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# Directive on the Safety of Water Retaining Facilities

## Part B: Particular risk potential as subordination criterion

*Note: This document is a preprint of Part B of the Directive on the Safety of Water Retaining Facilities (revised version, 2014-2015).*

*The Directive is addressed to both the relevant supervisory authorities and the operators of water retaining facilities. It defines and explains terminology contained in the legislation governing water retaining facilities in order to ensure uniform practical implementation. Deviations from the Directive are permissible as long as the specified safety objectives are attained.*

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## 1. Introduction and purpose

Article 2 of the Federal Act on Water Retaining Facilities (hereinafter “WRFA”) specifies two criteria for determining whether a water retaining facility is subject to the scope of application of the relevant legislation:

- Retention height and reservoir capacity (size criterion as stipulated in Article 2, paragraph 1, WRFA)
- Particular risk potential (risk criterion as specified in Article 2, paragraph 2, WRFA)

Water retaining facilities that meet the size criterion are *a priori* subject to the provisions of the corresponding legislation. And vice versa, water retaining facilities that do not meet the size criterion are *a priori* not subject to the provisions of the corresponding legislation.

In its capacity as federal supervisory authority, the SFOE is authorised, however, to exempt water retaining facilities from, or declare them subject to, the relevant legislation on the basis of the risk criterion (WRFA, Article 2, paragraph 2).

In the legislation governing water retaining facilities (Article 2, paragraph 2, Federal Ordinance on Water Retaining Facilities – hereinafter “WRFO”), the term “risk potential” is already defined as both the presumed scenario (assumption of a breach of the water retaining facility) and the impacts of that scenario (i.e. resulting risk to human life or risk of major material damage). In this context, Part B of the Directive describes the following aspects in greater detail:

- Presumed breach scenarios
- The method for estimating the flood wave resulting from a breach of a water retaining facility
- The criteria relating to the risk to human life or risk of major material damage resulting from a breach of a water retaining facility

The question whether a particular risk potential exists has to be reviewed on a periodical basis. In particular, if buildings are constructed or changes in utilisation are carried out below a water retaining facility, the relevant cantonal supervisory authority is required to determine whether a particular risk potential exists as the result of such developments. It is also possible to take suitable measures to mitigate a particular risk potential, for example by cutting a trench in the retaining structure that prevents a build-up of water or mud.

The procedures for cantons to register water retaining facilities with presumed particular risk potential, and for operators of water retaining facilities to apply for their facility to be declared exempt from the scope of application of the WRFA, are depicted in Figure B1.

The assessment of particular risk potential encompasses the following steps:

- 1) Identification of the applicable method as described in section 2 below
- 2) Estimation of the water depth and the intensity of the flood wave that would result from a breach of the facility in accordance with the assumptions cited in section 3 below
- 3) Assessment of particular risk potential based on the criteria cited in section 4 below

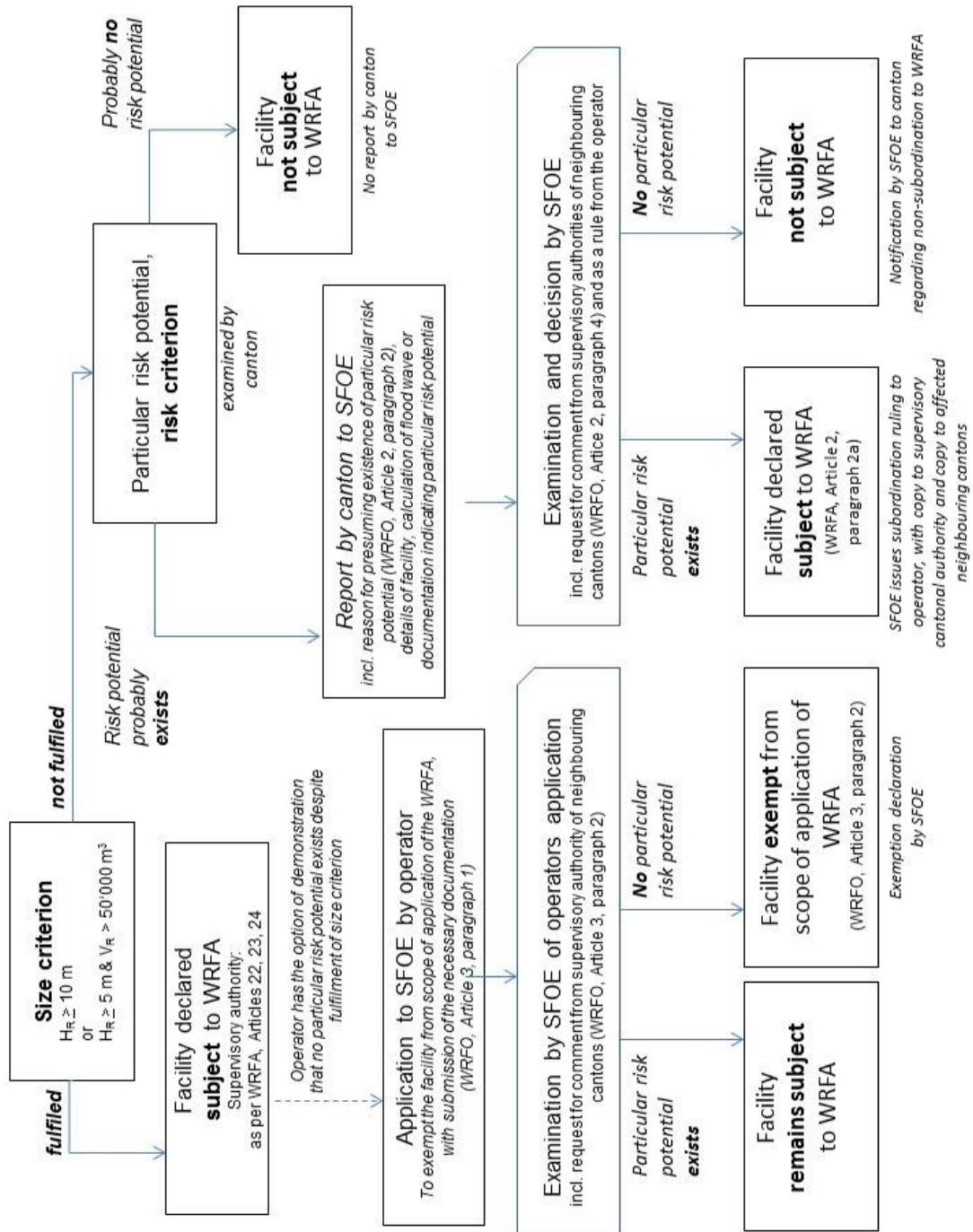


Figure B1: Procedure for declaring a water retaining facility subject to, or exempt from, the provisions of the WRFA



## 2. Procedure

### 2.1. Definition of permanent and temporary occupancy

In order to determine the applicable procedure in accordance with section 2.2 below, a distinction has to be made between **permanent occupancy** and **temporary occupancy**.

**Permanent occupancy**, i.e. regular occupancy over a lengthy period of time, is assumed in the following cases:

- In dwellings
- In work premises such as workshops, offices and factories, and in industrial zones
- In public buildings such as hospitals, schools and public sector buildings
- On public camp sites
- On motorways, railway lines and heavily frequented transport routes such as cantonal roads

**Temporary occupancy** is assumed in the following cases in particular:

- On hiking routes (signposted trails)
- On other transport routes
- In bathing areas open to the public
- On stretches of river on which activities such as bathing, boating or fishing are regularly carried out (with the exception of extreme sports such as canyoning)
- At locations where occasional officially approved events take place (e.g. concerts, film screenings, open-air circus shows)

### 2.2. Differentiated procedure according to size of facility

The applicable procedure is determined as follows (cf. Figure B2):

- a) Water retaining facilities that meet the size criterion: for verification purposes, both permanent and temporary occupancy have to be taken into account
- b) Smaller water retaining facilities that do not meet the size criterion: for verification purposes, only permanent occupancy has to be taken into account
- c) Furthermore, in the case of very small water retaining facilities (those with a storage height of less than 2 metres or with a storage height of less than 4 metres and a storage capacity of less than 5,000 cubic metres), it may be assumed that a particular risk potential does not exist unless:
  - Objects with **permanent** occupancy are located **immediately downstream** from the facility, and simultaneously
  - Failure processes are possible that could endanger such objects

For case c), verification of particular risk potential is made qualitatively based on the local situation, without additional quantitative assessments as per sections 3 and 4 below. In



these cases, local protection measures for objects should be taken into consideration wherever possible so that a particular risk potential can be excluded.

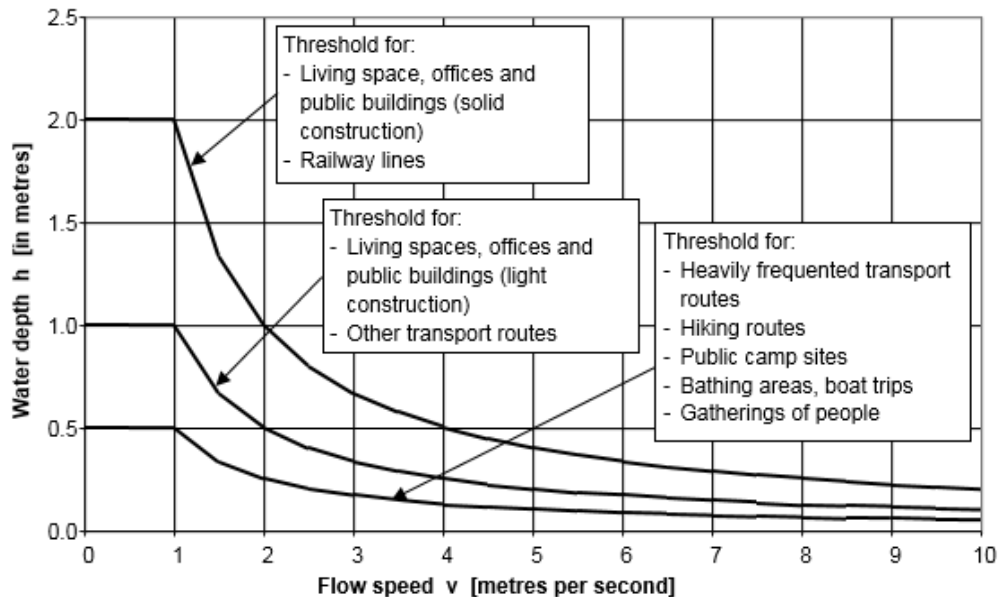


Figure B2: Overview of procedures for assessing high risk potential

### 2.3. Inclusion of other location-specific factors

For an assessment of particular risk potential, in addition to the cited permanently or temporarily occupied objects, a decision based on the individual situation also has to be taken on a case by case as to whether other location-specific factors such as potential material damage or the existence of a pollution risk (e.g. involving chemicals, oil, sewage) should be taken into consideration, similarly to the practice in the areas of flood protection and prevention of major accidents.

Furthermore, public awareness in the event of a breach of a water retaining facility should be taken into account, especially when a decision is to be taken regarding the possible exemption of a facility that meets the size criterion from the scope of application of the legislation.



### 3. Flood wave assessment

The following guidelines apply for assessing the potential flood wave in the event of a breach of a water retaining facility:

#### Initial conditions:

- It should be assumed that the reservoir is full prior to the breach. The initial water level prior to the breach corresponds to the relevant level for determining the storage height as described in Part A.
- A sudden breach of the retaining structure should be assumed. In particular:
  - Arch dams: complete breach of the dam
  - Gravity dams: complete breach of the dam
  - Weirs: three gate fields affected (scenario: initial collapse of a gate leading to collapse of the adjacent pillars)
  - Embankment dams and side embankments of run-of-river facilities: trapezoidal breach with base width equivalent to twice the storage height and lateral slope of 1:1
- A progressive breach formation, progressive breach or partial failure may be assumed insofar as this can be substantiated with the aid of scientifically founded methods. Here it is the breach scenario that triggers the largest possible flood wave that should be assumed.

#### Assessment procedure:

- The assessment procedure has to be adapted to the local circumstances.
- The assessment of a flood wave is based on a “water only” assumption. Other assumptions may be made, e.g. regarding a potential mud flow, if this can be substantiated with the aid of scientifically founded methods. In this case, the thresholds cited in Table B1 have to be modified accordingly.
- The SFOE tools [BFE 2014a] and [BFE 2014b] represent simple methods for estimating flood waves based on [Beffa 2000] and [CTGREF 1978].
- In the case of water retaining facilities that are arranged behind one another and form a cascade, the initial breach scenarios have to be examined for each facility. In these scenarios, a potential follow-on breach of downstream water retaining facilities that are reached by a flood wave has to be taken into consideration if the flood wave causes the water level in the downstream facilities to rise above their danger levels. The initial conditions of the downstream facilities have to be adapted to the specific circumstances – as a rule, it should be assumed that the reservoirs are full.

#### Extent of examination:

- For the registration by the cantons of water retaining facilities with particular risk potential it is sufficient to report details of at least one location at which a particular risk potential has been ascertained.





- In an application for exemption of a facility from the legislation governing water retaining facilities, the operator must demonstrate that a particular risk potential can be ruled out for all locations in the area that is potentially subject to flooding.

#### 4. Assessment criteria

The applicable criteria for the assessment of particular risk potential for a given location are as follows:

- The water level (height) of the flood wave
- The intensity of the flood wave, defined as the result of the combination of its water level and flow speed
- The vulnerability of the affected objects

For the determination of potential damage caused by flood waves, the intensity criteria cited in the document entitled “Consideration of Flood Hazards for Activities with Spatial Impact” (BWW-BRP-BUWAL, 1997) were referred to in a modified way. Reference was also made to the information concerning the vulnerability of objects contained in the document entitled “Downstream Hazard Classification Guidelines” [USBR, 1988].

The thresholds for “water only” scenarios as of which a particular risk potential exists are defined for various objects in Table B1 and depicted in Figure B3.

*Table B1: Thresholds for determining particular risk potential*

<b>Object</b>	<b>Threshold: water depth [m] or intensity [m<sup>2</sup>/s]</b>
Dwellings, offices, public buildings (solid construction)	2
Dwellings, offices, public buildings (light construction)	1
Heavily frequented transport routes (e.g. motorways, most cantonal roads)	0.5
Railway lines	2
Other transport routes	1
Hiking routes	0.5
Public camp sites	0.5
Bathing areas, boats	0.5
Gatherings of people	0.5

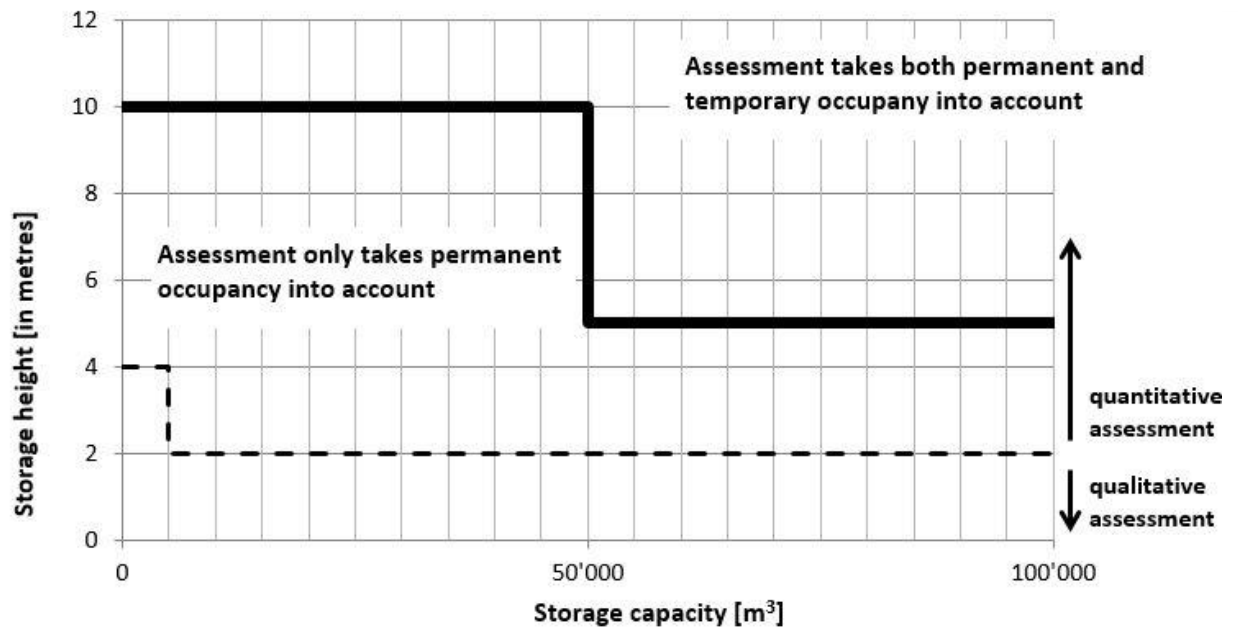


Figure B3: Depiction of applicable thresholds

In the case of water retaining facilities that are arranged behind one another and form a cascade, a particular risk potential exists for a specific facility if the assessment criteria cited above are met for the initial breach scenario of that facility (cf. scenarios to be assumed as outlined in section 3 above).

No generally applicable thresholds can be indicated for the other considered factors (damage caused, risk to the environment, public awareness in the event of a breach of a water retaining facility) cited in section 2.3. In these cases, the assessment has to be made on the basis of the specific local circumstances.



## 5. Special characteristics of run-of-river facilities

For run-of-river facilities (weirs) that do not fulfil the size criterion, the assessment of particular risk potential may be made qualitatively in deviation from the procedure described in section 2.2 and depicted in Figure B2. This simplification is permissible because in most cases there is only temporary occupancy below a weir. However, the procedure for side embankments has to be differentiated as described in section 2.

### References

*(Note: the list of references will be integrated at a later date into the full list for the Directive)*

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