Critical Flood Guidelines

Purpose of the “critical flood” rule is to recognize that in certain situations, overtopping dam failures may be insignificant in how much damage they cause to downstream areas. It is based on the assumption that if all downstream flood damages occur due to a base-flow flood that is less than the regulatory design flood for the dam, then requiring additional spillway capacity above this flood to satisfy the design flood requirement would therefore, not be necessary. For this outcome, a flood of lesser size may exists that would show a more measurable impact than the regulatory design flood for the dam. The measurable impact that occurs to downstream areas from any hypothetical base-flow flood, given the dam fails, must be greater than the amount occurred for the same flood, given the dam does not fail, before the flood can be labeled as critical. The term “base-flow” flood, used throughout this document, refers to a starting flood condition in which an action or undertaking is made and should not be misinterpreted as groundwater flow.

The importance as to the dam's value and benefits it provides to the owner and the community must always be evaluated before subjecting the dam to possible overtopping and failure by a flood that is less than the required design flood for the structure. An incremental damage analysis may be used to determine the inflow design (critical) flood that is less than the minimum requirements of 1501:21-13-02. The flood will be based upon a comparison of two flood simulations occurring with the dam in question present: one, a base-flow flood that has a size that would cause failure of the dam, but has been modeled without any effects from a dam failure (Condition A), two, the same flood, but modeled to include the dam-break discharges based on the most severe hypothetical dam failure that is possible (Condition B). These flood simulations are routed downstream through a reach that has been determined to be the recipient of the potential floodwater damages. The spillway capacity and inflow design flood will be acceptable where it can be shown that the dam failure flood (Condition B) would cause no expected additional loss of life and would not cause significant incremental flood damages downstream of the dam. Additional potential for loss of life, health or property in the critical routing reach is expected if the incremental depth of flow between the dam failure and non-failure floods is greater than 2.0 feet or the product of the average floodplain flow velocity and the incremental depth is greater than 7.0 feet^2/second.

The design for the critical flood must be for specific site conditions and based on a quantitative and relative impact analysis of the downstream critical routing reach. The owner must submit to the chief, in writing, a request for consideration of the critical flood as the design flood. This request must be accompanied by appropriate supporting calculations. The chief will not consider risk assessment based upon planned evacuation, probability of inhabitation, or monetary recovery of property damage.

The scope of the critical flood analysis will identify the flooding source, upstream and downstream limits of the stream reach to be studied, and the applicable hydrologic and hydraulic methodology to be used. The scope may require completion of any or all of the following work items:

I. Field surveys to obtain data for stream and adjacent floodplain cross sections and other structures that may affect the hydraulics of the study reach.

II. Hydrologic analyses to determine stream peak discharges for the dam's design flood and any floods of a lesser magnitude used in the process of determining the inflow design flood for the dam.

III. Hydraulic analyses to determine dam failure discharges, flood elevations and floodplain stream and channel velocities at critical locations along the study reach.

IV. Development of a flood inundation map for the critical structures within the study reach using topographic work maps of the floodplains.

General Requirements:

1. A critical flood study conducted in accordance with Ohio Administrative Code (OAC) Rule 1501:21-13-02 shall include a written statement of purpose and scope of the analysis.

2. The analysis shall identify the flooding source, recurrence intervals for all flood events that were analyzed, upstream and downstream limits of stream reach to be studied, and the applicable hydrologic and hydraulic methodology to be used. This scope of the study may include, but not be limited to, completion of any or all of the following work items:

    a. Preparation of topographic work maps of the floodplains within the study area. The maps must identify elevations of the critical structures that are affected by the flood study.

    b. Field surveys to obtain data for stream cross sections and other hydraulic parameters (i.e., Manning's "n", Expansion and Contraction coefficients, etc.).

    c. Hydrologic analysis to determine discharge rates used in flood routings for the various flood frequencies used to substantiate the critical flood flows.

    d. Hydraulic analysis to determine dam failure discharges, flood elevations, floodplain boundaries, and stream channel and floodplain velocities. Calculations to determine the dam failure discharges must include a sensitivity study on the set of boundary conditions established for the dam breach analysis. This study is required for obtaining the most severe hydraulic condition during a catastrophic dam failure that is theoretically possible. Dam breach parameters used in the critical flood analysis shall be based on suggested values established by the U. S. Army Corps of Engineers, or the Federal Energy Regulatory Commission, unless otherwise approved by the chief.

e. Compilation of other flood study technical documentation used in the analysis.

f. Preparation of a critical flood report with flood profiles and work maps of the floodplain.

3. A "critical flood" study conducted in accordance with OAC Rule 1501:21-13-02 shall be completed under supervision of a registered professional engineer who is qualified to do flood study work.

Data Acquisition and Mapping

1. Topographic mapping for critical flood studies conducted in accordance with OAC Rule 1501:21-13-02 shall conform to the following standards:

A. Mapping shall be done by photogrammetric methods and/or topographic surveying. If topographic mapping is based solely on field surveys, map accuracy requirements shall be the same as those required by photogrammetric methods.

B. Map scale may vary but should not exceed one inch equals 1000 feet for the study area.

C. Contour intervals shall not exceed 5 feet for the appropriate terrain. Intermediate one-foot contour intervals may be required for special cases such as unusually flat terrain.

D. Elevations used in the flood study shall correspond to the National Geodetic vertical datum of 1929 or, when available, the successor North American vertical datum of 1983. Elevation reference marks and temporary reference points established for the study shall be tied by survey to at least one official bench mark of the datum for which the exact elevation to the nearest hundredth of a foot has been obtained.

Data Standards and Procedures

1. The following standards and procedures shall apply to hydrologic data used in a critical flood determination study conducted in accordance with OAC Rule 1501:21-13-02.

A. Hydrologic data shall be from official government sources except as approved by the chief. Use of unofficial data sources, such as high-water marks, shall be dependent on reliability of the data.

B. Stream flow data used for calibrating the hydrologic model shall be from official government records such as published by the United States Geological Survey.

C. Precipitation data shall be from official government records such as published by the National Weather Service.

D. Watershed data shall be from official maps, survey documents, and aerial photography generated by pertinent government agencies. Sufficient field observations shall be made to interpret maps and photographs and identify any significant changes in watershed conditions since source materials were completed.

2. The following standards and procedures shall apply to channel and valley cross sections used in the critical flood study conducted in accordance with OAC Rule 1501:21-13-02:

A. Each cross section must span the entire floodplain for each of the appropriate discharges used in the flood study. The cross sections must represent the particular stream reach from which it was taken. Local irregularities in ground surface that are not representative of reaches shall be avoided in surveys.

B. Cross-section alignment shall be perpendicular to the direction of flow. Cross-sections may consist of straight, curved or zigzag segments as needed to achieve proper alignment.

C. Horizontal stations for the cross-section shall correspond to the distance measured to the nearest foot along the straight, curved or zigzag alignment of the cross-section.

D. Cross-section elevations shall be determined at all significant breaks in ground slope and at points where significant changes in hydraulic characteristics of the floodplain occur. Additional points shall be included, as appropriate, using the following criteria as a guide:

1. The distance between channel reach stations should be such that the depth of flow at the next neighboring cross-section downstream does not increase more than 20 percent.

2. No adjacent horizontal points in the overbank areas shall be separated by more than 10 percent of the complete valley and channel cross-section width.

3. No adjacent horizontal points in the main channel shall be separated by more than 20 percent of the main channel width or 2 feet, whichever is greater.

4. Elevations of above water portions of cross-sections shall be determined by field surveys or photogrammetric techniques, when reliable data of sufficient accuracy cannot be obtained from available sources. Elevation of below water portion of cross-

sections shall be determined by field survey except where reliable data of sufficient accuracy can be obtained from available sources. Field surveys shall normally be accomplished by differential leveling or a differential global positioning system.

3. The following standards and procedures shall apply to channel and overbank reaches used in the critical flood analysis conducted in accordance with OAC Rule 1501:21-13-02:

A. Channel reach length shall be the distance between cross sections as measured along the principal flow line of the stream channel at the flood stage.

B. Channel and overbank reach lengths between stream cross-sections shall be determined by field surveys or distance measurements on topographic work maps. Design drawings for bridges and hydraulc structures shall be used to obtain reach lengths if available.

4. The following standards and procedures shall apply to roughness coefficients used in the critical flood analysis conducted in accordance with OAC Rule 1501:21-13-02:

A. Roughness coefficients shall be determined by field inspection of channel and overbank areas. Consideration shall be given to variation in roughness at various flood stages. Aerial photographs, when available, shall be used to supplement field observations.

B. Roughness coefficients obtained from any previous work shall be field checked for accuracy and updated, if they do not reflect current conditions.

5. The following standards and procedures shall apply to bridges and hydraulic structures data used in the critical flood analysis conducted in accordance with OAC Rule 1501:21-13-02:

A. Dimensions and elevations of all bridges and hydraulic structures including below water sections shall be obtained from construction drawings and/or by field survey measurements.

B. Bridges and hydraulic structures data obtained from documents shall be field checked in sufficient detail to verify that the data are for the correct structure and match as-built conditions.

C. No dimensions or elevations for bridges and hydraulic structures shall be determined by photogrammetric methods. Photographs shall be used to supplement and document field observations or hydraulic structures.

6. The following standards and procedures shall apply to the dam failure analyses data used in

the critical flood study conducted in accordance with OAC Rule 1501:21-13-02:

A. All boundary conditions used in the dam failure analysis must be supported by sound engineering assumptions and supporting field data obtained for the dam. A sensitivity analysis shall be required by varying the input boundary conditions used in a dam break model as a means of converging on the worst case dam failure modeling scenarios. The maximum discharges obtained from the dam failure analysis shall be used for the basis of determining downstream impact on the critical routing reach.

B. Parameters used to estimate the erosiveness of the soils shall be field checked in sufficient detail to verify their validity in use. Each boundary condition used in the development of the dam failure model shall be supported by sound engineering assumptions.

Hydrologic Requirements

1. Hydrologic analyses for the critical flood determination conducted in accordance with OAC Rule 1501:21-13-02 shall require a determination of the base-flow flood discharges and dam failure discharges at appropriate stream stations downstream of the dam. The criteria used to establish the initial base-flow flood discharge for a class I dam is the probable maximum flood, for a class II dam, 50 percent of the probable maximum flood, and for a class III dam, 25 percent of the probable maximum flood. The dam failure discharges are determined by doing a breach analysis for the dam and combining the resulting breach hydrograph for the worst case failure condition with the base-flow flood hydrograph established for the dam.

A. Flood peak discharge estimates shall be determined for the downstream terminus of the stream reach studied and at all upstream stations where significant changes in peak discharge occur due to reduction in tributary drainage area and other factors.

B. Flood peak discharge estimates established for the study area by previous work shall be acceptable for use in flood studies provided that parameters used to make previous estimates remain valid for existing conditions, methodologies are consistent with standard engineering practices and guidelines, and accuracy of estimate is within confidence limits approved by the chief.

2. Methodology for calculating discharges conducted for critical flood analyses in accordance with OAC Rule 1501:21-13-02 shall conform to the following standards:

A. A rainfall-runoff model (e.g., HEC-1) shall be used to estimate the flood peak discharges used in the critical flood analysis. The model shall be calibrated as

appropriate and conform to the following standards:

1. Models shall normally be based on unit-graph theory as embodied in unit-graph procedures of the Natural Resources Conservation Service, United States Geological Survey, and United States Army Corps of Engineers. Use of an alternate runoff simulation modeling procedure must be approved by the chief.

2. Drainage areas and sub-basin areas for unit graphs shall have reasonable uniform hydrologic characteristics.

3. Durations of storm rainfall shall be the duration resulting in the largest discharges for the stream reach being studied.

4. Rainfall amounts for storm events of different duration and frequency shall be estimates as published by the National Weather Service or other approved source.

5. Point-Rainfall estimates shall be adjusted using area-depth relationships when the area of the modeled drainage basin exceeds ten square miles.

6. Rainfall distribution shall be an appropriate pattern such as national weather service median time distributions, miller distribution, or Natural Resources Conservation Service Type II storm pattern.

7. Methodology used to estimate flood peak discharges shall include procedures that account for urbanization, surface mining, regulation, and valley storage when these are significant factors affecting flood flows. Urbanization and surface mining shall be considered to be significant factors whenever more than 30 percent of the watershed is affected by these land use activities. Allowances for effects of urbanization on flood peaks shall be made by appropriate procedures such as those developed by the United States Geological Survey and the Natural Resources Conservation Service. Effects of Regulation and Valley Storage shall be accounted for by reservoir and stream routing techniques as appropriate.

8. When applicable, flood peak discharge estimates used in the critical flood analysis shall be checked for reasonableness by comparison with other flood peak data such as: actual flood peak discharges recorded for similar drainage basins, peak discharge estimates from other studies of similar basins, and estimates from alternative modeling techniques.

Hydraulic Requirements

Hydrologic analyses for the critical flood determination conducted in accordance with OAC Rule 1501:21-13-02 shall conform to the following standards:

1. Water-surface profiles shall be determined by step-backwater procedure whenever applicable together with other pertinent hydraulic formulae. Computer programs used for water surface profile analysis shall be step-backwater algorithms such as the United States Army Corps of Engineers's HEC-RAS program.

2. Dam failure discharges shall be determined by a flood routing program equipped with dam failure analysis routines and/or a specific dynamic reservoir routing program such as the Boss Dambreak program.

3. Initial water-surface elevation used in step-backwater analysis shall be based on normal depth or determined from stage-discharge rating at a control section. If normal depth is used to determine initial water-surface elevation, the modeling shall include at least three initial cross sections beyond the terminus of the stream reach where actual flood elevations are required to allow for iterative convergence of flood profile.

4. Models shall be calibrated using measured profiles and reliable high-water marks of past floods when such information is available. Models shall match known high-water marks within plus or minus 0.5 foot.

5. Any cases where computation of water-surface profiles may require use of two-dimensional computer modeling, dynamic wave routing or other special analysis shall be approved by the chief.

6. Location, alignment and subdivision of channel and floodplain cross-sections used in stream modeling shall be based on field observations and careful examination of topographic maps and aerial photographs. Cross-sections shall be typical of adjacent upstream and downstream reaches. A minimum of four cross-sections is required for the critical flood analysis.

7. Cross-sections shall be located where needed to account for changes in dimensions and roughness of the channel and floodplain. Cross-sections shall be located at all significant breaks in channel grade. Channel reach length between cross-sections shall be short enough to avoid excessive change in conveyance, velocity head, or energy loss.

8. Alignment of cross-sections shall normally be perpendicular to direction of flow in channels and overbank areas. For streams with severe meanders, where the majority of stream flow deviates from the channel, the alignment of cross-sections shall be perpendicular to the center of mass of the flow.

9. Floodplain and channel cross-sections shall be subdivided into at least channel and overbank

areas for analysis. Additional subdivisions may be required depending on the specific cross-section. Ineffective flow areas shall be excluded from cross-sections as appropriate to insure accurate modeling of stream flow.

10. Modeling of existing channel constrictions shall include a sufficient number of upstream and downstream cross-sections to accurately model flow lines.

11. Modeling of bridges and culverts using routines in step-backwater computer programs shall require at least four cross sections. Sections shall be located at the upstream and downstream sides of the structures and at appropriate distances upstream and downstream of the structures to properly model transitions and ineffective flow areas. Additional cross-sections shall be used as needed to establish starting water elevation and evaluate upstream and downstream impacts. Options in step-backwater programs for direct input of bridge and culvert profiles based on hydraulic charts and other sources may be used when appropriate.

12. Modeling of developed floodplain areas with buildings shall normally be based on adjustment of roughness coefficients by procedures such as those developed by the United States Geological Survey. In cases where it involves a single building or a limited number of buildings, these structures may be modeled using at least four cross-sections to model the blocked portion of the floodplain, ineffective flow areas, and open areas upstream and downstream of the buildings.

13. Split flow analysis shall be considered when stream flows divide around an island or overflow the banks of the main stream and take a different flow path. The analysis shall address the reduction in flow in the downstream reach when overflows leave the main channel and enter another basin. Acceptance of the procedures used in the split flow analysis will be required by the chief on a case by case basis.

14. Modeling of tributary streams shall proceed from initial water-surface elevations determined from normal depth on the main stream unless coincident peak situation applies or tributary flow depth is higher than the corresponding main stream event.

Flood Study Report

1. The critical flood analysis conducted in accordance with OAC Rule 1501:21-13-02 shall be summarized in a flood study report. Contents of the report shall include all applicable narratives and exhibit items detailed under this guideline.

2. Reports of the critical flood analysis shall contain a narrative text that is organized into thefollowing sections: Introduction, Area Studied, Hydrologic Analysis, Hydraulic Analysis, and Summary of Impact.

A. The introductory section of critical flood reports shall state the purpose of the study, cite the authority for the work, summarize the scope of the work, and discuss study requirements.

B. The area studied section of the critical flood report shall describe the location of the study area, flooding source, and define the critical routing reach for the dam.

C. The hydrologic analysis section of the critical flood report shall discuss the following items:

1. Methodology and adequacy for current study of flood discharge estimates for the flooding source.

2. Methodology used to compute peak discharge estimates for flooding source and document sources of hydrologic data.

3. Include a summary of discharges in a table that gives the following information: name of flooding source, location point on stream, drainage area in square miles, and the various flood frequency peak discharges for the with and without dam failure conditions.

4. Review any historical flood information for the flooding source and discuss comparative flood peak estimates based on alternative methodology as appropriate.

C. The hydraulic analysis section of the critical flood report shall discuss the following items:

1. Methodology used to generate flood profiles for the study reach.

2. Discuss methodology, engineering assumptions, and the hydraulic parameters for their adequacy in the development of the dam failure discharges.

3. Discuss methodology and field procedures used to generate flood profiles including: how cross sections were obtained, how channel and overbank reach lengths were determined, how roughness factors were estimated, how dimensions of hydraulic structures were obtained, how water surface elevations were computed, and how starting water elevations were determined.

4. Describe the concepts and procedures used to comply with the no impact requirements for critical flood determination.

5. Describe methods used to evaluate the hydraulic impact of a dam failure flood on

the critical routing reach, and summarize results of the hydraulic analysis.

3. Reports of the critical flood analysis, conducted in accordance with OAC Rule 1501:21-13-02 may include, but not be limited to the following exhibits: work maps, flood profiles, and photographs.

A. Work maps shall contain coverage of the critical routing reach and all potential affected structures.

1. Each work map shall be identified with the following information: date map was prepared, map bar scale, north arrow, source of base map and date, whether map is one of several maps, and a legend, if applicable, indicating any symbols used for identifcation purposes on the map.

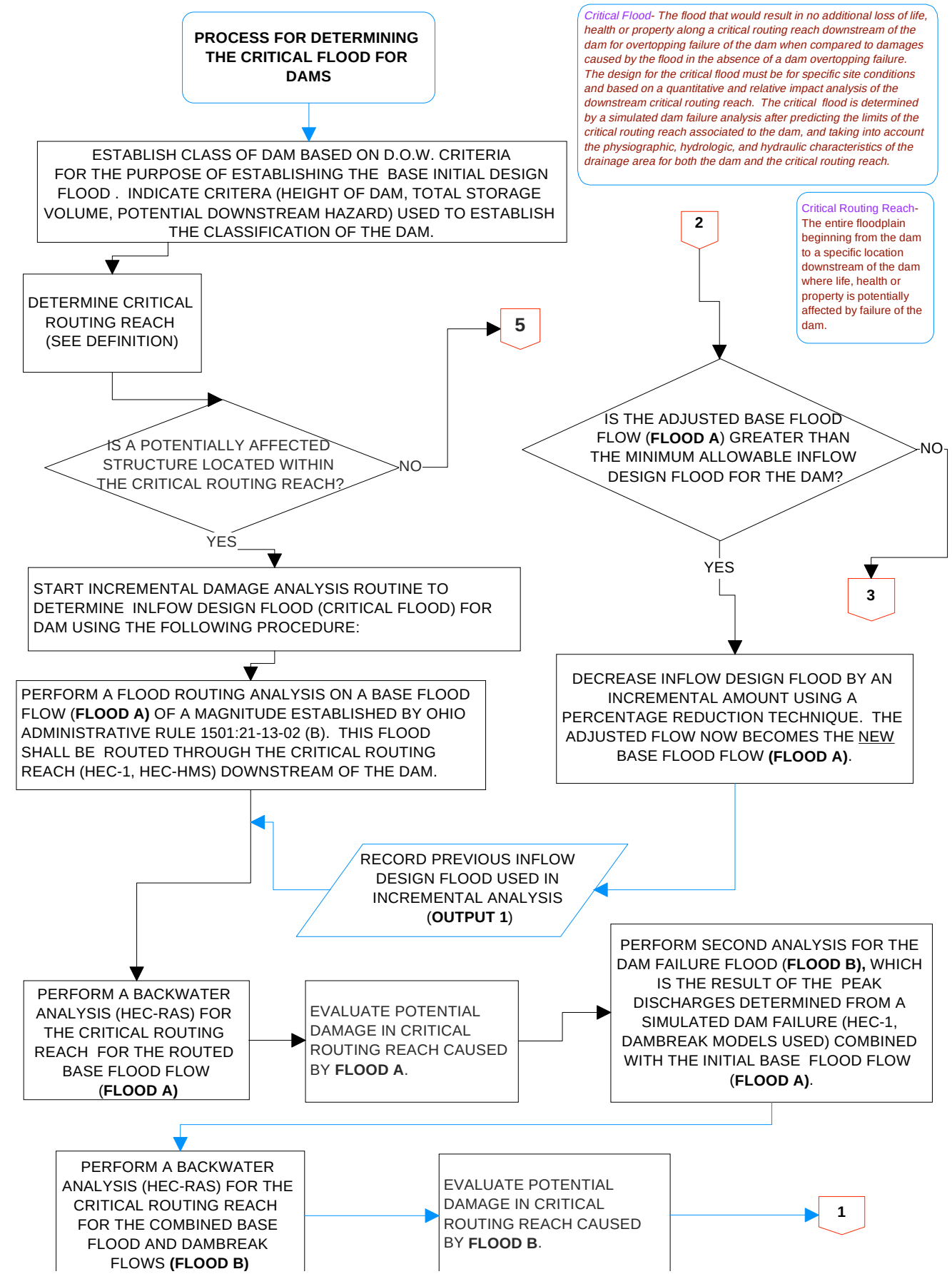
2. Work maps shall show existing topographic contours, low-water outline of streams and lakes, cross sections, boundaries of floodplains associated with the critical flood discharges.

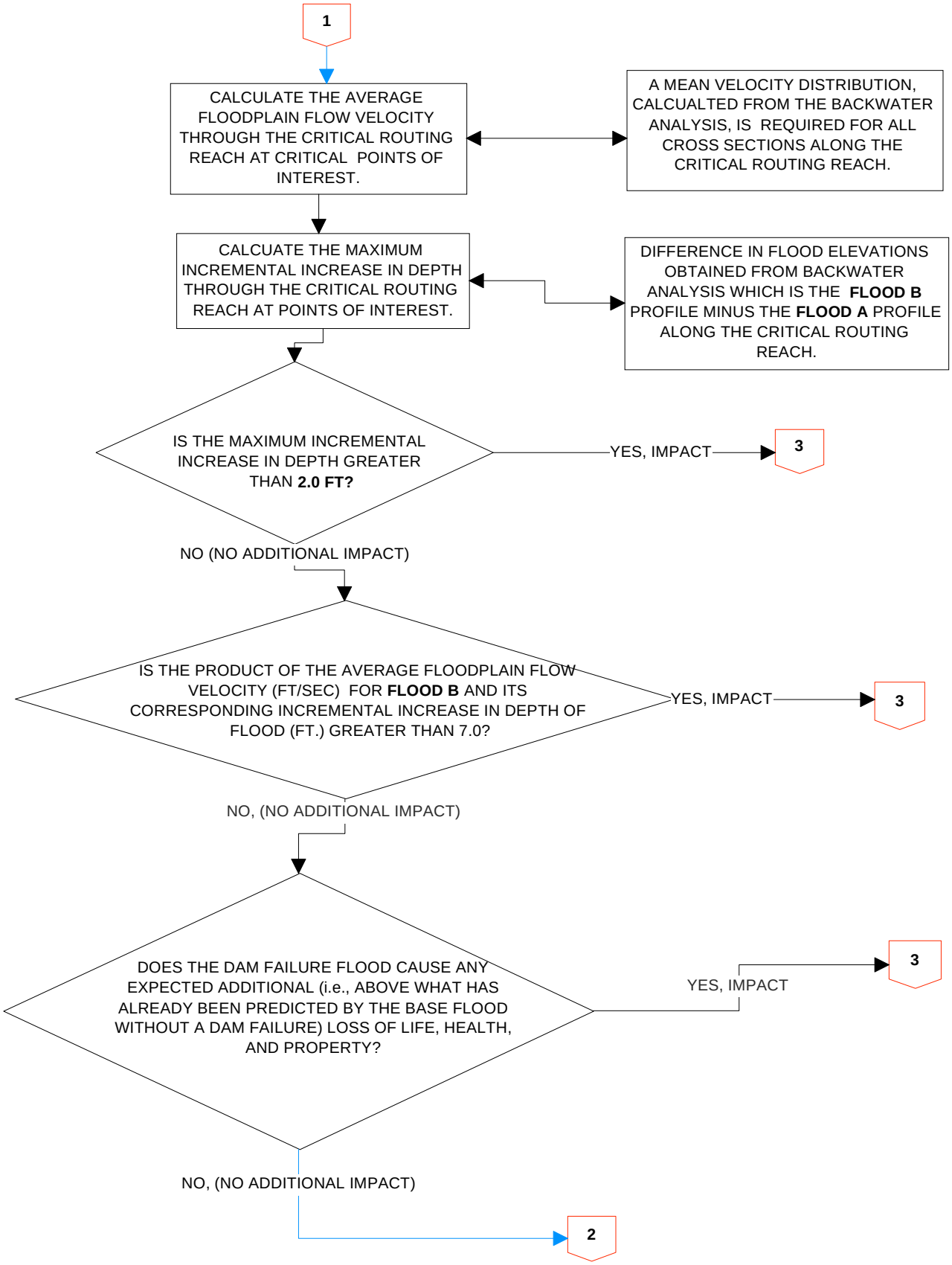
B. Flood profiles shall be prepared for all flood recurrence interval events studied.

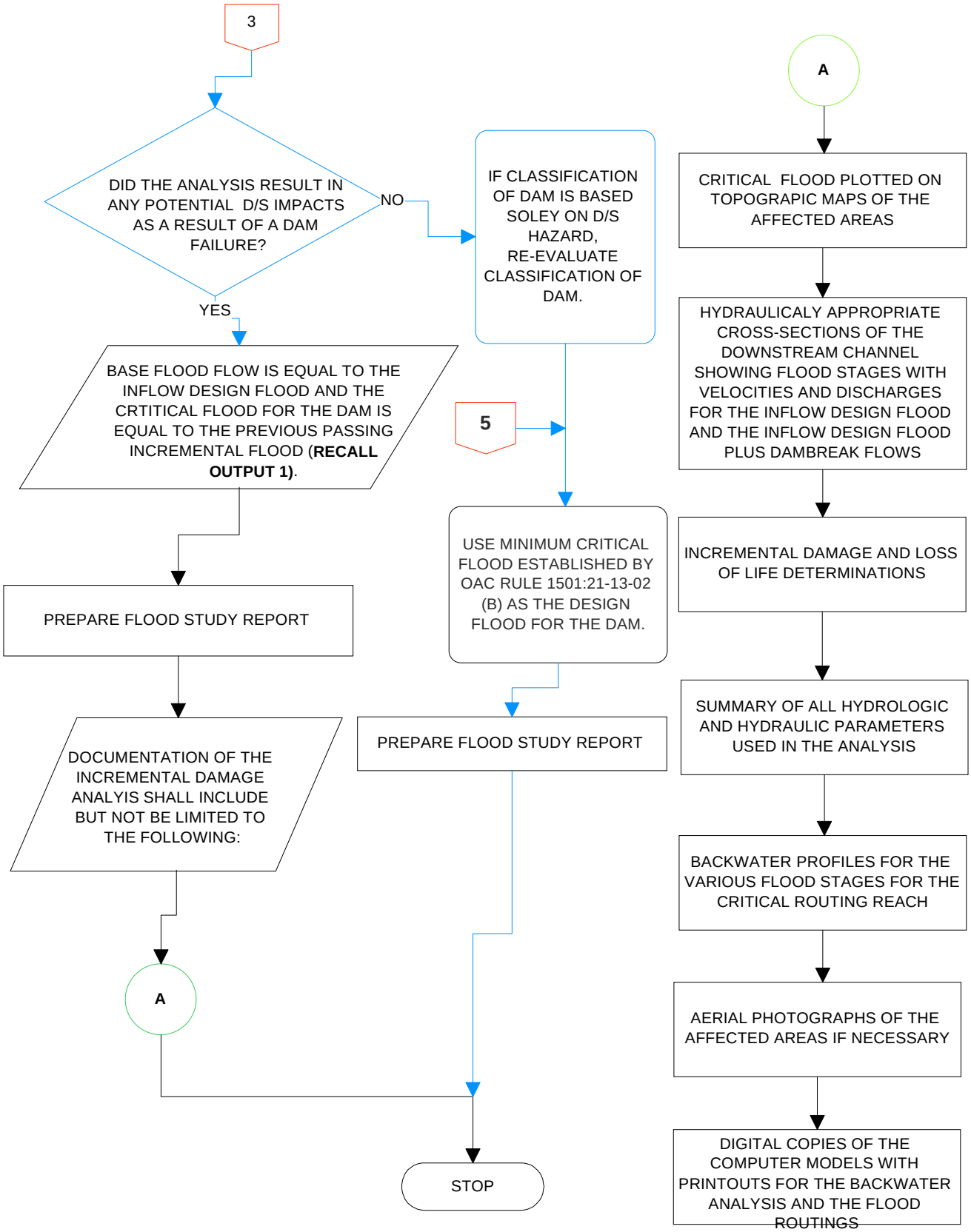
C. Photographs may be used in the critical flood analysis report to supplement text material and provide documentation of observed field conditions at the time of the study. Photographs may include views of the critical routing reach and its overbank areas, hydraulic structures, any structures in the floodplain that are potentially affected by the dam failure discharges, and other significant features of the landscape.

D. A certification page signed and stamped by the registered professional engineer in charge of the study. The engineer shall certify that the data for the physical parameters use in the critical flood study represent actual field conditions.

E. Submittals to the chief of reports and technical documentation of critical flood studies conducted in accordance with OAC Rule 1501:21-13-02 shall be accompanied by a cover letter identifying the report, its purpose, and any action requested of the chief.


PROCESS FOR DETERMINING THE CRITICAL FLOOD FOR DAMS
Critical Flood- The flood that would result in no additional loss of life, health or property along a critical routing reach downstream of the dam for overtopping failure of the dam when compared to damages caused by the flood in the absence of a dam overtopping failure. The design for the critical flood must be for specific site conditions and based on a quantitative and relative impact analysis of the downstream critical routing reach. The critical flood is determined by a simulated dam failure analysis after predicting the limits of the critical routing reach associated to the dam, and taking into account the physiographic, hydrologic, and hydraulic characteristics of the drainage area for both the dam and the critical routing reach.
ESTABLISH CLASS OF DAM BASED ON D.O.W. CRITERIA FOR THE PURPOSE OF ESTABLISHING THE BASE INITIAL DESIGN FLOOD . INDICATE CRITERA (HEIGHT OF DAM, TOTAL STORAGE VOLUME, POTENTIAL DOWNSTREAM HAZARD) USED TO ESTABLISH THE CLASSIFICATION OF THE DAM.
Critical Routing Reach- The entire floodplain beginning from the dam to a specific location downstream of the dam where life, health or property is potentially affected by failure of the dam.
2
DETERMINE CRITICAL ROUTING REACH (SEE DEFINITION)
5
IS A POTENTIALLY AFFECTED STRUCTURE LOCATED WITHIN THE CRITICAL ROUTING REACH?
NO
YES
IS THE ADJUSTED BASE FLOOD FLOW (FLOOD A) GREATER THAN THE MINIMUM ALLOWABLE INFLOW DESIGN FLOOD FOR THE DAM?
NO
YES
3
START INCREMENTAL DAMAGE ANALYSIS ROUTINE TO DETERMINE INLFOW DESIGN FLOOD (CRITICAL FLOOD) FOR DAM USING THE FOLLOWING PROCEDURE:
PERFORM A FLOOD ROUTING ANALYSIS ON A BASE FLOOD FLOW (FLOOD A) OF A MAGNITUDE ESTABLISHED BY OHIO ADMINISTRATIVE RULE 1501:21-13-02 (B). THIS FLOOD SHALL BE ROUTED THROUGH THE CRITICAL ROUTING REACH (HEC-1, HEC-HMS) DOWNSTREAM OF THE DAM.
DECREASE INFLOW DESIGN FLOOD BY AN INCREMENTAL AMOUNT USING A PERCENTAGE REDUCTION TECHNIQUE. THE ADJUSTED FLOW NOW BECOMES THE NEW BASE FLOOD FLOW (FLOOD A).
RECORD PREVIOUS INFLOW DESIGN FLOOD USED IN INCREMENTAL ANALYSIS (OUTPUT 1)
PERFORM A BACKWATER ANALYSIS (HEC-RAS) FOR THE CRITICAL ROUTING REACH FOR THE ROUTED BASE FLOOD FLOW (FLOOD A)
EVALUATE POTENTIAL DAMAGE IN CRITICAL ROUTING REACH CAUSED BY FLOOD A.
PERFORM SECOND ANALYSIS FOR THE DAM FAILURE FLOOD (FLOOD B), WHICH IS THE RESULT OF THE PEAK DISCHARGES DETERMINED FROM A SIMULATED DAM FAILURE (HEC-1, DAMBREAK MODELS USED) COMBINED WITH THE INITIAL BASE FLOOD FLOW (FLOOD A).
PERFORM A BACKWATER ANALYSIS (HEC-RAS) FOR THE CRITICAL ROUTING REACH FOR THE COMBINED BASE FLOOD AND DAMBREAK FLOWS (FLOOD B)
EVALUATE POTENTIAL DAMAGE IN CRITICAL ROUTING REACH CAUSED BY FLOOD B.
1


1
CALCULATE THE AVERAGE FLOODPLAIN FLOW VELOCITY THROUGH THE CRITICAL ROUTING REACH AT CRITICAL POINTS OF INTEREST.
A MEAN VELOCITY DISTRIBUTION, CALCUALTED FROM THE BACKWATER ANALYSIS, IS REQUIRED FOR ALL CROSS SECTIONS ALONG THE CRITICAL ROUTING REACH.
CALCUATE THE MAXIMUM INCREMENTAL INCREASE IN DEPTH THROUGH THE CRITICAL ROUTING REACH AT POINTS OF INTEREST.
DIFFERENCE IN FLOOD ELEVATIONS OBTAINED FROM BACKWATER ANALYSIS WHICH IS THE FLOOD B PROFILE MINUS THE FLOOD A PROFILE ALONG THE CRITICAL ROUTING REACH.
IS THE MAXIMUM INCREMENTAL INCREASE IN DEPTH GREATER THAN 2.0 FT?
YES, IMPACT
3
NO (NO ADDITIONAL IMPACT)
IS THE PRODUCT OF THE AVERAGE FLOODPLAIN FLOW VELOCITY (FT/SEC) FOR FLOOD B AND ITS CORRESPONDING INCREMENTAL INCREASE IN DEPTH OF FLOOD (FT.) GREATER THAN 7.0?
YES, IMPACT
3
NO, (NO ADDITIONAL IMPACT)
DOES THE DAM FAILURE FLOOD CAUSE ANY EXPECTED ADDITIONAL (i.e., ABOVE WHAT HAS ALREADY BEEN PREDICTED BY THE BASE FLOOD WITHOUT A DAM FAILURE) LOSS OF LIFE, HEALTH, AND PROPERTY?
YES, IMPACT
3
NO, (NO ADDITIONAL IMPACT)
2


3
DID THE ANALYSIS RESULT IN ANY POTENTIAL D/S IMPACTS AS A RESULT OF A DAM FAILURE?
NO
YES
IF CLASSIFICATION OF DAM IS BASED SOLEY ON D/S HAZARD, RE-EVALUATE CLASSIFICATION OF DAM.
BASE FLOOD FLOW IS EQUAL TO THE INFLOW DESIGN FLOOD AND THE CRTITICAL FLOOD FOR THE DAM IS EQUAL TO THE PREVIOUS PASSING INCREMENTAL FLOOD (RECALL OUTPUT 1).
5
PREPARE FLOOD STUDY REPORT
USE MINIMUM CRITICAL FLOOD ESTABLISHED BY OAC RULE 1501:21-13-02 (B) AS THE DESIGN FLOOD FOR THE DAM.
DOCUMENTATION OF THE INCREMENTAL DAMAGE ANALYIS SHALL INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING:
PREPARE FLOOD STUDY REPORT
A
STOP
A
CRITICAL FLOOD PLOTTED ON TOPOGRAPIC MAPS OF THE AFFECTED AREAS
HYDRAULICALY APPROPRIATE CROSS-SECTIONS OF THE DOWNSTREAM CHANNEL SHOWING FLOOD STAGES WITH VELOCITIES AND DISCHARGES FOR THE INFLOW DESIGN FLOOD AND THE INFLOW DESIGN FLOOD PLUS DAMBREAK FLOWS
INCREMENTAL DAMAGE AND LOSS OF LIFE DETERMINATIONS
SUMMARY OF ALL HYDROLOGIC AND HYDRAULIC PARAMETERS USED IN THE ANALYSIS
BACKWATER PROFILES FOR THE VARIOUS FLOOD STAGES FOR THE CRITICAL ROUTING REACH
AERIAL PHOTOGRAPHS OF THE AFFECTED AREAS IF NECESSARY
DIGITAL COPIES OF THE COMPUTER MODELS WITH PRINTOUTS FOR THE BACKWATER ANALYSIS AND THE FLOOD ROUTINGS