HYDROLOGY PROJECT

World Bank & Government of The Netherlands funded

Training module # SWDP - 42

How to report on discharge data

New Delhi, November 1999

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with
HALCROW, TAHAL, CES, ORG & JPS

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1. Module context

While designing a training course, the relationship between this module and the others, would be maintained by keeping them close together in the syllabus and place them in a logical sequence. The actual selection of the topics and the depth of training would, of course, depend on the training needs of the participants, i.e. their knowledge level and skills performance upon the start of the course.

2. Module profile

Title	:	How to report on discharge data
Target group	:	Hydrologists, Data Processing Centre Managers
Duration	:	One session of 60 minutes
Objectives	:	After the training the participants will be able to*:* • make yearly report on discharge data • make special report on discharge data
Key concepts	:	• yearly & special reports • graphical plot of temporal variation • basic statistics of discharge and runoff • year's discharge against average frequency curves • year's discharge against average duration curve • data validation and quality aspects • unusual flood events • revised long term statistics • bibliography of past publications
Training methods	:	Lecture,software
Training tools required	:	Board, OHS, Computer
Handouts	:	As provided in this module
Further reading and references	:	

3. Session plan

No	Activities	Time	Tools
1	***General*** • Important points (a) • Important points (b)	10 min	 OHS 1 OHS 2
2	***Yearly reports*** 2.1 Introduction 2.2 An observational network 2.3 Descriptive account of streamflow occurrence during the report year 2.4 Basic streamflow statistics • General • Typical output of tabular daily data • Typical output of tabular monthly data • Annual hydrograph plots • Flow duration curves	15 min	 OHS 3 OHS 4 OHS 5 OHS 6 OHS 7 OHS 8 OHS 9 OHS 10
3.	***Periodic reports - long term statistics*** • Overhead - highlighted text and bullet points		 OHS 11

4. Overhead/flipchart master

5. Handout

Add copy of Main text in chapter 8, for all participants.

6. Additional handout

These handouts are distributed during delivery and contain test questions, answers to questions, special worksheets, optional information, and other matters you would not like to be seen in the regular handouts.

It is a good practice to pre-punch these additional handouts, so the participants can easily insert them in the main handout folder.

7. Main text

Contents

How to report on discharge data

1. General

- **Published reports are the primary visible output of the Hydrological Information System. They have several purposes**

  - **to provide information for use in planning, design, operation and evaluation.** The list of potential users of streamflow data is very large. Data are used for:

    - for the design of water resources schemes taking into consideration particularly the risk of drought
    - for flood defence and drainage schemes taking into account the risk of flood discharges
    - for control of water quality considering the volumes of water available for dilution of industrial and domestic effluents
    - for water issues related to fisheries, ecology, recreation and navigation
    - for all the above with respect to education, research, policy making at state, inter-state and international levels.

  - **to advertise the work of the HIS and its capability and to create interest and awareness amongst potential users.**. With the availability of data on magnetic media it is conceivable that all requests for data could be met by a direct and specific response to data requests. This in fact is now the practice in many developed countries where there are well established links between data users and data suppliers and annual reports are no longer published in print (although the same information may be provided on the Internet). In India, the availability of streamflow data may not be well known even in related government departments; the annual report of streamflow therefore provides a suitable means of demonstrating the capability of the HIS.

  - **to provide tangible evidence to policy makers of a return on substantial public investment**

  - **to provide feedback to data producers and acknowledge the contribution of observers and co-operating agencies.** The HIS is an integrated system in which streamflow (and other) data are transferred by stages from the field, to local and regional offices for data entry, processing and validation. The annual report shows how observations at individual stations are integrated in the network. It provides an encouragement to observers and data processors to ensure that the raw and processed data are reliable.

  - **to provide a clear incentive to keep archives up to date and a focus for an annual hydrometric audit**

- **The HIS provides opportunities for storage, retrieval and reporting on magnetic media and there is now no necessity to publish daily flow records for all contributing stations.** Reports are primarily designed to cover a fixed time interval, most commonly the water year. In contrast users most commonly require data as full time series from the beginning to the end of the record. there is thus a degree of incompatibility between user requirements and reporting formats. It is not possible to provide complete records in report form, though these can conveniently be provided on magnetic media from the HIS. **The main function of the report therefore with respect**

to functional use is to inform users of the availability of data in digital and other formats.

The HIS thus makes data reporting and use more efficient by:

- ❖ reducing the amount of published data and cost of annual reports
- ❖ providing statistical summaries in tabular and graphical form which are more accessible and interesting to the user
- ❖ avoiding duplication of effort by users in keying in of data by provision on magnetic media

- **Annual reports are produced with respect to streamflow over the hydrological year from 1 June to 31 May.** Since the hydrological year corresponds to a complete cycle of replenishment and depletion, it is appropriate to report on that basis rather than with respect to the calendar year. Such reports incorporate

  - ❖ a summary of information on the pattern of streamflow over the year in question
  - ❖ information on the spatial and temporal pattern of streamflow in the region and how the recent year compares with past statistics.

  Reports of long term statistics of streamflow will be prepared and published at 5 or 10 year intervals. These will incorporate spatial as well as temporal analysis.

- **Annual and other reports will be produced at the State Data Processing Centre. Annual reports will be produced in draft form within six months from the end of the year covered by the publication and the report published within twelve months. Annual streamflow, rainfall and climate data may be presented in a single combined report.**

2. Yearly reports

The annual report provides a summary of streamflow for the report year in terms of distribution in time and space. It also makes comparisons with long term statistics. Details of the observational network and data availability are included. **The following are typical contents of the annual report:**

- Introduction
- The Observational Network
  - ❖ maps
  - ❖ listings
- A descriptive account of streamflow occurrence during the report year
- Basic streamflow statistics
- Annual summaries in graphical form
- Description and statistical summaries of major floods and droughts
- Data validation and quality
- Bibliography

2.1 Introduction

The report introduction, which may change little from year to year, will describe the administrative organisation of the streamflow network and the steps involved in the collection, data entry, processing, validation, analysis and storage of data. It will list those agencies contributing to the included data. It will describe how the work is linked with other agencies collecting or using streamflow data including the Central Water Commission and

operational departments in hydropower and irrigation. It will describe how additional data may be requested and under what terms and conditions they are supplied.

2.2 The observational network

The salient features of the observational network are summarised in map and tabular form.

The map of gauging stations must also show major rivers and basin boundaries and distinguish each site by symbol between operating agency. Mapped stations must be numbered so that they can be related to information contained in tabular listings (Fig. 1).

Tabulations of current stations are listed by named basin and sub-basin. Also listed are latitude, longitude, altitude, responsible agency, the full period of observational record and the period of observation which is available in digital format. A similar listing of closed stations may be provided. All additions and closures of stations must be highlighted in the yearly report. Similarly station upgrading and the nature of the upgrading should be reported.

2.3 Descriptive account of streamflow during the report year.

An account of streamflow occurrence in the region in the year can be concisely given in the form of a commentary for each month, placed in its meteorological context and in relation to the seasonal norms. Especially severe or prolonged periods of high or low flows can be highlighted.

2.4 Basic streamflow statistics

This forms the core of the report. As noted above **the full reporting of daily or hourly data for all stations is no longer required. However for selected major stations a full listing of daily flows will be provided** with accompanying statistical information relating to the year in question and with respect to comparisons with the previous gauged record. Stations will be ordered by basin and sub-basin - rather than in alphabetical order**. Fig. 2 provides an example of such a listing**. It includes:

- For the current year
  - ❖ the tabulation of daily mean flow for the year
  - ❖ the mean, maximum and minimum daily mean flow in each month
  - ❖ monthly flows against the frequency curves for different frequencies
  - ❖ the maximum instantaneous (peak) flow in each month
  - ❖ monthly flow volumes, runoff (mm) and basin rainfall (mm)
  - ❖ annual summary statistics
- For the previous record
  - ❖ average of monthly means, lowest monthly mean (and year) and highest (and year)
  - ❖ annual summary statistics
- For the basin
  - ❖ location details, station elevation and catchment area
  - ❖ summary description of the gauging station, its controls and limitations
  - ❖ summary description of the catchment including principal features of geology and land use
  - ❖ summary of artificial factors affecting flow, reservoirs and regulation, abstractions and return flows.

For the remaining stations, abbreviated summary statistics are provided. Fig. 3 provides an example which includes:

- For the current year
  - ❖ monthly and annual mean flows
  - ❖ monthly and annual maximum flows
  - ❖ monthly and annual runoff (mm)
  - ❖ monthly and annual basin rainfall
- For the previous record
  - ❖ Monthly and annual mean flows
  - ❖ Lowest monthly mean in period
  - ❖ highest monthly mean in period
  - ❖ highest monthly instantaneous flow
  - ❖ mean monthly runoff (mm)
  - ❖ mean monthly and annual basin rainfall
- For the basin
  - ❖ location details, station elevation and catchment area

Values of flow, whether, observed, mean daily or mean monthly should be reported to two decimal places or less. More than two decimal places is beyond the accuracy of measurement and gives a spurious impression of accuracy.

2.5 Graphical and mapped comparisons with average patterns

Graphical displays often provide the best and most accessible means of illustrating the time series of flow during the water year and how this relates to the previous record. The following graphical plots will be presented for a selection of stations.

- Annual hydrograph plot compared with previous maxima and minima (Fig. 4).
- Flow duration curve showing comparison of current year with long term curve (Fig. 5).
- Map showing annual runoff as a percentage of the long period average (Fig. 6) Note that this is a very generalised map since the value at a gauging station represents an average value over a basin whilst the runoff from different sub-catchments may be quite different in relation to the period norms.

2.6 Description and statistical summaries of major floods and droughts

Major floods which have caused loss of life or serious or widespread damage to property are described in more detail giving details of peak flow and average flow over selected durations for stations within the affected area, and showing how these statistics differ from the previous reported maxima Storms should be described with respect to their meteorological context, the most severely affected areas, and the impact of storm movement across the basin on the resulting flood. The description may be combined with the rainfall report for the storm (Module 13).

Similarly major droughts which have caused serious agricultural impacts or disruption of water supply should be illustrated by comparison of drought flow hydrographs compared with average and previous minima of experience.

2.7 Data validation and quality

The limitations of the data should be made clear to users. The accuracy of flow data are dependent primarily on the accuracy of the stage record and on the. the reliability of the stage discharge relationship. With respect to stage the number of values corrected or infilled as a total or a percentage may be noted for individual stations, by basin or by agency. With respect to the reliability of the stage discharge relationship, the number of gaugings in the period and the extent to which the gauging range falls short of the observed range should be reported. A list of reportable quantities is provided in Module 33.

2.8 Bibliography

Data users may be interested to know of other sources of streamflow and related climatic and rainfall data. The following should be included.

- Concurrent annual reports from the HIS of rainfall or climate data
- Previous annual streamflow reports (with dates) from the HIS.
- Previous annual streamflow reports (with dates) published by each agency and division within the state
- Special summary reports of streamflow statistics produced by the HIS or other agencies.

A brief note on the administrative context of previous reports, methods of data compilation, and previous report formats would be helpful.

3. Periodic reports - long term statistics

Long term point and areal statistics are important for planning, management and design of water resources systems. They also play an important role in validation and analysis. These statistics must be updated regularly and an interval of 10 years is recommended. **The following will be typical contents of such reports.**

- Introduction
- Data availability - maps and tabulations
- Descriptive account of annual streamflow and runoff since last report
- Thematic maps of mean monthly and seasonal runoff
- Basic streamflow statistics - monthly and annual means, maxima and minima
  - ❖ for the standard climatic normal period (1961-90) where available
  - ❖ for the updated decade
  - ❖ for the available period of record
- Analysis of periodicities and trend in the streamflow data