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DARE HYDROLOGIC EVALUATIONS (1990-1992): FORECASTERS' ASSESSMENT OF FUNCTIONS

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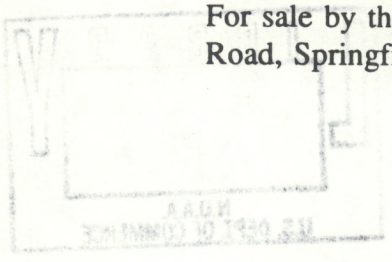

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TABLES

TERMS AND ACRONYMS

AWIPS-90	Advanced Weather Interactive Processing System for the 1990s
BAP	Basin Average Precipitation
DARE	Denver AWIPS-90 Risk Reduction and Requirements Evaluation
E-19	Memorandum E-19, a compilation of flood stage and damage data for selected headwater forecast points
FSL	Forecast Systems Laboratory
HB5ID	Handbook 5 Identifier - a station index number
NWS	National Weather Service
QPF	Quantified Precipitation Forecast
RFC	River Forecast Center
SHIMS	Service Hydrologist Information Management System
WARNGEN	Warning Generation Application Program
WSFO	Weather Services Forecast Office
WFO	Weather Forecast Office

DARE HYDROLOGIC EVALUATIONS (1990-1992): FORECASTERS' ASSESSMENT OF FUNCTIONS

Lynn E. Johnson

ABSTRACT. Hydrologic functions on the Denver AWIPS-90 Risk Reduction and Requirements Evaluation (DARE) workstation are an early realization of hydrologic forecasting tools that will be available at National Weather Service Forecast Office (WSFO/WFO) sites during the modernized era. The prototype workstation included five categories of hydrologic functions: 1) Radar-precipitation products, 2) RIVERS application, 3) HEADWATERS 'application, 4) textstation products, and 5) other hydrologic products (including WARNGEN). The hydrologic database supporting these functions contained precipitation, river stage, River Forecast Center (RFC) Guidance, and other relevant data.

The DARE realization provided the essential means to collect evaluation information even though the system was developmental and therefore not fully reliable, and the forecasters were not highly experienced in its use. The forecasters showed general willingness to participate in the evaluations providing their perspectives on the utility of the training and hydrologic functions in the operational environment.

A questionnaire for assessment of the DARE workstation was used to collect data on the forecasters' opinions of the DARE hydrologic functions. Seminars, one-on-one training and workstation exercises followed by limited on-the-job practice provided the experience base for responding to the questionnaire. The forecasters were asked to provide numerical ratings (5-point scale) on various aspects of the DARE hydrologic functions. These ratings and associated written comments constitute the primary dataset for the assessment.

Overall, the forecasters rated the DARE hydrologic functions as adequate (2.9 on the 5-point scale where a rating of 1=inadequate, 2=marginal, 3=adequate, 4=effective, and 5=exceptional). The lowest overall ratings were assigned to the data quality control and reliability factors which were rated marginal-to-adequate (2.3). The main problems cited by the forecasters concerned data quality control and reliability, and lack of experience with the hydrologic functions.

Of the five categories of hydrologic functions surveyed, the WARNGEN application was rated highest overall at more than effective (4.3). The radar-precipitation products received high ratings, at more than adequate and near the effective level (3.8). The textstation and other hydrologic products were rated between adequate and effective (3.5). The RIVERS and HEADWATERS applications were rated adequate (3.0).

The forecasters' ratings of the utility of the hydrologic functions indicated dissatisfaction with the quality and reliability of the data, and the speed of the applications. In addition to speed and data reliability, specific aspects of the functions were cited for their difficulty of access, complexity, and intermittent usage requirements. However, in general the forecasters indicated receptiveness to the DARE hydrologic functions and their their ratings and comments do not categorically condemn the content and utility of the functions. Many of the forecasters were able to use the functions and seemed willing to do so. This is evidenced by completion of the training program and questionnaire by 10 of the 13 forecasters at WSFO Denver. They were able to perform the unique interactive aspects of the functions and to make initial attempts to integrate the DARE hydrologic capabilities into their operational duties.

Recommendations developed from the forecasters' assessment includethe following. 1) Increase the speed of operation of the DARE hydrologic functions. 2) Improve the quality and reliability of the hydrologic data. 3) Complete delivery of the SHIMS (Service Hydrologist Information Management System). 4) Modify the interface to the RIVERS and HEADWATERS applications to allow more intuitive access to site-specific data and display of regionwide status (current and forecast) of the hydrologic system. Provide additional means beyond the limited color-coding of river stages for assessing critical precipitation and river stage values. 5) Develop hydrologic documentation which can be used by the forecasters to review the capabilities and interpret the data. 6) Provide additional training on a periodic basis to enhance and refresh the forecasters' knowledge of the hydrologic functions' operation and meaning per the WFO's flash flood warning responsibilities.

1. INTRODUCTION

A goal toward modernizing the NWS is to provide improved forecasts and more reliable detection and prediction of severe weather and flooding through the deployment of advanced observation, information processing, and communication technologies. Two major components of the modernization are 1) installment of advanced technologies, specifically AWIPS-90 (Advanced Weather Interactive Processing System for the 1990's) workstations and WSR-88D (Doppler Weather Surveillance Radar, 1988) in NWS offices, and 2) implementation of new forecast responsibilities. Introduction of the new technology poses challenges in the form of increased data volume and new workstation products and display capabilities.

A significant component of the modernized NWS forecasting environment will be new capabilities for hydrologic monitoring and forecasting. In addition to hydrologic display products produced by WSR-88D processing, the AWIPS workstation will have enhanced functionality for tracking precipitation and river flow amounts, as well as algorithmic support for forecasting flood magnitude and timing at the headwaters (i.e., local) scale. The hydrologic functionality of the AWIPS workstation will provide new tools to the NWS forecaster which have not been available before. Local-scale hydrologic responsibilities are expected be the norm for these National Weather Service offices. The DARE installation at WSFO Denver provided the first opportunity to use the AWIPS-like hydrological functions in an operational setting.

This report addresses the forecasters' assessment of DARE hydrologic functions and products. Forecasters' assessment covers their use of workstation functions, hydrological and other meteorological products, and application programs. The forecasters' perspectives on how these capabilities affect their ability to perform their jobs are also included. It is a companion report to two others: Assessement of DARE Hydrologic Training, and Assessment of DARE Hydrologic Forecasts.

The methodology for the evaluations included a questionnaire, observations and interviews. The questionnaire (Appendix A) was relied upon most heavily; interviews and observations were used to clarify questions. Workstation hydrologic exercises were conducted by the forecasters in association with a companion evaluation of training (Johnson, 1994). Comments obtained during completion of those exercises also applied to the subject workstation assessment and are included herein as appropriate.

2. DARE HYDROLOGIC FUNCTIONS AND PRODUCTS

2.1 Overview

The DARE hydrologic functions and applications programs included: 1) NEXRAD-type (NEXt-Generation RADar) precipitation products, 2) RIVERS application, 3) HEADWATERS application, 4) Textstation products, and 5) other hydrologic products (e.g., model products, WARNGEN). A subset of the DARE hydrological functions were first established during the summer season 1991, and were operationally available during the summer season 1992. A training program, conducted by the Service Hydrologist during the period 1990-1992, familiarized the forecasters with the DARE hydrologic functions so that these functions could be used operationally during the summer season 1992. The questionnaire forming the primary evaluation data was issued in the fall 1992.

2.2 DARE Functions and Products

The DARE workstation is designed to be an easy-to-use tool for accessing and manipulating large quantities of hydrometeorological data. Various hydrologic data display and forecasting algorithms have been developed and integrated into the workstation functionality, including: Mile High Doppler radar precipitation processing sequence (PPS), the RIVERS river stage and precipitation data display application, the HEADWATERS site-specific hydrologic forecast application, text station, and other hydrologic products (including WARNGEN). These hydrologic applications programs are representative of the state-of-the-art for

advanced flood warning that will be available as part of the AWIPS. However, the AWIPS is expected to have extended capabilities beyond those of the DARE prototype as hardware and software performance is enhanced.

2.2.1 Radar Precipitation Functions and Products

The radar algorithms seem particularly important for determining precipitation amounts in space and time. The radar PPS sequence consists of three algorithms that use the Doppler radar reflectivity data and rain gage reports to produce high-resolution rainfall accumulation products. These products include: total storm accumulation, 3-hour storm accumulation, and 1-hour storm accumulation. The products were displayable as color graphic images showing the spatial distribution of estimated rainfall amounts.

2.2.2 RIVERS Application

The RIVERS application provides a capability for assessing the hydrologic state of the forecast area by providing atlas-type data access and displays. RIVERS has four main sub-functions:

- o a time series (hydrograph) plot of observed and forecast river stages and discharges for individually selected river stations in a basin. Also displayed are E-19 flood damage data and the 10 highest floods of record,
- o precipitation map plot for precipitation stations in a basin group,
- o river stage map plot for river stations in a basin group,
- o rating table and rating curve plot for individually selected river stations in a basin group.

The RIVERS application uses the standard WFO map background displays, providing the capability to overlay any of the standard WFO-scale graphics and image products. Selected examples of these displays are included in Appendix B.

2.2.3 HEADWATERS Application

The primary function of the HEADWATERS application is to provide a site-specific hydrologic forecast for a headwater basin. The application uses the NWS ADVIS hydrologic forecast model to convert a forecaster-entered basin average rainfall to a forecast hydrograph for a particular headwater forecast point. The ADVIS model uses the Headwater Guidance (denoted as FFH) produced by the RFC. (Note: Not all RFCs issue headwater guidance, in which case the model defaults to county flash flood guidance (FFG) to compute the appropriate antecedent index (AI) and subsequently the excess rainfall available for runoff.) The unit hydrograph is then used to convert the computed runoff to a forecast outflow hydrograph at the headwater forecast point. The rating table is then used to convert the outflow hydrograph to a stage hydrograph. The primary output of the ADVIS model is a forecast hydrograph, with associated E-19 and historical flood information. Appendix B contains some examples of data displays obtained using the HEADWATERS application.

Simplifications used in the ADVIS model make its use appropriate for only relatively small headwaters basins having a time to crest within 6 hours of rainfall incidence. Rainfall is assumed uniform over the basin. Routing of a flood wave from upstream points in a basin to a downstream point is not supported by the model.

2.2.4 Text Station Hydrologic Products

In addition to hydrologic data and applications accessible through the DARE graphics and image display subsystem, the forecasters could also access selected products through the text subsystem. The text subsystem is a text retrieval and editing system used to call up alphanumeric and tabular forecast data as part of warning message preparation. The text editor provides the primary means for final message formulation dissemination. Products include the RFC guidnace values which are also available as a graphic.

2.2.5 Other Hydrologic Functions and Products

Other hydrologic products and applications are accessible on the workstation. These products include some that were formerly available as AFOS products and are now made available as graphic products on DARE. They include graphic displays of RFC flash flood guidance, QPF (Quantified Precipitation Forecasts), surface

products, and model products generated by NMC (National Meteorological Center). The topographic and road map background displays are also included in this product grouping. The Warning Generation Application (WARNGEN), which generates draft computer worded messages, is used for flash flood warnings and watches.

3. FORECASTER ASSESSMENT OF DARE HYDROLOGIC FUNCTIONS

3.1 Methodology

Denver WSFO forecasters assessed the DARE hydrologic functions using a questionnaire survey (Appendix A). The questionnaire was developed as a cooperative effort with the Denver WSFO Service Hydrologist, the NWS Central Region Hydrologist, and other staff interested in the workstation hydrologic topics. The questionnaire was divided into three main sections: utility of DARE for conducting WSFO hydrologic duties, specific DARE hydrologic applications and graphics (i.e. Mile High radar precipitation products, RIVERS, HEADWATERS, textstation products, and other hydrologic products), and DARE performance assessment. A fourth section of the questionnaire asked for recommendations for modifications to the DARE hydrologic products, applications, and graphics.

After developing and pilot testing, the questionnaires were distributed to the Denver WSFO forecasters during September 1992 and collected after one month. The timing was selected to occur after a full season of workstation use so the forecasters were afforded various training opportunities and on-line access during heavy precipitation events. Assessment of the hydrologic training activities was also a part of the questionnaire survey and results of the training assessment are addressed in a separate NOAA Technical Memorandum (Johnson, 1994). Responses to the questionnaire were tabulated, the ratings were statistically analyzed and the comments were summarized. Both descriptive and inferential statistical analyses were performed. The former summarizes questionnaire responses and the latter tests significance of differences. Comments offered by the forecasters were collated and sorted, and used as a supplement to other data.

3.2 Analysis

The forecasters were asked a series of questions on their hydrologic background (Appendix A). Overall, the forecasters had an average 11 years experience with the NWS (10/11/5.3; number of responses/average/ standard deviation), ranging from a high of 20 years to a low of 4 years. One-half (6 of 12 responding) of the forecasters had taken a 15-week college-level course on hydrology, and almost all (11 of 12) indicated they had received NWS hydrologic training at some point during their career.

On average the forecasters reported devoting approximately 60 hours to hydrology training (not counting formal training in college). Training time using the workstation hydrologic functions was estimated to be approximately 10 hours (one-on-one and workstation exercises) with on-the-job practice extending the training time estimates from 8 to 40 additional hours. Assessment of the training was addressed in the NOAA Technical Memorandum covering "Assessment of Training." An outcome of that work showed that these training times were minimally appropriate to attain a beginner-to-intermediate capability with the DARE hydrologic functions.

3.3 Results

3.3.1 Overall Assessment of Functions and Products

The forecasters were asked to assess the overall utility of the DARE hydrologic functions for supporting WSFO duties. Hydrologic duties include: monitoring and quality control of hydrologic data and related products; identification and resolution of hydrologic problems; and formulation and issuance of hydrologic products. Assessment was made on a numerical scale using ratings from 1 to 5 (1 = inadequate, 2 = marginal, 3 = adequate, 4 = effective, 5 = exceptional). Table 1 presents results of statistics obtained from the forecasters' ratings of overall utility.

Over all entries the forecasters rated the DARE hydrologic functions as adequate (10/2.9/0.9). Highest mean ratings were assigned for identifying main stem problems (10/3.2/0.7), issuing products (11/3.1/0.9), and

identifying headwater problems (10/3.0/0.6). Lowest mean ratings were assigned to quality control of data and products (12/2.3/0.8).

The forecasters' comments provided some details on the overall assessment of the DARE hydrologic functions. The comments were categorized into three groupings: quality control and reliability, applications, and training. Comments on the applications are summarized in sections relating to those applications. The forecasters' comments on quality control and reliability of the hydrologic functions included the following concerns: 1) except for Doppler precipitation, there was a lack of up-to-date data, 2) the data were not always updated in timely manner and sometimes were difficult to read or appeared to be erroneous, especially some of the E-19 data; and 3) they could not always determine if the data were representative of real usable values, or were improperly coded. It is noteworthy that the frequency of data updating for many products was 6 hours as established by RFC procedures. While this was not an inherent aspect of the DARE workstation, it does represent the overall system capabilities to which the forecasters had some negative reaction.

The forecasters' comments on training and experience in the use of hydrological functions are covered in the NOAA Technical Memorandum on "Assessment of Training." However, some forecasters expressed frustration regarding lack of experience using a fully operational system during heavy rainfall and flooding events. Thus, some of them suggested that their answers were based on very general observations, and that it was too early for such questions given their lack of experience.

TABLE 1

OVERALL UTILITY RATINGS FOR DARE HYDROLOGIC FUNCTIONS

Category of Hydro Duties	Utility Rating				
	Count	Avg.	Std.D.	Max	Min
Monitoring data & products.	12	2.8	0.8	4	2
Quality control of data & prods.	12	2.3	0.8	4	1
Identifying main stem problems.	10	3.2	0.7	4	2
Identifying headwater problems.	10	3.0	0.6	4	2
Evaluating RFC forecasts.	11	2.6	0.9	4	1
Eval. and using RFC Guidance.	10	2.9	1.0	4	1
Issuing products	11	3.1	0.9	4	2
Reducing workload.	12	2.8	0.6	4	2
Overall utility for duties.	12	2.9	0.9	4	2
All entries	100	2.8	0.9		

3.3.2 Mile High Radar Precipitation Products

The forecasters were asked to provide assessment ratings on various aspects of the Mile High Radar precipitation products; including the 1-hour accumulation, 3-hour accumulation, and total storm accumulation. A rating on the five-point scale (i.e. 1=Inadequate, 2=Marginal, 3=Adequate, 4=Effective, and 5=Exceptional) was to be assigned for the following assessment attributes: ease of use, accuracy, quality, reliability, timeliness, and utility, all of which were defined for the respondents (see Appendix A).

Table 2 presents summary statistics for the forecasters' product assessment ratings. Compared to other hydrologic products (i.e., RIVERS, HEADWATERS, and Other Products), the radar precipitation products were rated highest. For example, the total storm precipitation (72/3.8/0.8) was rated higher than any of the RIVERS products (e.g., Basin stream stages (66/3.0/1.0)), or the HEADWATERS products (e.g., ADVIS Forecast Hydrograph (55/3.1/0.6). The Other Products and Applications category received ratings equivalent to the radar precipitation products. Overall the WARNGEN application received the highest ratings (72/4.3/0.7).

Comparing the overall ratings for the three products, the average ratings (3.9,3.6,3.8) uniformly fell between adequate and effective. Comparing across assessment attributes, highest ratings were given for ease-of-use (12/4.4/0.5). The radar precipitation products uniformly received adequate-to-effective overall ratings (3.6 to 3.8). Mean ratings for accuracy, quality, reliability, timeliness, and utility also fell in the range 3.4 to 4.1, which averages more than adequate.

TABLE 2

ASSESSMENT RATINGS FOR MILE HIGH RADAR PRECIPITATION PRODUCTS

Precip. Product	Forecaster's Ratings (5 pt. scale)				
	Count	Avg.	Std.D.	Max	Min
1-hour accumulation					
Ease of use	12	4.4	0.5	5	4
Accuracy	12	3.7	0.5	4	3
Quality	12	3.8	0.7	5	3
Reliability	12	3.5	0.8	5	2
Timeliness	12	3.8	0.8	5	2
Utility	12	4.1	0.9	5	2
Overall rating	72	3.9	0.8		
3-hour accumulation					
Ease of use	11	4.4	0.5	5	4
Accuracy	11	3.5	0.7	4	2
Quality	11	3.8	0.7	5	3
Reliability	11	3.4	1.1	5	1
Timeliness	11	3.4	1.0	5	1
Utility	11	3.4	0.9	5	2
Overall rating	66	3.6	0.9		
Total storm accumulation					
Ease of use	12	4.4	0.5	5	4
Accuracy	12	3.6	0.5	4	3
Quality	12	3.8	0.7	5	3
Reliability	12	3.5	0.9	5	2
Timeliness	12	3.8	0.8	5	2
Utility	12	3.8	0.9	5	2
Overall rating	72	3.8	0.8		

The forecasters were asked to rate the extent to which the radar-precipitation products allow: Flash flood problem assessment (11/4.0/0.7), River flood problem assessment (11/3.5/0.7), and Formulation of flood/flash flood products (11/3.8/0.6). The radar-precipitation products were rated as effective for flash flood assessment and adequate-to-effective for river flood problems. A better-than-adequate rating was also assigned for the extent to which the radar-precipitation products allowed formulation of flood products.

The forecasters' comments were generally favorable toward the radar precipitation products, although they did list some concerns. For example, even though there were situations where ground truth and derived data did not match, the radar products at least gave a sense of the situation. Other comments concerned a need for more cases of actual flash flooding, more frequent display updates are needed, and the 3-hour PCPN displays were considered very similar to the storm total. One forecaster suggested that the MHR PCPN displays could be very helpful for putting data into HEADWATERS application.

3.3.3 RIVERS Application

The forecasters were asked to provide assessment ratings and comments on various information displays obtainable from the RIVERS application: basin rainfalls, basin stream stages, stage hydrograph, stage-discharge rating table, and E-19 information. Ratings were to be applied using the five-point rating scale.

Table 3 presents summary statistics for the forecasters' RIVERS assessment ratings. Of the five information displays, the E-19 information received the highest overall ratings at the adequate-to-effective level (65/3.5/0.7). The basin rainfalls received the lowest ratings at less than adequate (66/2.7/1.0). Ratings for the information displays on basin stream stages, stage hydrograph and stage-discharge rating table were grouped closely at the adequate level.

Taken individually and in order, the basin rainfalls received highest average ratings for ease-of-use (11/3.3/0.6). All of the other attributes received less-than-adequate ratings; reliability (11/2.5/1.0), timeliness (11/2.5/1.0) and accuracy (11/2.6/1.1).

The basin stream stages display received highest average ratings for ease-of-use (11/3.3/0.6). A less-than-adequate rating was assigned for the timeliness of basin stream stages (11/2.5/1.0). The stage hydrograph display received highest ratings for ease-of-use (11/3.2/0.7). A less-than-adequate rating was assigned for timeliness of the stage hydrograph product (11/2.5/1.0). The stage-discharge rating table display received approximately adequate ratings across all assessment attributes.

The E-19 information display received the highest ratings of any within the RIVERS with all attributes being rated at more-than-adequate. The accuracy of the E-19 information received the highest rating within RIVERS (11/3.8/0.7). The other average ratings were 3.4 or 3.5.

The forecasters were asked to rate the extent to which the RIVERS application allows for: assessment of main-stem river problems (9/3.2/0.4), evaluation of RFC stage and crest forecasts (9/2.8/0.8), and formulation of high quality river flood products (9/3.0/0.5). The average ratings obtained for these assessment factors were generally at the adequate level.

Comments offered by the forecasters were generally critical of the speed and accessibility of the application, the reliability of the data, the age or lack of data for many stations, and the confusing format of the display. Also, a lack of familiarity with RIVERS was cited by some forecasters; more experience with real cases and more training were cited as the way to address this shortcoming.

3.3.4 HEADWATERS Application

The forecasters were asked to provide assessment ratings on various aspects of the HEADWATERS application program; including: ADVIS station selection, basin average precipitation, and ADVIS forecast hydrograph. A rating for the assessment attributes was assigned on the five-point scale (Appendix A).

TABLE 3

ASSESSMENT RATINGS FOR RIVERS APPLICATION

Product	Forecaster's Ratings (5 pt. scale)				
	Count	Avg.	Std.D.	Max	Min
Basin Rainfalls					
Ease of use	11	3.3	0.6	4	2
Accuracy	11	2.6	1.1	4	1
Quality	11	2.8	1.0	4	1
Reliability	11	2.5	1.0	4	1
Timeliness	11	2.5	1.0	4	1
Utility	11	2.7	1.1	4	1
Overall rating	66	2.7	1.0		
Basin Stream Stages					
Ease of use	11	3.3	0.6	4	2
Accuracy	11	3.0	1.0	4	1
Quality	11	3.0	1.0	4	1
Reliability	11	2.8	1.0	4	1
Timeliness	11	2.5	1.0	4	1
Utility	11	3.1	1.0	4	1
Overall rating	66	3.0	1.0		
Stage Hydrograph					
Ease of use	11	3.2	0.7	4	2
Accuracy	11	3.0	1.0	4	1
Quality	11	3.0	1.0	4	1
Reliability	11	2.8	1.0	4	1
Timeliness	11	2.5	1.0	4	1
Utility	11	3.1	1.0	4	1
Overall rating	66	2.9	1.0		
Stage-Discharge Rating Table					
Ease of use	11	3.2	0.7	4	2
Accuracy	11	3.1	1.1	4	1
Quality	11	3.2	0.9	4	1
Reliability	11	2.9	1.1	4	1
Timeliness	11	3.0	1.1	4	1
Utility	11	3.1	1.1	5	1
Overall rating	66	3.1	1.0		
E-19 Information					
Ease of use	11	3.4	0.6	4	2
Accuracy	11	3.8	0.7	5	3
Quality	11	3.4	0.6	4	2
Reliability	11	3.5	0.8	5	2
Timeliness	10	3.5	0.8	5	2
Utility	11	3.5	0.8	5	2
Overall rating	65	3.5	0.7		

Table 4 presents summary statistics for the forecasters' HEADWATERS assessment ratings. Overall, the HEADWATERS application was rated as adequate. The ADVIS station selection received the highest overall rating (58/3.4/0.7). The basin average precipitation (BAP) received the lowest ratings at slightly less than adequate (66/2.8/0.8). The BAP assessment attributes receiving the lowest ratings were those for accuracy (11/2.5/0.9), reliability (11/2.6/0.8) and timeliness (11/2.6/0.7). (Note: The forecasters were required to estimate the BAP themselves, and then enter the BAP values into the HEADWATERS application. Thus the ratings for BAP accuracy and timeliness may have reflected their ability to accomplish this. The ADVIS forecast hydrograph received generally adequate ratings overall (55/3.1/0.6).

TABLE 4

ASSESSMENT RATINGS FOR HEADWATERS APPLICATION

Product	Forecaster's Ratings (5 pt. scale)				
	Count	Avg.	Std.D.	Max	Min
ADVIS Station Selection					
Ease of use	10	3.2	0.7	4	2
Accuracy	9	3.6	0.7	5	3
Quality	10	3.6	0.7	4	2
Reliability	10	3.3	0.6	4	2
Timeliness	9	3.4	0.5	4	3
Utility	10	3.3	0.6	4	2
Overall rating	58	3.4	0.7		
Basin Average Precipitation					
Ease of use	11	3.0	0.4	4	2
Accuracy	11	2.5	0.9	4	1
Quality	11	3.0	1.0	4	1
Reliability	11	2.6	0.8	4	1
Timeliness	11	2.6	0.9	4	1
Utility	11	2.8	0.7	4	1
Overall rating	66	2.8	0.8		
ADVIS Forecast Hydrograph					
Ease of use	9	3.2	0.4	4	3
Accuracy	9	3.0	0.5	4	2
Quality	10	3.3	0.8	4	2
Reliability	9	2.8	0.6	4	2
Timeliness	9	3.1	0.6	4	2
Utility	9	3.1	0.6	4	2
Overall rating	55	3.1	0.6		

The forecasters were asked to rate the extent which the HEADWATERS application allows for: assessment of headwater flood problems (8/3.0/0.5), assessment of RFC headwater guidance (8/2.6/0.7), and development of high quality flash flood products (8/3.1/0.6). Overall the ratings were adequate although the assessment was less than adequate for RFC headwater guidance.

A question was asked on the extent to which the ADVIS model supported issuing site-specific stage forecasts. The responses indicated ADVIS was in general adequate for this purpose (8/2.9/1.7), although the high variability indicated some disparity of opinion perhaps attributable to lack of operational use of ADVIS.

Comments offered by the forecasters emphasized lack of familiarity with ADVIS, the speed of the application., and problems with accessing the data. The application required too many keystrokes to get to the data, and the entry of hourly precipitation estimates was considered ponderous. Data displays were criticized as being difficult to read and a basin display of site names was requested. One forecaster said the HEADWATERS application will be the best hydrologic forecasting tool available.

In connection with the training evaluation, the forecasters were asked which aspects of the DARE hydrologic functionality were the most difficult and why. The responses primarily cited the RIVERS and HEADWATERS applications as being the most difficult because of the complicated menu structure, number of options and lack of day-to-day experience.

3.3.5 Textstation Products and Applications

The forecasters were asked to provide assessment ratings and comments on the textstation products and applications, including RFC guidance (text), and the text editor.

Table 5 presents summary statistics for these assessments. The RFC guidance text product(s) received an adequate rating overall (54/3.0/0.9). The highest average rating for this category was for ease-of-use (9/3.8/0.8), while lower ratings were assigned for accuracy (9/2.8/0.9), reliability (9/2.7/0.8), timeliness (9/2.9/0.7) and utility (9/2.8/0.8). The textstation editor was rated overall at adequate-to-effective (51/3.6/0.8).

The forecasters were asked to rate the extent to which the textstation products and applications allow for development of high quality flood products. The assigned ratings were in the adequate-to-effective range (10/3.5/0.8).

The forecasters' comments ranged from general acceptance of the textstation products and criticism of the editor. Some had difficulty finding the RFC Guidance products and the five letter identifier code.

TABLE 5

ASSESSMENT RATINGS FOR TEXTSTATION HYDROLOGIC PRODUCTS

Product	Forecaster's Ratings (5 pt. scale)				
	Count	Avg.	Std.D.	Max	Min
RFC Guidance (Textstation)					
Ease of use	9	3.8	0.8	5	2
Accuracy	9	2.8	0.9	4	1
Quality	9	3.0	1.1	5	1
Reliability	9	2.7	0.8	4	1
Timeliness	9	2.9	0.7	4	2
Utility	9	2.8	0.8	4	1
Overall rating	54	3.0	0.9		
Text Editor					
Ease of use	9	3.6	0.8	4	2
Accuracy	7	3.6	0.7	4	2
Quality	9	3.8	0.8	5	2
Reliability	9	3.9	0.9	5	2
Timeliness	8	3.6	0.7	4	2
Utility	9	3.7	0.8	5	2
Overall rating	51	3.6	0.8		

3.3.6 Other Hydrologic Products

The forecasters were asked to provide ratings and comments on other hydrologic products available in the DARE system, including: RFC flash flood guidance, QPF graphics from NMC, Surface products, Model products, Topographic map background, Road map background, and the WARNGEN application.

Table 6 presents summary statistics for these assessments. Comparing across products the WARNGEN received the highest ratings at the effective-to-exceptional level (72/4.3/0.7). This was the highest rating for any hydrometeorologic product/application on the workstation. Other hydrologic products having overall average ratings at the adequate-to-effective level included the model products (71/3.7/0.8), surface products (72/3.6/0.8), topographic map background (70/3.4/1.1), road map background (70/3.3/1.3) and QPF graphic (60/3.2/0.9). The lowest rating at the adequate level was assigned to the RFC guidance graphic (66/3.0/0.9).

The forecasters were asked to rate the extent to which these other hydrologic products contribute to development of high quality flood products. The response was at the adequate-to-effective level (11/3.5/0.8).

The forecasters rated the extent to which the WARNGEN application allows for development of high quality hydrology products at better-than-effective (11/4.3/0.6). Ratings on the extent to which WARNGEN reduced workload indicated that it somewhat reduced workload (11/3.7/1.9). The forecasters indicated that moderate-to-few modifications are required to make the WARNGEN output acceptable.

The forecasters added specific comments to their ratings, as follows:

- o The RFC flash flood guidance ignores new rainfall (within past 12-24 hours) and should be updated more often.
- o The number of locations in the WARNGEN warning could be reduced.
- o The call-to-action section of the WARNGEN text could be reduced in length.
- o Data access is convoluted.

3.3.7 DARE Performance Assessment Relative to AFOS

The forecasters were asked to provide an overall assessment of the DARE hydrologic package performance relative to AFOS. The assessment was obtained by rating the DARE versus AFOS performance using the five-point rating scale and applied to the following attributes:

- o Ease of use (10/4.2/1.0),
- o Accuracy (10/3.1/1.4),
- o Quality of flood and flash flood products (10/3.7/0.8),
- o Timeliness (10/3.9/1.3),
- o Utility for river products (10/3.7/0.8),
- o Utility for flash flood products (10/3.9/0.7),
- o Availability (10/4.0/1.1), and
- o Overall comparison (10/4.4/0.7).

The ratings' scores are summarized in Table 7. Overall, the DARE system was rated as effective-to-exceptional in comparison to AFOS. The ease of use and availability also were rated at the effective level. The lowest rating of adequate was assigned for accuracy. The remaining attributes for product quality, timeliness, and utility were assigned ratings at better than adequate relative to AFOS.

An additional rating was requested on the extent to which the DARE system enhanced overall service to the public in comparison to AFOS. Here, the DARE system received a rating of more-than-effective (10/4.3/0.7).

Comments by the forecasters indicated agreement that the DARE system is clearly superior to AFOS, but that improvements could still be made.

TABLE 6

ASSESSMENT RATINGS FOR OTHER HYDROLOGIC PRODUCTS

Product	Forecaster's Ratings (5 pt. scale)				
	Count	Avg.	Std.D.	Max	Min
RFC Guidance (Graphic)					
Ease of use	11	3.9	0.5	5	3
Accuracy	11	2.5	0.9	4	1
Quality	11	3.1	1.0	5	1
Reliability	11	2.9	0.8	4	2
Timeliness	11	3.0	0.7	4	2
Utility	11	2.6	0.8	4	1
Overall rating	66	3.0	0.9		
QPF Graphic					
Ease of use	10	3.9	0.5	5	3
Accuracy	10	3.1	0.7	4	2
Quality	10	3.3	0.9	5	2
Reliability	10	3.1	0.9	5	2
Timeliness	10	2.9	0.7	4	2
Utility	10	2.9	0.8	4	1
Overall rating	60	3.2	0.9		
Surface Products					
Ease of use	12	3.4	0.6	5	3
Accuracy	12	3.6	0.9	5	2
Quality	12	3.5	0.8	5	3
Reliability	12	3.5	0.8	5	2
Timeliness	12	3.6	0.8	5	2
Utility	12	4.1	0.5	5	3
Overall rating	72	3.6	0.8		
Model Products					
Ease of use	12	4.1	0.5	5	3
Accuracy	11	3.5	0.8	5	2
Quality	12	3.8	0.7	5	3
Reliability	12	3.5	0.8	5	2
Timeliness	12	3.4	0.9	5	2
Utility	12	3.7	0.7	5	2
Overall rating	71	3.7	0.8		
Topo Map Background					
Ease of use	12	3.7	0.7	5	2
Accuracy	12	3.4	1.2	5	1
Quality	12	3.3	1.2	5	1
Reliability	11	3.5	1.1	5	1
Timeliness	11	3.5	1.0	5	1
Utility	12	3.3	1.1	5	1
Overall rating	70	3.4	1.1		
Road Map Background					
Ease of use	12	3.6	0.9	5	2
Accuracy	12	3.3	1.4	5	0
Quality	12	3.1	1.5	5	0
Reliability	11	3.2	1.5	5	0
Timeliness	11	3.5	1.0	5	1
Utility	12	3.3	1.4	5	1
Overall rating	70	3.3	1.3		
WARNGEN Application					
Ease of use	12	4.6	0.5	5	4
Accuracy	12	4.2	0.6	5	3
Quality	12	4.1	0.6	5	3
Reliability	12	4.1	0.6	5	3
Timeliness	12	4.3	0.7	5	3
Utility	12	4.4	0.8	5	3
Overall rating	72	4.3	0.7		

TABLE 7

ASSESSMENT RATINGS ON DARE PERFORMANCE VERSUS AFOS

Performance Attribute	Forecaster's Ratings (5 pt. scale)				
	Count	Avg.	Std.D.	Max	Min
Ease of use	11	4.2	0.9	5	2
Accuracy	10	3.4	1.0	5	1
Quality of products	11	3.5	0.9	5	2
Timeliness of products	11	3.6	1.5	5	1
Utility of river prods	11	3.5	1.1	5	1
Utility of FF prods	11	3.6	1.1	5	1
Availability	11	3.7	1.4	5	1
Overall performance	11	4.2	0.9	5	2

3.4 Recommended Modifications to DARE Hydrologic Products

The forecasters were provided an open-ended opportunity to make recommendations for modifications to the DARE hydrologic products and applications. The forecasters clearly stated need for increased speed and reliability of the product display and applications. There were also suggestions that the menu structures for accessing the data be simplified, and that a map-oriented display of forecast river stages be provided that updates automatically and can be looped. Accessing the RIVERS and HEADWATERS applications was identified as being too involved and cumbersome, and having too many options. There were comments requesting inclusion of all data sources in the workstation, such as from local raingage networks. This could be attained in part by completing delivery of the SHIMS (Service Hydrologist Information Management System) so the database could be augmented and edited. Also, there were suggestions that complete documentation be provided to explain the hydrologic function operations and background.

During a followup interview with the Service Hydrologist it was suggested that the interface to RIVERS and HEADWATERS be modified to be a map interface in which the forecaster could point to a gage location on the display, and then obtain a window of basic information on the site and a menu of data selection/application options.

4. SUMMARY AND RECOMMENDATIONS

4.1 Summary

The forecasters indicated general willingness to participate in the evaluation. Ten of the 12 forecasters responding to the questionnaire provided complete responses. The remaining two responses were not fully completed due to cited lack of experience with the DARE hydrologic functions and concerns with the performance of the functions. It is suggested that the forecasters' responses must be viewed in the context of their level of expertise and the maturity of the DARE hydrologic functions. Although the system is developmental and therefore not fully reliable and the forecasters are not fully experienced in its use, the realization did provide information useful for evaluation.

Overall, the forecasters rated the DARE hydrologic functions as adequate (2.9 on the 5-point scale where a rating of 3=adequate). The lowest overall ratings were assigned to the data quality control and reliability factors which were rated marginal-to-adequate (2.3). The main problems cited by the forecasters concerned the data quality control and reliability, and lack of experience using the hydrologic functions.

Of the five types of hydrologic functions surveyed, the radar-precipitation products received the highest ratings, at near the effective level (3.8). The textstation and other hydrologic products were rated between adequate and effective (3.5), and the RIVERS and HEADWATERS applications were rated adequate (3.0). The WARNGEN application was rated highest overall at more than effective (4.3).

In general, the forecasters indicated receptiveness to the DARE hydrologic functions. Their ratings of the utility of the available realization indicate dissatisfaction with the quality and reliability of the data, and the speed of the applications. However, their ratings and comments do not categorically condemn the content and utility of the functions. In addition to speed and data reliability, specific aspects of the functions are cited for their difficulty of access, complexity, and intermittent usage requirements.

Conversely, many of the forecasters were able and willing to use the functions. This is evidenced by completion of the training program and questionnaire by 10 of the 13 forecasters at WSFO Denver. They were able to perform the unique interactive aspects of the functions and to make initial attempts to integrate the DARE hydrologic capabilities into their operational duties.

4.1.1 Radar-Rainfall Products

The radar-rainfall products had overall average ratings of nearly effective in general with all factors receiving rating greater than 3.4. The ease-of-use factor received the highest rating at effective-to-exceptional (4.4). The radar-rainfall products were useful even if the ground truth is suspect because it shows overall patterns of a storm. It was observed that the radar-rainfall products were appropriate for flash flood situations and suggested that the products be used to provide the rainfall inputs to the HEADWATERS application.

4.1.2 RIVERS Application

The RIVERS application was rated as adequate (3.0). The highest rated component of RIVERS was the E-19 information (3.5). The RFC stage and crest forecasts were rated slightly less-than-adequate (2.8). Primary concerns were associated with data timeliness, accuracy, and reliability which were rated as less-than-adequate (2.5). Although cited as being straightforward to use, the forecasters indicated dissatisfaction with the slow speed, and (often) erroneous data in the RIVERS application.

4.1.3 HEADWATERS Application

The HEADWATERS application was rated as adequate (3.1). The lowest rated component of HEADWATERS was the basin average precipitation at slightly less-than-adequate (2.8). Some forecasters noted that is was tedious entering the BAP estimates into the menu boxes and that these estimates were not very accurate. HEADWATERS was criticized for being too slow and inaccessible via the menu tree. Also, a lack of experience with the application and its underlying theory was noted by several forecasters.

The applications RIVERS and HEADWATERS were cited as being the most difficult during the forecasters' evaluation of workstation exercises. The applications are highly interactive and unique in format in comparison to other products and operations on the workstation. They require user initiation to obtain site specific data and application access, direct entry of input data, and graphical review of application results. Also, interpretations of hydrological data and analysis results are new to the forecasters and operational requirements for such are intermittent. In spite of these impediments, the forecasters seemed willing to attempt to use hydrological functions, and to consider how the information obtained could be used during operations.

4.1.4 Textstation

The textstation hydrologic functions included the RFC Guidance (as text) and the text editor. General satisfaction with the RFC Guidance text product was indicated by its rating of adequate (3.0). Concerns were expressed with the relevance of the RFC Guidance data after rainfall has occurred in the forecast region. Also, the forecasters do not access the RFC guidance on the textstation when it is available as a map graphic. The textstation editor was rated as adequate-to-effective (3.6), although one forecaster commented that it was subpar.

4.1.5 Other Hydrologic Products

In the category of other hydrologic products the WARNGEN application was rated at more-than-effective (4.3). Following WARNGEN in decreasing order of ratings were surface products (3.7), model products (3.6), topographic map background (3.4), road map background (3.3), QPF (3.2) and RFC flash flood guidance (3.0).

4.1.6 DARE versus AFOS

The DARE hydrologic functions were rated effective-to-exceptional (4.4) in comparison to the AFOS. Although rated as adequate (3.0) for accuracy and cited for needed improvements, the DARE system was rated at more-than-effective (4.3) for enhancement of overall service to the public.

4.2 Recommendations

Recommendations on the DARE hydrologic functions are derived from the forecasters' ratings and comments.

o Increase the speed of operation of the DARE hydrologic functions, especially the RIVERS and HEADWATERS applications. The utility of the DARE system to support continuing and additional evaluations is conditioned on its speed of operation and quality of the data.

o Improve the quality and reliability of the hydrologic data. Provide quality control of data posted to the hydrologic database to minimize erroneous data. Incorporate local data sources, such as those obtainable from the ORAT PC, in the hydrologic database.

o Complete the delivery of the SHIMS (Service Hydrologist Information Management System) so that the Service Hydrologist can upgrade and maintain the static elements of the hydrologic database.

o Modify the interface to the RIVERS and HEADWATERS applications to allow more intuitive access to site-specific data and display of regionwide status (current and forecast) of the hydrologic system. Provide additional means beyond the limited color coding of river stages for assessing critical precipitation and river stage values.

o Develop hydrologic products and applications documentation that can be used by the forecasters to review the capabilities and interpret the data.

5. REFERENCES

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6. ACKNOWLEDGMENTS

The participation of the Denver WSFO forecasters and support of WSFO management are gratefully acknowledged. The cooperation and insights of Larry Tunnell, the Denver WSFO Service Hydrologist, were instrumental in the development and interpretation of the evaluations. The hydrologic evaluation activities were conducted with oversight by Larry Mooney, Meteorologist-In-Charge, and Marvin Maddox, Deputy Meteorologist-In-Charge at the Denver WSFO. The efforts of Scott O'Donnell, Ed May, Robert Tibi and other FSL staff in developing the workstation hydrologic functions are also gratefully acknowledged. Lee Larson, Central Region

Hydrologist, and the Norman Evaluation Committee on Hydrology provided important input on the questionnaire design. Other members of the FSL Evaluation Team, including William Roberts, Cindy Lusk, and Patrice Kucera helped design the questionnaire and provided review comments. Karen Medde of the University of Colorado at Denver assisted in developing the exercises and other analysis tasks.

APPENDIX A

FORECASTERS' ASSESSMENT OF HYDROLOGIC FUNCTIONS

QUESTIONNAIRE

SEPTEMBER 1992

WSFO DENVER HYDROLOGIC TECHNICAL EVALUATION

STAFF ID CODE _____ Date _____

The purpose of this evaluation is to obtain information on hydrologic aspects of the DARE workstation; including assessment of DARE hydrologic applications and product quality and hydrologic training. The topic organization is:

A. DARE HYDROLOGIC APPLICATIONS AND GRAPHICS
   A.1.UTILITY OF DARE FOR CONDUCTING HYDROLOGIC DUTIES
   A.2 SPECIFIC DARE HYDRO APPLICATIONS AND GRAPHICS
   A.3 DARE HYDRO FUNCTION PERFORMANCE ASSESSMENT
   A.4 RECOMMENDATIONS FOR MODIFICATIONS TO DARE HYDROLOGIC FUNCTIONS
B. HYDROLOGIC TRAINING
   B.1 HYDROLOGIC TRAINING BACKGROUND
   B.2 HYDRO TRAINING ASSESSMENT
   B.3 HYDRO TRAINING NEEDS

Although this is a lengthy evaluation, your feedback is important for understanding the many issues associated with hydrologic activities at a "modernized" weather service office. A similar version of the questionnaire is also to be issued to the Norman forecasters in early 1993.

It is also important to remember that the purpose is to evaluate the various topics and issues, not you personally. Reports generated from this technical evaluation will not associate names with any specific responses. YOUR NAMES WILL REMAIN CONFIDENTIAL.

We have attempted to make many of the questions easy to answer by providing a rating scale. A 1-to-5 rating scale is used for many of the questions, according to the following definitions.

1. INADEQUATE - Frequently impedes accomplishing job requirements.
2. MARGINAL - Does not consistently enable accomplishing job requirements.
3. ADEQUATE - Does not lead to degradation nor enhancement of job performance.
4. EFFECTIVE - Frequently enhances accomplishing job requirements.
5. EXCEPTIONAL - Consistently enhances accomplishing job requirements.

NA - Not applicable (e.g. have not used it enough, no knowledge of topic).

A copy of the rating scale is appended to the end of this questionnaire so that you can remove it and refer to it. We encourage you to provide supplementary remarks in order to fully understand your response as well as to obtain information not originally anticipated. Please feel free to use the margins, bottom of the page, or back of the page if you need more space for your responses to the open-ended questions. Use additional sheets if necessary, making sure to number any responses continued on another sheet.

Finally, in association with this questionnaire, you can input any other comments to the E-LOG at any time during the coming months and at any frequency you like. Your E-LOG comments proved most insightful to the EFT evaluation, and it would be helpful to obtain similar inputs on the DARE hydrologic functions and related training. You may recall that the E-LOG is accessed through the text station by typing M:009 and is saved to "DENRRMDEN".

Your time and effort in completing this questionnaire are greatly appreciated. You can return the technical evaluation to Eric Thaler. Contact Larry Tunnell or Lynn Johnson with any questions. Please complete the questionnaire by September 30.

RATING SCALE FOR DARE HYDROLOGY ASSESSMENT

A 1-to-5 rating scale is used for many of the questions, according to the following definitions.

1. INADEQUATE - Frequently impedes accomplishing job requirements; likely to lead to degradation of performance.

2. MARGINAL - Does not consistently enable accomplishing the job requirements; may lead to degradation of performance.

3. ADEQUATE - Consistently enables accomplishing job requirements; does not lead to degradation nor enhancement of performance.

4. EFFECTIVE - Frequently enhances accomplishing job requirements; may lead to enhanced performance.

5. EXCEPTIONAL - Consistently enhances accomplishing of job requirements; likely to lead to enhanced performance.

NA - Not applicable (e.g. did not happen, hydrologic duties not relevant; no knowledge of topic).

Note that the scale is centered on the mid-point rating of (3) ADEQUATE. From this it follows that (2) MARGINAL represents a rating barely within the lower limit of quality while (4) EFFECTIVE represents a rating just within the upper limit of quality. Similarly, (1) INADEQUATE indicates a rating below the lower limit of quality and (5) EXCEPTIONAL is a rating above the upper of limit of quality. The NA entry should be used wherever the question cannot be answered.

A. DARE HYDROLOGIC APPLICATIONS AND GRAPHICS

(Note: Response statistics are shown in highlighted font.)

This section refers to all hydrologic products, graphics and application programs available on the DARE workstation, including: (a) WSR-88D radar precipitation products; (b) RIVERS application; (c) HEADWATERS application; (d) textstation products; and (e) other hydrologic products.

The first set of questions (Section A.1) are directed to assessment of your opinion on how well - in the aggregate - the DARE workstation contributes to accomplishing your hydrologic duties. Section A.2 addresses specific aspects of the DARE applications and graphics. These are followed by a set of questions relating to the impact of DARE on the quality of hydrologic products (Section A.3). Section A of this technical evaluation ends (Section A.4) with a solicitation of your recommendations for modifications to DARE.

A.1. UTILITY OF DARE FOR CONDUCTING HYDROLOGIC DUTIES

This section addresses the utility of the DARE hydrologic functions for supporting WSFO hydrologic duties. Hydrologic duties include: monitoring and quality control of hydrologic data and related products; identification and resolution of hydrologic problems; and formulation and issuance of hydrologic products.

Rate the DARE hydrologic package's usefulness for accomplishing the listed hydrologic duties.

	Rate from 1 to 5 (per definitions provided)
(A1) Monitoring hydrologic data and products.	12/2.8/0.8
(A2) Quality control of hydrologic data and products.	12/2.3/0.8
(A3) Identifying main stem hydrologic problems.	10/3.2/0.7
(A4) Identifying headwaters hydrologic problems.	10/3.0/0.8
(A5) Evaluating RFC river stage and crest forecasts.	11/2.6/0.9
(A6) Evaluating and applying RFC headwater guidance.	10/2.5/1.0
(A7) Issuing appropriate products.	11/3.1/0.9
(A8) Reducing hydrologic workload.	12/2.8/0.6
(A9) Conducting the hydrologic program (in general).	12/2.9/0.9

(A10) Comments:

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A.2 SPECIFIC DARE HYDRO APPLICATIONS AND GRAPHICS

It is of interest to obtain your opinion on specific DARE applications and graphics; including:

- Mile High Radar Precipitation Products (A.2.1)
- RIVERS Application/Graphics (A.2.2)
- HEADWATERS Application/Graphics (A.2.3)
- Textstation Products and Applications (A.2.4)
- Other Products (A.2.5)

The following assessment attribute definitions are provided to guide your ratings of the various applications/graphics.

EASE OF USE - User-friendly; not difficult, cumbersome, or complicated to use.

ACCURACY - Data/application accurately reflects (current and/or forecast) hydrologic conditions.

QUALITY - Visual clarity; readability; adequate background explanation; colors, contrast, sharpness and brightness.

RELIABILITY - Complete data sets and application consistently available when requested.

TIMELINESS - Data/function available in time to affect hydrologic analysis and/or forecast.

UTILITY - Usefulness of data/function information content for meeting job responsibilities; more information having more detail.

Please use the 5-point rating scale (i.e. 1. INADEQUATE, 2. MARGINAL, 3. ADEQUATE, 4. EFFECTIVE, 5. EXCEPTIONAL) to fill out the matrix entries on the following pages.

A.2.1. Mile High Radar Precipitation Products

(A11) Rate the assessment attributes for the Mile High precipitation products using the 5-point rating scale defined above.

	Ease of Use	Accuracy	Quality	Reliability	Timeliness	Utility
(a) 1-hour precip.						
(b) 3-hour precip.						
(c) storm total prec.						

(A12) Rate the extent to which Mile High products:

	Rate from 1 to 5 (per definitions provided above)
(a) allow assessment of flash flood problems.	11/4.0/0.7
(b) allow assessment of river flood problems.	11/3.5/0.7
(c) allow formulation of flood/flash flood products.	11/3.5/0.6

(A13) Comments:

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A.2.2 RIVERS Application/Graphics

(A14) Rate the assessment attributes for the following aspects of the RIVERS application/graphics using the 5-point rating scale.

	Ease of Use	Accuracy	Quality	Reliability	Timeliness	Utility
(a) Basin rainfalls	10/3.3/0.6	11/2.6/1.1	11/2.8/1.0	11/2.5/1.0	11/2.5/1.0	11/2.7/1.0
(b) Basin stream stages	11/3.3/0.5	11/3.0/1.0	11/3.0/1.0	11/2.8/1.0	11/2.5/1.0	11/3.1/1.0
(c) Stage hydrograph	11/3.2/0.7	11/3.0/1.0	11/3.0/1.0	11/2.8/1.0	11/2.5/1.0	11/3.1/1.0
(d) Rating table	11/3.2/0.7	11/3.1/1.1	11/3.2/0.9	11/2.8/1.1	11/3.0/1.1	11/3.1/1.0
(e) E-19 Information	11/3.4/0.5	11/3.8/0.7	11/3.4/0.5	11/3.5/0.5	10/3.5/0.5	11/3.5/0.5

(A15) Rate the extent to which RIVERS application allows for: (Use the 5-point scale)

(a) assessment of main-stem river problems.	9/3.2/0.4
(b) evaluation of RFC stage and crest forecasts.	9/2.8/0.8
(c) formulation of high quality river flood products.	9/3.0/0.5

(A16) Comments:

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A.2.3 HEADWATERS Application/Graphics

(A17) Rate the assessment attributes for the HEADWATERS application/ graphics using the 5-point rating scale defined above.

	Ease of Use	Accuracy	Quality	Reliability	Timeliness	Utility
(a) ADVIS station selection						
(b) Basin average precipitation						
(c) ADVIS forecast hydrograph						

(A18) Rate the extent to which HEADWATERS application allows for: (Use the 5-point scale)

(a) assessment of headwater flood problems.

(b) evaluation of RFC headwater guidance.

(c) development of high quality flash flood products.

(A19) Rate the extent to which the ADVIS model supports issuing site-specific stage forecasts for headwater and/or river flooding.

Rating (Use the 5-point rating scale):

(A20) Comments:

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A.2.4 Textstation products and applications

(A21) Rate the assessment attributes for the textstation products and applications: (Using the 5-point rating scale.)

	Ease of Use	Accuracy	Quality	Reliability	Timeliness	Utility
(a) RFC guidance (text)						
(b) Text editor						
(c) Other _____						
_____						

(A22) Rate the extent to which the textstation products and applications allow for development of high quality flood products.

Rating (Use the 5-point rating scale):

(A23) Comments on textstation products and applications:

_____

_____

_____

_____

A.2.5 Other Hydrologic Products

(A24) Rate the assessment attributes for these other hydrologic products and applications using the 5-point rating scale.

	Ease of Use	Accuracy	Quality	Reliability	Timeliness	Utility
(a) RFC flash flood guidance						
(b) QPF graphics (NMC)						
(c) Surface products						
(d) Model products						
(e) Topo map background						
(f) Road map background						
(g) WARNGEN						

(A25) Rate the extent to which other hydrologic products contribute to development of high quality flood products.

Rating (Use the 5-point rating scale):

(A26) Rate the extent to which the WARNGEN application allows for development of high quality hydrology products.

Rating (Use the 5-point rating scale):

(A27) Rate the extent to which the WARNGEN application <u>reduces hydrologic workload</u> ?
(1 = Greatly increases workload, 3 = No change, 5 = Greatly decreases workload, NA = not applicable)

Rating:

(A28) How much modification is required to make the WARNGEN output acceptable ?
(1 = A lot of modifications required, 3 = Moderate changes required, 5 = No modification required)

Rating:

(A29) Comments on other hydrologic products:

_____

_____

_____

_____

A.3 DARE PERFORMANCE ASSESSMENT

This section is directed to an overall assessment of the DARE hydrologic package per its performance in support of hydrologic product issuance and duties. The basis of comparison is relative to AFOS, so the same 5-point rating scale applies except that the entries are referenced to performance obtained with AFOS (e.g. 1 = Inadequate, less capability than AFOS; 3 = Adequate, no change from AFOS, 5 = Exceptional, significant improvement over AFOS. If you have no AFOS experience enter "NA".)

(A30) Rate the attributes below for the flood and flash flood products obtained by the DARE package versus AFOS: (Rate 1 to 5 per definitions provided above)

(a) Ease of use. [redacted]

(b) Accuracy [redacted]

(c) Quality of flood and flash flood products. [redacted]

(d) Timeliness (i.e. more lead time, more updates). [redacted]

(e) Utility for River Products. [redacted]

(f) Utility for Flash Flood Products. [redacted]

(g) Availability. [redacted]

(h) Overall comparison (AFOS to DARE) [redacted]

(A31) Rate the extent to which the DARE applications and graphics enhance overall service to the public in comparison the AFOS.

Rating (Use the 5-point rating scale): [redacted]

(A32) Comments on DARE performance assessment:

_____

_____

_____

A.4 RECOMMENDATIONS FOR MODIFICATIONS TO DARE HYDROLOGIC FUNCTIONS

(A33) Please provide recommendations for modifications to the DARE hydrologic products, applications and graphics:

_____

_____

_____

_____

_____

_____

(Continue on back side if needed)

B. HYDROLOGIC TRAINING

B.1 Hydrologic Training Background

(B1) The following questions concern your training in hydrology. Some of you may have previously answered similar questions, but due to the number of new staff at Denver and the intervening months it is necessary to do it again.

When answering, try to be specific about dates, length of training sessions, and presentation format. The Format entry can be made as follows: L = lectures; R = reading; W = written exercises; O = one-on-one training (e.g. with Service Hydrologist); P = operational practice (e.g. informal communication with other forecasters); CTM = computer-based training module (e.g. workstation exercises). Also, provide an assessment rating (using the 5 point scale) on how effective the training was for accomplishing your hydrologic duties: (a) in general, and (2) using the workstation.

For example:

			Assessment Rating	
Date	Length	Format	General	Workstation
1982	16 weeks	L,R,W	3	1
7/92	2 hours	O	3	4

			Assessment Rating	
Date	Length	Format	General	Workstation

a. Formal Training (e.g. college course work)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

b. NWS Training (e.g. Hydro Service Course, workshops, seminars)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

c. Other hydrology training (e.g. conferences, seminars)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

d. Information from Service Hydrologist

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

e. On-The-Job Practice & Communication With Other Forecasters

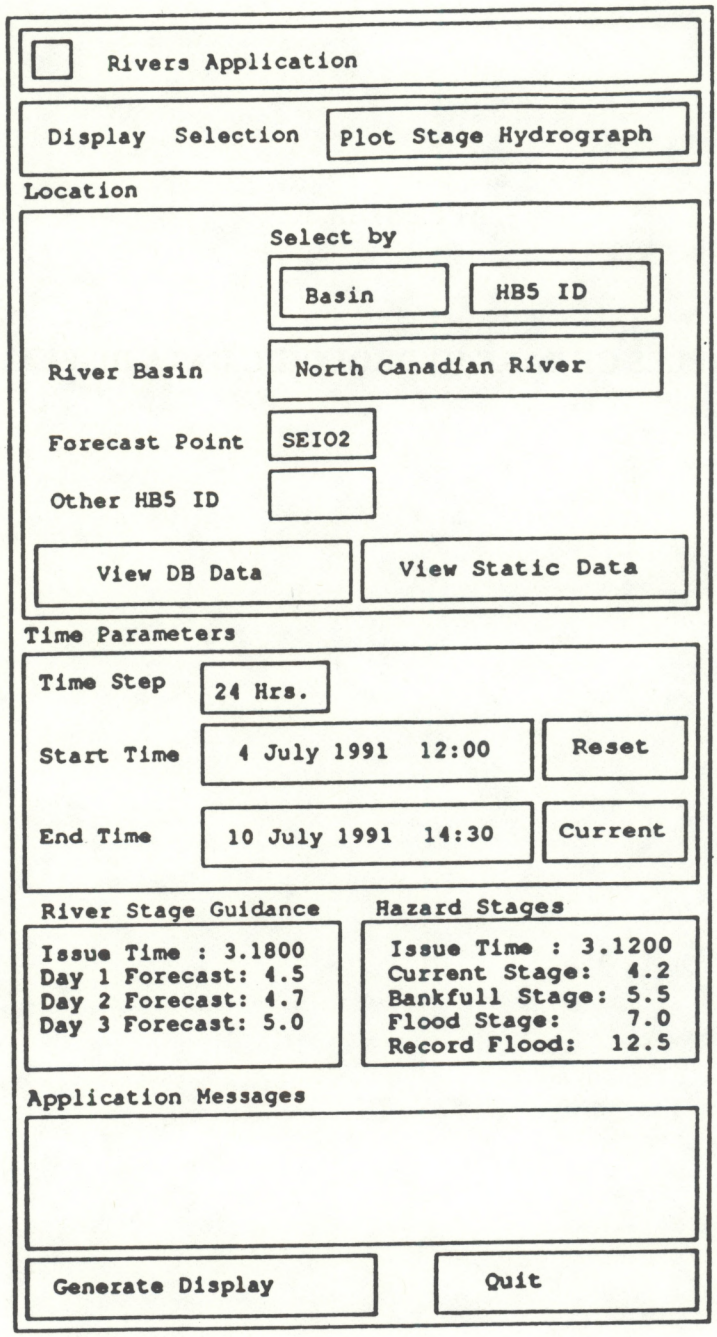
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

f. Workstation Hydro Exercises

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

APPENDIX B

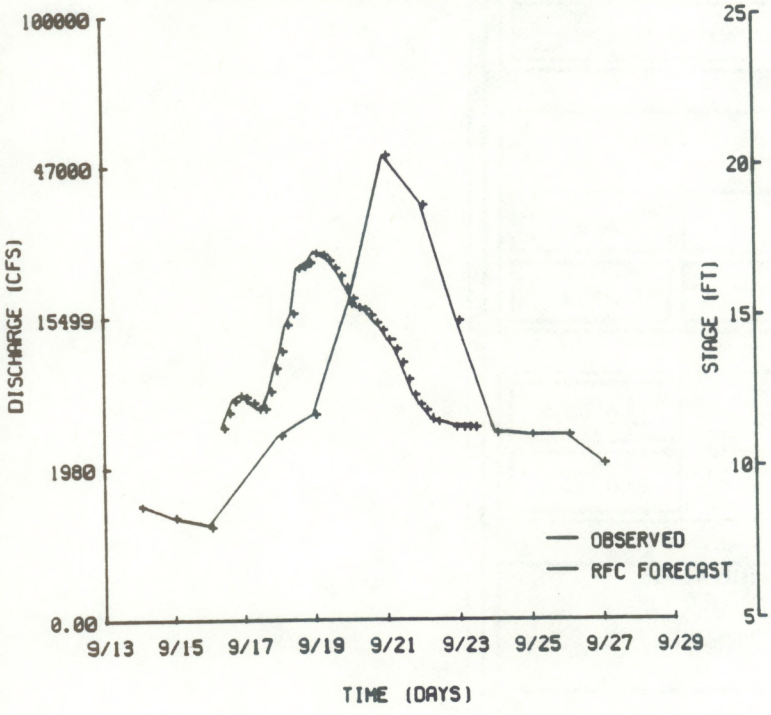
EXAMPLES OF DARE HYDROLOGIC DATA DISPLAYS


Rivers Application
Display Selection
Plot Stage Hydrograph
Location
Select by
Basin
HB5 ID
River Basin
North Canadian River
Forecast Point
SEI02
Other HB5 ID
View DB Data
View Static Data
Time Parameters
Time Step
24 Hrs.
Start Time
4 July 1991 12:00
Reset
End Time
10 July 1991 14:30
Current
River Stage Guidance
Issue Time : 3.1800
Day 1 Forecast: 4.5
Day 2 Forecast: 4.7
Day 3 Forecast: 5.0
Hazard Stages
Issue Time : 3.1200
Current Stage: 4.2
Bankfull Stage: 5.5
Flood Stage: 7.0
Record Flood: 12.5
Application Messages
Generate Display
Quit

TRL02 HIGH WATER RECORDS

33.6 : 22-OCT-1983
32.7 : 31-MAY-1987
28.1 : 08-JUN-1941
27.2 : 19-MAY-1935
26.7 : 19-MAY-1951
23.3 : 07-OCT-1955
23.2 : 24-OCT-1986
22.7 : 04-JUN-1957
22.4 : 21-MAY-1955
21.5 : 31-OCT-1941

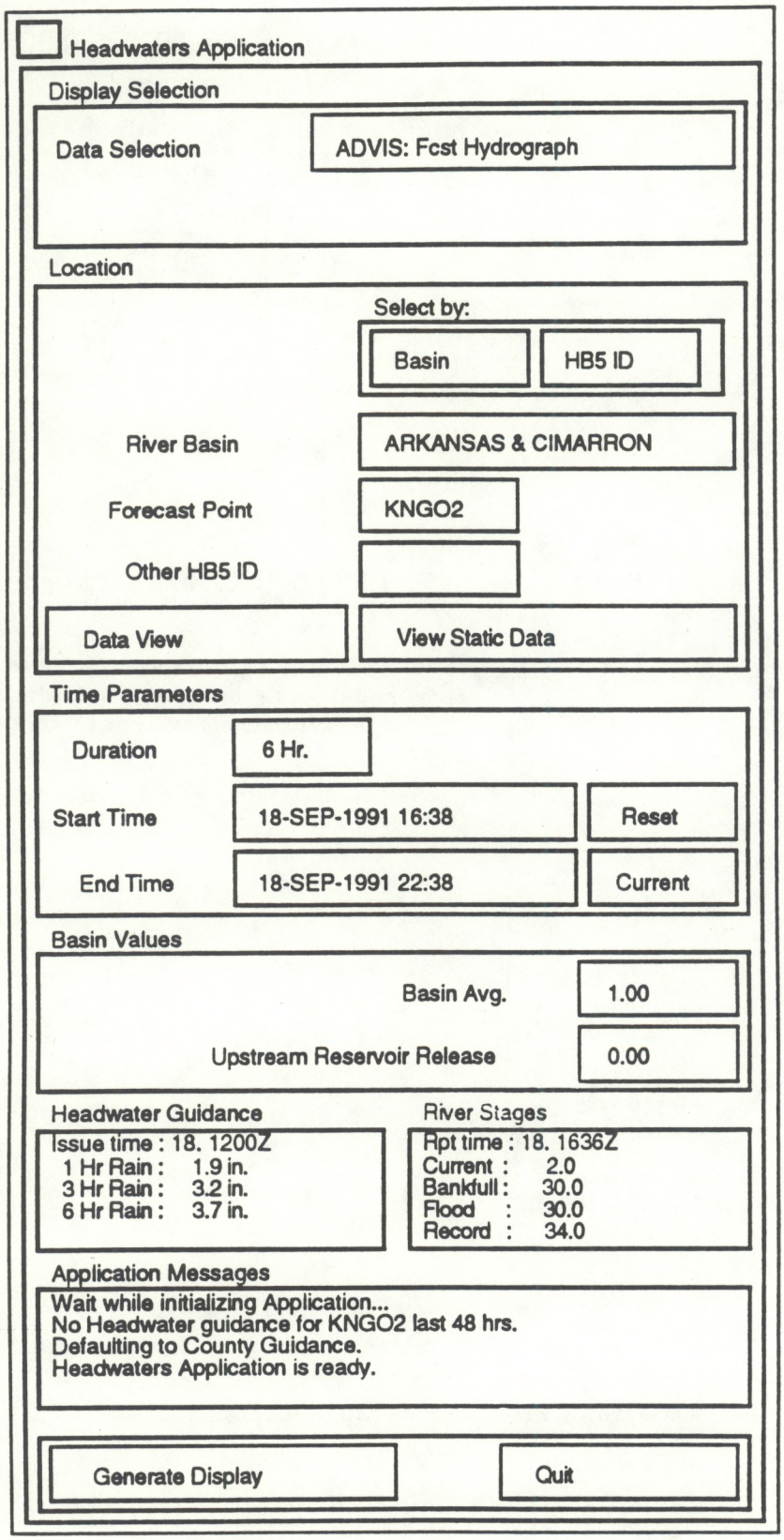
TRL02 DISCHARGE HYDROGRAPH



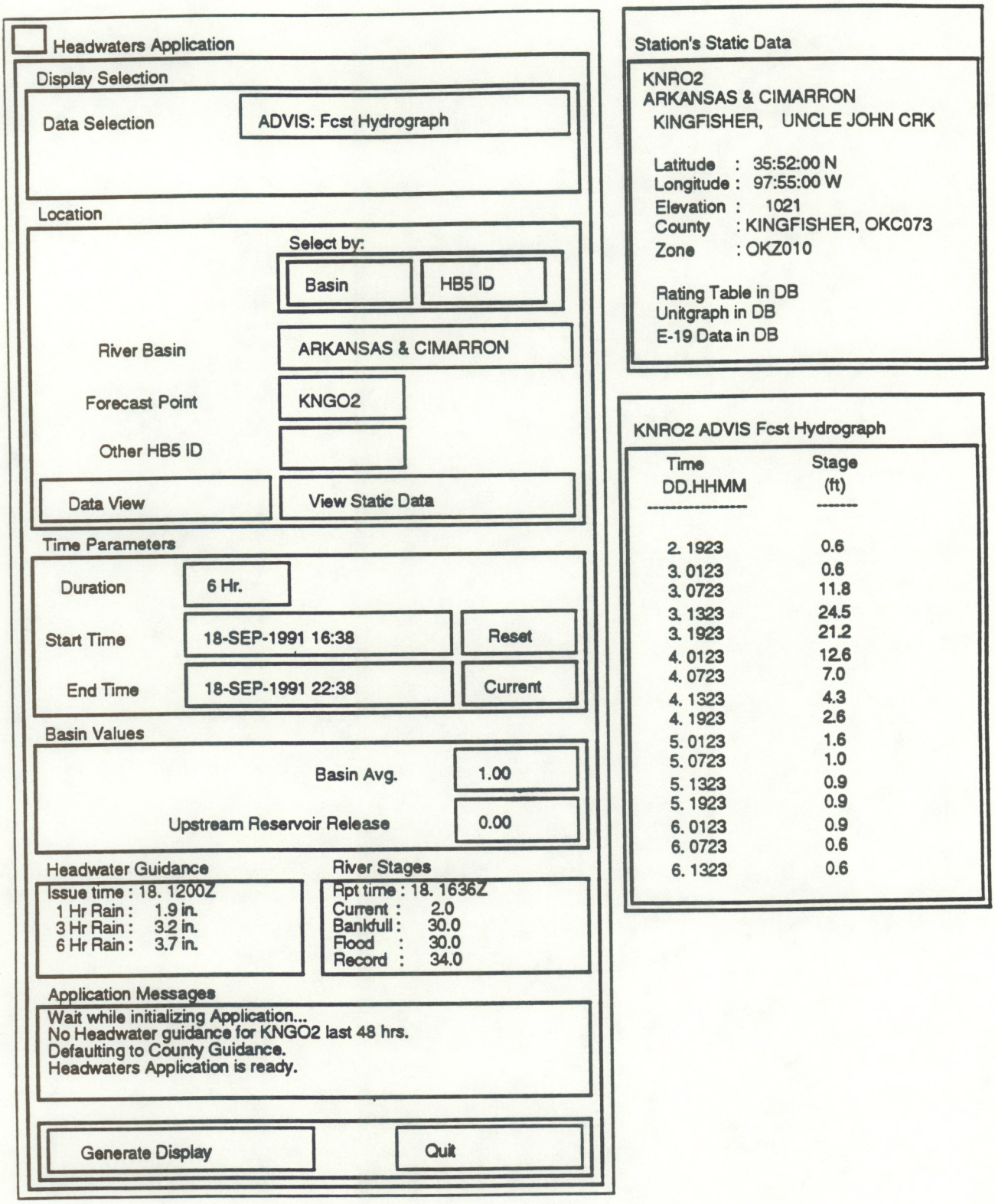
E-19 FLOOD DAMAGE INFORMATION

23.0 Ag leves overtop. Pecan orchards inundated
FLOOD STAGE: 22.0 Flood Stage. Ag lands: crop & posture
21.0 Isolates large cattle herds in lowlands

Example of Rivers Application, Plot Hydrograph output screen



Norman Pre-AWIPS Headwaters Application Menu



Norman Pre-AWIPS Headwaters Application menu with "View Static Data" window (top right) and ADVIS: Fcst Hydrograph text window (bottom right)

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