Guidance Document for Class C and Class B Hazard Dam EAPs

Under Section 22a-411a-2(a) of the Regulations of Connecticut State Agencies (RCSA), owners of Class C (High Hazard) and Class B (Significant Hazard) dams are required to prepare an Emergency Action Plan (EAP) for their dam. The EAP must be prepared by a Professional Engineer licensed in the state of Connecticut.

Section 22a-411a-2(a) RCSA: *Each owner of a Class C or Class B dam shall prepare an emergency action plan (EAP) for each Class C or Class B dam that he or she owns. The owner shall coordinate with the agencies responsible for providing emergency services when developing the plan. The owner shall update the EAP a minimum of every two years, or more frequently as necessary to reflect significant changes. Copies shall be filed with the commissioner and the chief executive officer and the emergency management officer of any municipality that would potentially be affected in the event of an emergency involving the dam for which the EAP has been prepared.*

The CT Department of Energy and Environmental Protection published an EAP template which can be found at https://portal.ct.gov/deep/water/dams/emergency-action-plans. This document provides the necessary format as well as useful advice and explanations of the components that form the framework for an acceptable EAP. A checklist is also included to ensure that the EAP is both a complete and operational document.

The inundation map is a fundamental element of the EAP document and provides the basis of the actions required to be undertaken in the event of a dam failure. The EAP identifies the areas to be evacuated as well as the timing of any potential evacuations.

Dam Breach Modeling

Many computer programs (e.g., HEC-RAS, HEC-HMS, NWS-DAMBRK, and DSS-WISE Lite) are available to model dam breach outflow hydrograph computations and downstream flood routing. These models require that the potential breach characteristics or parameters be estimated independently of the model. These breach parameters include the elevation of the water surface in the impoundment, the breach width and depth, the breach development time, the failure location and the failure mode. Reasonable values for the breach size and development time are needed to make a reliable estimate of the breach flows.

Photo based mapping may be used if prior permission is obtained from the Dam Safety Program.

The DEEP requires that the breach inundation mapping show the “wet weather” breach inundation area. The wet weather condition is a conservative approach in determining the extent of the area affected by the breach wave. Pre-breach conditions shall include the water level in the impoundment to be at the top of dam, or at the highest elevation reached during the occurrence

of the spillway design storm. If the modeler is routing a storm event through the impoundment and then downstream, it would be appropriate to continue to use the spillway discharge as calculated for either of those events. If the storm isn't being routed through the impoundment and then downstream, it is suggested that the 100-year FEMA discharge be used in the areas below the dam as a base flow on which to add the breach flow.

The breach characteristics and breach outflows can be estimated in several ways; including: comparative analysis (comparing the subject dam to historical failures of dams of similar size, materials and water volume); regression equations (equations developed from historical dam failures in order to predict peak outflow or breach size and development time); and physically based computer models (computer programs that attempt to model the physical breaching process by using sediment transport/erosion equations, soil mechanics, and principles of hydraulics).

Some of the methods for making these selections are discussed in FEMA P-946 which can be found at Dam Safety Federal Guidelines | FEMA.gov.

Inundation mapping shows the area potentially at risk in the event of a dam failure. This area starts at the dam and continues downstream to a point where the breach flood no longer poses a risk to life and property. In general, the routing should be carried downstream until the incremental increase in water depth (above the no breach elevation) is 1.5 feet or less. The area downstream of a dam should always be inspected by the engineer to verify the following: the number of residences and structures; the existence of road crossings and bridges for their potential to create backwater and the over-all characteristics of the downstream channel or floodplain.

Simplified Inundation Mapping, B Hazard Class Dams Only

Simplified inundation mapping uses conservative estimates of inundation limits and can be used when there are a limited number of homes and a small population (population of around 2,000) in the evacuation area. **Simplified Inundation mapping may not be used where there are complex hydraulic factors such as cascading dam failure, split flow, or there is backwater from a downstream bridge.**

DSS-WISE Lite may be used to generate a dam breach analysis as long as a HCOM (Human Consequences Model) report is generated for all breach scenarios. The highest elevation for the spillway must be used for modeling. If culverts are present downstream of the dam, then a culverts report must be submitted in addition to the inundation mapping to show if the culverts downstream of the dam are properly sized. Population at Risk (PAR) should indicate low density rural areas.

Guidance for EAP Inundation Mapping: *(May also refer to EAP Checklist)*
Link to EAP Checklist: EAP Review Checklist
Inundation Mapping Must Include:

- Elevations based on a reference to Geodetic North American Vertical Datum (NAVD88).
- The name, address, and location of the dam
- The names of pertinent downstream features such as buildings, homes, railroads, bridges, schools, hospitals, campgrounds, other dams, any other significant facilities as well as municipal boundaries.
- Inundation zone for wet weather, with arrows indicating direction of the flood wave
- A north arrow and bar scale
- Pertinent downstream cross sections, such as roads (include road names)
- An estimated timeline that shows arrival times of peak floodwaters expressed in hours and minutes and incremental increase in water depth above the baseline elevation at critical intersection(s), structure(s), or inhabited structure(s).
- A list of all streets, roads, and highways, including the address of the residences and businesses subject to flooding.

In addition, the following information must be provided

- A location map sufficient in scale to clearly show the exact location of the impoundment in relation to the surrounding area, other dams in the area, and the delineation of the drainage area. Said map shall include a north arrow, a bar scale, and the size of the drainage area noted in square miles.
- A description of the method or computer model used to prepare the inundation map.
- *For DSS-WISE Lite analysis, please provide the dam breach simulation report.*