

## **METHOD TO MAKE RAPID ASSESSMENTS OF DETAILED BREACH ANALYSIS NEEDS**

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This presentation describes the usefulness of GIS and GeoRAS to identify specific areas downstream of Natural Resources Conservation Service (NRCS) assisted dams that field staff with limited dam breach analysis experience can readily identify for investigation.

In 2008, Texas NRCS had 541 dams requiring hazard classification reviews to complete. The field staff priority was on Emergency Watershed Protection (EWP) assignments along with regular responsibilities and had little available time to do hazard classification. Hydraulic engineering time was also limited so a conservative shortcut was developed.

This shortcut gives the field staff a conservative aerial limit of view downstream of a dam by using digital orthophotographic aerial imagery to identify potential breach concerns that require detailed analysis. This procedure takes data from the National Inventory of Dams (NID) data base to compute the NRCS Technical Release 60 (TR-60) breach discharge from formula  $Q_{max}=65Hw^{1.85}$  and to assign a breach volume. The GeoRAS interface established streamlines and cross sections for export to HECRAS. The HECRAS was loaded with the NRCS TR-66 derived breach hydrograph and unsteady flow profiles were created to establish maximum water surface elevations. The maximum water surface profile was imported into the GIS model and a delineated flood boundary was created.

The field staff reviewed the area within these boundaries with their most current orthophotography and some field investigation for potential flood impact identification. This process reduced the number of dams requiring further detailed analysis. Identification of potential impacts within this conservative zone of interest would require a second level of analysis using detailed data of as-built information, engineering survey, road department drawings, and accepted procedural calculation of the breach discharge and hydrograph. In 2008, the work was completed.

### **INTRODUCTION**

Natural Resources Conservation Service (NRCS) policy is to review the safety of individual NRCS-assisted dams every 5-years. The policy created a need for each state to manage the number of dams that could be reviewed each year with available staff. The State of Texas NRCS keeps track of its assisted dams each year as to which requires a 5-year review. The dams to review are of low and significant hazard classification and NID inventory size. In 2008, Texas NRCS had 541 dams scheduled for hazard review on the 5-year cycle. In a January 2008 Texas NRCS Bulletin, a plan of action was included to accomplish this task. The following was directed in that bulletin.

**Hazard Class Verification – Actions required by District Conservationists and Zone/Field Office Engineers** To be in compliance with the 5-year cycle required by NRCS policy, the hazard classification of 541 project dams need to be verified in Texas in 2008. This will be accomplished with minimal direct impact to field office operations as outlined below:

Level 1: District Conservationists, with assistance of Zone and Field Office engineers, will review aerial photography and local knowledge of sites. No field visits will be required, as this level is designed to handle only the most obvious situations. Document Dams by County spreadsheet for dams which do not have a change in hazard classification. Zone engineers will report dams that need field review and surveys for levels 2 and 3 as soon as they become aware of the need, but not later than March 31, 2008. District Conservationists will submit Dams by County spreadsheet to the Zone Office by May 1, 2008.

Level 2: Zone and Field Office engineers will perform on-site evaluations and collect minor additional survey data. Other Field Office personnel may be requested to assist with surveys or provide access to dams. Level 2 evaluations will be completed and submitted by May 31, 2008.

Level 3: Detailed breach evaluations will be conducted by State Office engineers. Some assistance on surveys or access to dams may be requested from Field Office personnel. Level 3 evaluations must be completed by August 1, 2008.

**Conservative shortcut for Level 1** Experienced and lesser-experienced staff would perform Level 1. The chosen method to reduce time of training, human error and to establish uniformity in results of review was of two parts. The first part was to schedule highly experienced Water Resources Staff members to gather required in-house information on selected dams and assess the dams in the field as to if they required Level 2 analysis or a recommendation of greater hazard classification. The second part was to generate a conservative boundary or zone of interest below dams to simplify the Level 1 task for available staff with less hazard review experience. This shortcut gives the field staff a conservative aerial limit of view downstream of a dam by using orthophotographic imagery to identify potential breach concerns that require Level 2 analysis. The zone of interest is an in-house NRCS Texas working tool and is not considered, or conveyed to the public, as a breach boundary. The second part of the method used in Level 1 analysis is the subject of this paper.

**Software and Data** GIS and HecRas software was used to estimate conservative aerial limits of view downstream of dams by using orthophotographic imagery. This allowed rapid identification of potential breach concerns that required detailed analysis. This procedure takes data from the National Inventory of Dams (NID) data base to compute the NRCS Technical Release 60 (TR-60) breach discharge from formula  $Q_{max}=65Hw^{1.85}$  and to assign a breach volume. GIS was used with orthophotographic imagery, road and railroad layers, a watershed structure location layer, and elevation terrain models. The GeoRAS interface established streamlines and cross sections for export to HECRAS. The HECRAS was loaded with the NRCS TR66 derived breach hydrograph and unsteady flow profiles were created to establish maximum water surface elevations. The maximum water surface profile was imported into the GIS model and a delineated flood boundary was created.

The NID was a necessary tool for rapid data compilation. Its data was queried for the review dams of the year 2008 list. The NID consists of dams meeting at least one of the following criteria:

- 1) High hazard classification - loss of one human life is likely if the dam fails,
- 2) Significant hazard classification - possible loss of human life and likely significant property or environmental destruction,
- 3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage,
- 4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

The NID contained dam height and storage volume values used in computing the breach discharges and flood hydrographs.

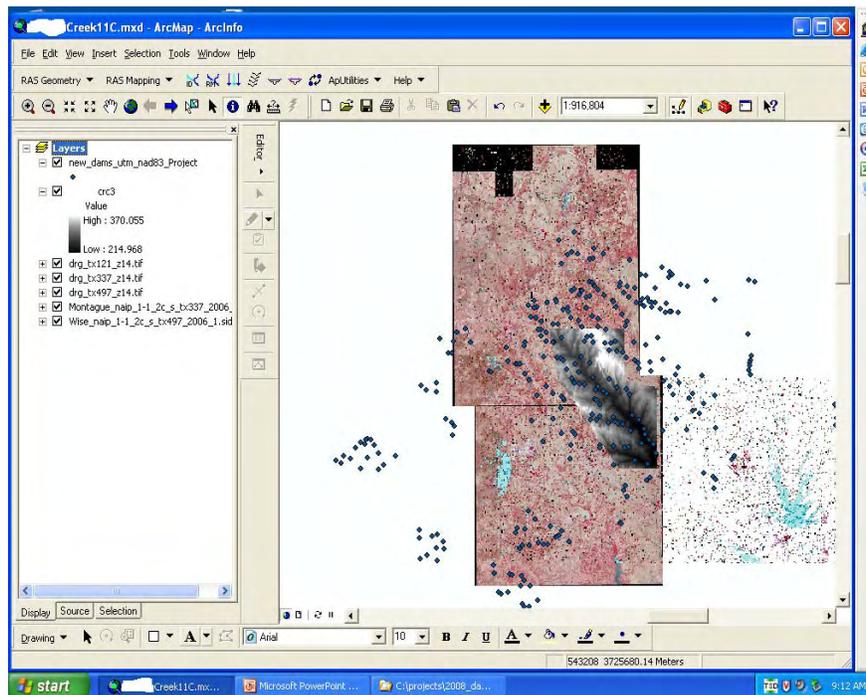


Figure 1 GIS Arc Map with GeoRas tools, NID structure locations, Elevation model, Ortho, and USGS quadrangle imagery.

The required dams for hazard review are selected in the NID point file GIS attribute table and were readily located on the map. Study areas are defined when the structures are located and then GeoRas processing creates georeferenced geometry for HecRas modeling.

A template spreadsheet computation of a breach hydrograph for a conservative discharge of each dam was made using NID data (height of dam, Hw and Volume to top of dam) and NRCS TR-66. This was used for HecRas unsteady flow computations. HecRas modeling computes Maximum Water Surface Elevations for each cross section that is still identifiable on the GIS model. The HecRas output is exported to GIS after review.

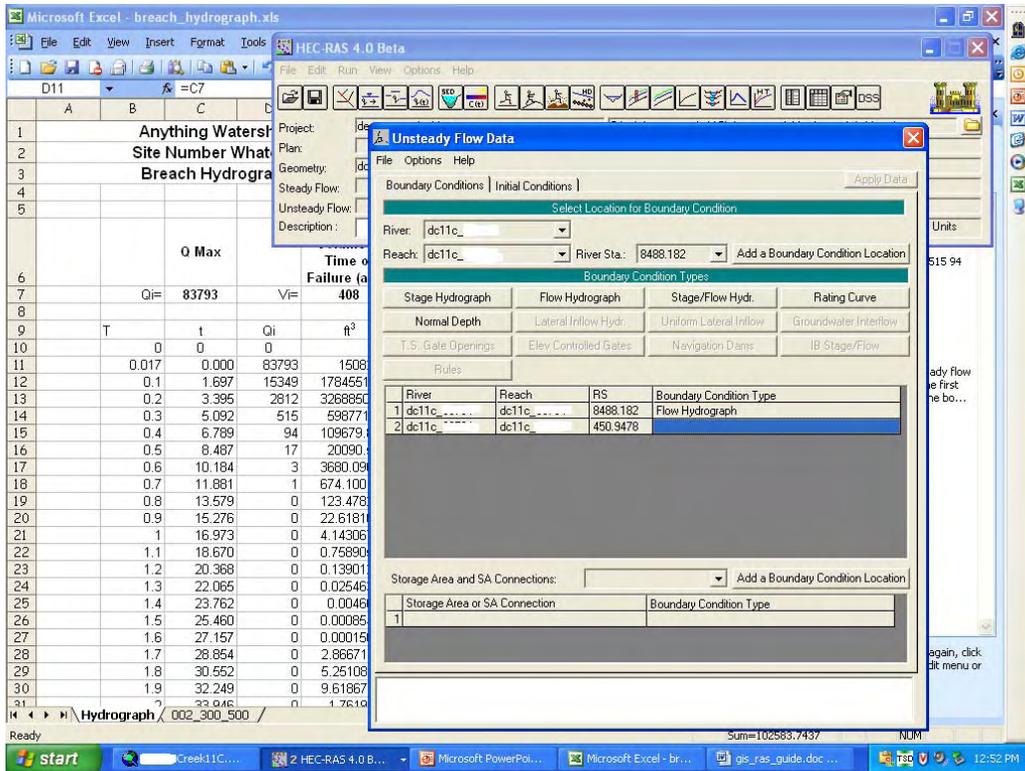


Figure 3 Hydrograph data is copied to the HecRas Unsteady Flow Data Boundary Conditions.

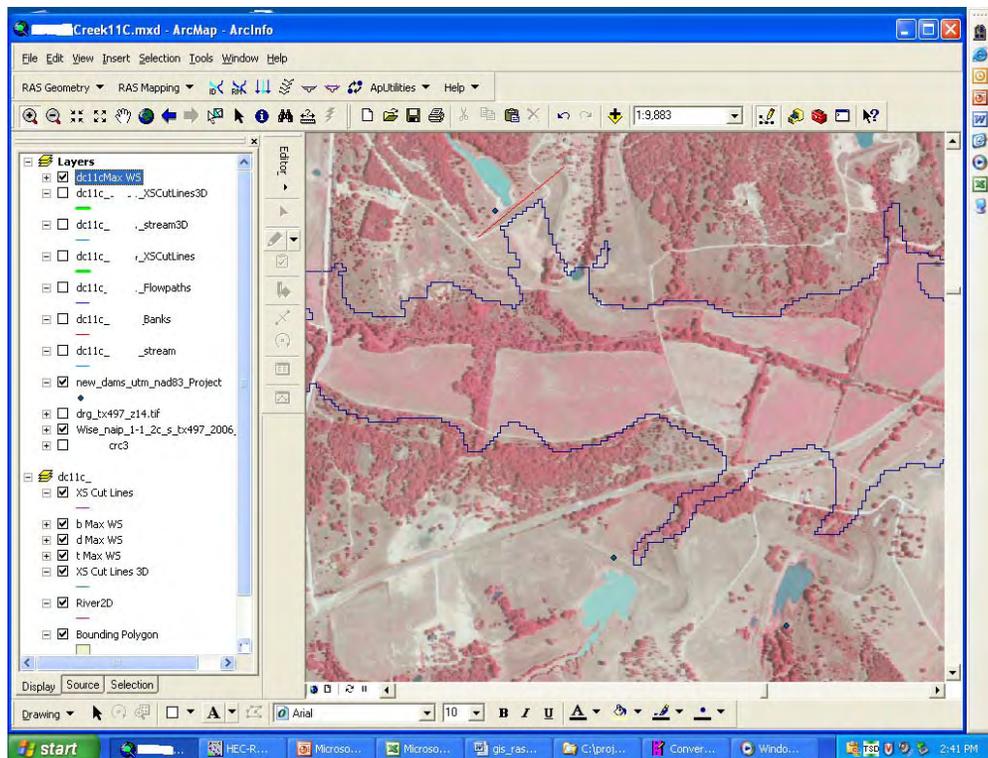


Figure 5. GIS HecRas Mapping of Zone of Interest

This example in Figure 5 shows the Zone of Interest as a blue boundary line on a 2006 background map. The field offices had access to the same GIS maps and in some cases had newer maps. The product delivered to the field was the digital georeferenced Zone of Interest layers as shown in Figure 6.

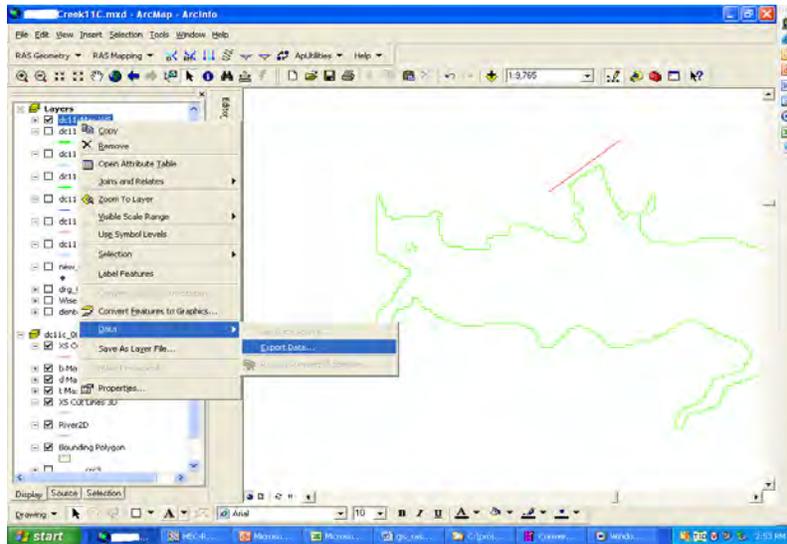


Figure 6. GIS Zone of Interest.

The Zone of Interest gives the field staff a shortcut in identifying what to look at with a conservative aerial limit of view downstream of a dam. Potential breach concerns that require Level 2 analysis are identified by using orthophoto imagery, local knowledge or field investigation within the Zone of Interest.

The GIS and HecRas models are saved to substantiate review findings and used in Level 2 evaluations with required TR60 Breach Discharge criteria and necessary field survey.

## REFERENCES

- ESRI Inc., ArcMap 9.2
- US Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS 4.0 and HEC- GeoRAS 4.1
- United States Department of Agriculture, Natural Resources Conservation Service, Earth Dams and Reservoirs TR-60, July 2005
- United States Department of Agriculture, Natural Resources Conservation Service, Simplified Dam-Breach Routing Procedure 3<sup>rd</sup> Edition, September 1985
- US Army Corps of Engineers, Texas NID 2008
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