaged, how was it handled and the costs of abatement measures;
7) adverse impact on cultural heritage, describing what was damaged, how was it handled and the costs of abatement measures;
8) adverse economic impacts, describing what was damaged, how was it handled and the costs of abatement measures;
9) evaluation on whether a similar flood happening again would have the same, less or more serious consequences.
Based on these criteria 190 significant historical floods were identified. Out of these 190 significant historical floods, there were only 12 that had adverse consequences for all the four types of consequences (health, economy, environment, culture) (FD 4.4 last sentence), while 34 had three types of consequences and 42 had two types of consequences (p. 24 in national PFRA report).

Only fluvial floods were considered. The reasons for not including other types of floods were: the unpredictable nature of pluvial floods and the lack of data compiled at national level for this flood type; the lack of sufficient spatial resolution in the digital elevation model to consider sea floods; and a not yet completed project on planning of preparedness for handling damage to artificial water-bearing infrastructure (damage to hydropower dams). These flood types will be included in the next cycle of FD reporting, according to info in WISE FD4.3.

**Question 6: What methods and criteria were used to identify potentially significant future floods and what were the reasons for not including some types of potential future floods?**

**Summary assessment**

The criteria used to identify potentially significant future floods are limited to fluvial floods (see justification in Q2 above) affecting urban areas (FD7.3, last paragraph). The following 8 criteria were used:

1) at least 500 inhabitants will be affected by a flood level corresponding to the highest estimated flow (10 000 years flood);

2) A hundred-year flood should affect at least 100 people;

3) at least 100 employees will be affected by a hundred years flood;

4) the adverse impacts on human health must occur at one or more areas within the urban area flooded;

5) the adverse impacts on economic activities must occur at one or more areas within the urban area flooded;

6) the adverse impacts on the environment must occur at one or more areas within the urban area flooded;

7) the adverse impacts on cultural heritage;

8) The urban area must have had at least one historical flood with significant adverse consequences or an evaluation that if a similar flood would occur today it would have significant adverse consequences, including severe problems with ice-jams.
All 8 criteria must be fulfilled to define an area with PSFR. The reasons for not including the other types of floods are lack of data or methods to predict future floods, see reply to Q1.

**Question 7: What types of flood were considered but not assessed as being significant, and what were the reasons given?**

**Summary assessment**

Only fluvial floods were considered, see reply to Q1 above. Non-significant fluvial floods do not affect many people, large parts of the community nor basic values and functions.

**Question 8: What types of flood were not considered at all, and why?**

**Summary assessment**

Only fluvial floods were considered, as they represent the majority of historical floods in Sweden.

Pluvial floods were not considered due to the unpredictable nature of such floods, and the lack of method to analyse the consequences of such floods at national level. Pluvial floods may be considered in the next reporting cycle.

Sea floods were not considered due to the lack of sufficient resolution in the spatial elevation model. Improvements of this model are ongoing, including national scenarios of extreme sea water level, so this type of flood will be analysed (and presumably reported) in the next reporting cycle. Such floods have been quite rare in Sweden, as only 5 of 190 historical floods were caused by sea floods.

Floods caused by damage to water bearing infrastructure were not included, due to the need to complete an ongoing project to compile data and maps of such floods focusing on river basins with dams constructed for hydropower production. This information was found mainly in FD4.3.

Groundwater-related floods are said not to occur in Sweden. In FD7.1 there is one APSFR (out of 18) where groundwater is mentioned in addition to fluvial as the source of flooding. Sweden has subsequently indicated that this reference is erroneous and the correct sources of flooding in this APSFR are snowmelt and slow onset floods.

**Question 9: What criteria were used to define an adverse consequence?**

**Summary assessment**
The adverse consequences that are included in the assessment of APSFR are given in FD4.8.

For human health these are: population, number of employees, protected areas for water abstraction, wells representing single water abstraction points outside of protected areas, hospitals, rescue services, radio stations, TV stations, emergency centrals, electricity transformers and infrastructure, roads, railways and airports.

For economic activity these are: industries and other work places, including those posing environmental threats, electricity and transport infrastructure (as mentioned under human health above).

For environmental consequences: protected areas, industries and other activities posing environmental threats (I interpret this to mean risk of hazardous substances entering the environment in a flood situation), areas with polluted soils, as these can pose a threat to protected areas in a flood situation.

For cultural heritage: world cultural heritage sites (interpreted as UNESCO sites), archives and museums, cultural remnants and churches, cultural protected area, sites of national interest of cultural environment protection.

**Question 10: What adverse consequences were excluded or not considered, and what were the reasons for their exclusion?**

**Summary assessment**

Only fluvial floods were considered (see replies to questions above). The following adverse consequences of fluvial floods were not considered within the main type of consequences (based on info in FD4.3, 4.6, 4.8, 4.10, 7.1, 7.2, 7.3):

**Human health:** Land slides that often coincide with fluvial floods in hilly areas were not considered. Sewage overflows were also not considered.

**Environment:** Water status was not considered, although water quality was mentioned as an adverse consequence of most of the significant historical floods reported (source: xls-file from WRc describing each of the Swedish significant historical floods)

**Economic activity:** Rural land use was not considered.

**Cultural heritage:** Landscape damage was not considered.

The reasons for their exclusion are not given in the WISE FD reports, nor in the national Swedish PFRA report. Sweden has subsequently indicated that information was provided as descriptive text but these have not been extracted for assessment.
**Question 11: What methods were used to identify and quantify potential future adverse consequences and impacts?**

**Summary assessment**

The method is given in FD4.8, saying: Hydrodynamic models including natural water retention capacity in lakes and wetlands were used to assess the extent of areas flooded for a 100 years flood and a 10,000 years flood. The consequences of flooding of these areas were not quantified, but the impacts on the four focus areas (health, environment, economy and cultural heritage) were qualitatively assessed using geographic data on population, industries (incl those dealing with hazardous substances) and other work places, hospitals, drinking water protected areas, private wells, transport infrastructure, electricity infrastructure, Natura 2000 sites, other protected areas, areas with polluted soils, museums, churches, cultural remnants. Sweden has also indicated that flood inundation maps have been produced for two different discharges.

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**Question 12: What long term developments were considered, what methods were used and what were the expected impacts on the occurrence of potentially significant future floods?**

**Summary assessment**

Climate change has not been fully considered in this first PFRA/APSFR reporting, but will be done in the next cycle, according to information found in WISE FD4.7 and 4.9. However, in the national PFRA report annex 4, the extension of areas affected by 100 year floods is presented for the periods 2021-2050 and 2069-2098, based on climate simulation models. The results indicate that in most of Sweden the areas affected by floods will be less extensive in the last period compared to the first period. For other long term developments (e.g. population, land use) no information was found in the FD reports, nor in the national report. Sweden has subsequently indicated that, nationally, areas around cities are expanding and people are moving from the countryside to the cities.
**Number of identified Areas of Potential Significant Flood Risk**

**Table 6** Areas of Potential Significant Flood Risk (APSFR) and types of consequences

Source: WISE Flood aggregation report: “FD 7.1 Areas of Potential Significant Flood Risk”

<table>
<thead>
<tr>
<th>Member State</th>
<th>Source</th>
<th>Mechanism</th>
<th>Characteristics</th>
<th>Number of APSFR</th>
<th>Number with reported consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Human Health</td>
</tr>
<tr>
<td>SE</td>
<td>Fluvial</td>
<td>Natural exceedance</td>
<td>Slow onset flood</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SE</td>
<td>Fluvial</td>
<td>Natural exceedance</td>
<td>Snow melt flood, Slow onset flood</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>SE</td>
<td>Fluvial</td>
<td>Natural exceedance</td>
<td>Snow melt flood, Slow onset flood, Other</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

More than one type of consequence can be reported for each aggregated consequence (e.g. economic activity) for each flood event, and therefore the totals in the consequence cells may be greater than the total number of flood events reported for each type of flood.

**International coordination**

MS were required to report how international cooperation had been achieved when undertaking a PFRA under Article 4; and also for APSFR under Article 5. Those applying Article 13.1.a are expected to have coordinated cooperation in the identification of APSFR but not necessarily for the PFRA.

The relevant articles are:

Article 4. 3. In the case of international river basin districts, or units of management referred to in Article 3(2)(b) which are shared with other Member States, Member States shall ensure that exchange of relevant information takes place between the competent authorities concerned. And;

Article 5.2. The identification under paragraph 1 of areas belonging to an international river basin district, or to a unit of management referred to in Article 3(2)(b) shared with another Member State, shall be coordinated between the Member States concerned.

**Number of international UoMs in SE: 5**

**Number of non-international UoMs in SE: 5**

**Table 7** Mechanisms of international coordination for preparation of PFRAs and APSFRs

<table>
<thead>
<tr>
<th>Type of coordination</th>
<th>Number of UoMs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PFRAs</td>
</tr>
<tr>
<td>Informal arrangement (groups, discussions and exchange of information)</td>
<td>5</td>
</tr>
<tr>
<td>Bilateral cooperation project to develop flood</td>
<td>1*</td>
</tr>
<tr>
<td>Type of coordination</td>
<td>Number of UoMs</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>maps, a database and a model</td>
<td></td>
</tr>
<tr>
<td>Bilateral agreement to prevent flood and environmental emergencies and to coordinate plans and actions in the catchment (Border River Commission)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1*</td>
</tr>
</tbody>
</table>

*As indicated in subsequent information from Sweden,