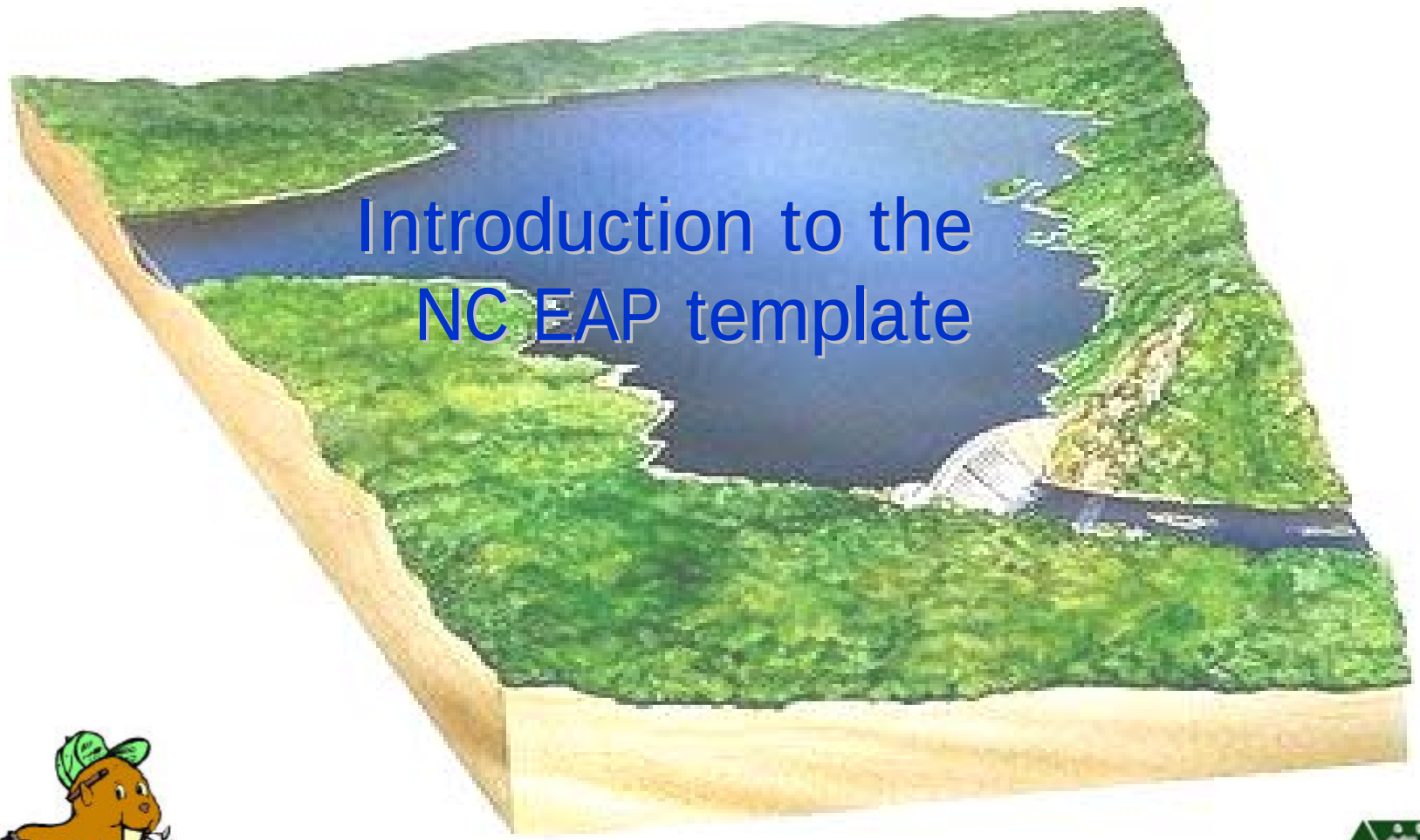
# Emergency Action Plans for Dam Safety



## Introduction to the NC EAP template

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NCDENR

# Primary Purposes of an EAP

- Reduce risk to loss of life
- Determine emergency level
- Make notifications for possible evacuations
- Identify potential people at-risk and properties at-risk
- Provide technical guidance for emergency actions to reduce downstream impacts

# NC EAP Background

- Existing EAP formats from around the country were reviewed
  - ASDSO/NRCS, FEMA64, USFWS, USBR, States of MO, IN, WA, TX
- Lessons learned from actual emergencies included
- NC has finalized an EAP sample template for dam owners to use
  - Although the template does look ominous at 68 pages long, the format is meant to be user friendly regardless of the background or experience of the owner, operator or detector of emergency
  - 3-ring notebook for durability and easy updating
  - Top “Hot Tabs” for key pages
  - Basic dam info on each header to ensure correct dam
  - During an emergency, stress and adrenalin make the human thought process much more difficult. The 4 step process can walk you through an emergency situation.

# Parts of an EAP

- Cover Sheet
- The 4 STEP Process
- MAPS, FIGURES AND SUPPORTING DATA
- Directions and Emergency Access Routes Map
- A list of Residents/Businesses/Roads/Infrastructure at Risk downstream (including names, addresses & telephone numbers listed in the order they would be affected
- Map of Hazards Downstream
- Evacuation Map (If available, developed by local Emergency Management Agency)
- NC Inventory of Dams Data Sheet
- APPENDICES- Defines Roles & Responsibilities, Emergency contacts, locally available resources, tracks EAP updates and distribution and provides other supporting data as needed.

The Cover Sheet should include the following information:

- Name of Dam
- State Identification #
- The version # and date of the EAP
- Owner's Name and Contact Information
- general location map that shows where the dam is located relative to other key local roads, drainages, and population centers.

# Dam Name

## Emergency Action Plan (EAP)

**State ID: (first 5 letters of County) COUNT-*****

**County Name County, North Carolina**

Revision Number___

Month and Year

*Owner/Operator Information:*

Name and Title

Address

Day Phone: Insert Day Phone #

Other Phone: Insert Emergency Phone #


Insert Vicinity map here or draw map showing neighboring towns, major roads and location of your dam. Color in your county on the North Carolina map to the left.

Highlight this text

Click on "Insert Picture"

Choose map to insert

# 4 STEP Process of an EAP

Step 1 – Event Detection and Level Determination

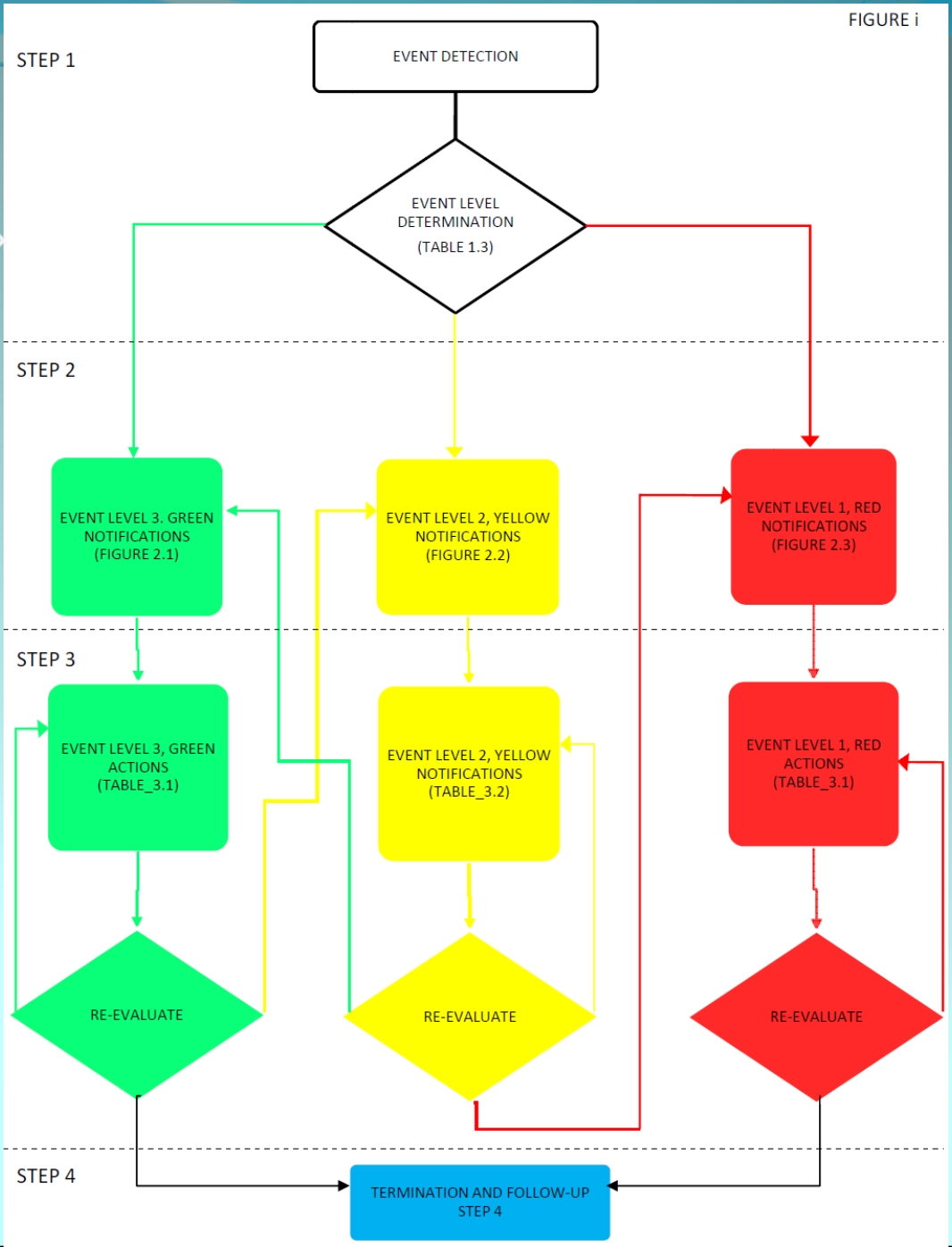
Step 2 – Notifications and Communication

Step 3 – Expected Actions

Step 4 – Termination and Follow-Up

# EAP Process

## Step 1 – Event Detection Level Determination



# Event Levels

- **Level 1, RED Emergency - Urgent!! Dam Failure Imminent or is in Progress**
- **Level 2, YELLOW Emergency - Potential dam failure situation, rapidly developing**
- **Level 3, GREEN Emergency - Unusual event, slowly developing**

**Levels are numbered and color coded to prevent confusion.**

## Level 1, RED Emergency - Urgent!! Dam Failure Imminent or is in Progress

This is an extremely urgent situation when a dam failure is occurring or obviously is about to occur and cannot be prevented. When it is determined that there is no longer time available to implement corrective measures to prevent failure, an order for evacuation of residents in potential inundation areas shall be issued by the Incident Commander

## Level 2, YELLOW Emergency - Potential dam failure situation, rapidly developing

This classification indicates that a situation is developing that could lead to dam failure, but there is not an immediate threat of dam failure. The dam Owner/Operator should closely monitor the condition of the dam and periodically report the status of the situation. A reasonable amount of time is available for analysis before deciding on evacuation of residents.

# Level 3, GREEN Emergency
## Unusual event, slowly developing

This classification indicates a situation is developing, but has not yet threatened the operation or structural integrity of the dam. The Owner's technical representative or engineer AND NC Dam Safety Office should be contacted to investigate the situation and recommend actions to take. The condition of the dam should be closely monitored, especially during storm events, to detect any development of a potential or imminent dam failure situation.

# Level Determination

STEP 1

| Event | Condition | Emergency level* |
|---|---|---|
| Earth spillway flow | Reservoir water surface elevation at auxiliary spillway crest or spillway is flowing with no active erosion | 3 |
| | Spillway flowing with active gully erosion | 2 |
| | Spillway flow that could result in flooding of people downstream if the reservoir level continues to rise | 2 |
| | Spillway flowing with an advancing headcut that is threatening the control section | 1 |
| | Spillway flow that is flooding people downstream | 1 |

# What is a Decision Table?

A guidance document that provides pre-selected threshold levels to help dam operators determine the severity of common dam safety emergencies

# Example Earthquake Thresholds

## Emergency Level 3, GREEN

Measurable earthquake felt at the dam or reported within 50 miles of the dam

## Emergency Level 2, YELLOW

Earthquake resulting in visible damage to the dam or appurtenances

## Emergency Level 1, RED

Earthquake resulting in uncontrolled release of water from the dam

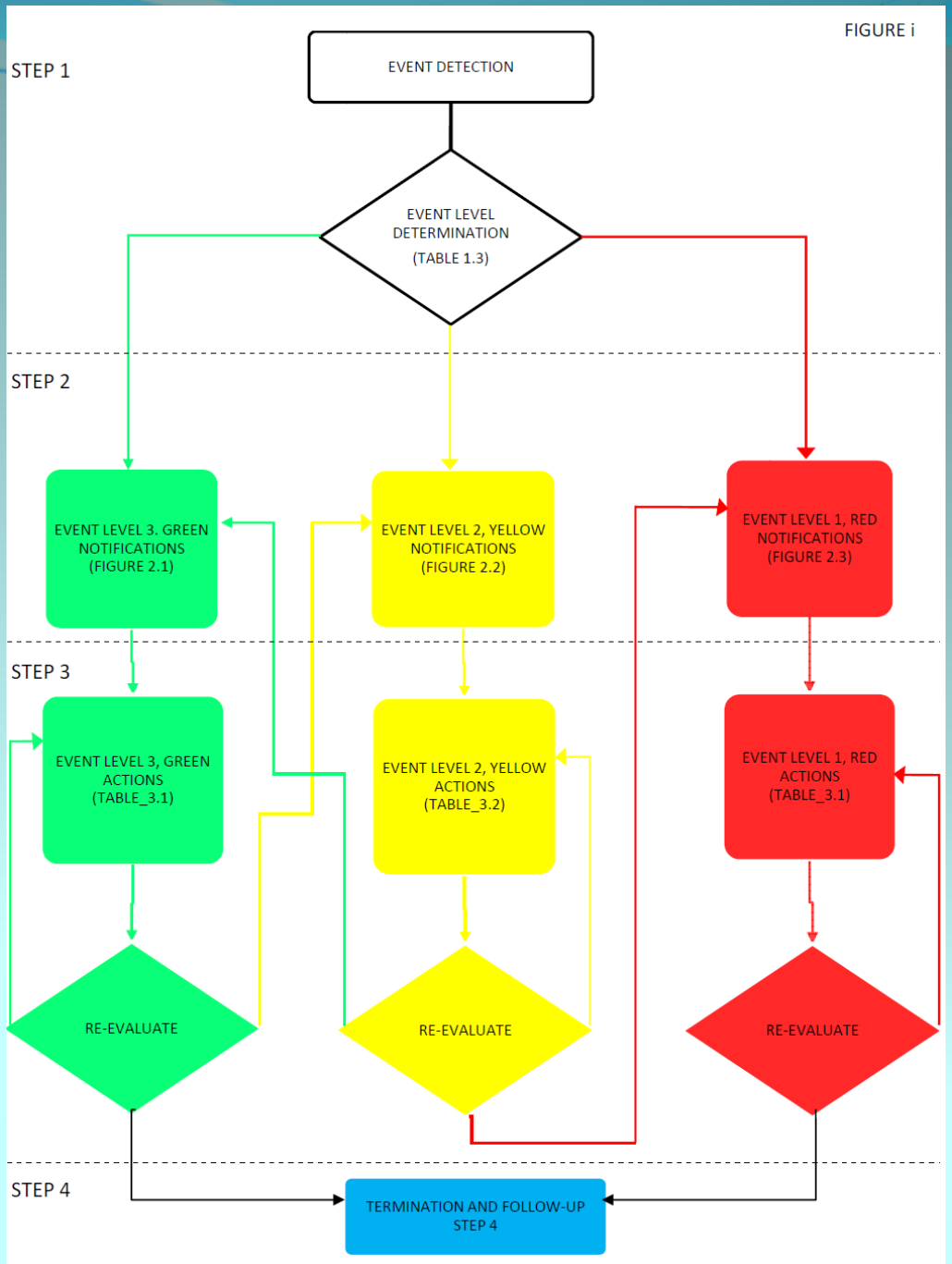
# Common Event Types for Earthen Dams

- Earth Spillway flow
- Embankment overtopping
- Seepage
- Sinkhole
- Embankment cracking
- Embankment movement
- Instrument readings abnormal
- Earthquake
- Security threat
- Sabotage/Vandalism
- Blocked culverts

# EAP Process

Step 1 – Event Detection Level Determination

Step 2 – Notification & Communication



**UNUSUAL EVENT, SLOWLY DEVELOPING**
(Can usually wait until regular business hours unless Level is elevated)

S T E P 2

**Dam Owner/Operator**

**Name**

XXX-XXX-XXXX (Office)
XXX-XXX-XXXX (Home)
XXX-XXX-XXXX (Cell)

(1)

**Dam Owner's Engineer**
**(if applicable)**

*Name of engineer*

XXX-XXX-XXXX (Office)
XXX-XXX-XXXX (Home)
XXX-XXX-XXXX (Cell)

(2)

**Land Quality Section Staff**

**BUSINESS HOURS**

### Regional Office

Phone: ### ### ####

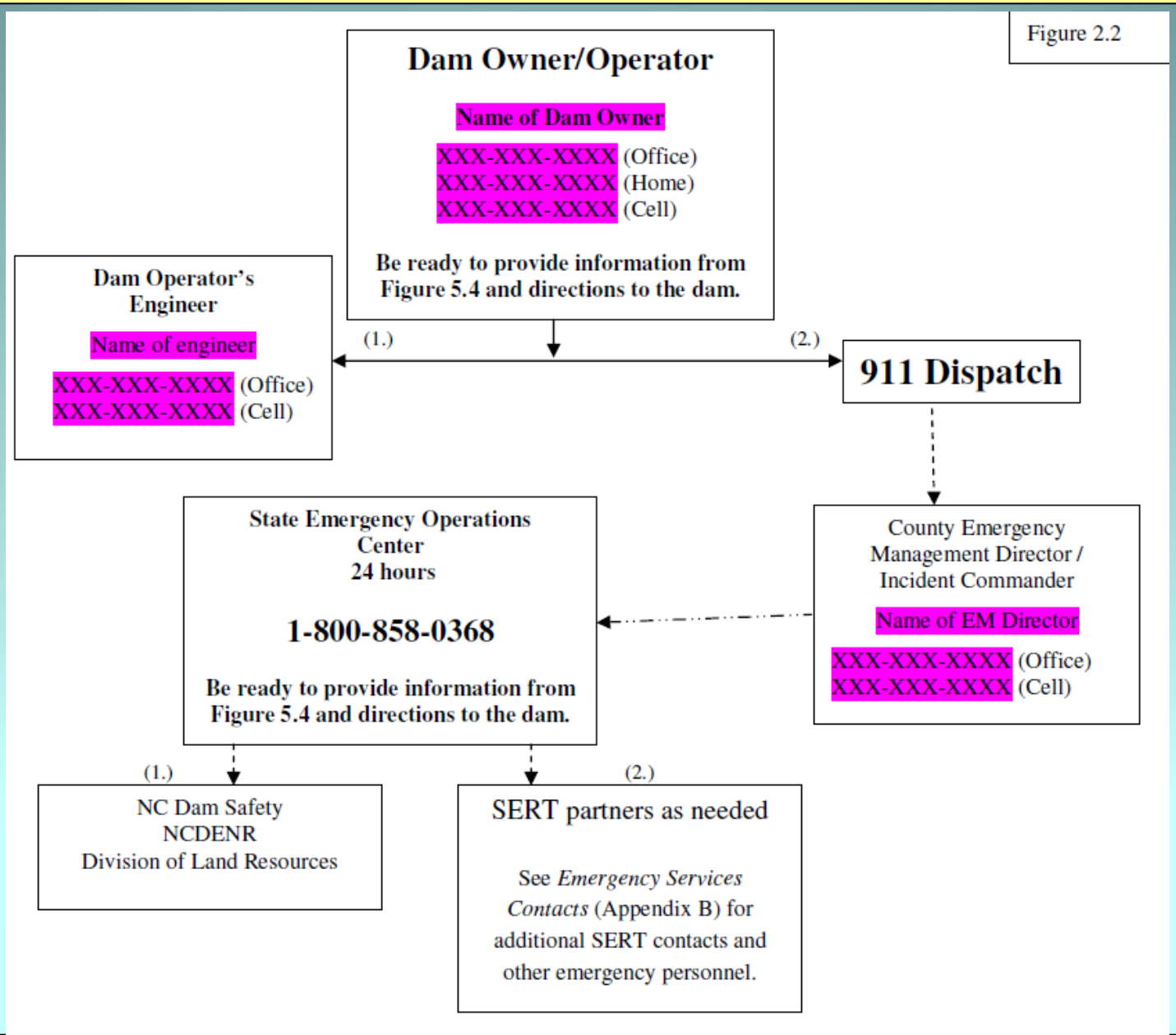
Or

Raleigh Central Office

Phone: 919-733-4574

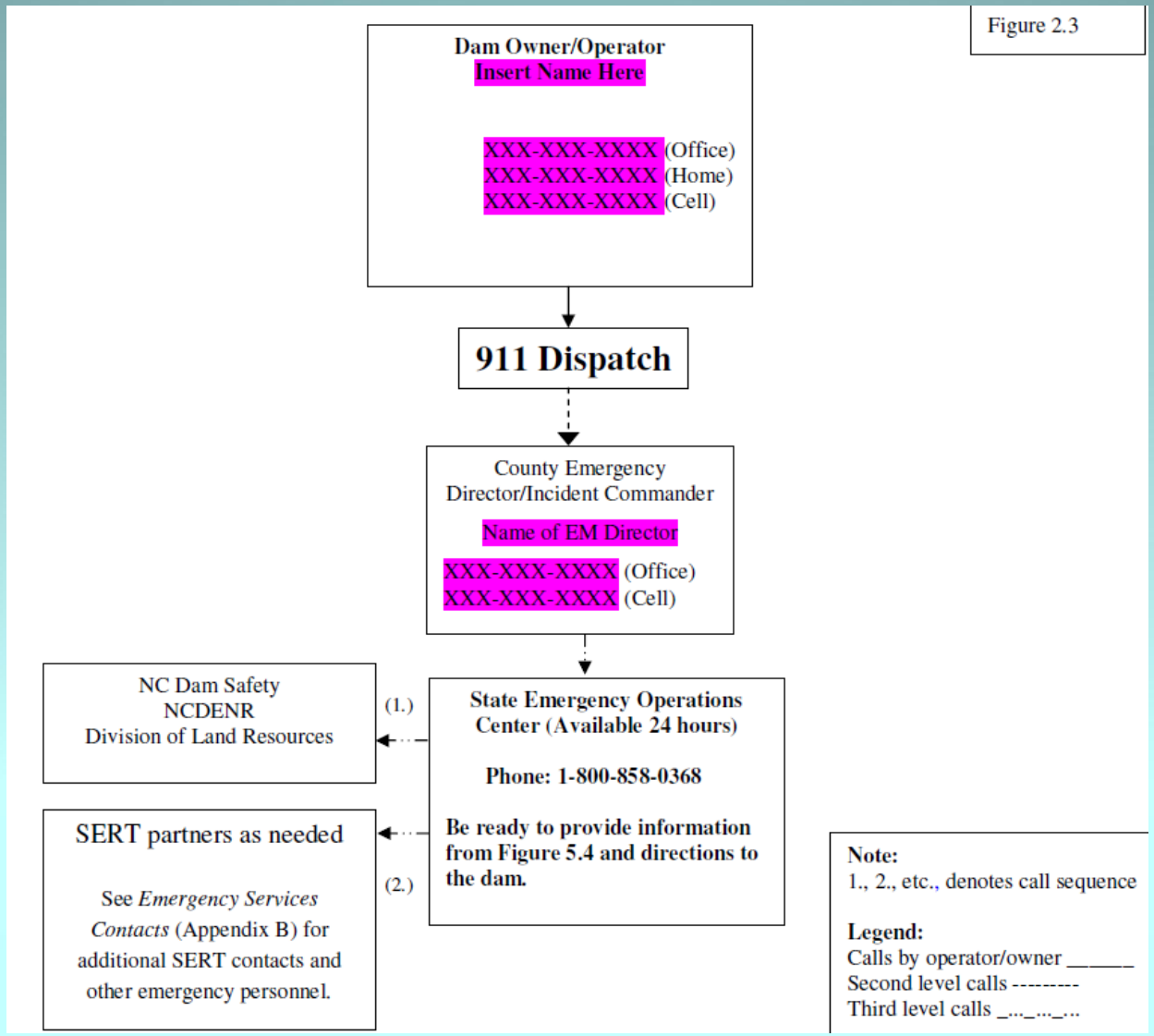
# Emergency Level 2 YELLOW Notifications
# Potential dam failure situation, rapidly developing

Figure 2.2



# Emergency Level 1, RED Notifications
# FAILURE IN PROGRESS

Figure 2.3



# Notification Flow Charts

- Notification procedures may be expanded to address needs of Owner or local responders.
- North Carolina has 100 Counties
  - That does not include the number of local government and volunteer responders and 911 Communications
  - Every County has different capabilities and capacities for local response.
  - Communication with the County Emergency Management Director where your dam is located is critical in determining whether the flow charts provided in the template is adequate.

# Suggested phone messages are included on each Notification Flow Chart

Goals of pre-scripted messages :

Help the dam owner  give the 911 dispatcher appropriate message

Prevent miscommunication of proper information  to responders

# Repeat after me

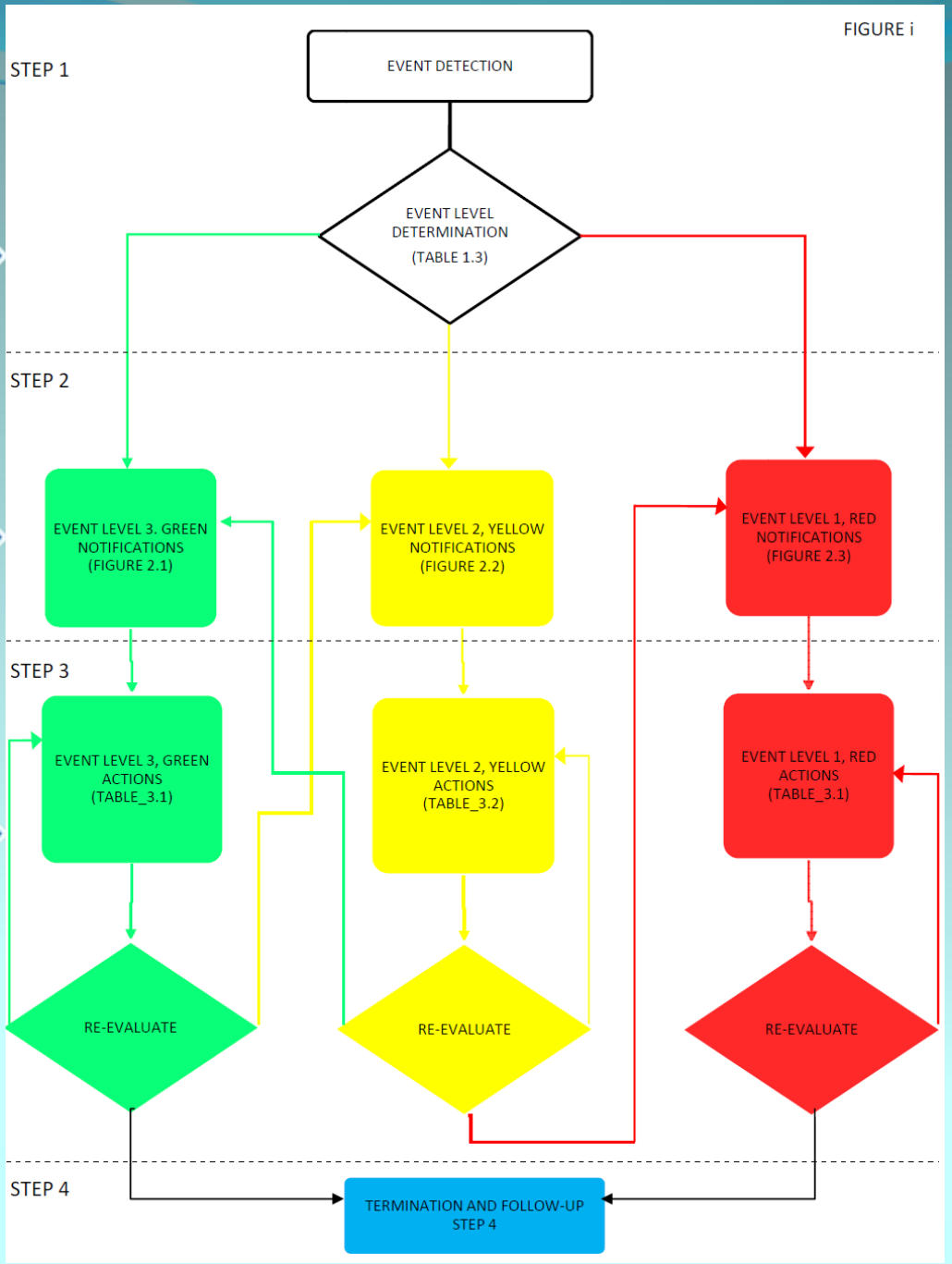
- This is an EMERGENCY. This is (Identify yourself)
- The (Dam Name) is failing. The downstream area must be evacuated immediately. Repeat, the (Dam Name) is failing.
- We have activated the Emergency Action Plan for this dam and are currently under Emergency Level 1.
- Evacuate immediately according to the evacuation map in your copy of the Emergency Action Plan.
- I can be contacted at the following number Phone No. If you cannot reach me. Please call the following alternative number Alt. No.

# EAP Process

Step 1 – Event Detection Level Determination

Step 2 – Notification & Communication

Step 3 – Expected Actions



STEP 3

# Expected Actions

- After the *EAP Coordinator* has determined the event level in STEP 1 and has made the appropriate notifications, the *EAP Coordinator* shall take action, using the Action Data Sheets as a guide

- Action Data Sheets are provided for the most common types of events for earthen dams. Additional Data Sheets may be needed for other types of dams

# What are Action Data Sheets ?

- Pre-planned preventative actions to consider to minimize the consequences of the unusual or emergency situation and prevent the situation from worsening.
- Pre-planned actions must be tailored to address individual dam
- Appropriate Actions will vary depending on the Emergency Event Level
- A knowledgeable dam safety engineer should always be consulted *if time permits*

# Recall the Level Determination Table 1.3

| Event | Condition | Emergency level* |
|---|---|---|
| Earth spillway flow | Reservoir water surface elevation at auxiliary spillway crest or spillway is flowing with no active erosion | 3 |
| | Spillway flowing with active gully erosion | 2 |
| | Spillway flow that could result in flooding of people downstream if the reservoir level continues to rise | 2 |
| | Spillway flowing with an advancing headcut that is threatening the control section | 1 |
| | Spillway flow that is flooding people downstream | 1 |

# Table 3.1
# Action Data Sheet Index

| Event | Event Level | Action Data Sheet |
|---|---|---|
| Earth Spillway Flow | 3 | A3 |
| | 2 | A2 |
| | 1 | A1 |
| Embankment Overtopping | 2 | B2 |
| | 1 | B1 |
| Seepage | 3 | C3 |
| | 2 | C2 |
| | 1 | C1 |
| Sinkholes | 2 | D2 |
| | 1 | D1 |
| Embankment Cracking | 3 | E3 |
| | 2 | E2 |
| Embankment Movement | 3 | F3 |
| | 1 | F1 |
| Instruments | 3 | G3 |
| Earthquake | 3 | H3 |
| | 2 | H2 |
| | 1 | H1 |
| Security Threat | 2 | I2 |
| | 1 | I1 |
| Sabotage/Vandalism | 3 | J3 |
| | 2 | J2 |
| | 1 | J1 |
| Blocked Culverts /Spillways | 3 | K3 |

## RECOMMENDED ACTIONS

Time/Date Completed

*Owner/EAP Coordinator*

A. Make sure notifications on Figure 2.1 have been made.

B. (*Describe a course of action that closely monitors the situation. Careful observation and inspection of every part of the dam is necessary; this should be done without compromising the safety of anyone performing these tasks. Clearly describe potential problems so that the individual(s) carrying out the inspection know what may be dangerous. Off-site areas and/or instrumentation may also need to be monitored. If necessary, confer with the On-Call Engineer or designee to determine any preventative action that must be take[illegible]nally, develop a plan to avoid dam failure and minimize damage downstream*

C. Record all information, observations, and actions on a[illegible]n (Form 3.2).

D. Contact the *Owner's Engineer* at least daily to r[illegible]bservations and conditions. If conditions change significantly, return to S[illegible]-evaluate Emergency Level and follow relevant steps immediately.

*Owner's Engineer*

A. (*Describe a cou[illegible]e followed by this position. In general, this will be to review all pertinent i[illegible]der to recommend appropriate actions to the EAP Coordinator. If necessa[illegible]local emergency contractors and/or other individuals that may be able to assist in monitoring the situation.*)

NC Dam Safety Staff

A. Provide decision support and technical support to the *Incident Commander* as appropriate.

# General Emergency Level 3, GREEN Actions

(Non-emergency, unusual event, slowly developing)

- Make an inspection of the dam
- Contact a dam safety engineer for advice
- Consider the following:
  - Increased monitoring
  - Lower the reservoir
  - Initiate repair strategies
- Record all contacts, observations, and actions

# General Emergency Level 2, YELLOW Actions

(Potential dam failure, rapidly developing)

- Contact a dam safety engineer for advice
- Contact local emergency management :
  - Prepare to evacuate
- Provide timely updates to local emergency management
- If time permits, inspect the dam
- Record all contacts, observations, and actions
- Initiate preventative actions if time permits

# General Emergency Level 1, RED Actions

(Dam failure is imminent or in progress)

- Immediately contact local emergency management and advise *immediate* evacuation
- If possible observe and record the event from a safe, high ground location
- Update local emergency management throughout the event Record all contacts, observations, and actions
- Do not attempt further remediation efforts

## RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly. Using Table 1.3 [illegible] Table 3.1, determine whether:

A. The event can be terminated (e.g. Inflows are decreasing, *Specify other [illegible] which this is an acceptable decision*)

B. The event remains at the current Event Level 3 (No chan[illegible]

C. The event warrants escalation to Event Level 2 (e[illegible] of channel beginning, spillway flow that may result in flooding of people downstrea[illegible]ues to rise, *Specify other parameters for which this is an acceptable decision*).

Based on this determination, follow [illegible] actions below.



| A) TERMINATION | B) EVENT LEVEL 3 | C) EVENT LEVEL CHANGE |
|---|---|---|
| Go to **Termination & Follow-up** (Section 4) | Continue recommended actions on this sheet | Go to **Event Level 2 or Event Level 1 Steps 2&3** |

Each data sheet guides you through a continuous process. Once an Event Level determined, Notifications are made, and Actions taken, the situation must be re-evaluated. The EAP may go through multiple event levels during STEPS 2 and 3 as the situation either improves or worsens.

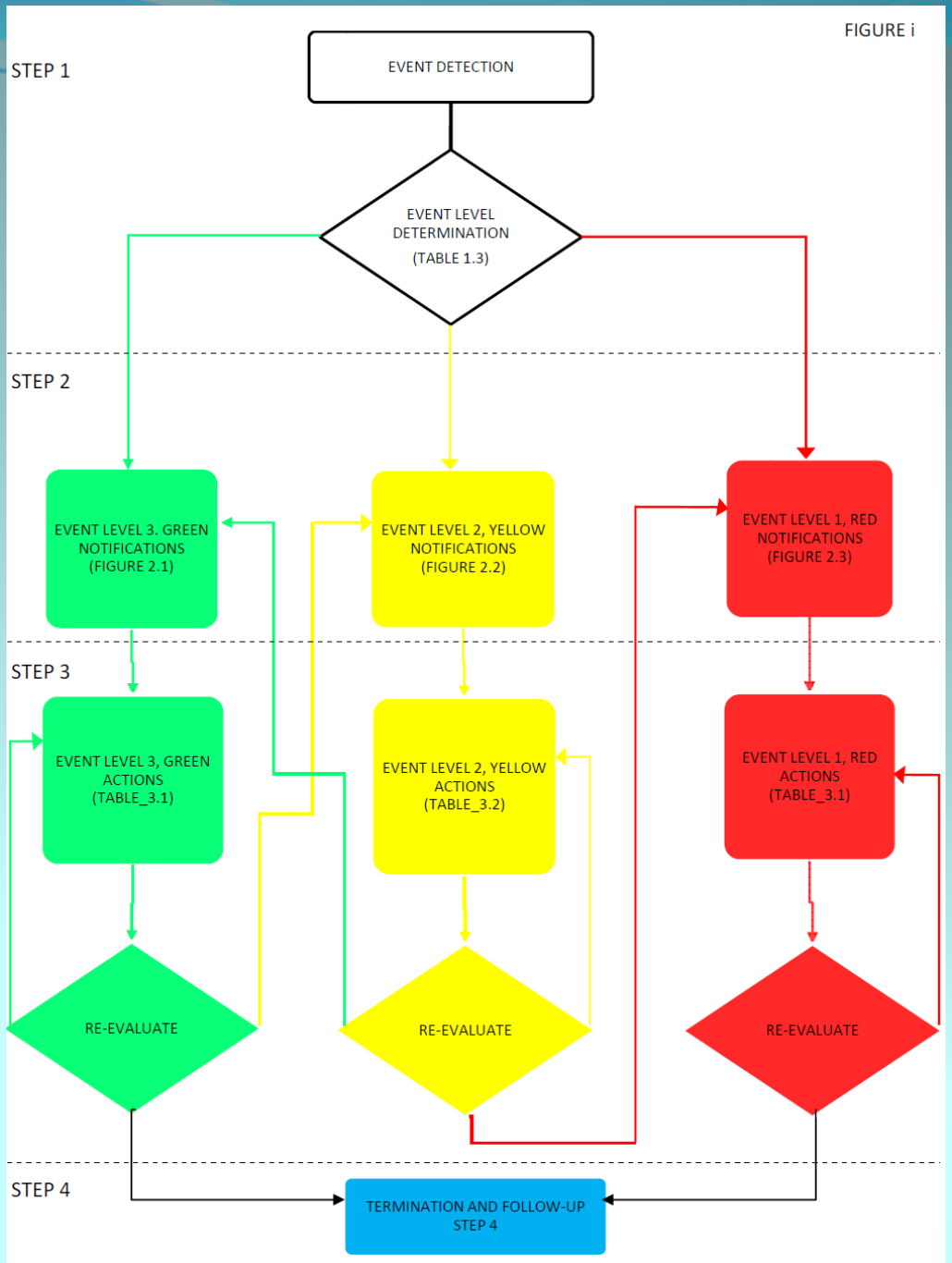
# EAP Process

Step 1 – Event Detection Level Determination

Step 2 – Notification & Communication

Step 3 – Expected Actions

Once Re-evaluation made, follow the continuous process lines.



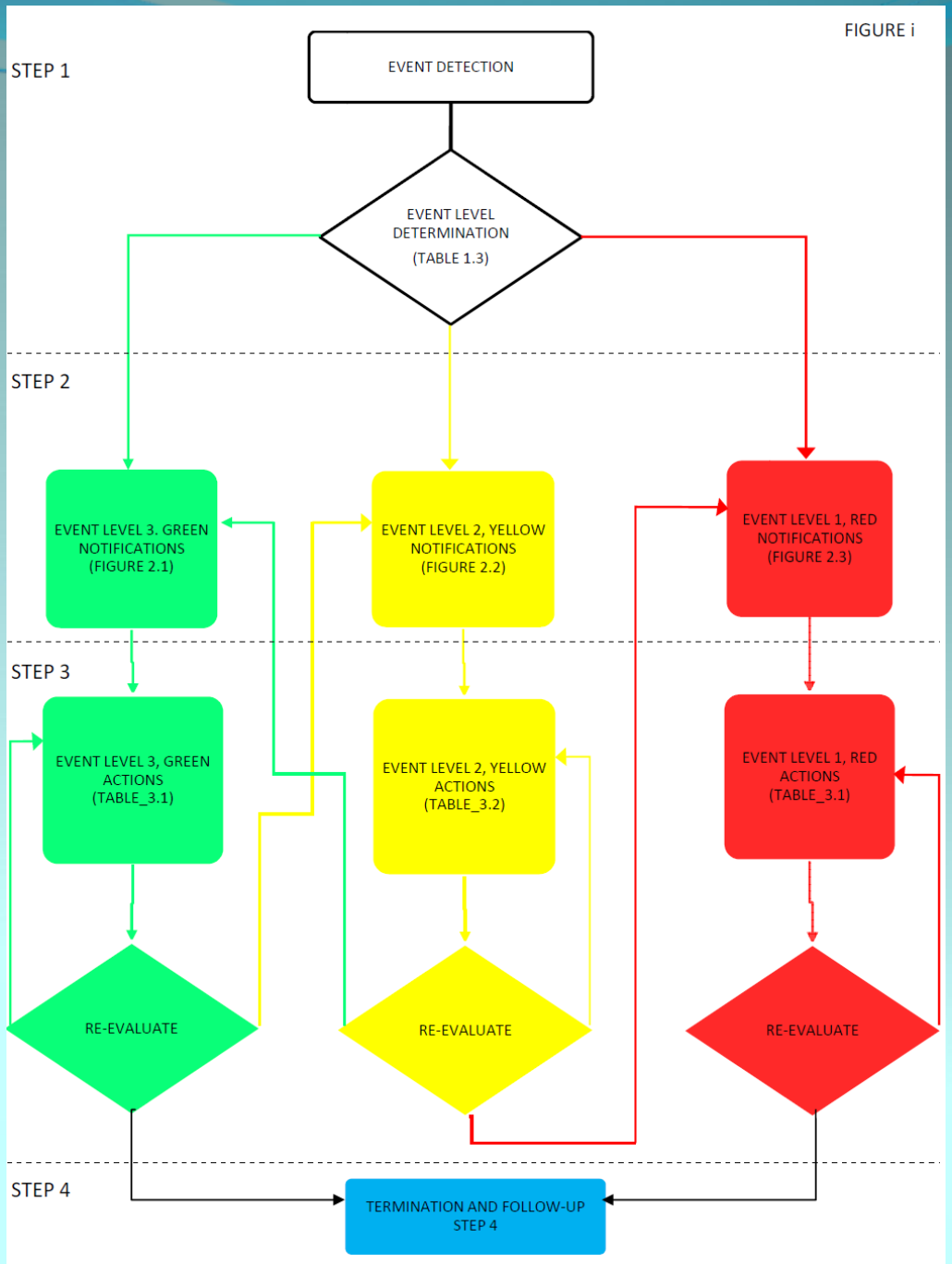
# EAP Process

Step 1 – Event Detection Level Determination

Step 2 – Notification & Communication

Step 3 – Expected Actions

Step 4 – Termination & Follow-up



# Termination and Follow-up

STEP 4

- Identify the individual responsible for terminating EAP operations. This must not necessarily be the EAP Coordinator
- Describe notification protocol to be followed once EAP activities have been terminated
- Outline any special actions that are to be taken prior to termination of a Level 1 event that did not result in dam failure. These actions should ensure the safety of people and property downstream. Do not terminate the EAP unless it is certain that there is no further threat
- document any EAP procedures that were followed effectively, as well as any ways that the EAP could be improved, make any updates necessary and ensure distribution to the list of EAP holders.

# MAPS, FIGURES AND SUPPORTING DATA

- Directions and Emergency Access Routes Map
- A list of Residents/Businesses/Roads/Infrastructure at Risk downstream. Should include names, addresses & telephone numbers listed in the order they would be affected
- Map of Hazards Downstream
- Evacuation Map (If available, developed by local Emergency Management Agency)
- NC Inventory of Dams Data Sheet

# Directions and Emergency Access Routes Map

- This map will enable responders to access the dam in a safe manner.
- Some dams may not have a safe ingress route without traveling through the area that would be affected if the dam were to fail.  This should be considered during EAP development.
- The first rule of response is safety of the responders. If the responders can not make it safely to the incident, they can not help others.

# Residents/Businesses/Roads/ Infrastructure Downstream

**Residents/Businesses/Roads/Infrastructure at Risk**

Brief summary of number of entities within hazard zone.

| Entity No. | Resident/business/roads or other impacted entity | Property Address | Phone No. with area code | Distance downstream from dam (mi) |
|---|---|---|---|---|
| X | Name of entity | Address/location of entity | XXX-XXX-XXXX | Distance from dam |
| X | Name of entity | Address/location of entity | XXX | Distance from dam |
| X | Name of entity | Address/location of entity | XXX | Distance from dam |

listed in the order they would be affected

# Map of Hazards Downstream

North Carolina Simplified Inundation Maps For Emergency Action Plans

**OR**

More detailed surveying or modeling

**Whichever method is appropriate for your dam**

# Evacuation Plan and Map

- An Evacuation Plan and Map (Provided by Local EM) is based upon the Inundation map (Provided by the dam owner).
- It specifically outlines the evacuation process and procedures and evacuation routes.
- This may include special provisions for nursing homes and other special needs within the inundation zone.
- Outlines responsibilities of other local and state responders such as Highway Patrol, DOT, Sheltering agencies, etc.

# Data Sheet for your Dam
# Provided by NC Dam Safety Office

## General Information

Alternate names:

| | |
|---|---|
| *Status: | IMPOUNDING |
| *Dam Type: | Earth |
| Dam Purposes: | Water Supply |
| Year Constructed: | |
| Region: | Asheville Regional Office |
| *Quadrangle: | Bald Creek |
| *Latitude: | 35.9426 |
| *Longitude: | -82.4949 |
| River or Stream: | Big Laurel Creek |
| *River Basin: | French Broad |
| Nearest City/Town: | Faust |
| Distance Downstream: | 4.0 |

## Inspection Information

| | |
|---|---|
| *Last Inspection Date: | 12/10/2009 |
| *Type Inspection: | Routine |
| *Inspector(s): | WW/WCB |
| *Next Routine Inspection: | 12/10/2010 |
| Comments: | |

## Details

| | |
|---|---|
| *Structural Height (ft): | 48.5 |
| Normal Freeboard (ft): | 8 |
| *Hydraulic Height (ft): | 40.5 |
| *Crest Length (ft): | 306 |
| *Crest Width (ft): | 19 |
| *Upstream Slope XH:1V: | 2.5 |
| *Downstream Slope: | 3.5 |
| *Max Spillway Capacity (cfs): | |
| *Low Flow Requirement (cfs): | 0 |
| *Normal Pool Elevation: | 0 |
| *Drainage Area (ac): | 535 |
| Surface Area (ac): | 2.8 |
| Normal Pool Capacity (ac-ft): | 30 |
| *Max Pool Capacity (ac-ft): | 40 |
| Bottom Drain? | Y |
| Bottom Drain Operable? | Y |

## Enforcement

NOD

Deadline
Resolved?

DSO

Deadline
Resolved?

EAP? Y

EAP Date 11/12/2009

## Hazard Information

*Hazard Class High

*Hazard Description State Road, Residences

## Spillways

**Primary Spillway** **Channel**

Bottom Width: 29 Side Slope: 0 Lining: Concrete

# APPENDICES

- Roles, Responsibilities, and Authority
- Emergency Services Contacts
- Locally Available Resources (Equipment, Labor, and Materials)
- Record of EAP Annual Review, Revision and Periodic Test
- Record of Revisions and Updates
- EAP Distribution and Acceptance
- Engineering Documents
- Glossary of Terms

# Why Should EAPs be Tested?

- Familiarizes local emergency management agencies with the dam and its potential downstream consequences
- Improves the EAP
- Trains dam operators and emergency responders on the use of the EAP

# EAP Tabletop Exercise

- Informal meeting of the dam owner and state and local emergency officials
- Minimum stress is involved
- The exercise begins with the description of a simulated scenario
- A discussion to evaluate the EAP, response procedures and resolve questions about coordination and responsibilities

# Typical Tabletop Test Agenda

- Introductions
- Document Overview
- Inundation Map Overview
- Introduce and Discuss a Mock Emergency
- Document and Review Improvement Comments


# Jellystone Park Dam
# TABLE TOP EXERCISE SCENARIO

It's 4:00 p.m. on Friday, July 1st and Ranger Smith, is getting ready for the long holiday weekend. He is hoping that the rain will stop soon as it has been raining almost all week.

Ranger Smith is concerned about the extended forecast so he looks at the National Weather Service website and finds that the forecast calls for continued rain until at least Monday, with potentially heavy thundershowers.

Based on the forecast, Ranger Smith drives to Jellystone Park Dam to check the conditions at the dam prior to going home for the long, holiday weekend. He notices that the reservoir pool has risen to the auxiliary spillway crest.

# FORM 3.2

## Unusual or Emergency Event Log

(To be completed during the emergency)

Dam name: County:

When and how was the event detected?

Weather conditions:

General description of the emergency situation:

Emergency level determination: Made by:

## Actions and Event Progression

| Date | Time | Action/event progression | Recorded by |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# New Information July 1, 2010 6:00 pm

Reservoir pool rises with 1' of flow over aux. Spillway; flooding possible downstream if reservoir continues to rise 

# New Information July 2, 2010 8:00 am

Reservoir has dropped to .5 feet below aux. spillway crest

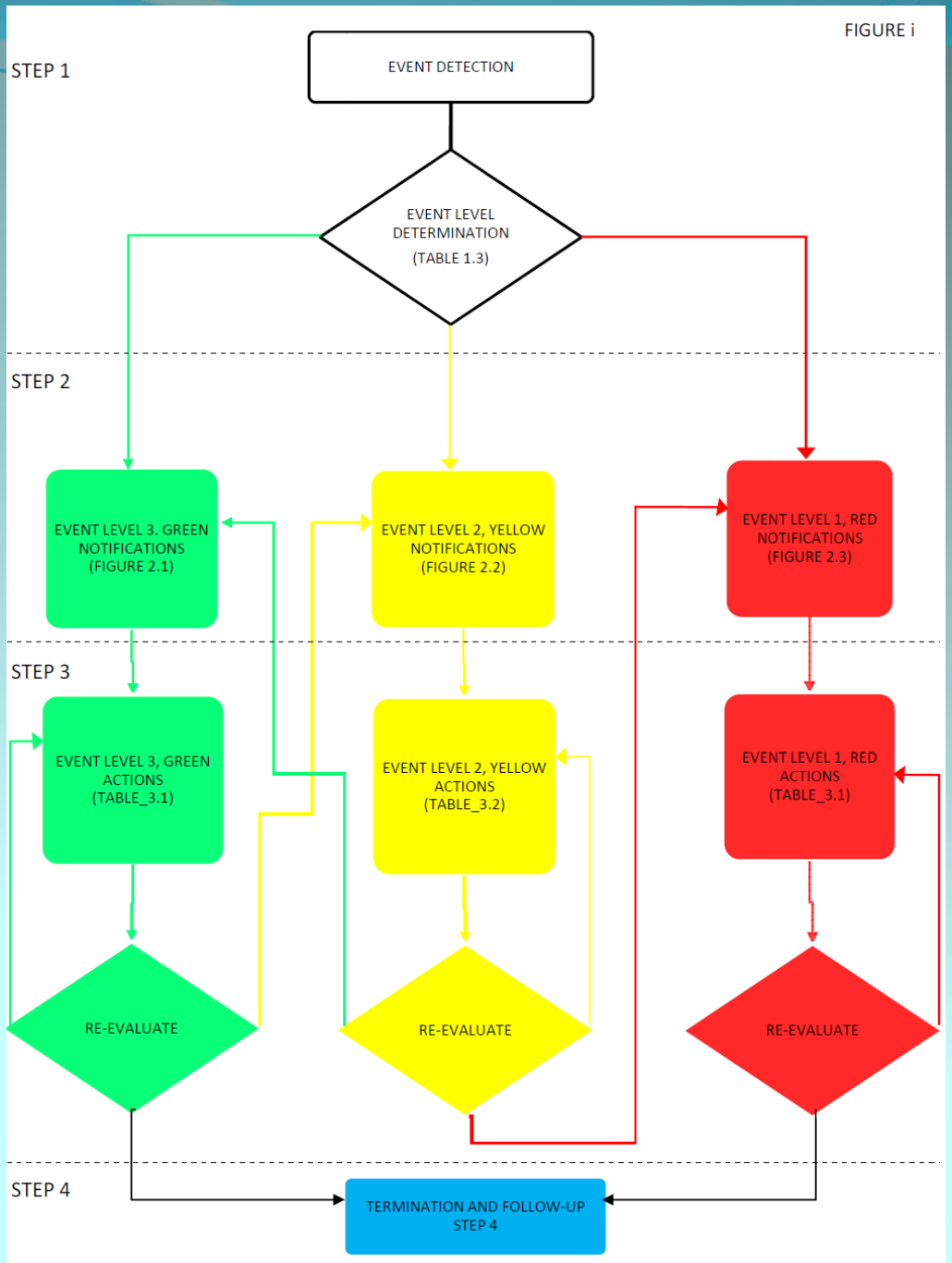
# EAP Process

Step 1 – Event Detection Level Determination

Step 2 – Notification & Communication

Step 3 – Expected Actions

Once Re-evaluation made, follow the continuous process lines.



# Updating an EAP

- EAPs are living documents; must be updated periodically to have the greatest effectiveness
- Owner should train new personnel or people with assigned responsibilities.

# Annual Testing/Drill by Owner

- Owner calls all contacts on Notification Charts to verify phone numbers and contact person name
- Owner verifies that contact person can find EAP
- Owner checks if current version of EAP is being used (e.g., Revision No. 2)
- Owner asks if contact person understands roles and responsibilities

# Annual Testing/Drill by Owner (cont'd)

- Owner checks locally available resources (gravel sources, equipment suppliers, etc) for phone numbers and contacts
- Owner ensures familiarity with EAP 4 STEP process (event level determination, notification, emergency actions, and termination)
- Owner documents annual testing


QUESTIONS?