



FOREWORD

The basic purpose of this plan is to provide a guide for emergency operations. The plan is intended to assist key officials and emergency organisations to carry out their responsibility for the protection of life and property under a wide range of emergency conditions.

When disasters threaten or strike a jurisdiction, people expect elected leaders to take immediate action to deal with the problem. Local government is expected to marshal its resources, channel the efforts of voluntary agencies and private enterprise in the community, and solicit assistance from outside the jurisdiction, if necessary.

This is the Emergency Action Plan for Meenkara Dam. It assigns responsibility to organizations and individuals for carrying out specific actions in emergencies exceeding to the capacity or routine responsibility of any agency. The plan sets forth lines of authority and organizational relationships and shows how coordination should be achieved. The Plan describes how people and property will be protected and identifies personnel and resources available within the districts involved, or by agreement with others, for use during response and recovery operations.

Although an organization may have the foresight to plan for anticipated situations, such planning is of little worth if the planning is not reduced to written form. Personnel familiar with unwritten plans may be unavailable at the time it becomes necessary to implement them. A written plan will furnish a documentary record, which can be referred to as needed. This documentary record will serve to refresh the knowledge of key individuals and can be used to inform persons who become replacements.

Primary goals of Emergency Action Plan are:

- Protect life and property and alleviate human distress.
- Ensure that the public safety and welfare is maintained by coordinating aid.
- Improve emergency response through planning and education.
- Define roles of Departments and agencies for large and small emergencies.
- Develop effective response and coordination among district agencies.
- Promote mobilization with less duplication of effort or gaps.
- Outline access to resources within corresponding districts.
- Encourage partnerships between government, private and volunteer sectors.
- Outline the recovery and restoration process (resilience).

We wish to place on record our heartfelt thanks to Dr.Vishwas Mehta IAS, Additional Chief Secretary, Home & Water Resources for his support and encouragement throughout.

We also wish to place our sincere gratitude to Dr. B. Ashok IAS, Secretary, Water Resources for his constant advice and inspiration. We personally thank all field Engineers including Superintending Engineer, Siruvani Project Circle, Palakkad, Executive Engineer, Irrigation Division, Chittur, Assistant Executive Engineer, Irrigation Sub Division No.1, Chittur and Assistant Engineers, Chulliar Dam Section & Meenkara Dam Section, Chittur for their efforts in drafting this document with all the inputs. We personally thank all the members of SPMU for their efforts in addressing the issues that was raised time to time and which required intellectual input and strategic thinking. Finally, we personally thank Sri. Rajesh S, Assistant Director, Dam Safety for his painstaking efforts to finalise the document on a time bound manner and without whose contribution this proposal would not have materialized.

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Meenkara Dam

KL07MH0010

Palakkad

Emergency Action Plan for Meenkara Dam was published in August 2019. This is the Revision in as updated in

Disclaimer

Every effort has been taken to estimate the severity of flooding and inundation areas likely to be affected by Meenkara Dam in an emergency condition. These estimates are based on available primary and secondary data. Every effort has been made to foresee varied emergency possibilities and develop appropriate notification procedures for timely rescue and relief operations. However, implementation of the Emergency Action Plan (EAP) involves many agencies, who are required to work in a coordinated manner to reduce the consequences of the emergency triggered by the dam site condition. Effectiveness of the rescue and relief operations depend on many factors including the adequacy and accuracy of the estimation of the severity of flooding, coordinated efforts of all the agencies involved in rescue and relief efforts and availability of facilities like power telephones, road communications, etc. EAP Developer may therefore, not be held responsible for the efficacy of the EAP.

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Meenkara Dam

Project ID Code [KL07MH0010]

Approval and Implementation

This Emergency Action Plan has been prepared by State Project Management Unit in collaboration with Meenkara Dam Officials. This version of the document is hereby approved. This plan is effective immediately and supersedes all previous editions.

[Secretary to Govt, Water Resources Department]

Date

I have received a copy of this Emergency Action Plan and concur with the notification procedures.

[District Collector/ District Representatives]

Date

I have received a copy of this Emergency Action Plan and concur with the notification procedures.

[State Disaster Management Authority]

Date

I have received a copy of this Emergency Action Plan and concur with the notification procedures.

[State Dam Safety Organisation]

Date

Meenkara Dam
Project ID Code [KL07MH0010]
EAP Distribution List

A copy of the EAP is provided to the following people

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Emergency Action Plan Meenkara Dam

Project ID Code [KL07MH0010]

1. Purpose

The purpose of this Emergency Action Plan (EAP) is to identify emergency situations that could threaten Meenkara Dam and to plan for an expedited, effective response to prevent failure of the dam and warn downstream residents of impending danger. This plan defines the notification procedures to be followed in the event of a potentially hazardous situation. The procedures are intended to protect lives and prevent property damage from an excessive release of water from the **dam** spillways or an uncontrolled outflow of water from the breached portion of dam.

2. Dam Description

2.1. General

Meenkara Dam and Reservoir are owned and operated by Irrigation Department, Kerala. It is located on Meenkara in Palakkad District, approximately 36 kilometres south-east of Palakkad, Kerala. Meenkara is a tributary of the Gayathri River, located in the Bharathapuzha River Basin. The dam was completed in 1964 and granted to Owner in 1964. The reservoir was constructed to serve as an Irrigation project.

A vicinity map showing the location of the dam is presented in Annexure 1. Inundation maps showing the areas subject to flooding as a result of a dam failure are provided in Annexure 2. The inundation area is described in further detail in the Inundation Area section of the report. Lastly, a description of the dam, its spillways, and other features are outlined in the Dam Description in Annexure 4.

2.2. Reservoir Operations

Reservoir Features:

FRL	=	156.36 m
MWL	=	156.36 m
TBL	=	158.80 m
MDDL	=	143.64 m
Crest of Spillway	=	151.75 m
Dead storage Capacity	=	1.00 Mm ³
Gross storage Capacity	=	11.33 Mm ³
Revised Peak Flood	=	1209 Cumecs (SPF)
No of Bays	=	2 Gates of 12.19 m (W) X 4.57 m (H) each

Regulation of Spillway shutters:

The Assistant Engineer in charge of the dam shall be responsible for the operation of the spillway shutters. All the water reaching the reservoir from the catchment shall be impounded until the level in the reservoirs reaches about two feet below the full reservoir level. Daily readings of the reservoir level shall be taken at 8:30 am. All the data regarding the reservoir shall be sent to the Assistant Executive Engineer, Executive Engineer, Superintending Engineer, Chief Engineer and to Dam Safety Head Quarters from time to time. When the water level is raising and reaches 153.36 m the water level shall be noted every 6 hours. When the level reaches 155.36 m the level shall be noted every two hours. When the level reaches 155.76 m the water level shall be noted every hour and the inflow rates should be computed.

When the reservoir level is raising rapidly it is expected that the spillway shutters may have to be opened to let down the flood water, timely flood warning shall be given to the people in the downstream areas.

When the water level reaches 155.36 m the Assistant Engineer in charge of the dam shall give the first warning by sending message (SMS/Email) ***“Meenkara Reservoir level at 155.36 m only one metre below Full Reservoir Level”*** to the following officers: -

1. The District Collector, Palakkad
2. The District Police Chief, Palakkad
3. The Tahsildar, Chittur
4. The Tahsildar, Alathur

When the level is nearing 155.76m, the Assistant Engineer shall closely watch the inflow rate, rise in the water level etc and obtain further instructions from the Assistant Executive Engineer regarding the opening of the spillway shutter.

When the reservoir level reaches 155.76 m, the following messages (SMS/Email) ***“Meenkara Reservoir level at 155.76 m shutter being opened”*** shall be sent to the following officers: -

1. The District Collector, Palakkad
2. The District Police Chief, Palakkad
3. The Chief Engineer, Projects – I Kozhikode
4. The Chief Engineer, DSO, IDRB, Thiruvananthapuram
5. The Superintending Engineer, Siruvani Project Circle, Palakkad
6. The Executive Engineer, Irrigation Division, Thrissur

3. Responsibilities

3.1. Dam Owner's Responsibilities

The Dam Owner, Irrigation Department is responsible for all dam operation and maintenance. This EAP is not intended to designate a specific person for a specific responsibility but instead will designate the person's duties or job description for both, before and during an Emergency event (Table 1)

Table – 1: Dam Owner’s Responsibilities

Officer Designation	Responsibilities (During Preparedness and Emergency Events)
Executive Engineer (Emergency Planning Manager)	<p><u>Preparedness Responsibilities:</u></p> <ul style="list-style-type: none"> • Coordinate routine inspections and Dam’s Operations as per guidelines for safety inspection of dams. • Conduct pre and post monsoon inspection of dams. • Ensure effective transmission of hydro-metrological and stream flow data through different means. • Ensure proper accessibility to all vulnerable points for constant monitoring during emergency situations • Identify primary and secondary communication systems, both internal (between persons at the dam) and external (between dam personnel and outside entities). • Provide security measures at the dam (CCTV surveillance, security guards, fencing). • Ensure the availability of adequate staff at dam site during holidays, nights and round the clock in weekdays. • Ensure that the EAP is functional and staffs are familiar with their responsibilities. • Ensure that a signboard is installed and clearly visual in different locations at dam site and operation room, with the most common evidence of distress and corresponding levels of alert and remedial actions. • Ensure all the equipment/means at dam site to response to an emergency are easily accessible and well maintained (generators, vehicles, lanterns, radios, heavy equipment, etc) • Ensure the installation and proper maintenance of a warning system (sirens, horns) in the critical areas within the floodplain (less than 2 hours of wave arrival time) • Ensure the current approved version of the EAP is available to all relevant stakeholders (those who have a

	<p>functional role in the emergency response)</p> <ul style="list-style-type: none"> • Ensure all necessary means to manage the emergency response are available and operative in the Emergency Operation Center. • Participate in exercises for test/improvement of this EAP. In charge of organizing publicity at strategic points in Dam. Area limited for forewarning people on opening of gates. <p><u>During Emergency Responsibilities:</u></p> <ul style="list-style-type: none"> • Ensure a continuous and reliable communication with dam site officers • Receive and assess any distress condition as notified by site engineers, observer or regular inspection. • Classify the incident/distress condition reported by the observer into the different Emergency Levels (Blue, Orange, Red) based on the ANNEXURE 4 (Emergency Level Determination/Action Sheets) and ANNEXURE 2 (Inundation Maps) • Initiate/implement the Emergency Action Plan and the Emergency Operation Centre if it is deemed necessary • Identify the areas that would be potentially impacted by the emergency events. • Provide updates of the situation to the District(s) Disaster Management Authority to assist them in making timely and accurate decisions regarding warnings and evacuations. • Propagate the emergency information to other relevant stakeholders. • Support the communication needs of local emergency authority.
<p>Dam Site Engineers (Assistant Executive Engineer, Assistant Engineers)</p>	<p><u>Preparedness Responsibilities:</u></p> <ul style="list-style-type: none"> • Conduct routine inspections as per guidelines for safety inspection of dams and follow up on the events, if any noticed. • Continuous monitor & surveillance of dam and appurtenant structures looking for evidence of distress as mentioned in Annexure 4 • Conduct Pre and Post monsoon Inspections along with the

	<p>Emergency Planning Manager</p> <ul style="list-style-type: none"> • Inform the Emergency Planning Manager about any irregular/unusual condition at dam site and keep him/her posted about any progression/change • Operate dam's gates/under sluices, under the express direction of Chief Engineer / Superintending Engineer / Executive Engineer • Conduct routine dam maintenance • Collect instrumentation measurements, evaluate and report if found necessary. • Ensure that all the data are properly recorded. • Ensure effective working conditions of the warning system (Sirens) • Participate in exercises for test/improvement of this EAP <p><u>During Emergency Responsibilities:</u></p> <ul style="list-style-type: none"> • Monitor the emergency event at dam site and keep posted the Emergency Planning Manager about any change in development • Contact the supplier / contractors • Supervise the work of the labour contractors and machineries engaged in the site for rehabilitation / remedial works • Conduct the remedial actions as per Action Data Sheets (Annexure 4)
<p>Superintending Engineer</p>	<p><u>Preparedness Responsibilities:</u></p> <ul style="list-style-type: none"> • Ensure an annual review of the EAP • Coordinate the annual / regulator testing events of the EAP, such as tabletop exercises, mock drills, stakeholder's consultation. • Coordinate training events in problem detection, evaluation

	<p>and appropriate corrective measures</p> <ul style="list-style-type: none"> • Supervise the functioning of control room and ensure to be well equipped with all type of information to facilitate the rescue and relief operations. • Ensure proper access to site at the earliest possible • Ensure that all related machinery / equipment are in running conditions and can be deployed as per requirement at emergency site • Formation of Purchase Committee / Committee in consultation with Chief Engineer for Procurement of Material from Appropriate Source through Spot purchase • Ensure the correctness of Gauge Discharge sites under his control every year well before monsoon • Have a constant liaison with Indian Meteorological Department (IMD) and other National / International agencies involved in forecasting. <p><u>During Emergency Responsibilities:</u></p> <ul style="list-style-type: none"> • Provide decision support and technical support to Emergency Planning Manager as appropriate • Have a constant liaison with Indian Meteorological Department (IMD) during emergency periods related with flood events • Advise the Emergency Planning Manager of the emergency level determination, if time permits • Disseminate information and make contact to utilize media as appropriate at the time of emergency on behalf of Chief Engineer, Projects – I
<p>Chief Engineer</p>	<p>Preparedness Responsibilities:</p> <ul style="list-style-type: none"> • Assist the Dam Owner's officers in preparation of Action Data Sheets (Annexure - 4) • Recommend specific actions in order to improve the readiness of emergency actions

	<ul style="list-style-type: none"> • Support and Monitor the remedial construction activities such as earth moving, special investigations, etc. • Decide depending upon the quantum of repair/reconstruction work, whether the work is to be got executed through large construction firms or purely through the department or small contractors. • Undertake an engineering assessment of the safety hazard at the dam in collaboration with the State Dam Safety Organization <p>During Emergency Responsibilities:</p> <ul style="list-style-type: none"> • Advice the dam's Emergency Planning Manager / Superintending Engineer with the emergency level determination, if time permits. • Advice the dam's Emergency Planning Manager / Superintending Engineer with remedial actions to take if Blue / Orange events occurs, and if time permits. • Direct specific and appropriate procedures to open/close the spillway's gates during the reservoir operation. • Play the role of "Public Affairs Officer" in case external / public notifications should be released. • Keep close watch on the different activities being carried out by different agencies at the time of emergency
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3.2. Dam Safety Organization's Responsibilities

The following are the basic emergency planning and response roles and responsibilities for the dam safety authorities (State and National level). The Dam Safety Organization (DSO) is the first point of contact for **BLUE** alert

- Is the responsibility of the Dam Safety Organizations undertaking an engineering assessment of the safety hazard at the dam.
- The DSO may inspect the Dam at its discretion and inform the Emergency Planning Manager if **Meenkara dam** is considered to be at **BLUE** alert.
- The DSO may advise the Dam Owner/Emergency Planning Manager of remedial actions to take if **BLUE/ORANGE** events occur.

- The DSO may have an active role in **ORANGE/RED** levels of alert. The DSO may advise the Dam Owner/Emergency Planning Manager of the emergency level determination.
- A DSO's officer may be called on to be the Subject Matter Expert at the Emergency Operation/Response Center.
- The DSO is responsible for reviewing and accepting the Emergency Action Plan, before its final publication.
- State Dam Safety Organization shall constitute a Dam Safety Review Panel consisting of engineers, geologist and hydrologist to analyse the distress conditions of Dam periodically.
- Support for the preparation of asset management plans, emergency preparedness plans, emergency warning systems, flood plain mapping, preparation of flood inundation maps in different areas for the river Basin and downstream impact mitigation measures
- Focus on legal, regulatory and technical frameworks for dam safety assurance

Participate/Conduct a stake holders meeting before finalization of the Emergency Action Plan

3.3. Responsibilities for Notification

After an event level has been determined appropriate notifications should be made in accordance with the corresponding notification Flow Chart provided in this EAP (**See Notification Flowcharts Tab**). These Notification Flowcharts list the names and contact information and identifies who is to be notified of a dam safety incident, by whom, and in what order. Alternate contacts and their confirmed telephone number is also listed, in case primary contact is unavailable. Each official listed in the notification flowcharts should be familiar with it and immediately notify the Emergency Planning Manager in case of cessation of his/her functions within the organization.

Table 2- Responsibilities for Notification

Officer Designation	Responsibilities During Emergency Events
Executive Engineer (Emergency Planning Manager)	<ul style="list-style-type: none"> • Notify the District Disaster Management Authorities (District Collector) in case of Orange/Red alert • Notify the District Authorities about any emergency response actions at dam site and their impacts in the downstream area (e.g. large releases) • Notify the District Collectors/ Relief Authorities involved in the emergency response actions with information about

condition at dam site

- Where the residences located immediately downstream of a dam that would be inundated within minutes of a dam failure, wherein the available warning time is very limited, in that cases, Emergency Planning Manager will arrange to notify the residences directly without waiting for the local administration to act upon before an emergency situation develops.

<p>Dam Site Engineers (Assistant Executive Engineer, Assistant Engineers)</p>	<ul style="list-style-type: none"> • Keep inform the Emergency Planning Manager about the progress of the situation at dam site
<p>Superintending Engineer/ Chief Engineer</p>	<ul style="list-style-type: none"> • Notify Dam Safety Organization and request technical advice as required. • Notify/inform higher authorities on the mishap as per notification flow chart of particular alert level as per situation at site. • Notify/inform media representatives about the emergency situation. • Define emergency situations for which each medium will be utilized and include an example of a news release that would be the most effective for each possible emergency, avoiding disseminate false/overstated messages among the population.
<p>District Collector(s) / District Disaster Management Authority</p>	<ul style="list-style-type: none"> • Implement the Notification Flow chart for regional and State Disaster Management Contacts • Contact Local Law Enforcement Authorities and Relief Authorities under their jurisdiction • Liaising and coordinating with Early Warning Agencies like IMD, CWC, INCOIS, etc. for disaster specific information and disseminating the information for coordinating with the State Government, and facilitating the deployment of NDRF in the disaster affected districts during disaster. • Issue public announcements in coordination with Dam

<p>Relief Authorities (Police Department, Civil Defence, Army Forces)</p>	<p>Owner's officials and media representatives about the status of the emergency event</p> <ul style="list-style-type: none"> • Notify downstream residents in vulnerable areas. • Provide to the District Disaster Management Authority precise and accurate feedback information about the progress of relief actions and advise when the emergency can be terminated. • Notify to their corresponding command the necessity to deploy more resources to attend the rescue and relief actions.
<p>Media Representatives</p>	<ul style="list-style-type: none"> • Disseminate wide public awareness during emergency condition of Dam through Social Media Platform such as Facebook, Twitter, Whatsapp & Instagram. • The news media, including radio, television and newspapers, should be utilized to the extent available and appropriate. • Pre-plan in coordination with Chief Engineer/Superintending Engineer the most effective way to disseminate the most delicate and common emergency situations among the population. Pre-defined news shall be available in order to improve readiness of the decision-making process

3.4. Responsibilities for Evacuation

Evacuation and relief actions are exclusive responsibilities of Districts Authorities, and emergency relief forces at local and state level. For Meenkara Dam, a total of 1 District /2 Taluks /13 villages/ would be directly affected by a potential failure/emergency event at the dam site, and therefore, each District's representative is responsible for evacuation/relief actions in their jurisdiction.

Sl. No.	District Name
1	Palakkad

District Collector(s) acting as District's Disaster Management Authority is responsible to coordinate actions along with the following specialised teams/forces: Police and Fire Departments, National Disaster Management Authority (Response Force), Civil Defence, Army Forces.

Within their responsibilities are:

UNDER NO EMERGENCY (Preparedness)

- Participate in review, updates and exercises of the EAP.
- Dissemination among the population making them aware about their own risks.
- Conduct training/education programs among the population in regard how to act before, during and after emergency events such as flash floods.

UNDER ORANGE ALERT

- Prepare emergency response personnel for possible evacuations that may be needed if a **RED** alert is declared.
- Provide resources as necessary to the dam owners.
- Serve as the primary contact responsible for coordination of all emergency actions for potentially affected communities.
- Consider drafting a State of Local Emergency in preparation for **RED** alert.
- Maintain close liaison with the district and the State Governments as well as the nearest units of Armed Forces/Central Police Organizations and other relevant Central Government organizations like Ministries of Communications, Water Resources, Health, Drinking Water, Surface Transport, who could supplement the efforts of the district administration in the rescue and relief operations.
- Decide in coordination with the Emergency Planning Manager when to terminate the Emergency.

UNDER RED ALERT

- Initiate warnings and order evacuation of people under vulnerable areas as per inundation maps (**Annexure 2**)
- Direct local emergency response services (may include local law enforcement) to carry out the evacuation of people and close roads/crossings within the evacuation area (see local Evacuation Plan, Annexure 2 and Annexure 3 tables).
- Declare a State of Local Emergency if required.
- Provide resources as necessary to the dam owners.
- Decide in coordination with the Emergency Planning Manager when to terminate the Emergency.

Police Department(s) Responsibilities

- Warn the public under vulnerable areas in their jurisdiction as per inundation maps (**Annexure 2**).
- Secure and control access to evacuated areas.
- Install barricades in the affected bridges and crossings as per **Annexure 3** flood hazard values
- Assist in conducting rescue and recovery operation as required.
- Ensure proper access to the emergency services
- Prioritize the vehicle movement to the emergency site
- Control the traffic and divert through alternative routes.
- Ensure no unauthorized persons entering into the emergency site.
- Permit with minimum delay the entry of authorized personnel and recognized outside agencies, vehicles etc. involved in the emergency operations that come to help.
- Any other responsibility as entrusted by the high officers.

Fire Department(s), Army & Navy Forces Responsibilities

- Assist in evacuation operations and initiate the evacuation of impact areas in cooperation with Emergency Management Agency and Police Department.
- Request mutual aid for boats and initiate rescue of trapped residents as needed.
- Supply special equipment/teams to support rescue operations (e.g. Helicopters, divers, off-road and amphibious vehicles)

3.5. Responsibilities for Termination and Follow-Up

Once EAP operations have begun under **BLUE**, **ORANGE** or **RED** alerts levels, the EAP operations must eventually be terminated and follow-up procedures completed. EAP operations can only be terminated after completing operations under **RED** or **BLUE** alert levels. If **ORANGE** Event Level is declared, the operations must be designated **RED** Event Level or **BLUE** before terminating the EAP operations.

Please check the Action data Sheets (**Annexure 4**) for further details in when to declare an emergency event terminated. **Table - 4** below shows the main responsibilities in the termination and follow-up process.

Table 4– Termination and Follow-Up Responsibilities

Officer Designation	Responsibilities (Termination and Follow Up)
Executive Engineer (Emergency Planning Manager)	<ul style="list-style-type: none"> • Declare the termination of the emergency operations in coordination with District Disaster Management Authority and Relief/Response Forces. • A detailed report to be compiled • Conduct a post review of the EAP procedures. • Identify EAP procedures that were followed effectively, as well as any ways that the EAP could be improved. • Identify the causes that could have triggered the emergency event and propose actions to improve readiness and early detection. Support from the Dam Safety Organization may be requested in this regard • For Major Emergencies, the Emergency Planning manager will maintain detailed records of cost expended and will prepare a detailed report in this regard.
Superintending Engineer/ Chief Engineer	<ul style="list-style-type: none"> • Ensure that all parties that participated in the EAP activities are involved in the review process. • Impose a time frame within which the EAP review is to be completed. Propose any ways that the EAP could be improved. • Present the final results of the EAP evaluation in a documented report to Government • Ensure that there is no danger of spread of any epidemics or water borne diseases after the floods.
Dam Safety Organisation (State / Central level)	<ul style="list-style-type: none"> • Identify in coordination with the Emergency Planning Manager the causes that could have triggered the emergency event and propose actions to improve readiness and early detection. A report should be presented to the dam owner's authorities in this regard.
District(s) - All districts - and National Disaster Management Authority	<ul style="list-style-type: none"> • Declare the termination of the emergency operations in coordination with Emergency Planning Manager and Relief/Response Forces.

- Identify EAP procedures that were followed effectively, as well as any ways that the EAP could be improved.

4. COMMUNICATIONS NETWORKS

Local officials and downstream residents will be notified by landline telephone, if available; otherwise via cell phones or emergency personnel (in person or using their radios). The various networks for emergency use include the networks of the following:

- District Collector / District Disaster Management Authority
- Indian Meteorological Department
- Central Water Commission
- All affected Districts Police and Fire Departments (See **Table 3**)
- State Disaster Management Authority
- Army/Navy Forces

Sample public announcements appear in **Annexure 6** and internal suggested phone messages are also available in each notification flow chart. Verification or authentication of the situation can be made by contacting the Emergency Planning Manager and the corresponding District Disaster Management Officials (**See District-wise Notification Flow Charts Tab**). Television, Radio and bulk SMS facilities of the local Mobile Network Operators can be used as much as possible to notify area residents of the possible dangers.

As per notification responsibilities (Section 3.3) public announcements are to be issued by the concerned District Disaster Management officials and the Chief Engineer in coordination with media representatives.

EMERGENCY DETECTION, EVALUATION, AND CLASSIFICATION

5.1. Emergency Detection

5.1.1. Situations

Many dam conditions can lead to emergency situations, not all of which will require the implementation of the EAP. However, if any of them occur, the appropriate actions must be taken. **Annexure 4** of this EAP shows the most common emergency situations that may emerge in Meenkara Dam and appurtenances, along with the corresponding specific actions to be done by each of the dam's officials. Some of these emergency situations are summarized as follows:

Severe Storms/Inclement Weather: Although generally not in themselves a threat to the dam, severe storms and other inclement weather conditions can contribute to an existing problem and hinder any remediation efforts. Severe storms also cause the uncontrolled release of floodwater and increase flow in already rain-swollen areas.

Tropical cyclones: Tropical cyclones do occur in the area, with the potential for structural damage to the dam, possibly resulting in its failure. If a tropical cyclone has struck in the area, an inspection of the dam for any signs of damage will be appropriate.

Earthquakes: Meenkara dam is located in the Seismic Zone Number III. This zone is classified as Moderate Damage Risk Zone which is liable to MSK VII. and also 7.8. The IS code assigns zone factor of 0.16 for Zone III. Therefore, an earthquake is a possibility, and appropriate post-earthquake inspections should be performed.

Sabotage: A threat to damage the dam has been made. Appropriate actions must be taken to protect the dam.

5.1.2. Signs of Failure

Site engineers in coordination with the Executive Engineer (Main Dam Division) are responsible for conducting routine inspections and identifying conditions that could indicate the onset of problems leading to a dam failure. The early identification of potentially dangerous conditions can allow time for the implementation of the EAP. The following sections describe some of the different types of failure which could lead to a dam failure.

- Seepage Failure: Although all earthen embankments allow some minor seepage through the dam or the foundation, excessive, uncontrolled seepage can result in piping (the movement of embankment material in the seepage flow) and lead to failure. Piping can occur for years at a slow rate. If the piping has progressed to a dangerous level, it will be evident by increased flow or the discharge of muddy water (or both). At that stage, immediate action to stop the piping is needed. Fully developed piping is difficult to control and is very likely to result in failure. A whirlpool in the reservoir is a sign of uncontrollable piping and necessitates immediate emergency action.
- Embankment or Foundation Sliding: Sliding is usually first apparent when cracks or bulges in the embankment appear. Slides with progressive movement can cause failure of the embankment.
- Structural Failure: The structural failure or collapse of any non-overflow portion of the dam, spillway or spillway gates could result in loss of the reservoir. A structural failure of a portion of the spillway could cause piping and possibly embankment failure
- Overtopping Failure: Overtopping of the embankment results in erosion of the dam crest. Once erosion begins, it is very difficult to stop.

5.2. Emergency Evaluation and Classification

This section lists the conditions and actions which may be used to classify the level of emergency response, as a guide for the **Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur)**. Specific dam observations and corresponding emergency classification levels can be found in Annexure 4, along with appropriate and recommended actions to follow in each case.

Internal Alert Condition **BLUE** — A "watch" condition. A problem has been detected at the dam that requires constant monitoring. At this time, the distress condition is manageable by dam personnel. The **Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur)** along with the support of site engineers will be responsible for monitoring and repair as soon as possible and implementing the appropriate Notification Flowchart. The following is a main list of happening that would initiate this condition:

- Cloudy or dirty seepage or seepage with an increase in flow, boils, piping, or bogs.
- Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.
- Any slide that degrades the crest of the embankment or that is progressively increasing in size.
- Cracking or movement of any concrete structure.
- An increase in the reservoir level leading to engagement of the spillway gate's.
- Exceptionally heavy rainfall in the catchment of the dam reservoir.

External Alert Condition **ORANGE** - This is indicative of a dam condition that is progressively getting worse;and there is a high probability of dam failure. Although there is no immediate danger, the dam could fail if conditions continue to deteriorate. The **Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur)**will be responsible for initiating immediate repairs, including lowering the reservoir if appropriate and implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate this condition:

- Any spillway's release matching with an **ORANGE** alert in accordance with **Annexure 4**
- Large boils, increasing in size and flow rate, especially if there is flowing muddy water
- Significantly increasing seepage, especially flowing muddy water
- Slides involving a large mass of material that impairs the crest of the dam and is continuing to move

- Sinkholes with seepage flowing muddy water
- Large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam
- An increase in the reservoir level to near the top of the dam
- Near to 'Design Flood' inflow forecast

External Alert Conditions RED - These are "failure" conditions. Either the dam is in immediate danger of failing or has already failed. No time remains to implement measures to prevent failure. Evacuate immediately. Evacuation efforts will continue until the situation is stabilized. The **Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur)** is responsible for implementing the appropriate Notification Flowchart. The following is a main list of conditions that would initiate "imminent dam failure" or "dam failure" conditions:

- Any spillway's release matching with a **RED** alert in accordance with **Annexure 4**
- Rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones.
- Rapidly increasing seepage, especially flowing muddy water
- Slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area
- Settlement that is predicted to degrade to the reservoir level
- Cracks that extend to the reservoir level
- Significant movement or failure of any structure that forms an integral part of the dam
- Overtopping of the earthen dam
- Uncontrollable release of the reservoir

5.3. Previously / Existing Known Problems

- The presence of vegetation over the dam structure imposing danger to the stability of the dam.

6. PREPAREDNESS

Preparedness actions are to be taken both before and following the development of emergency conditions and should identify ways of preparing for an emergency, increasing response readiness in a uniform and coordinated manner, and helping to reduce the effects of

a dam failure. The following are some steps that could prevent or delay failure after an emergency is first discovered.

6.1. Surveillance

Round the clock surveillance at the dam and its appurtenant (on the rim of reservoir (left & right)) will be carried out by site engineers during emergency situations. For this, the posting of special observer of high experience and keen observation is an important requirement of EAP during high flood period. To ensure that the whole system (including civil structures & mechanical installations) is being maintained well upto satisfactory level, the repair maintenance must be carried out as per requirement of O & M of Meenkara Dam. In addition, it must be ensured that maintenance and upkeep of different components is carried out and will be only possible through deployment of well procedure conversant and trained staff. The list of such persons should be displayed on a photo frame mounting at convenient safe places at dam site and list of local telephone numbers inside the dam & outside the dam area. It will be updated from time to time for any change.

6.2 Response on forecast of excessive inflow

Dam Engineers as well as **Emergency Planning Managers** will respond to the situation of excessive inflow forecast in close co-ordination with IMD especially during monsoons for their forecast by way of controlled spillway releases as per the warning levels as per warning levels in Clause 2.2 of Reservoir Operations. Warnings will be intimated to the affected downstream authorities and 24 x 7 monitoring will be initiated.

6.3 Response during weekends and holidays

The Standard Operating Procedure with Reservoir Operation & Maintenance Manual and Gate Operation Manual are strictly followed throughout the year whether it is weekends/holidays/night. **Executive Engineer (Irrigation Division Chittur)** will be available for emergency response during weekends and holidays and can be present at the dam site within 45 minutes of detection of an emergency condition. In case of non-availability of the **Executive Engineer (Irrigation Division Chittur)**, the **Assistant Executive Engineer(Sub Division No.I, Chittur)** will take his responsibilities.

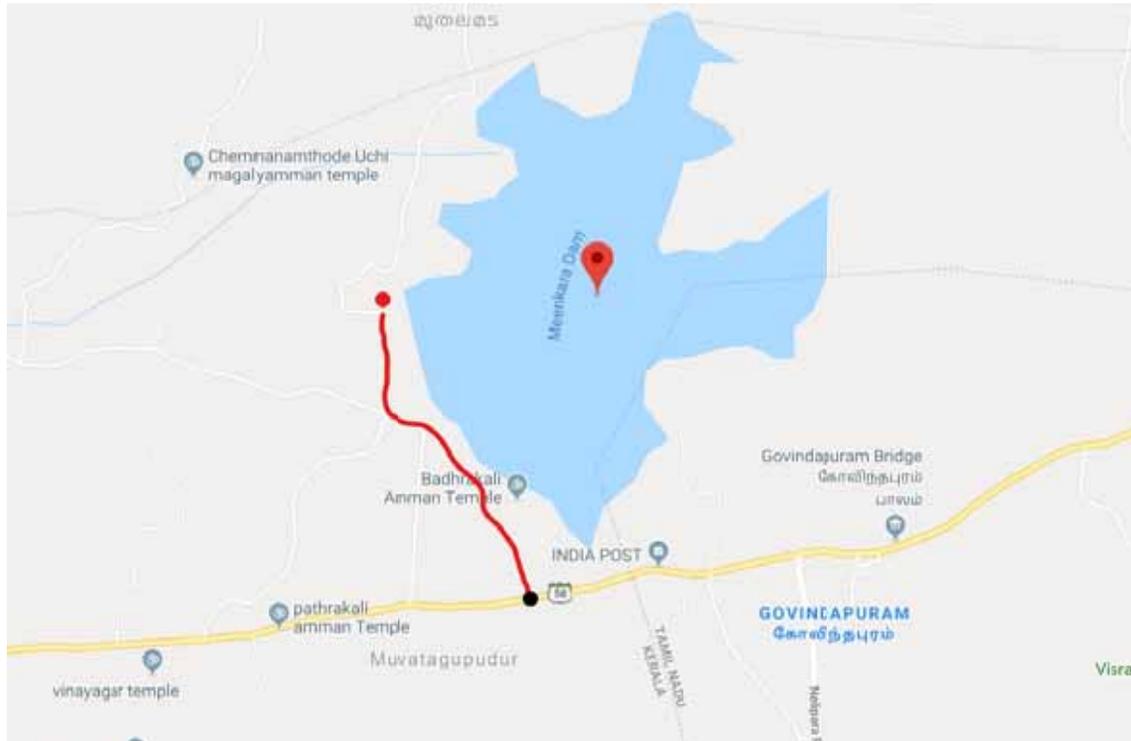
6.4 Response during periods of darkness and adverse weather

The **Executive Engineer (Irrigation Division Chittur)** and **Site Engineers** will arrange for access to generators and lights to adequately monitor the situation. **Site Engineers** will ensure the generators and emergency light are well maintained and available under any circumstances. **Executive Engineer (Irrigation Division Chittur)** will be able to access the site during adverse weather conditions by off road vehicle.

6.5. Access to the site

The existing road route to the dam can be used during emergency situation since the road is located in a higher terrain than the surrounding areas.

Accesses to Meenkara Dam under Emergency Conditions



6.6. Remedial Actions

Preparedness and remedial actions can be taken in an emergency to prevent the catastrophic failure of the dam, but such repairs should be undertaken with extreme caution. The repairs are only temporary, and a permanent repair should be designed by an engineer as soon as possible.

Specific actions for different emergency situations are described in the Annexure 4 (Action Data Sheets), which can be used in conjunction with Annex 4- Emergency Level Determination - Action Data Sheet Index). Examples of the actions to be taken for dam's officials under the direction of a professional engineer or contractor are described below. In all cases, the appropriate Notification Flowchart must be implemented and the personnel of the State Dam Safety Organization be notified.

Consider the following remedial actions if the dam's integrity is threatened by:

Seepage Failure

- Plug the flow with whatever material is available (hay, bentonite, or plastic) if the entrance is in the reservoir.
- Consider lower the water level in the reservoir

- Place an inverted filter (a protective layer of sand and gravel) on the exit area to hold the material in place.
- Continue operating at a lower level until a repair is made.

Embankment or Foundation Sliding

- Lower the water level in the reservoir to an elevation considered safe, given the slide condition.
- Stabilize the slide, if on the downstream slope, by weighting the toe area below the slide with soil, rock, or gravel.
- Continue operating at a lower level until a repair is made.

Structural Failure

- Implement temporary measures to protect the damaged structure, such as placing rock riprap in the damaged area.
- Lower the water level to a safe elevation through the low flow outlet.

7. SUPPLIES AND RESOURCES

7.1 Contracts

If Dam Project's personnel and resources prove to be inadequate during an emergency, requests will be made for assistance from other local jurisdictions, other agencies, and industry, as needed. Such assistance may include equipment, supplies, or personnel. All agreements will be entered into by the following authorized officials, as deemed necessary to prevent the failure of the dam:

- Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur.)
- Superintending Engineer, Siruvani Project Circle, Palakkad.
- Chief Engineer, Projects – I Kozhikode.

7.2 Equipment and Supplies

Equipment that is available for use and local contractors that can be contacted to provide equipment during an emergency event are listed in **Annexure 5**.

7.3 Reports

Pre-monsoon and post-monsoon inspections of the dam are made every year during the month of **May and December** respectively by the Site Engineers in coordination with the **Emergency Planning Manager (Executive Engineer, Irrigation Division,**

Chittur) to evaluate its structural safety, stability, and operational adequacy. In the event of an abnormal occurrence, reference to these reports, particularly the photographs, can be beneficial in the evaluation of a potential problem.

Technical records such as drawings and inspection reports are stored and carefully maintained at the Control Room in dam site and in the **Emergency Planning Manager's Office**. **Site Engineers** are familiar with the location of the documents in the event of an emergency situation.

8. EMERGENCY OPERATIONS CENTRE

8.1. Activity log

Any unusual or emergency condition should be documented, including the following:

- Activation or deactivation of emergency facilities
- Emergency notifications to other local governments and to state and central government agencies
- Significant changes in the emergency
- Major commitments of resources or requests for additional resources from external sources
- Telephone calls will be recorded in chronological order
- Issuance of protective action recommendations to the public
- Evacuations and casualties
- Termination of the incident

8.2. Costs of the Emergency Operations Centre

For major emergencies, the emergency operations centre will maintain detailed records of costs expended. These records may be used to recover costs from the responsible party or insurers, or as a basis for requesting financial assistance for certain allowable response and recovery costs from the state or central government. Documented costs should include:

- Personnel costs, especially overtime
- Equipment operation
- Equipment leasing and rental
- Contract services to support emergency operations
- Specialized supplies expended in emergency operations

9. INUNDATION AREA

Inundation maps in **Annexure 2** illustrate the areas subject to flooding from a failure of the main dam and others recurrent flood scenarios (**Table 5**). The maps were prepared using the results of a two-dimensional flow analysis and contain profiles of the peak flood levels expected, as well as an estimation of the time from the beginning of the breach to the moment the location start to be inundated. More hazard reference values such as depth, velocity, vulnerability, and water surface elevation are included in **Annexure 2** in both, tabular and map format for each of the affected locations

Table – 5 Scenarios included in the Emergency Action Plan

Annexure Index	Scenario	Hazard Parameters	No. of Tiles
2 A	Large Controlled Release	Depth, Velocity, Water Surface Elevation	3
2 B	Over Topping	Depth, Velocity, Water Surface Elevation, Arrival Time	12
2 C	Non-Flood Failure	Depth, Velocity, Water Surface Elevation, Arrival Time	12

After examining the results of the breach analysis of Meenkara Dam, it has been determined that there were a significant number of structures that could be affected due to a design flood or sunny-day dam breach. These structures are located along the Meenkara river. Muthalamada, Kollengode, Vadavannur, Kavasseri, Alathur and Pallassana Grama Panchayats can suffer a significant impact from a breach of the dam. In addition, water results from a breach, and associated damages, can, under certain circumstances, travel down the Meenkara river affecting Elevachery, Erimayur, Melarcode Grama Panchayats.

The breach analysis contains profiles of the peak flood levels expected, as well as an estimation of the time from the beginning of the breach to the peak flood elevations. A comparison of the areas that are likely to be flooded with the plots showing the times from the start of the breach to the flooding shows the areas of evacuation and the time constraints involved. Figures in the breach analysis include information on the estimated impact of flooding on the bridges along the Meenkara river. These structures may suffer such impacts before the peak elevation of the flood wave

Table -6: Affected Taluk and Villages

State	District	Taluk/Municipality	Villages
Kerala	Palakkad	Chittur Taluk	Kollengode-I
			Vallanghy
			Elavancherry
			Kollengode-II
			Muthalamada-I
			Pallassana
			Vadavannur
			Pattanchery
			Muthalamada-II
		Alathur	Melarcode
			Kavasseri-I
			Erimayur-II
			Alathur (CT)
			Erimayur-I

It is also determined that there are significant numbers of buildings/roads, located on the banks and adjoining areas of stream and banks of Meenkara River could be affected due to a large control discharge from the spillways or flood wave resulting from dam breach scenario. Figures in the breach analysis include information on the estimated impact of flooding on the bridges along the Meenkara River. The most important crossing structures and parts of roads, likely to be submerged due to various scenarios, are summarized in the Table 7

Table 7 List of Main Crossing Structures likely to be submerged

Sl. No.	Name of Bridge / Location	Title Id in Inundation Map
1	Muthalamada – Chammanampathy road	
2	Vadakkencherry – Polachi rd.	
3	Muthalamada railway station road	
4	Pudunagaram – Kollengode rd.	
5	Kollengode Kunisseri rd	

6	Koduvayur Pallavoor Vithanasseri rd	
7	Pazhathara Public cemetary rd	
8.	Vallanghy – Kunniserri rd	
9	Kottekulam Tazhakottukavu rd	
10	Koduvayur Tripalur rd	
11	Trippalur – Pullode rd	
12	Pazhayannur rd	
13	Sawab Nagar rd	
14	Arapuzha rd	
15	Gayathri bridge at Pallasena	
16	Oottara bridge	
17	Kootalur Bridge	

The breach analysis contains profiles of the peak flood levels expected, as well as an estimation of the time from the beginning of the breach to the peak flood elevations. A comparison of the areas that are likely to be flooded with the plots showing the times from the start of the breach to the flooding shows the areas of evacuation and the time constraints involved. These structures may suffer such impacts before the peak elevation of the flood wave.

9.1. Local Evacuation Plan

If imminent failure of Meenkara Dam with uncontrolled downstream flooding is anticipated, local disaster management and law enforcement personnel should notify those downstream (**Table 6**), for evacuation in the most expedient manner possible following the procedure given in the notification flow charts of this document (**Notification Flow Chart Tab**). Local law enforcement officials, along with local mobile network operators, radio and media representatives can best spread the notice for evacuation (**See Responsibilities Sections, 3.3 and 3.4**)

In addition, **Annexure 4 (Emergency Level Determination & Action Data Sheets)** can be used as support in the decision-making process either to escalate or downgrade an emergency event. The most important actions that should be taken during an evacuation process are:

- Police Departments will barricade all bridges and roads that could possibly be flooded to prevent access to the affected area. These bridges include all crossings and its tributaries as well as those affected roads shown in the **Annexure 2 (Inundation**

Maps). Inundation Maps along with Flood Hazard Reference Values in crossings locations included in this annexure indicate the appropriate barricade locations under the responsibility of local law-enforcement authorities.

- The Districts Disaster Management Authorities (Districts Collectors) will assist with the notification of all persons and agencies involved (relief authorities), with the possibility of additional support—including contacting others not accessible by radio or telephone.
- Relief Authorities (Police, Fire, Army) are generally familiar with developed areas in their jurisdiction. Such knowledge, coupled with the requirements of state law that they respond to disasters, make them the logical officials to be notified and to spread the warning message to all areas subject to flooding.

Based on the specific results of the dam breach analysis (wave arrival time) a local evacuation plan has been developed to assist disaster management authorities in the relief actions. The local evacuation plan and complete list of relief camps (shelters) is included in **Annexure 3**

10. IMPLEMENTATION

10.1 Development

This EAP version has been prepared by State Project Management Unit in collaboration with Dam Officials. The document has been sent to the State Dam Safety Organization and Disaster Management Authority for review, and agency their comments will be incorporated into this document for final publication.

10.2 Updating

Copies of the EAP have been provided to all authorities/officials included in the distribution list and the document has been approved and signed by the Secretary of Kerala Water Resources Department, District Disaster Management Authority and the Dam Safety Organization.

This plan will be reviewed and updated annually before the **1st of June** of every year by the **Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur) and the Superintending Engineer, Siruvani Project Circle, Palakkad**. This review will involve corresponding personnel from local disaster management agencies in conjunction with Dam Safety Organization's staff.

The Superintending Engineer will organize every year prior to monsoon an orientation meeting to introduce the revised EAP to local officials, emergency responders. This meeting will give an opportunity to all the stakeholders to review and comment on EAP document and their respective roles.

The Emergency Planning Manager (Executive Engineer, Irrigation Division, Chittur) will review and complete all items on the Annual EAP Evaluation Checklist in **Annexure 8**. After the annual update is complete, a new Approval and Implementation sheet will be attached and the annual update will be documented on the Plan Review and Update sheet in **Annexure 9**.

If revisions to the EAP are made as a result of the annual update, such changes will be recorded on the Log Sheet of Changes form at the front of the report. A copy of the updated portions of the EAP will be sent to the SDSO and all other concerned as per the EAP Distribution List. If the EAP was reviewed and revisions were not required, the [Dam Owner] will submit written notification to all concerned that no updates to the EAP have been adopted or implemented.

10.3. Testing

The Superintending Engineer shall organize the following exercises as specified below:

- **Orientation (Stakeholders' Consultation):** The Superintending Engineer will organize an orientation meeting every year with local responders and stakeholders to solicit input, established roles during emergency situation and facilitate reliable responses to the emergencies. In orientation meeting, the Emergency Planning Manager will introduce the revised EAP to local officials and emergency responders and provide those entities the opportunity to review and comment on the documents and on their roles and responsibilities, described in EAP.
- **Tabletop exercises-** Superintending Engineer and Emergency Planning Manager will organize a table-top drill once in 2 years to discuss and review the simulated or imaginary emergency situation. The tabletop drill involves a meeting of **Emergency Planning Manager** with local and state **Disaster Management Officials** in a conference room. The drill begins with a description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures, and to resolve concerns regarding coordination and responsibilities. Any problems identified during a drill should be included in revisions to the EAP.

Before the tabletop exercise begins, meeting participants will visit the dam to familiarize with the dam site. **Emergency Planning Manager** will present a scenario of an unusual or emergency event at the dam. The scenario will be developed prior to the exercise with the support of the **Dam Safety Organization**.

Once the scenario has been presented, the participants will discuss the risk involved, responses and related actions that they would take to address and resolve the scenario throughout the exercise. The exercise provides an opportunity to discuss EAP and response procedures and resolve the questions throughout the exercise. It will also clarify roles and responsibilities and will identify additional threat mitigation and preparedness actions.

Records and reporting of the main conclusions/findings of both meetings will be maintained in **Annexure 10** and following the deadline given in **Table 8**.

Table 8 : EAP Exercise / Testing Techniques

Exercise	Schedule	Reporting Deadlines
Orientation (Stakeholder's Consultation)	Annual	<ul style="list-style-type: none"> ▪ <u>Pre-Event</u> : Submit Agenda to Stakeholders 30 days before meeting ▪ <u>Post-Event</u> : Update Form 2 (Annexure 10), within 30 days after meeting
Tabletop Exercise	Once every 2 years (before monsoon season)	<ul style="list-style-type: none"> • <u>Pre-Event</u> : Submit Exercise Plan and Schedule to participants 90 days before meeting • <u>Post-Event</u> : Update Form 2 (Annexure 10), and submit Evaluation Report within 60 days after exercise

10.4. Training

The Superintending Engineer will ensure all people involved in the EAP be trained to guarantee that they are thoroughly familiar with its elements, the availability of equipment, and their responsibilities and duties under the plan. Personnel will be trained in problem detection, evaluation, and appropriate corrective measures. This training is essential for proper evaluation of developing situations at all levels of responsibility. Training records will be maintained also in **Annexure 10**.