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Manual of Hydrometric Data Review Procedures

Fifth Edition

INLAND WATERS DIRECTORATE
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Manual of Hydrometric Data Review Procedures

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1. INTRODUCTION

This manual was prepared by Mr. D.W. Kirk, Data Review Engineer, and approved by Mr. W.J. Ozga, Head, Data Control Section, to provide a uniform set of standards and procedures for use in the review of historical hydrometric survey data. The primary purpose of data review is to discover and correct, as far as possible, significant errors in the existing records. The review also serves broadly to assess the reliability of the records produced, and also serves as a means for recommending future improvements where possible. On completion of the review for the various drainage basins, the users will be notified of the revisions in the appropriate publications.

The systematic review of hydrometric survey data was initiated in 1960 by the Water Resources Branch, although prior to that date, data for individual gauging stations had been reviewed from time to time for various purposes.

In 1971, a decision was made in the Water Resources Branch to give high priority to a program of completing the review of past records. The program was started in April 1972 and involved both Ottawa and Regional staffs, with a projected date of completion of March 31, 1976. In selecting the stations to be reviewed, the following stations were excluded: streamflow stations with less than five years of records to 1970; stations where data were contributed; and canal stations.

However, in 1974, due to manpower and budgetary restrictions the decision was made to modify the review program. While it was recognized that data review was essential to ensure that the data supplied to users by the Water Survey of Canada were as error-free as possible and met national standards, it was no longer possible to pursue the original objectives of the data review program. Because of this change of emphasis, it was necessary to terminate the existing program and finalize the existing Review Reports.

Normal hydrometric computation practice require that anomalies in historical records, exposed by current findings, be revised. As such, data review will continue to be a function in the Regions, although not as a specific activity. Historical reviews, or updates of reviews, will also be undertaken by the Regions as time permits, or for specific requirements.

Data review will continue to be a function of the Data Control Section in Ottawa. Preliminary basin reports assessing the need for review will be undertaken in consultation with the Regional Offices and, based on this assessment, individual stations will be selected for review.

Historical data prior to about 1979 were collected, computed and published in imperial units but converted to metric (SI) units on magnetic tape in 1980. This instructional manual has been written assuming that most data being examined for data review purposes have been collected in imperial units. As a general rule, the data reviews will be conducted in the units of the original computations, but revisions will be expressed in metric units on the appropriate forms for updating the historical tape files.

This is the fifth edition of this manual and supersedes the former "Manual of Hydrometric Data Review Procedures" dated December 1, 1972 and is of course subject to revision as further new or improved procedures are developed.

2. GENERAL HYDROMETRIC DATA REVIEW PROCEDURES

2.1 General Procedures

2.1.1 Objectives

To be effective, the review procedure must be as uniform as possible. To achieve this uniformity the review operation will be conducted under the general supervision of the Data Control Section in Ottawa. Regular contact will be maintained between Ottawa and the Regional Offices.

All review work will be done in accordance with the procedures outlined in this manual. Exceptions to this rule will be made only with the approval of the Data Control Section, Ottawa.

Although the Regions will not have staff permanently assigned to the review of hydrometric survey data, the aim is to eventually review all Water Survey of Canada data by one of the following criteria:

(a) A periodic updating of Review Reports for active stations.

(b) An immediate final review of an active station which is being discontinued.

(c) A review of all stations in a basin when required for a special basin study.

(d) A systematic review of all stations not previously reviewed, at the discretion of the Regional Office.

The Data Control Section will conduct preliminary investigations, in consultation with the Regional Offices, assessing the need for review. Based on this assessment, individual stations will be selected for review in Ottawa.

2.1.2 Approval Authority

After completion of the review of a group of stations, a report will be prepared covering the results of the review for each station in the group. Joint approval is required by the Regional Office and Ottawa before the results of the review can be released to users. This approval is indicated on the Cover Sheet by the signatures of the Regional Chief in the Region, and by the Head of the Data Control Section in Ottawa. The magnetic tape files in Ottawa will be updated from the Review Report and corrected printouts will be sent to the Region for a final check.

2.1.3 Extent of Reviews

The instructions outlined in this manual are designed as a guide for the review of streamflow data in the various Regional Offices. It is essential that the review be conducted with care and in sufficient detail so that another review of the same data will not be necessary at a later date. However, since time and staff are limiting factors it will not be possible to check each figure or minor interpretation; therefore, short-cut methods will have to be used with spot checks being made of the routine computations.

The review involves the examination of the base data available to the Regional Office staff at the time the original computations were made and pertinent data acquired subsequently, as well as the checking of the records for errors in

interpretation and/or computation. The review also involves the examination of material pertaining to the magnetic tape files FLOW and PEAKS; this examination will reveal typographical errors and errors made in the computation of monthly summary figures. Data previously published in the Surface Water Data publications will also be examined and the errors noted. Whether or not revisions are made will depend on the criteria outlined herein and upon the judgment of the reviewer in their application.

In reviewing past records, inconsistencies may be noted in the methods of computation; for example, some of the monthly total discharges in ac-ft have been computed from the monthly mean discharge in cfs while others have been computed from the total cfs-days for the month. It will be noted also that the number of significant figures used in the original computations may not be consistent throughout the period of record. All these inconsistencies in past records were removed when the magnetic tape file FLOW was created. However, when revisions are indicated as a result of the review, all necessary hand computations must be carried out in conformity with present standards. The "cfsm" and "depth in inches" will not be re-computed.

2.1.4 Drainage Area

The determination or check of drainage areas will not be part of the review program but will remain the responsibility of the Regional Office, with assistance being provided as required from Ottawa. However, an attempt should be made to determine if changes have been made to the natural drainage pattern and any diversions should be explained.

2.1.5 New Editions of the Manual

Experience gained in the review may result in suggestions for revision in some of the procedures outlined in this manual. Such suggestions should be forwarded to the Data Control Section, Ottawa, for consideration and approval prior to implementation. Any suggestions adopted will be covered by addendum sheets to this instruction manual. New editions of the manual will be published when considered necessary.

2.2 Criteria for Revising Streamflow Data

2.2.1 Revision Criteria

As a general rule, a revison will be made when the indicated change of:

(a) a daily discharge is 50% or more;

(b) an annual extreme, either maximum instantaneous, or maximum or minumum daily discharge is 15% or more;

(c) a monthly mean discharge is 10% or more.

Computation errors in daily discharge figures, such as those resulting from the misapplication of a stage-discharge table or from the use of incorrect gauge heights usually will be corrected only as required by criterion "a". Although the indicated changes to the daily discharge figures in a particular month may be within this criterion, the monthly mean should always be roughly re-computed to check that criterion "c" is not exceeded. Typographical errors in daily discharge figures which do not involve a revision of associated data usually will be

corrected wherever found, regardless of the criterion, recorded in the Review Report, and corrected on the FLOW file.

Typographical errors in monthly summary figures will also be corrected wherever found, regardless of the percentage given in criterion "c". However, computation errors in monthly summary figures need only be listed as revisions if the indicated change exceeds 1%. (By "computation error" is meant an error in the addition of the daily discharges and division and multiplication of the total to obtain the mean and acre-feet).

If a revision is made to satisfy one of the above criteria, all the affected data must be revised. For example, if a maximum instantaneous discharge is revised by 18% because of a revision to the stage-discharge curve, all the daily discharges, monthly totals, means and acre-feet affected must be re-computed for all years in which the curve was used, regardless of the percentage criteria.

2.2.2 Exceptions to the Rule

Application of any of the criteria should be made with discretion. Instances will be encountered where the criteria should either be relaxed or be made more stringent. Poor definition of the stage-discharge relation through lack of adequate discharge measurements in the high or low water range may warrant an increase in the percentage given in criterion "b" to 20 per cent or more. In other cases, criterion "c" may have to be relaxed for certain periods where changes in excess of 10 per cent are indicated, such as during a shift in the stage-discharge relation. Strict application of the percentages given in the criteria may not be justified where discharges are very small, for example, a change in a monthly mean discharge from 0.5 cfs to 0.4 cfs may be indicated but it is doubtful if such a revision would be worthwhile. Special consideration should be given to the appropriateness of the criteria in high and low flow periods especially when either the maximum or minimum for the period of record is involved. In these instances revisions may be desirable even if the indicated revision is less than the tolerance suggested. It is probable that other instances will be encountered when a strict application of the criteria will not be practical.

2.3 Symbols and Computation Standards

Symbols will be used when necessary to explain a particular condition. The symbols described in the latest edition of the "Manual of Hydrometric Data Computation and Publication Procedures", such as the following symbols, should be used where applicable:

A - Manual Gauge

B - Ice Conditions

E - Estimated

Use the same symbol, capitalized, for the same purpose throughout the review. Every symbol must be accompanied by an appropriate reference in a footnote.

Note that the current version of the PEAKS file has made provision for symbols to be included. These symbols will therefore be used for maximum instantaneous values as well as for daily values.

When hydrometric data are being recomputed or extended for review purposes, the most recent computation standards will be used as laid down in the latest "Manual of Hydrometric Data Computation and Publication Procedures". Where possible, the digitizer should be used for computing data.

Since the calendar year has been adopted as the basis for publication of Surface Water Data, review work will also be performed on that basis.

2.4 Revising or Extending Streamflow Records

2.4.1 Revising Streamflow Records

Follow the criteria as outlined herein to aid in deciding when revisions are required. Records should not be revised unless documentary substantiation is available on which to base the revision. No revision should ever be made merely on the basis of a different interpretation or opinion.

In some cases the base data may be so doubtful and incomplete as to render effective revision impossible for the entire record, but this decision should not be made without careful consideration and thorough investigation. A complete explanation must be given in the "Explanation of Revisions" if any records cannot be revised through lack of data, even though revision appears necessary. Do not destroy such records, but make an appropriate notation on the original records.

2.4.2 Deleting Streamflow Records

If previously published records have been reviewed and found unreliable, these records should be removed from the FLOW, LEVELS and PEAKS files. This must be indicated in the Surface Water Data Reference Index by submitting a revised Gauging Station Inventory to the Data Control Section, Ottawa. If the entire period of record has been found unreliable, then field 31 "Records Obtained" should be revised to show miscellaneous measurements available for the entire periopd; field 51 should show "Data not published by WSC"; and field 75 "General Remarks" should have an appropriate notation, e.g. "Discharge records for the entire period of record June 1935 to September 1944 have been found unreliable and should not be used. Miscellaneous measurements only available". If only a portion of the records has been found unreliable, this period should be indicated as miscellaneous measurements in field 31 "Records Obtained" and an appropriate notation made in fields 73 or 74 "Remarks for Historical ..... Publication", e.g. "Records for the period May 1910 to August 1915 have been found unreliable and should not be used".

2.4.3 Extending Streamflow Records

If feasible, streamflow records should be extended to complete a partial month or a partial year. This should be one of the major concerns of a data review and it is especially desirable if the incomplete period is short in comparison with the entire period of record. Records may be extended by correlation, comparison with discharge hydrographs for nearby stations, use of meteorological records, etc. Where appropriate, a revised Gauging Station Inventory must be submitted to the Data Control Section, Ottawa.

2.4.4 Updating Original Files

When revisions or extensions are made to any part of the daily discharge records for a calendar year they should be noted on the appropriate forms as

explained in Section 3. These forms will appear in the Review Report which will be filed in the Revisions File.

Also when a revision is made, make the necessary corrections on the original records if this can be done legibly, then initial and date. Otherwise, mark the original month(s) as "Obsolete, see Revisions File". Additional explanatory notes may be added as required, e.g. "Daily discharges for the period June 15 to 18, 1915 were revised".

No original data or work sheets are to be destroyed, even if they have been made obsolete in the review. Work sheets involved in the review of each station will be filed in a "Revisions File" or a "Review of Hydrometric Survey Data to ..." file as set up in each Region.

2.5 International Gauging Stations

On waters adjacent to the International Boundary, certain gauging stations are maintained by Canada (or the United States) under agreement with the United States (or Canada) and the records are collected and complied in a manner equally acceptable to both countries. These stations are designated as "International Gauging Stations".

The following procedures should be used as a guide for reviewing International Gauging Stations. They follow the framework outlined in the "Procedural Guide for Operation of International Gauging Stations dated November 4, 1969".

(a) Review only stations for which the original calculations were done by the Water Survey of Canada, following the same procedure as outlined in this manual. Some of the discharge measurements and level checks may have been made by U.S.G.S. personnel and should be treated as if done by Regional staff.

(b) After completion of the review, joint approval of the Review Report is to be made by the two appropriate Regional Chiefs or their representatives, and the Head of the Data Control Section, Ottawa, prior to making any changes to published data. Their signatures will appear on the cover sheet of the Review Report.

(c) Following the joint approval, copies of the completed Review Reports will be provided to the appropriate Regional Offices, and to the Data Control Section, Ottawa. The revisions will be edited for publication according to the standards of the agency publishing them. Similarily, the data stored on magnetic tape may be processed according to the standards of either country.

2.6 Units of Review

The data will be reviewed in the units of the original computations. In the event that the station has been converted to metric units within the period undergoing review, the Review Report will be separated to show the distinction, if necessary.

The magnetic tape files have been converted to metric units but copies of the original tape files in imperial units are available on microfiche for review purposes. The retrieval programs for retrieving data from magnetic tape produce listings in m^3/s and hydrographs in m^3/s or $L/(s.km^2)$. However options are available so that historical data can still be retrieved in imperial units.

No doubt there will always be some confusion when reviewing the data which were originally computed in imperial units, and it may be necessary to do a certain amount of converting during the review. Annual hydrographs with measurements plotted on them in imperial units present no problems, but on the stage-discharge sheet it may be necessary to convert some recent curves or high water measurements to imperial units to get a total picture of the curves. Revisions should be computed in the units of the original computations, but the revised figures which will appear in the reports on the "Daily Data Files Updating" form, the "PEAKS File Updating" form, and the "Summary of Revisions" form should be converted to metric units.

2.7 Revising data stored on SAVE tapes

Since 1969, hydrometric data have been computed by the Water Survey of Canada using the STREAM and MANUAL computer programs. The card input to these programs are the following: Station Name, Datum, Update Corrections, Stage-Discharge Table, Gauge Correction, Shift Correction, and Digitized water levels (or keypunched gauge readings). Each year after completion of the computations, these cards are stored permanently on magnetic tape (some Regions store only digitized cards). The tape is labelled according to the data being stored, e.g. Regina 1972 SAVE tape would have the 1972 data.

During data review there will be times when revisions will be made by retrieving cards from the SAVE tape and recomputing, e.g. when a stage-discharge table has been revised, when gauge corrections were improperly applied, or when a portion of the chart has to be redigitized. The SAVE tapes will not be revised with these corrections, however the new cards may be stored on the next SAVE tape being created, e.g. if 1972 data were revised in 1982, they would probably be stored with the 1981 data on the 1981 SAVE tape.

Whenever revised cards are being stored on a SAVE tape, this information should be noted in the Revisions File (Section 8). Similarily, whenever data are being retrieved from the SAVE tape, the Revisions File should be examined to see if revisions have been made to the data.

New SAVE tapes have been created in Ottawa (for some Regions) by combining the annual SAVE tapes to store data chronologically by station. All SAVE data for a particular station are therefore stored together on one tape. Although the data for each station are chronological, revised data are still located with the data with which they were originally stored, as explained in the previous paragraph.

3. PROCEDURE FOR REVIEWING STREAMFLOW DATA

(a) Assemble all the available data for the station under review. These will include the original discharge measurement notes and level checks, the list of discharge measurements, the gauge observation books, recorder charts, stage-discharge curves and tables, original forms 067-2124 (R79) or equivalent, hydrographs, winter discharge computations, published records, letter file, station description, gauge history, station analysis, etc.

(b) Use "Review Progress" form 067-2132 for each station, checking the spaces provided as each step in the review is completed, even if there are no data to be checked.

(c) Prepare the "Station History", using the following headings:

(i) Period of record. Indicate whether the station is active on the date the Station History is prepared, e.g. "May 1913 to date". Also list any changes in the name of the station.

(ii) Purpose. State the purpose for which the station was originally established, any changes in purpose, the requesting agency (quote reference file and letter), co-operation with other organizations, known users of the data, and reason(s) for discontinuing or re-establishing the station.

(iii) Location. Describe the original location and changes, if any, and reasons for changes. In some cases where there has been a change it may be more desirable to show headings 3.(iv) to 3.(viii) separately for each location.

(iv) Drainage area. Give the drainage area in square miles. This may aid in interpreting the significance of rapid fluctuations in the annual discharge hydrographs and may also provide a guide to the significance of a discharge measurement not plotting on the hydrograph. If the drainage area has been affected by diversions, this should be explained. It is not necessary to determine or check the drainage area as part of the review.

(v) Discharge measurements. Indicate whether the measurements were made by wading, from cableway, etc., and give the location of the measuring section in relation to the gauge. A general note will suffice in cases where the location of the section varies.

(vi) Types of gauges. List the types of gauges and period of use. Indicate the types of manual and recording gauges that were used, e.g. "0-9 ft staff", "chain", "wire weight", "reference point on bridge", "continuous (or weekly) recorder", "recorder (pencil)", etc. In some cases it may not be possible to give the length of the staff gauge or the type of recorder; however, it is desirable to note if recorder charts were produced in pencil.

(vii) Gauge datum. Give the name of the gauge datum, the factor to convert to other datums and changes, if any.

(viii) Bench marks. Write a description of the bench marks, give the date of installation and the bench mark from which elevations were run, the

elevation and changes, if any. It is not necessary to list temporary bench marks which have not been used.

(d) Obtain discharge hydrographs from the Data Control Section, Ottawa. These hydrographs are produced by computer methods, and are available upon 2 to 3 weeks notice. Plot the discharge measurements on these hydrographs. The hydrograph will assist in revealing periods of questionable record which should be checked. For example, a sharp drop for a period of one or two days and perhaps followed by an equally rapid recovery may be the result of a one to two-foot error in transferring the gauge readings from the observer's book to a form 067-2124 (R79). Hydrographs are useful also in making comparisons between stations on the same stream or on adjacent streams having similar characteristics. Hydrographs may not be required for stations on streams subject to extensive regulation.

(e) Plot all the stage-discharge curves used during the period of record on an arithmetic curve sheet, preferably form 067-2004, using one scale for the entire range of application. Measurements obtained and curves drawn outside the review period should also be considered (where applicable) to help confirm the curves under review. Label the curves as required for convenience of reference. It may be desirable to separate the curves into groups coinciding with changes in gauge datum or location, significant changes in the control, etc. If the number of curves makes it impractical to draw them all on one sheet, two or more sheets should be used, using the same scale on each sheet. Each curve should only be plotted to the maximum discharge for which the curve was used. The extreme high and low water discharge measurements should be plotted to verify the delineation of the curves. Individual curves that are inconsistent with the general pattern will be exposed on this composite curve sheet. List the stage-discharge curves and their period of use and their range of use in the space provided on form 067-2004. In some cases it may be found necessary to plot the discharge measurements on a logarithmic curve sheet (form 067-2005), to verify extensions of stage-discharge curves.

(f) Review each year of record and accept it or revise it if possible, according to the adopted criteria in the following general order, checking off the steps in the review on form 067-2132 as they are completed:

(i) Review the gauge corrections and their distribution. It should not be necessary to check or review in detail all original level notes except to verify correction applications.

(ii) Spot check the list of discharge measurements, form 067-2122 (R56), from the original notes, with particular emphasis on the gauge heights and discharges, and spot check the plotting of these measurements on the original curve sheets.

(iii) Spot check the daily gauge height computations.

(iv) Compare the stage-discharge curves for the year under review with those for the period of record on the composite curve sheet.

(v) Spot check the daily discharge computations.

(vi) Inspect periods of questionable record on the discharge hydrographs and if possible compare them with hydrographs for stations on the same or adjacent streams. The comparison hydrographs discussed in Section 6 should be used for this purpose.

(g) Check the "Extremes of Discharge" as shown in the latest Historical Streamflow Summary publication against original records, and include a copy of the page in the Review Report. Values which are in error in the publication should be indicated and the revisions copied on form 067-2081. The maximum instantaneous discharge for the year will not be available for some stations, particularily those equipped with manual gauges only. However, if enough readings are available, a graph should be drawn through these readings to produce a maximum instantaneous discharge (Estimated). If an extreme is the result of some unusual condition it should be referenced by a footnote.

(h) Use an "Explanation of Revisions" page to explain errors found and revisions made. Enter the period of record reviewed and the years that were revised. Using a heading for each year in which the errors occur, explain the type of revision that was made, e.g. stage-discharge curve revision, computation error, gauge correction error, error in transfer of gauge observation, etc. Show the percentage change in daily values and the percentage change in affected monthly means (based on the original figure). Explain if any records were extended or considered unreliable. In some cases a revison may be indicated by applying the adopted criteria, but will not be made because it is considered unwarranted or it cannot be reasonably substantiated. For example, there may be some question regarding the accuracy of the daily gauge heights, the discharge measurements, level checks, stage-discharge curve, etc. In these cases, explain why a revision was not made. It is not necessary to explain why revisions were <u>not</u> made if indicated changes are within the limits of the criteria, although a statement that the discrepancies were noticed may be useful for future reference. The extent of the explanation as to why revisons were not made will be left to the discretion of the reviewer.

(i) Compare the monthly means in cfs shown on the original computation forms with the values published in the latest Historical Streamflow Summary publication. This comparison will verify that all the original data have been stored correctly on the FLOW file and will also reveal any computational errors in the monthly summary figures. It will be necessary to convert the cfs to m^3/s for comparison purposes.

(j) Use the "Daily Data Files Updating" form 067-2080 to list all daily revisions as well as revisions in the identification of valid daily extremes. In some cases this coding form may be replaced by Daily Discharges form 067-2124 (R79) or by a "(PRELIMINARY) DAILY DISCHARGE" listing. Use the "PEAKS File Updating" form 067-2081 to list all revisions to the maximum instantaneous discharges. These forms for updating the magnetic tape files should be completed in metric units.

(k) Use the "Summary of Revisions", form 067-2140 to summarize the type of revisions, extent of revisions and percentage of revisions. Show the monthly and annual percent of revision for each year revised.

(l) A Summary of the Review Report should now be made. This Summary serves to draw attention to any conditions which affect the quality of records produced at the station, and is also used to recommend future improvements. The Summary should be subdivided in paragraphs for the following headings:

(i) Remarks. Explain if natural or regulated runoff, the extent of the regulation and year it began, changes in the control, co-operation with other organizations and other pertinent information. Explain if any base data are missing, questionable or not readily accessible; this includes both original field data and work sheets used in the original office computations.

(ii) Conclusions. Any of the physical features of the station, or its operation, which may affect the quality of the record should be mentioned here. Lack of a stable control, incidence of backwater, turbulence at the measuring section, lack of winter measurements, the fact that a manual gauge read once daily is the only record of stage, - any or all of these features, and others, should be noted. Appropriate comments should be made on the extent to which the stage-discharge curves are defined, and the extent to which the curves were extrapolated. Such comments would supply a guide to the reliability of the record. If necessary, close off the section with any recommendations for improvements, such as the need for a recording gauge or a two-recorder setup at stations subject to backwater, etc.

4. PREPARATION OF THE REVIEW REPORT

A Review Report and at least one copy will be required for each station reviewed; the original report will be filed in the Regional Office, and a copy (excluding hydrographs) at Head Office. Additional copies may also be required for outside agencies. The extent of the Review Report will depend largely on the changes required in the existing records. Where a station record is reviewed and virtually no change is found necessary, the report would be very short; where the changes were extensive the report will of necessity be considerably larger to cover them adequately.

The Review Report will consist of:

(a) The signed "Cover Sheet".

(b) The "Contents Sheet".

(c) The "Summary" of Review.

(d) "Summary of Revisions", form 067-2140.

(e) "Station History".

(f) "Extremes of Discharge", from the Historical Streamflow Summary publication.

(g) "Explanation of Revisions".

(h) Composite curve sheets.

(i) Special studies, such as logarithmic stage-discharge curves, plots of observers' readings from manual gauges to estimate instantaneous maxima, etc.

(j) Revised stage-discharge curves and tables where appropriate.

(k) "PEAKS File Updating", form 067-2081.

(l) "Daily Data Files Updating", form 067-2080.

(m) Revised forms 067-2124 (R79) where needed.

(n) Annual hydrographs with discharge measurements plotted. These hydrographs should also show revised or extended data where appropriate.

(o) "Review Progress", form 067-2132.

5. BASIN REPORT

As well as reviewing the records for each individual station in the review program, a comparison of records for stations within a basin, or in an adjacent basin, could reveal major errors or confirm the records. An explanation of what to include in this report follows.

(a) For each drainage basin prepare a separate book which will contain data for comparing the streams. This book will be used as a work file for review purposes and will not be included as part of a Review Report but will serve as a Basin Report. Upon completion of the review, the reports should be retained in a Basin Report file.

(b) A copy of the list of stations being reviewed in the basin will be included in this book. This may be a copy of the appropriate pages from the Surface Water Data Reference Index with the stations being reviewed indicated.

(c) Include copies of the Means and Extremes pages from the latest Historical Streamflow Summary publication. This is useful for revealing missing data which may possibly be computed.

(d) Include a map of the basin under review, showing the stations, drainage boundaries, rivers, lakes, diversions, dams, reservoirs, etc.

(e) One or more schematic diagrams should be drawn showing the stations to be compared. This will be a sketch showing the rivers with gauging stations indicated and numbered, and may include stations not on the review program, e.g. contributed data which will be compared to Water Survey of Canada data.

(f) The period of record (showing seasonal or continuous) and the drainage area should be indicated on one of these pages. A useful way of showing the period of record, particularly when making the selection of what comparison hydrographs to request, is to use a horizontal bar graph.

(g) To request comparison hydrographs, use the schematic diagram and the bar graph to select the stations and periods of record which are to be compared. Check that the data requested are on magnetic tape (FLOW file). Copy this information on form 067-2087 "Request for Comparison Hydrographs", as explained in section 6.2, and send the form to Ottawa for plotting the hydrographs. The comparison hydrographs will be sent to the Regions in about 2 weeks, and may be filed in the Basin Report, or separately, depending on the number of hydrographs. It is recommended that comparison hydrographs to a reduced scale (20% of full scale) be specified for the preliminary basin review. Full scale comparison hydrographs for questionable periods can be requested later for the review reports.

(h) Regional analysis printouts giving monthly mean and annual mean runoff in "inches per square mile" or "cfs per square mile" are available as an alternative method for comparing the records from stations within a drainage basin. Again, the schematic diagram and bar graph will assist in selecting the stations to be compared. Send a list of the stations selected to Ottawa and the printouts will be supplied in about 2 weeks. One printout page per station will contain all the summary information giving the monthly mean runoff in the units requested for each month with complete data. It should be noted that in computing these data only the current value of the drainage area is used, so care must be taken if a station has been moved significantly within its period of use, or if diversions, etc. affect the drainage area. Insert these printouts in the Basin Report.

(i) The comparison hydrographs and the regional analysis printouts are to be used as a quick method to recognize periods where the data could be in error and require further investigation. A convenient time to inspect the data for questionable periods is just prior to, or following, step (f) section 3.

A written summary of each comparison hydrograph should be included explaining whether the hydrograph was useful or not for comparison purposes and what factors affect the runoff pattern. Questionable periods which were noticed shoud be listed and an explanation given of any investigations.

(j) A brief summary should be included of the basin review as follows:

(i) If this is a preliminary review, the summary should assess the quality of the data and determine whether or not a detailed review is necessary or justified.

(ii) If a review of the stations within the basin has been completed, the summary, in addition to assessing the quality of the data should summarize the revisions made including why a revision was necessary.

6. REQUEST FOR COMPARISON HYDROGRAPHS FORM 067-2087

6.1 Explanation of Comparison Hydrographs

(a) Comparison hydrographs can be plotted to show each individual station on the same graph, stations summed or subtracted with the totals plotted, or a combination of these arrangements. A maximum of 5 stations and 5 plots is permitted. Hydrographs can be plotted in m^3/s or $L/(s.km^2)$. Plots are also available in imperial units if requested.

(b) When discharge data for stations are being summed (or subtracted), a plot will be produced only if data are available for all the stations involved.

(c) The hydrographs are plotted on CALCOMP Plot Paper, drawn to the same scale as form 067-2002 (3 cycle semi-log). The grid is not shown on the plots but the plots may be overlayed on form 067-2002 if the daily values are required. In selecting the numerical values for the cycles, the program searches for the maximum discharge to be plotted for the entire period. This discharge is assigned to the upper cycle, and the numerical values of the three cycles are automatically computed. The comparison hydrographs are then plotted on the 3 cycle scale, provided that all the daily values are within this range. The computer searches for the minimum value to be plotted, and if the minimum to maximum exceeds three cycles, then the lower portion of the bottom cycle is converted to arithmetic scale going to zero flow, so that all daily values may be plotted. Negative flows can be plotted and are flagged by an arrow.

(d) The horizontal scale can be reduced or expanded. A reduced scale of 0.2 full size is a useful plot for preliminary examination purposes.

(e) Any length of record may be requested. The program will automatically produce the plots in 5-year sections for convenience in handling the completed plot and accuracy in plotting. However, if it is desired to produce the plots in smaller or larger sections, any length (in years) of the section may be requested.

(f) Each hydrograph is plotted with a different coloured pen, so the various plots can be distinguished. The plots are identified to the right of the comparison hydrographs by whatever identification is desired.

6.2 Instructions for completing Form 067-2087

(a) Request card: Enter a code 1 for discharge records, in column 1. Codes are also available if plots for water levels (4) or suspended sediment concentrations (7) are being requested.

Enter the entire period for which comparison hydrographs are required in columns 3-11. For example if data are available for the years 1908-12, 1931-36, 1948-68 and hydrographs are required for the entire period of record, then request the period 1908-1968. Hydrographs will be produced only for the years containing data.

The computer program will automatically produce the plots in 5-year sections. However, if it is desired to produce the plots in smaller or larger sections, the length (in years) of the section should be indicated in columns 13 and 14 (right justified).

If a reduced or expanded horizontal (time) scale is required, enter the scale factor in columns 16-18 right justified from 0.1 to 10.0.

(b) Stations involved: List the stations in numeric order in columns 3-9. Each station number is given successively an identification number from 1 to 5 in the first column. The identification numbers will be used when identifying the hydrographs to be plotted. The Region number should be filled in for each station number in column 11.

Ordinarily the hydrograph will be plotted in m^3/s (or cfs). However, an option is available whereby discharge hydrographs can be plotted in $L/(s.km^2)$ or (cfs per sq. mi.). If this option is required, then the Drainage Area for each station must be entered in columns 13-18, right justified.

If water level stations are being compared, it may be necessary to add or subtract a conversion factor to bring the water levels to a common datum. Enter the conversion factor in columns 21 to 29 if required. The decimal should appear in column 26.

(c) Plot code: Use Code "8" if individual stations are to be plotted on the same graph. Use Code "9" if stations are to be summed or subtracted with the totals plotted, or if a combination of individual stations and summed stations are to be plotted.

(d) Plot identification: Under the heading "Plot Identification Number" fill in the identification numbers of the hydrograph to be plotted in the appropriate column; one plot per row. If two or more stations are to be added (or subtracted), the signs should also be indicated. Show the "Identification Desired on Hydrograph" for each plot in columns 11-70. A maximum of 60 characters is allowed.

7. PUBLICATION INSTRUCTIONS

The source data for the summary of monthly means will be the magnetic tape file, TOTALS. Since this file is created from the FLOW file all approved revisions to daily discharges must be incorporated thereon. Therefore, when a Review Report is submitted to the Data Control Section, Ottawa, the corrections will be made directly from the revision forms submitted in the report, and the printouts will be sent to the Region for checking.

A summary of monthly means and annual extremes for the entire period of record of the station are published every 5 years. Revisions to the monthly means and the annual extremes have not been identified in this publication, but plans are being made to rectify these procedures. In 1980 an Historical Streamflow Summary to 1979 edition will be published which will be the first to contain data in metric units. All revisions to the data stored on the FLOW, LEVELS or PEAKS files since January 1980 will be identified by an "R" on the files and in the publications. Users requiring the revised daily values will be advised that they are available upon application to the appropriate Regional Chief.

Each station where a review has been completed has been identified by a footnote in the Surface Water Data Reference Index. A revised Gauging Station Inventory should be submitted with each Review Report, indicating in fields 56 and 57 that data have been reviewed to a specified year. As mentioned in Section 2.4, any data which are considered unreliable during a certain period must be indicated in the appropriate fields.

8. REVISIONS FILE

8.1 Filing Reports and Revisions

Hydrometric data may be revised as a result of various reviews, such as the Hydrometric Data Review Reports, updates to previous Review Reports, ongoing or routine annual reviews, or examination of specific periods which have been questioned.

Whatever the reason for the review, it is necessary that all revisions to past data be filed together so that they can be located easily. This is of particular importance since a person retrieving data from the SAVE tape may be unaware that revisions have been made, unless there is some central place to locate the revisions. A new file will be established for each station which will contain all revisions, as explained below.

(a) Hydrometric Data Review Reports:

The original Review Reports were written for the review of all historical data up to a specific date, and are titled "Report on Review of Hydrometric Survey Data to ....". These reports should be filed in the station Revisions File. Work sheets involved in the review of the station may be filed in this file, or separately depending on bulk.

(b) Updates to previous Review Reports:

For stations which have previously been reviewed and Review Reports written, it will be necessary to update the reports periodically, say every five years. Instructions in the previous manual had recommended that the update be bound together in the same book as the previous Review Report. This will not be necessary since both reports will be together in the same Revisions File.

The updated Review Report will be written following the standards and procedures as given herein, including signing procedures. Since the report is basically a continuation of the previous one, it will be titled "Report on Review of Hydrometric Survey Data from .... to ....". The extent of the updated Review Report will vary with each station depending on what changes may have occurred since the last review. For example, at one station the same gauge, bench marks, and stage-discharge curve that were described in the previous report may still be in use, while another station may have moved to an entirely new location, requiring a new "Station History" and "Composite Curve Sheet".

It may not be necessary to include an updated "Station History" in the report, if there are no changes, but in this case reference should be made to the previous Review Report.

It is desirable that the "Composite Curve Sheet" in the updated Review Report contain all the curves used during the period of record. However, to avoid duplication of work and if it is convenient, the curves for the updated period may be plotted on a copy of the original curve sheet from the previous Review Report. This sheet should be labelled "Updated for ... Data Review", and included in the updated Review Report. If a new curve sheet is used, it should be drawn to the same scale as the original sheet so the sheets can be overlayed for comparison.

The "Remarks" and "Conclusions" from the previous Review Report should be considered when writing up the "Summary" for the updated Review Report. Special reference should also be made to any recommendations from the previous Review Report.

(c) Ongoing or routine annual reviews:

These are similar to update reviews, since the station will have previously been reviewed and a Review Report written, however, since only one year is being reviewed it will not be necessary to write a report or require signing authority from Ottawa.

If necessary, the "Station History" should be updated. If there are any new curves, they should be plotted on a copy of the "Composite Curve Sheet". It is up to the reviewer's discretion as to which measurements should be plotted on this sheet. If, as a result of a new curve definition, previous records are affected, then all revisions should be made at this time and documented in an "Explanation of Revisions". All revisions are to be coded on the "Daily Data Files Updating" form 067-2080 or "PEAKS File Updating" form 067-2081. The "Summary of Revisions" form 067-2140 must also be completed. All these forms will remain in the Revisions File.

Copies of the update forms and the "Summary of Revisions" should be sent to the Data Control Section in Ottawa for updating the magnetic tape files (these will be retained in Ottawa in a Data Review File). Keypunched cards may accompany the forms. Revised printouts will be returned to the Region for final verification.

Special attention should be paid to any recommendations made in previous Review Reports or reviews.

(d) Examination of specific periods which have been questioned:

Any such review should be documented in an "Explanation of Revisions" whether or not revisions actually occurred. All revisions should be coded on the "Daily Data Files Updating" form 067-2080, "PEAKS File Updating" form 067-2081 and the "Summary of Revisions" form 067-2140 must be completed. Copies of these forms will be sent to the Data Control Section, Ottawa.

(e) General comments:

It is recommended that an additional sheet be included in the front of the Revisions File which would list the reviews which have been made and which should be in the file. This sheet may be titled "Data Review History" and could show the Station Name and No. and columns for the Period Reviewed, Reviewed by, Date, and Remarks. The remarks should state if follow-up is required.

Note that when a revision has been made to a year, the original records should be flagged by a suitable comment such as "See Revisions File".

8.2 Identifying Revisions on Tape

In 1980 all data stored on magnetic tape (to 1978) were converted to metric units, and new tapes created. These historical daily values in metric units have been put on microfiche and distributed to specific users. It is proposed that subsequent revisions to the historical values will be identified by an "R" symbol

following the daily value, which will be stored on the FLOW and LEVELS files. The "R" symbol will also be stored on the PEAKS file to indicate revisions to the maximum instantaneous values. A revision to the tape files will be defined as "any change to the data stored on tape", which includes data which have been revised, extended data, and historical data which were not previously stored on tape. The symbol "R" and the date will automatically be stored with the value whenever the revised data are being updated onto tape; this will exclude the current data which are added to the tapes annually. The "R" symbol will not be stored on tape if a complete month has been deleted from the tapes.

Revised daily values will not be published, but the "R" symbol after all revised monthly means in the Historical Streamflow (Water Levels) Summary publications, will indicate that at least one daily value in the month has been revised. The "R" symbol will also be shown after revised maximum daily means, minimum daily means, or maximum instantaneous values.

9. ONGOING ANNUAL REVIEWS

9.1 Streamflow Data

Mention has already been made of the review of historical data as part of the annual computation procedures, but since this is not an established procedure as yet it will be explained in this manual for now.

This review should be done annually by the staff responsible for the station. It involves examining the current year's computations, comparing the records with comparable (possibly contributed) stations, verifying these records stored on magnetic tape and in the publications, examining the effect of current records on historical records, and making the necessary revisions and explanations.

(a) Examine the Revisions File:

The first step would be to examine the "Data Review History" sheet which is in the Revisions File and which summarizes all previous reviews. This sheet will indicate if there were previous findings which required follow-up and should also show what follow-up was done.

The "Station History" from the previous reviews should be examined. This is a useful exercise for staff working on the station to remain familar with the history of their stations. Changes to this history, such as a new location, gauge, bench mark or standard period should be recorded.

The "Composite Curve Sheet" should also be updated with any new curves. It is up to the reviewer's discretion as to which measurements should be plotted on this sheet. If as a result of this new curve definition, previous records are affected, then all revisions should be made at this time and documented in an "Explanation of Revisions".

Special attention should be paid to any recommendations made in previous Review Reports or reviews.

(b) Examine the Comparison Hydrographs:

Comparison hydrographs may be obatined by one of the following three methods:

(i) Comparison hydrographs for historical data may be requested from Ottawa for comparing 2 to 5 stations on the same graph (see Section 6).

(ii) Comparison hydrographs for current data may be obtained in the Regions as options in the STREAM or MANUAL programs, for comparing 2 to 4 stations on the same graph. This option will be available in future editions of these programs.

(iii) Hydrographs for current data may be compared by overlaying hydrograph plots and examining them on a light table.

It may be useful information to record which stations give good comparison results and which do not, and why not. This may eliminate ordering hydrographs which are not much help, in following years.

The comparison hydrographs should reveal any large discrepancies caused by false interpretation of data, e.g. weeds, ice, plugged intakes pipes, etc. They may also reveal certain computation errors, e.g. the use of a wrong stage-discharge curve. The hydrographs may also be useful for estimating missing periods or validating extremes codes. Questionable periods should be examined and if necessary, revised.

(c) Examine the Annual Calculations:

The computer pages from the STREAM or MANUAL programs should be spot checked to ensure that each step in the computations has been carried out properly. The annual hydrograph with the measurements plotted should also be examined and questionable periods investigated. The steps for reviewing a year are given in section 3.(f).

When reviewing the current year's calculations, all errors should be revised regardless of criteria.

(d) Examine the Monthly Means and Extremes Listings:

The Regions are supplied annually with monthly means listings and extremes listings for the period-of-record for all active stations. These listings are usually supplied in August.

Examine these listings, considering the historical significance of the year under review. Missing periods will be revealed and should be completed if at all possible. If an unusually high or low extreme has occurred, it should be double checked. For partial years, extreme codes may be required.

Note that if a standard period has been revised, it may be necessary to go back and check the extremes codes for all previous years.

(e) Examine the Gauging Station Inventory:

Examine the information given on the Gauging Station Inventory listing and update it if necessary. In particular, the Remarks for the publications as well as the General Remarks should be verified.

(f) Explain the Review:

All revisions to historical data made as a result of the review should be fully documented in an "Explanation of Revisions" (see Section 3.(h)). Other discrepancies or investigations should also be explained. A "Summary of the Review" (see Section 3.(l)) should be written if any condition requires further explanation.

All revisions are to be coded on the "Daily Data Files Updating" form 067-2080 or "PEAKS File Updating" form 067-2081. The "Summary of Revisions" form 067-2140 must also be completed. All these forms will remain in the Revisions File, but copies will be sent to the Data Control Section in Ottawa for updating the magnetic tape files. Keypunched cards may accompany the forms. The copies will remain in Ottawa in a Data Review File, but revised printouts will be returned to the Region for final verification.

(g) Update the "Data Review History" Sheet:

The final step is to list the review on the "Data Review History" sheet, as explained in Section 8.1 (e). If follow-up is required this should also be noted.

If revisions were made using the automated method, and if these cards are to be stored on the SAVE tape, then this form should state on which SAVE tape the revised cards will appear.

9.2 Water Level Data

In the past, water level stations have not been reviewed as part of a review program, although individual stations were examined and revised from time to time. With the creation of the LEVELS file, it was necessary to check the data being put on tape and to check the datum. For that purpose a review was conducted of all the water level stations operated by the Water Survey of Canada, but not necessarily in as much detail as desirable. Reports were not written.

Since the review of historical data is part of the annual computation procedures, water level stations should also be reviewed. The review procedure will be the same as for a streamflow station, except that many of the steps will not be necessary. Special attention should be given to the gauge datum and bench marks.

Environment Canada — Environnement Canada

Environmental Management — Gestion de l'environnement

REVIEW PROGRESS/ÉTAT DES TRAVAUX

Station name / Nom de la station ______________________ Station no. / N° de la station ______________

Year / Année	Gauge Correction / Rectification de la jauge	Form / Formule 067-2122	Discharge Hydrograph / Hydrogram. des débits	Stage disch. Curve / Courbe Haut.-débits	Daily discharge comput./Calcul des débits quoti.				Form / Formule 067-2134	Publ. Errors Noted / Erreurs de public notées	FLOW File Errors Noted / Erreurs notées du fichier FLOW
					Shift correc. / Rectif. du décalage	Open water Period / Pér. d'eaux libres	B.W. correc. / Rectif. du remous	Ice period / Période des glaces			

Remarks:
Remarques:

067-2006 Updated on/mis à jour le ______________

067-2080 Completed on/complété le ______________

067-2081 Completed on/complété le ______________

Time spent on Review / Temps consacré à l'étude ________ **man-days** / jours-hommes

Prepared by/Préparé par ______________________ **Date** ______________

WATER RESOURCES BRANCH - DIRECTION DES RESSOURCES EN EAU

067-2132M(01/80)R256

Environment Canada Environnement Canada

Environmental Management Gestion de l'environnement

SUMMARY OF REVISIONS/RÉSUMÉ DES RÉVISIONS

Station name
Nom de la station ______________________ Station No.
N° de la station ______________

Period of Record Reviewed/Période de la révision des données ____________ years/années.

Type of Data/Type de donnée	Year Année	Revised/Révisé			Remarks/Remarques
		By/Par %	From/De m^3/s	To/À m^3/s	

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