

## Plate 5.1<sup>2</sup> Hydrometric Networks

### Introduction

The hydrometric networks in Switzerland include measuring stations for water-levels and discharge run by various operators. At present the federal measuring network is maintained by the Swiss National Hydrological Survey (SNHS), which is part of the Federal Office for Water and Geology. In addition various cantons have set up their own measuring networks. A number of individual hydrometric stations have also been established by «private» organisations, for example by hydro-electric power stations or university departments. The SNHS also runs a special flood measuring network.

All these networks have undergone drastic changes over recent years, for which reason it has been deemed necessary to revise plate 5.1.

### Historical development of the measuring networks

The basis for the systematic observation of the water-levels of Swiss lakes and rivers was established in 1863 with the founding of the Swiss Hydrometric Commission [4]. Over the years, in particular after the beginning of the 20<sup>th</sup> century, discharge rates were measured at an increasing number of stations. Today there are hardly any stations on rivers which measure only the water-level. In addition limnigraphs, which continuously record the water-level, have gradually been installed at all stations. In the case of older measurement series, the daily mean discharge is often based on between one and three water-level readings per day only.

From the middle of the 20<sup>th</sup> century on, the federal measuring network was expanded by the addition of new networks (see diagram). More and more cantons set up their own networks. While the first cantonal measuring stations were concentrated in the Central Lowlands and north-western Switzerland, the measuring networks in the Alps too have been extended in recent years (see small-scale maps). The cantonal stations cover mainly smaller rivers, which can also be seen from the median of the catchment areas of these stations. For the cantonal stations in operation today this median is 26 km<sup>2</sup>, as opposed to 210 km<sup>2</sup> in the case of the SNHS measuring stations. Since 1950 the number of hydrometric stations run by hydro-electric power stations or university departments has gradually increased. Most of these stations have been installed for a single specific purpose. In the case of hydro-electric power stations, their measuring stations provide basic information for operations, for example, or for monitoring minimum instream flow. Most of the measuring stations run by universities have been installed for hydrological surveys; in many cases there exist in-depth studies of the catchments in question.

The flood measuring network which was set up by the SNHS in 1984, has been expanded as part of the National Flood Programme with the aim of improving knowledge about flood discharge.

### Representation of the measuring stations on the map and in the table

For reasons of comprehension a selection had to be made when the stations were mapped. Only those SNHS stations are indicated for which digital information is available concerning daily mean discharge or water-levels of lakes. Stations on rivers which provide only water-levels were omitted entirely. Of the cantonal and «private» measuring networks only those discharge measuring stations on rivers and water-level stations on lakes are mapped from which information is available to third parties (in annual reports or on request). Information about a number of stations which have not been included for the above reasons can be found in [6], and in particular information concerning the latest measuring networks in hydrological annual reports issued by the cantonal and federal authorities [2]. The map included in the Atlas represents the situation as in 2000.

All mapped stations are indicated on the table pages, grouped according to federal, cantonal or private operators, SNHS flood measuring stations being shown separately. It has often happened that stations have been relocated in the vicinity of the old site and have acquired a new name and number. Insofar as the data series are still comparable, such stations are shown on the map as

one single station, labelled with the latest number. The tables provide information as to whether a measurement series is a compilation and under which number the corresponding data can be found. Data provided by the federal measuring stations can be requested from the SNHS, while sources for cantonal and private measuring stations are indicated at the end of the corresponding table.

Apart from the names of the stations, the tables include additional information: the precise location of each station can be determined using the coordinates (Swiss National Ordnance Survey). The surface area normally refers to the surface catchment area as determined from a topographical map; in some cases it refers to the delineation of the catchment based on a hydrogeological survey. Information concerning mean altitude and proportion of glaciation provides a basic picture of the catchment covered by a measuring station. The precise duration of the records and any interruptions can be seen from the measurement series.

### **Federal measuring stations**

The stations within the federal measuring network are arranged according to their SNHS database numbers. Apart from other uses, part of this measuring network serves to determine discharge from the «representative basins». The purpose here is to ensure the long-term observation of the water balance in differing catchments which are in as natural a state as possible. In many basins inflow and outflow (drinking water and waste water) are also measured, apart from the discharge in the channel. Information on further factors, in particular areal precipitation, is also available. Evaluations concerning water balance in the representative basins can be found in [4] and [5]. The principal physiographical properties are also available for all these basins [1]. The map shows the current as well as former representative basins. The name of each can be deduced from that of the corresponding discharge measuring station.

Flood measuring stations are indicated by the code HW and the SNHS number. As a rule they have crest gauges which indicate the flood level reached between two readings a few times a year. Using suitable methods, the corresponding peak discharge can be calculated. Certain of these stations also have a flood limnigraph. It is only with this apparatus that, apart from the flood level, time and pattern of the flood wave can be recorded.

### **Cantonal measuring stations**

The numbering system used so far in the Hydrological Atlas has now been abandoned. The numbers of the cantonal stations are made up of the abbreviation for the canton in question and the official cantonal designation of each station. If the latter does not exist, the number previously indicated in the Atlas has been used if the station has already been included in a plate. Otherwise the station has been given a new number. In the latter two cases, these numbers serve purely to locate the stations on the map and in the table.

### **Privately run measuring stations**

The measuring stations run by hydro-electric power stations and universities are designated with a «P» followed by a number. All the information is based on a survey which was carried out in 2000. Only those stations have been included for which data is available to third parties. Measurements concerning water intake and records of the flow rate calculated from the energy produced by the turbines have not been included.

## Different types of measuring stations

The various pictures show a series of typical hydrometric stations.

The structure and the technical equipment installed in discharge measuring stations is adapted to each individual site. Water-levels are measured using floats in stilling wells or tubes, hydrostatic measuring instruments (pressure sensors, bubble gauges) on the banks and shores, or radar [8]. In the case of low discharge rates of a few litres per second, the flow rate can be determined using the volumetric method. The dilution method using tracers (salt or fluorescent dyes) is applied in turbulent watercourses where the discharge rate is higher [7]. In most rivers and streams, however, discharge rates are measured using propeller type current meters [3], either on a rod from a bridge or suspended from a cable. In larger watercourses, ultrasound measuring instruments are becoming increasingly common.

A flood crest gauge is a tube mounted on a river-bank. The tube is open at the bottom end and contains a graduated gauge on to which a water-soluble coloured tape is stuck. The water entering the tube during high-water washes the colour away, with the result that the maximum level can be read off at a later point.

Floats and hydrostatic instruments are normally used to measure the water-level of lakes.

## References

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