Minutes of the Hydrologic Frequency Analysis Work Group
3601 Eisenhower Ave., Alexandria, Virginia
October 16, 2002

The sixth meeting of the Hydrologic Frequency Analysis Work Group was convened at the office of Michael Baker, Jr., 3601 Eisenhower Ave., Alexandria, Virginia. The following people were in attendance:

Bill Kirby, U.S. Geological Survey
Mike Eiffe, Tennessee Valley Authority
Don Woodward
Will Thomas, Michael Baker, Jr.
Rocky Durrans, University of Alabama
Ken Bullard, Bureau of Reclamation
Jerry Coffey
Martin Becker
Zhida Song-James, Dewberry & Davis
Bill Merkel, Natural Resources Conservation Service
Joe Krolak, Federal Highway Administration

Gary Estes participated in the meeting by teleconference.

The following topics were discussed.

Membership

Will Thomas described changes in the work group membership. Bill Lane, retired Bureau of Reclamation, asked to be removed from the work group. Rick McCuen, University of Maryland, asked to be become a corresponding member. Ken Bullard commented that the Subcommittee on Hydrology (SOH) is agency oriented but the Hydrologic Frequency Analysis work group is not. Will Thomas commented that the use of agency names on the work group is just an expedient way of identifying members.

Ungaged Paper – Evaluation of Flood Frequency Estimates for Ungaged Watersheds

The following discussion was oriented toward the intended purpose of the ungaged paper.

Don Woodward noted that the SOH should make a statement as the use or purpose of the ungaged paper.

Jerry Coffey commented that guidelines cannot be enforced and he believes that "recommended practice" is softer and more applicable than guidelines in defining the purpose of the ungaged paper. He commented that the work group recommendations in the ungaged paper are not exclusive of using other methods.

Zhida Song-James noted that the majority of the work group agreed on the content of the ungaged paper but not as guidelines. She commented that the intent of the ungaged paper was already a part of FEMA's "Guidelines and Specifications for Flood Hazard Mapping Partners", http://www.fema.gov/fhm/gs_main.shtm.

Joe Krolak commented that the Federal Highway Administration would not like to see the ungaged paper as a guideline.

Bill Kirby asked the question what is the next step if rainfall-runoff model estimates are unreasonable. Bill suggested that this be given in the paper and should be included in the response to David Goldman's minority report. Will Thomas indicated that if the rainfall-runoff model estimates are considered unreasonable then the model parameters should be adjusted or regression estimates used if no hydrograph is required for the study. This is described in the ungaged paper on page 6.

Will Thomas discussed a draft response that he prepared to David Goldman's May 12, 2001 Minority Report. One minor change was made to the response to state that "The Thomas and others (2001) paper should be considered guidance for evaluating flood frequency estimates for ungaged watersheds but should not be considered a standard or guideline similar to Bulletin 17B." This revision is consistent with the discussions reported above. The response to the minority report is given as Attachment 1.

Chairman's note: The ungaged paper is on the HFAWG web site at http://water.usgs.gov/wicp/acwi/hydrology/Frequency/index.html. The minority report of David Goldman is no longer on the web page.

Frequently Asked Questions (FAQs)

Bill Kirby indicated that the latest version of the FAQs is dated October 10, 2002. A few minor editorial changes were made to the FAQs and the work group concluded that the FAQs are ready for submission to the SOH for their review.

Chairman's note: The FAQs were submitted to the SOH at the October 17, 2002 meeting and were approved for posting on the web site at their January 23, 2003 meeting. The FAQs are on the HFAWG's web site at: http://water.usgs.gov/wicp/acwi/hydrology/Frequency/index.html.

Regulated Flood Frequency

A draft document on "Regulated Flood Frequency" prepared by Rocky Durrans was discussed.

Bill Merkel commented there is a chance of the regulated flood frequency document becoming too academic. He suggested the need to keep it practical and useful for application by most engineers.

Martin Becker commented there is guidance on flood frequency analysis for small detention structures and that guidance is needed on flood frequency analyses for multi-purpose reservoirs. He indicated there was a need to identify the data required for regulated frequency analysis, relate the data to procedures or analysis approach, and describe the different levels of complexity of analyses.

Mike Eiffe gave an overview of the TVA flood risk evaluation project. This project is underway and the purpose is to evaluate changes in flood risk for various reservoir operating scenarios at 36 major dams in the Tennessee River Basin.

Bulletin 17B References

Gary Estes indicated that many of the references in Bulletin 17B are difficult to locate and many are out of print. He suggested that the HFAWG obtain should undertake the task of locating and compiling all the references and make them available to the public.

Don Woodward suggested that the HFAWG should propose to the SOH the following tasks: identify the source of the references, scan and put these references on the HFAWG web site, and/or find a more recent reference on the same topic.

Chairman's note: This new topic was proposed to the SOH at their October 17, 2002 meeting. The chairman's report that was presented at the October 17, 2002 SOH meeting is given as Attachment 2.

Will Thomas
July 22, 2003

Attachment 1.

Subcommittee on Hydrology Response to the Minority Report prepared by David Goldman, dated May 12, 2001

Background

The minority report was in the form of a memorandum from David Goldman to the Subcommittee on Hydrology (SOH). The subject of the memorandum was "Objections to Flood Frequency Work Group recommended methods for ungaged frequency analysis, a minority report." The recommended methods referred to in the minority report are from the paper "Evaluation of Flood Frequency Estimates for Ungaged Watersheds" by W. O. Thomas, Jr., M. M. Grimm, and R. H. McCuen, dated August 28, 2001. This paper was prepared on behalf of the SOH by the Hydrology Frequency Analysis Work Group (HFAWG).

In December 2001, the paper by Thomas and others (2001) and the May 12, 2001 minority report by David Goldman were both put on the web site of the HFAWG by the U.S. Geological Survey. The web site address for the HFAWG is http://water.usgs.gov/wicp/acwi/hydrology/Frequency/index.html.

At the April 25, 2002 meeting, the SOH agreed that having both papers on the web site may cause public confusion. The SOH agreed that the Thomas and others (2001) paper should remain on the web site and the minority report should be removed. It was further agreed that a response be prepared to the minority report and this response become part of the minutes of the April 25, 2002 meeting of the SOH.

The minority report implies that the Thomas and others (2001) paper constitutes **guidelines for performing** ungaged flood frequency analysis. For clarification, Thomas and others (2001) is an approach for evaluating the reasonableness of flood frequency estimates based on rainfall-runoff modes and regional regression equations. The Thomas and others (2001) paper should be considered guidance for evaluating flood frequency estimates for ungaged watershed but should not be considered a standard or guideline similar to Bulletin 17B.

Responses to minority paper

The following comments address concerns expressed in the minority report.

Concern: The value of watershed models for estimating regulated flood frequency curves is unfairly discounted in comparison to regional regression equations. The U.S. Water Resources Council (USWRC) report (1981) cannot be considered to be definitive regarding the superiority of the regression approach.

Response: The regression equations are not applicable to watersheds regulated by flood detention structures and this is noted in a few places in the Thomas and others (2001)

paper. For example, on page 4 the statement is made that "The regression equations are considered applicable for evaluating rainfall-runoff model estimates if the watershed, climatic, and urbanization characteristics for the studied streams are within the range of those of the gaging stations used to develop the equations and regulation by flood detention structures does not significantly effect flow rates." By implication, watershed models are more appropriate for watersheds regulated by flood detention structures.

The reference to the USWRC 1981 report was intended to provide motivation for why regression equations, if applicable, could be used to judge the reasonableness of rainfall-runoff model estimates. The reference to the USWRC 1981 report was not intended to demonstrate the superiority of the regression approach.

Concern: The recommended criterion for accepting watershed model estimates of flood quantiles, one standard error about the regression, is too stringent. If in fact the regression approach is presumed to be uniformly superior, then perhaps the standard error criterion should be dropped, and the **guidelines** require that a watershed model to be calibrated to the regional regression results.

Response: As stated on page 3 of Thomas and others (2001), "The standard error is recommended as a predefined error band for judging the reasonableness of flood discharges since this measure of uncertainty is easy to compute, is frequently used, is often reported in the literature and is better understood by engineers and hydrologists." As noted in the Thomas and others paper, the choice of one standard error may be revised in the future as more experience is obtained with the evaluation procedure.

The assumption of the Thomas and others paper is not that the regression approach is uniformly superior but that flood estimates from rainfall-runoff models and regression equations for the same watershed should be within one standard error of each other. Calibration of rainfall-runoff models to regression estimates is a good idea but this recommendation goes beyond the scope or objective of the Thomas and others paper.

Concern: The weighting or averaging of different estimates of ungaged frequency curves should be considered in obtaining the final estimates.

Response: As David Goldman noted in his minority report, the major objection within the work group to weighting flood estimates from watershed models and regression equations is "that there is no readily available means for quantifying watershed model prediction uncertainty". Procedures for defining watershed model prediction uncertainty need to be developed and this effort was considered beyond the scope of the Thomas and others paper, hence the weighting of flood estimates was not considered feasible at this time. The recommendation in Thomas and others (2001) is to orient future research to determining the accuracy of flood discharges estimated from rainfall-runoff models.

Concern: The standard error used to characterize the regression prediction error does not correctly account for the time-sampling error in the flood estimates from the gaged records used to obtain the regression equation.

Response: Both the standard error of estimate and prediction are given in many USGS regional flood reports and this is noted in the Thomas and others paper. The standard error of estimate does not account for the time-sampling error in the gaged records. The standard error of prediction is more indicative of the prediction accuracy of the regression equations, can be estimated in different ways and attempts to account for the time-sampling error in the gaged records. In the more recent USGS reports (since about 1990), the standard error of prediction is estimated using procedures described in the Stedinger and Tasker (1986) paper cited by David in his minority report. The procedure described in Stedinger and Tasker (1986) is now the standard within USGS for estimating the standard error of prediction and this approach does account for the time-sampling error in the gaged records.

Concern: The appropriate measure of error for an individual prediction should be obtained from split-sample testing. The standard error of the regional regression is probably not indicative of the error in the prediction of future flood exceedance at a given location.

Response: The Thomas and others (2001) paper relates to flood frequency estimates for ungaged watersheds where there are no observed annual peak data. It is not clear how split-sampling techniques would be applied to ungaged watersheds. The split-sampling testing of the USWRC referred to by David was for evaluating the prediction accuracy of flood estimates at gaged locations with many years of annual peak flow record.

The standard error of prediction estimated by procedures described in Stedinger and Tasker (1986) are considered to be reasonable estimates of the error in prediction of future flood exceedances at a given location. This approach is considered more appropriate for estimating prediction errors for ungaged watersheds than split-sampling techniques.

References

Stedinger, J. R., and Tasker, G. D., 1986, *Regional Hydrologic Analysis 2, Model-Error Estimators, Estimation of Sigma and Log-Pearson Type 3 Distributions*: Water Resources Research, Vol. 22(10), pp. 1487-1499.

Thomas, W. O., Jr., Grimm, M. M., and McCuen, R. H., 2001, *Evaluation of Flood Frequency Estimates for Ungaged Watersheds*: Hydrologic Frequency Analysis Work Group web page, http://water.usgs.gov/wicp/acwi/hydrology/Frequency/index.html.

Attachment 2. Hydrologic Frequency Analysis Work Group Report to the Subcommittee on Hydrology, October 17, 2002

The Hydrologic Analysis Frequency Work Group (HFAWG) met on October 16, 2002 at the office of Michael Baker, Jr. in Alexandria, VA. Following are issues that need direction from the Subcommittee on Hydrology (SOH):

1. Status of paper entitled "Evaluation of Flood Frequency Estimates for Ungaged Watersheds" by Thomas, Grimm and McCuen. This paper is presently posted on the HFAWG web page. The minority report by David Goldman was removed from the web page based on a decision by the SOH at the April 25, 2002 meeting. The work group believes that the SOH should have asked for an agency / organizational review of the ungaged paper and minority report before removing the minority report from the web page. Therefore, the work group recommends an agency/organizational review of the following documents and recommends that SOH make a statement as to the intended use of the Thomas and others paper:

- The paper by Thomas, Grimm and McCuen dated August 28, 2001 (http://water.usgs.gov/wicp/acwi/hydrology/Frequency/index.html),
- The minority report by David Goldman dated May 12, 2001,
- The proposed SOH response to the minority report dated October 14, 2002.

2. A list of Frequently Asked Questions (FAQs) about Bulletin 17B has been prepared by the work group. Bill Kirby, USGS, coordinated this effort. The purpose of the FAQs is to clarify and supplement guidance in Bulletin 17B. The work group is providing the FAQs to the SOH and asking for an agency / organizational review. Once approved, the FAQs will be put on the HFAWG web page.

3. The references in Bulletin 17B are getting quite dated and some are very difficult or impossible to find. The HFAWG is proposing to undertake the following task. Try to locate the source of all references in Bulletin 17B (Appendix 1). If the reference is difficult to locate for the general public, then scan this document or the pertinent portions and put it on the HFAWG web page. If the reference cannot be found, then locate a more recent reference that provides equivalent guidance. Either the scanned reference material or the new reference would be put on the HFAWG web page. The work group would like SOH approval to proceed with this effort.

4. Informational item – The work group is preparing a report on guidance for regulated flood frequency analysis. Rocky Durrans, University of Alabama, is leading this effort.

5. Informational item – Rocky Durrans became Chair of the HFAWG at the October 16, 2002 meeting and Will Thomas, Michael Baker, Jr. became Vice Chair.