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 Kanhirapuzha 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 heartful 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, KPIP Division No.1, Kanhirapuzha, Assistant Executive Engineer, KPIP Head Works Sub Division-III, Kanhirapuzha and Assistant Engineers, KPIP Section No.1/3 & Section No. 2/3, Kanhirapuzha 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.

Chief Engineer (I&D)  
IDRB, Vikas Bhavan  
Thiruvananthapuram

Chief Engineer  
Projects – I  
Kozhikode
PREFACE

The Kanhirapuzha Irrigation Project is one of the major irrigation project in Kerala State. It comprises of a storage reservoir across river Kanhirapuzha, a tributary of Thuthapuzha, which is a tributary of Bharathapuzha. The Project was started in 1961 and partially commissioned in 1980. The dam was completed in 1983. The head works is located at Mannarkkad 43 Km North West of Palakkad town and 38 Km from Palakkad junction of South Railway. The nearest air port is at Kozhikode (Karippur) of Kerala State which is about 85 Km away from the head works.

The projects consists of a) An earth dam with a central masonry spillway portion. b) A net work of canal system to irrigate an area of 9,720 ha. The dam is a straight gravity rubble masonry one of 231.6m length with a central spillway of 3 spans of 12.2m each and flanked by earthen dams on either side of total length 1896m. Maximum height of the dam is 42.13 m. Gross storage of the reservoir is 70.8274 Mm3.

The EAP is prepared using the Inundation map developed by central Project Management Unit (CPMU) for the following three causes of flooding: (1) A dam failure caused by over topping from the inflow design flood leading to breaching and uncontrolled release of impounded water, (2) A non-flood dam failure caused by internal erosion (piping) with the reservoir at supply level leading to breaching and uncontrolled release of impounded waste and (3) A large controlled release flood without dam failure. The inundated area falls in Mannarkkad taluk of Palakkad district.
Kanhirapuzha Dam

KL07HH0033

Palakkad

Emergency Action Plan for Kanhirapuzha Dam was published in July 2019. This is the ……………….Revision as updated in …………………

Disclaimer

Every effort has been taken to estimate the severity of flooding and inundation areas likely to be affected by Kanhirapuzha 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.

Chief Engineer
Projects – I
Kozhikode
MobileNo:9447332645
Office No:04952385595
Emergency Action Plan
Kanhirapuzha Dam

Irrigation Department, Kerala

Contents

Approval and Implementation..........................................................05
EAP Distribution List........................................................................06
Log Sheet of Changes.......................................................................07
Emergency Action Plan.................................................................08

1. Purpose......................................................................................8
2. Dam Description.........................................................................8
   2.1 General................................................................................8
   2.2 Reservoir Operations..........................................................8
3. Responsibilities..........................................................................10
   3.1 Dam Owner’s Responsibilities..............................................10
   3.2. Dam Safety Organization's Responsibilities.......................15
   3.3 Responsibilities for Notification.........................................16
   3.4 Emergency Operation Center..............................................18
   3.5 Responsibilities for Evacuation..........................................18
   3.6 Responsibilities for Duration, Security, Termination and Follow
       up.....................................................................................20
4  Communications.........................................................................21
5  Emergency Detection, Evaluation and Classification..................22
   5.1 Emergency Detection.........................................................22
      5.1.1 Situations.....................................................................22
   5.2 Emergency Evaluation and Classification............................23
   5.3 Previously Known Problems..............................................24
6  Preparedness.............................................................................25
   6.1 Surveillance..........................................................................25
   6.2 Response on forecast of excessive inflow............................25
   6.3 Response during weekends and holidays............................25
   6.4 Response during periods of darkness and adverse weather....25
   6.5 Access to the site.................................................................25
   6.6 Remedial Actions...............................................................26

7 Supplies and Resources...............................................................27
   7.1 Contracts..............................................................................27
7.2 Equipment and Supplies ...........................................27
7.3 Reports ..........................................................27
8. Emergency Operations Centre ......................................27
8.1 Activity Log .........................................................27
8.2 Costs of the Emergency Operations Centre .................28
9. Inundation Area .......................................................28
9.1 Local Evacuation Plan .............................................29
10. Implementation ......................................................30
10.1 Development ......................................................30
10.2 Updating ..........................................................30
10.3 Testing .............................................................31
10.4 Training ............................................................32
Notification Flowchart (Watch Condition) .........................33
Notification Flowchart (Failure Condition) .........................34
Annexure 1 – Vicinity map ..........................................35
Annexure 2 – Inundation Map .......................................36
Annexure 3 – Flood Hazard Reference Values & Local Evacuation Plan ........59
Annexure 4 - Emergency Level Determination – Action Data Sheet Index ....61
Annexure 5 – Sample Public Announcements ......................93
Annexure 6 – Evidence of Distress ..................................94
Annexure 7 – Dam Description ......................................100
Annexure 8 – Supplies and Resources ..............................101
Annexure 9 – Annual EAP Evaluation Check list ..................102
Annexure 10 – Plan Review and Update .........................103
Annexure 11 – Training Record ......................................104
Annexure 12 – List of Officials for Communication ..............105
Kanhirapuzha Dam
Project ID Code [KL07HH0033]

Approval and Implementation

This Emergency Action Plan has been prepared by State Project Management Unit in collaboration with Kanhirapuzha 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
A copy of the EAP has been provided to the following people

<table>
<thead>
<tr>
<th>Authority</th>
<th>Name, Title, Phone</th>
<th>Address</th>
<th>Acceptance Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam Owner(s) and Representatives</td>
<td>Chief Engineer</td>
<td>Office of the Chief Engineer, Projects – I, Kozhikode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobile No: 944732645</td>
<td>Kozhikode</td>
<td></td>
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<tr>
<td></td>
<td>Office No: 0495238595</td>
<td>Email – <a href="mailto:cep1kkd@gmail.com">cep1kkd@gmail.com</a></td>
<td></td>
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<tr>
<td></td>
<td>Superintending Engineer</td>
<td>Siruvani Project Circle</td>
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<tr>
<td></td>
<td>Mobile No: 9447303940</td>
<td>Palakkad</td>
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<tr>
<td></td>
<td>Office No: 0491 2577425</td>
<td>Email- <a href="mailto:sespcpkd@yahoo.co.in">sespcpkd@yahoo.co.in</a></td>
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<tr>
<td>District Collector, Palakkad</td>
<td>District Collector</td>
<td>Office of the District Collector Civil Station</td>
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<tr>
<td></td>
<td>Mobile No: 8547610100</td>
<td>Keranathuparambu, Kunathurmedu, Palakkad, Kerala 678013</td>
<td></td>
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<tr>
<td></td>
<td>Office No: 0491-2505266</td>
<td><a href="mailto:Email-dcpkd@kerala.nic.in">Email-dcpkd@kerala.nic.in</a></td>
<td></td>
</tr>
<tr>
<td>State Dam Safety Organisation</td>
<td>Chief Engineer</td>
<td>Office of the Chief Engineer (I&amp;D), IDRB, Vikas Bhavan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Email : <a href="mailto:idrbtvm@gmail.com">idrbtvm@gmail.com</a></td>
<td>Thiruvananthapuram</td>
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<td></td>
<td>Mobile No: 9447780159</td>
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<td></td>
<td>Office No: 0471-784001 <a href="mailto:idrbtvm@gmail.com">idrbtvm@gmail.com</a></td>
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<td></td>
<td>Director (Designs), IDRB</td>
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<td>Mobile No: 9446685757</td>
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<td></td>
<td>Office No: 0471-2303972 <a href="mailto:idrbtvm@gmail.com">idrbtvm@gmail.com</a></td>
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<tr>
<td>Central Dam Safety Organisation</td>
<td>Chief Engineer</td>
<td>Sewa Bhavan, Sector 1, RK Puram, NewDelhi, Delhi 110066</td>
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<tr>
<td></td>
<td>CDSO Mobile No: 9717333808</td>
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<td>Mobile No: 011-26106848</td>
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<td></td>
<td>Director, DRIP</td>
<td>CWC Library Buildings, RK Puram, NewDelhi, Delhi 110066</td>
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<td></td>
<td>Mobile No: 9958975928</td>
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<td></td>
<td>Office No: 011-26192633</td>
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<tr>
<td>State Emergency Operation Center, Kerala</td>
<td>Member Secretary Email:</td>
<td>Observatory Hills, Museum, Vikas Bhavan P O Thiruvananthapuram, Kerala 695033</td>
<td></td>
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<tr>
<td>Disaster Management Authority</td>
<td><a href="mailto:keralasdma@gmail.com">keralasdma@gmail.com</a></td>
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<tr>
<td></td>
<td>Mobile No: 94000202927</td>
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<td></td>
<td>Office No: 0471-2331345</td>
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<tr>
<td>National Disaster Management Authority</td>
<td>Advisor <a href="mailto:advopscomm@ndma.gov.in">advopscomm@ndma.gov.in</a></td>
<td>NDMA Bhawan,A-1, Safdarjung Enclave, New Delhi - 110029</td>
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<tr>
<td></td>
<td>Mobile No: 011-26701886</td>
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<tr>
<td></td>
<td>E-mail: <a href="mailto:controlroom@ndma.gov.in">controlroom@ndma.gov.in</a></td>
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<tr>
<td>District Police Chief</td>
<td>District Police Chief, Palakkad Mobile No:</td>
<td>Office of the District Police Chief, Palakkad</td>
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<td></td>
<td>9497996977</td>
<td>Pudupalli Thiruvu, Nurani, Palakkad</td>
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<tr>
<td></td>
<td>Office No: 0491-2534011</td>
<td>Email: <a href="mailto:spplkd.pol@keral.gov.in">spplkd.pol@keral.gov.in</a></td>
<td></td>
</tr>
<tr>
<td>The District Fire and Rescue Chief</td>
<td>Fire and Rescue Chief Palakkad</td>
<td>Fire and Rescue services Civil Station (P.O) Palakkad Email: <a href="mailto:dopkd.frs@kerala.gov.in">dopkd.frs@kerala.gov.in</a></td>
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<tr>
<td>The District Health Officers</td>
<td>The District Medical Officer Palakkad (Health) Ph No: 0491-2505264 Mobile: 9946105487</td>
<td>2 nd floor, Civil Station, Palakkad</td>
<td></td>
</tr>
<tr>
<td>Taluk Offices,</td>
<td>Contact: Tahsildar, Palakkad Ph No: 0491-2505770 Mobile : 944735012</td>
<td>Taluk Office, Palakkad Email: <a href="mailto:tahrpkd.rev@kerala.gov.in">tahrpkd.rev@kerala.gov.in</a></td>
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<tr>
<td></td>
<td>Contact: Tahsildar, Ottapalam Mobile No: 9447735015 Office No:0466-2244322</td>
<td>Taluk Office, Ottapalam Email: <a href="mailto:tahr_otp.rev@kerala.gov.in">tahr_otp.rev@kerala.gov.in</a></td>
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<tr>
<td></td>
<td>Contact: Tahsildar, Mannarkkad Mobile No: 9447735016 Office No:0492-4222397</td>
<td>Taluk Office, Mannarkkad Email: <a href="mailto:tahr_mkds.rev@kerala.gov.in">tahr_mkds.rev@kerala.gov.in</a></td>
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<td></td>
<td>Contact: Village Officer, Pottassery I Mobile No: 8547615213</td>
<td>Village Office, Pottassery I, Palakkad</td>
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<td>Contact: Village Officer, Pottassery II Mobile No: 8547615214</td>
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<td></td>
<td>Contact: Village Officer, Mannarkkad I Mobile No: 8547615211</td>
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Kanhirapuzha Dam

Project ID Code [KL07HH0033]

Log Sheet of Changes

The following changes have been made to the EAP and revisions have been provided to the people shown on the EAP Distribution List.

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</table>
Emergency Action Plan

Kanhirapuzha Dam

Project ID Code [KL07HH0033]

1. Purpose

The purpose of this Emergency Action Plan (EAP) is to identify emergency situations that could threaten Kanhirapuzha 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

Kanhirapuzha Dam and Reservoir are owned and operated by Irrigation Department, Kerala. The dam was constructed across Kanhirapuzha River a tributary of Kunthipuzha, which is a tributary of Bharathapuzha. The dam is located at Mannarkkad, 43 km North West of Palakkad Town via road. The Project was started in 1961 and partially commissioned in 1980 and completed in 1983 and the project envisages irrigating an ayacut of 9713 Ha. The Project consists of an earth dam with a central masonry spillway.

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:

<p>| | |</p>
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<tr>
<td>FRL</td>
<td>97.50 m</td>
</tr>
<tr>
<td>MWL</td>
<td>97.50 m</td>
</tr>
<tr>
<td>TBL</td>
<td>100.28 m</td>
</tr>
<tr>
<td>MDDL</td>
<td>77.40 m</td>
</tr>
<tr>
<td>Crest of Spillway</td>
<td>92.95 m</td>
</tr>
<tr>
<td>Dead storage Capacity</td>
<td>1.6 Mm³</td>
</tr>
<tr>
<td>Gross storage Capacity</td>
<td>70.8274 Mm³</td>
</tr>
<tr>
<td>Revised Peak Flood</td>
<td>1427 Cumecs (SPF)</td>
</tr>
</tbody>
</table>
Type of Spillway : Ogee Spillway
Type of Gate      : Vertical Lift Gate
No of Bays       : 3 Gates of 12.20 m (W) X 4.5744 m (H) each
Spillway Capacity: 512.50 m$^3$/s

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 94.50 m the water level shall be noted every 6 hours. When the level reaches 96.50 m the level shall be noted every two hours. When the level reaches 97.00m 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 96.50 m the Assistant Engineer in charge of the dam shall give the first warning by sending message (SMS/Email) “Kanhirapuzha Reservoir level at 96.50 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, Mannarkkad
4. The Addl.Tahsildar, Mannarkkad

When the level is nearing 97.00m, 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 97.00 m, the following messages (SMS/Email) “Kanhirapuzha Reservoir level at 97.00 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, KPIP Division No.I, Kanhirapuzha
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>
<thead>
<tr>
<th>Officer Designation</th>
<th>Responsibilities (During Preparedness and Emergency Events)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Executive Engineer</strong>  (Emergency Planning Manager)</td>
<td></td>
</tr>
<tr>
<td><strong>Preparedness Responsibilities:</strong></td>
<td></td>
</tr>
<tr>
<td>• Coordinate routine inspections and Dam's Operations as per guidelines for safety inspection of dams.</td>
<td></td>
</tr>
<tr>
<td>• Conduct pre and post monsoon inspection of dams.</td>
<td></td>
</tr>
<tr>
<td>• Ensure effective transmission of hydro-metrological and stream flow data through different means.</td>
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</tr>
<tr>
<td>• Ensure proper accessibility to all vulnerable points for constant monitoring during emergency situations</td>
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<tr>
<td>• Identify primary and secondary communication systems, both internal (between persons at the dam) and external (between dam personnel and outside entities).</td>
<td></td>
</tr>
<tr>
<td>• Provide security measures at the dam (CCTV surveillance, security guards, fencing).</td>
<td></td>
</tr>
<tr>
<td>• Ensure the availability of adequate staff at dam site during holidays, nights and round the clock in weekdays.</td>
<td></td>
</tr>
<tr>
<td>• Ensure that the EAP is functional and staffs are familiar with their responsibilities.</td>
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</tr>
<tr>
<td>• 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.</td>
<td></td>
</tr>
<tr>
<td>• Ensure all the equipment/means at dam site to response to an emergency are easily accessible and well maintained</td>
<td></td>
</tr>
</tbody>
</table>
(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 functional role in the emergency response)

- 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.

**During Emergency Responsibilities:**

- 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 5 (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
- Support the communication needs of local emergency authority.

<table>
<thead>
<tr>
<th>Preparedness Responsibilities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Conduct routine inspections as per guidelines for safety inspection of dams and follow up on the events, if any noticed.</td>
</tr>
<tr>
<td>• Continuous monitor &amp; surveillance of dam and appurtenant structures looking for evidence of distress as mentioned in Annexure 7</td>
</tr>
<tr>
<td>• Conduct Pre and Post monsoon Inspections along with the Emergency Planning Manager</td>
</tr>
<tr>
<td>• Inform the Emergency Planning Manager about any irregular/unusual condition at dam site and keep him/her posted about any progression/change</td>
</tr>
<tr>
<td>• Operate dam's gates/under sluices, under the express direction of Chief Engineer/Superintending Engineer/Executive Engineer</td>
</tr>
<tr>
<td>• Conduct routine dam maintenance</td>
</tr>
<tr>
<td>• Collect instrumentation measurements, evaluate and report if found necessary.</td>
</tr>
<tr>
<td>• Ensure that all the data are properly recorded.</td>
</tr>
<tr>
<td>• Ensure effective working conditions of the warning system (Sirens)</td>
</tr>
<tr>
<td>• Participate in exercises for test/improvement of this EAP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>During Emergency Responsibilities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Monitor the emergency event at dam site and keep posted the Emergency Planning Manager about any change in development</td>
</tr>
<tr>
<td>• Contact the supplier / contractors</td>
</tr>
<tr>
<td>• Supervise the work of the labour contractors and machineries engaged in the site for rehabilitation /</td>
</tr>
</tbody>
</table>
remedial works

- Conduct the remedial actions as per Action Data Sheets (Annexure 5)

**Preparedness Responsibilities:**

- 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 and appropriate corrective measures
- 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.

**During Emergency Responsibilities:**

- 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

<table>
<thead>
<tr>
<th>Preparedness Responsibilities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assist the Dam Owner's officers in preparation of Action Data Sheets <em>(Annexure - 5)</em></td>
</tr>
<tr>
<td>• Recommend specific actions in order to improve the readiness of emergency actions</td>
</tr>
<tr>
<td>• Support and Monitor the remedial construction activities such as earth moving, special investigations, etc.</td>
</tr>
<tr>
<td>• 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.</td>
</tr>
<tr>
<td>• Undertake an engineering assessment of the safety hazard at the dam in collaboration with the State Dam Safety Organization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chief Engineer</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>During Emergency Responsibilities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Advice the dam's Emergency Planning Manager/Superintending Engineer with the emergency level determination, if time permits.</td>
</tr>
<tr>
<td>• Advice the dam's Emergency Planning Manager/Superintending Engineer with remedial actions to take if Blue/orange events occurs, and if time permits.</td>
</tr>
<tr>
<td>• Direct specific and appropriate procedures to open/close the spillway's gates during the reservoir operation.</td>
</tr>
<tr>
<td>• Play the role of &quot;Public Affair's Officer&quot; in case external/public notifications should be released.</td>
</tr>
<tr>
<td>• Keep close watch on the different activities being carried out by different agencies at the time of emergency</td>
</tr>
</tbody>
</table>
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 Kanhirapuzha 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

#### Table 2- Responsibilities for Notification

<table>
<thead>
<tr>
<th>Officer Designation</th>
<th>Responsibilities During Emergency Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Engineer (Emergency Planning Manager)</td>
<td>• Notify the District Disaster Management Authorities (District Collector) in case of <strong>Orange/Red</strong> alert</td>
</tr>
<tr>
<td></td>
<td>• Notify the District Authorities about any emergency response actions at dam site and their impacts in the</td>
</tr>
<tr>
<td></td>
<td>downstream area (e.g. large releases)</td>
</tr>
<tr>
<td></td>
<td>• Notify the District Collectors/ Relief Authorities involved in the emergency response actions with information about condition at dam site</td>
</tr>
<tr>
<td></td>
<td>• Where the residences located immediately downstream of a dam that would be inundated within minutes of a dam</td>
</tr>
<tr>
<td></td>
<td>failure, wherein the available warning time is very limited, in that cases, Emergency Planning Manager will</td>
</tr>
<tr>
<td></td>
<td>arrange to notify the residences directly without waiting for the local administration to act upon before</td>
</tr>
<tr>
<td></td>
<td>an emergency situation develops.</td>
</tr>
<tr>
<td>Dam Site Engineers (Assistant Executive Engineer, Assistant Engineers)</td>
<td>• Keep inform the Emergency Planning Manager about the progress of the situation at dam site</td>
</tr>
<tr>
<td></td>
<td>• Notify Dam Safety Organization and request technical advice as required.</td>
</tr>
<tr>
<td></td>
<td>• Notify/inform higher authorities on the mishap as per notification flow chart of particular alert level as per</td>
</tr>
<tr>
<td></td>
<td>situation at site.</td>
</tr>
<tr>
<td></td>
<td>• Notify/inform media representatives about the emergency situation.</td>
</tr>
<tr>
<td></td>
<td>• Define emergency situations for which each medium will be utilized and include an example of a news release that</td>
</tr>
<tr>
<td></td>
<td>would be the most effective for each possible emergency, avoiding disseminate false/overstated messages among the</td>
</tr>
<tr>
<td></td>
<td>population.</td>
</tr>
<tr>
<td>Superintending Engineer/ Chief Engineer</td>
<td>•</td>
</tr>
</tbody>
</table>

### District Collector(s) / District Disaster Management Authority

- 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 Owner's officials and media representatives about the status of the emergency event

### Relief Authorities (Police Department, Civil Defense, Army Forces)

- 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.

### Media Representatives

- 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 Emergency Operations Centre

In the event of a failure condition, the Superintending Engineer, Siruvani Project Circle, Palakkad will activate the Emergency Operations Centre to serve as the main distribution centre for warning and evacuation activities. The Emergency Operations Centre will be established at the Office of the Superintending Engineer, Siruvani Project Circle, Palakkad. The Superintending Engineer will be responsible for initiating actions from this location.

3.5. Responsibilities for Evacuation

Evacuation and relief actions are exclusive responsibilities of Districts Authorities, and emergency relief forces at local and state level. For Kanhirapuzha Dam, a total of 1 Districts, 9 Panchayaths and 11 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.

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 Defense, 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)

3.6. 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 5) 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>
<thead>
<tr>
<th>Officer Designation</th>
<th>Responsibilities (Termination and Follow Up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Engineer</td>
<td></td>
</tr>
<tr>
<td>(Emergency Planning Manager)</td>
<td>• Declare the termination of the emergency operations in coordination with District Disaster Management Authority and Relief/Response Forces.</td>
</tr>
<tr>
<td></td>
<td>• A detailed report to be compiled</td>
</tr>
<tr>
<td></td>
<td>• Conduct a post review of the EAP procedures.</td>
</tr>
<tr>
<td></td>
<td>• Identify EAP procedures that were followed effectively, as well as any ways that the EAP could be improved.</td>
</tr>
<tr>
<td></td>
<td>• 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</td>
</tr>
<tr>
<td></td>
<td>• For Major Emergencies, the Emergency Planning manager will maintain detailed records of cost expended and will</td>
</tr>
</tbody>
</table>
prepare a detailed report in this regard.

| Superintending Engineer/Chief Engineer | • 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) | • 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 | • 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
- 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.

5. 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 necessitate the implementation of the EAP. However, if any of them occur, the appropriate actions must be taken.

- 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: Kanhirapuzha Dam is located in the seismic zone III. This zone is classified as Moderate Damage Risk Zone.
- Sabotage: If a threat to damage the dam has been made. Appropriate actions must be taken to protect the dam.

A. Signs of Failure

The Executive Engineer, KPIP Division No.I, Kanhirapuzha is 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 EAPs. It is important to understand how distress can develop into failure. With appropriate action, distress need not lead to a catastrophic failure of the dam. 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 Executive Engineer. Specific dam observations and corresponding emergency classification levels can be found in the Evidence of Distress table in Annexure 6.

**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 Executive Engineer, KPIP Division No.I, Kanhirapuzha will be responsible for monitoring and repair as soon as possible and implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate this condition:

- Cloudy or dirty seepage or seepage with an increase in flow, boils, piping, or bogs
- Seepage around conduits
- 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 emergency spillway
- 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 Executive Engineer, KPIP Division No.I, Kanhirapuzha 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:
• 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
• Overtopping of a dam that is not designed for overtopping
• 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 Executive Engineer is responsible for implementing the appropriate Notification Flowchart. The following is a list of conditions that would initiate "imminent dam failure" or "dam failure" conditions:

• 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 an earthen dam
• Uncontrollable release of the reservoir

**5.3. Previously Known Problems**

There are wet or slushy patches observed on the downstream slope of the left hand side earthen dam about 430 m from left end of embankment. Seepage at the downstream side wall of gallery at spillway portion because of there is a water pool very near to the downstream side of dam. Free flow of water through the leading channel from the toe drain
at right hand side of earthen dam very near to masonry dam is obstructed due to water logging.

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

Executive Engineer will monitor the dam during emergency situations such as a severe storm event. Round the clock surveillance at the dam and its appurtenant will be carried out by site engineers during emergency situations. 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

Executive Engineer will respond to situation of excessive inflow forecast by way of controlled spillway releases after ascertaining the reliability of the forecast.

6.3 Response during weekends and holidays

Executive Engineer will be available for emergency response during weekends and holidays and can be present at the dam site within 15 minutes of detection of an emergency condition. In case of non-availability of the Executive Engineer (Dam Division), the Assistant Executive Engineer(Dam Division)will take his responsibilities.

6.4 Response during periods of darkness and adverse weather

Executive Engineer and site Engineers will arrange for access to generators and lights to adequately monitor the situation. Executive Engineer will be able to access the site during adverse weather conditions by foot, utility vehicle, or some other means.
6.5 Access to the site

Access routes from Chirakkalapadi in NH 966 via Kanjirapuzha Dam Road is safe in case of an emergency event occur at the dam.

Alternate Access Routes to Dam

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.

The following actions should only be undertaken under the direction of a professional engineer or contractor. In all cases, the appropriate Notification Flowchart must be implemented and the personnel of the SDSO must be notified.

Consider the following preparedness 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.
- Lower the water level in the reservoir by using the low flow outlet and pumping if necessary, until the flow decreases to a non-erosive velocity or until it stops.
- 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 by using the low flow outlet and pumping if necessary at a rate and 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 and by pumping if necessary.

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, Dam Division)
- Superintending Engineer, Siruvani Project Circle, Palakkad
- Chief Engineer, Projects – I

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 9.

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, Dam Division) 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 should 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 and water surface elevation are included in Annexure 2 in both, tabular and map format for each of the affected locations.
After examining the results of the breach analysis of Kanhirapuzha 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 Kanhirapuzha river. Kanjirapuzha, Kallamkuzhi, Kanjiram, Chirakkalpadi and Chooriyode in Kanjirapuzha 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 Kanhirapuzha river connecting to Kunthipuzha river affecting Kottiyyode, Thachampara, Nottanmala, Mannarkkad and Kumaramputhur Grama Panchayats.

**Table -6: Affected Taluk and Villages**

<table>
<thead>
<tr>
<th>State</th>
<th>District</th>
<th>Taluk</th>
<th>Villages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerala</td>
<td>Palakkad</td>
<td>Mannarkad</td>
<td>Pottassery I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pottassery II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thachampara</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thenkara</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mannarkad II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Kumaramputhur</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Karimpuza I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Karimpuza II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sreekrishnapuram</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thachanattukara II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vellinezhi</td>
</tr>
</tbody>
</table>
Table 7 List of Main Crossing Structures likely to be submerged

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Bridge / Location</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kanhirapuzha- Palakkayam road Bridge</td>
<td>10.986012</td>
<td>76.535321</td>
</tr>
<tr>
<td>2</td>
<td>Arippanazhi bridge</td>
<td>10.984154</td>
<td>76.522405</td>
</tr>
<tr>
<td>3</td>
<td>Kallamkuzhy Bridge</td>
<td>10.977861</td>
<td>76.512519</td>
</tr>
<tr>
<td>4</td>
<td>Chooriyode- Kallamkuzhy road Bridge</td>
<td>10.973650</td>
<td>76.504629</td>
</tr>
<tr>
<td>5</td>
<td>Chooriyode NH Bridge</td>
<td>10.974760</td>
<td>76.499013</td>
</tr>
<tr>
<td>6</td>
<td>Kundukandam Bridge</td>
<td>10.954252</td>
<td>76.490354</td>
</tr>
<tr>
<td>7</td>
<td>Kolappakkam Bridge</td>
<td>10.951751</td>
<td>76.480089</td>
</tr>
<tr>
<td>8</td>
<td>Kilirani-Pullushery Road Bridge</td>
<td>10.944471</td>
<td>76.470767</td>
</tr>
</tbody>
</table>

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 Kanhirapuzha river. These structures may suffer such impacts before the peak elevation of the flood wave.

9.1. Local Evacuation Plan

If imminent failure of the dam with uncontrolled downstream flooding is anticipated, local disaster management and law enforcement personnel should notify those downstream, for evacuation in the most expedient manner possible. The organizations and personnel on the Notification Flowchart should be contacted immediately. Local law enforcement officials, along with local mobile network operators, radio and television stations can best spread the notice for evacuation. The immediate impact will be to areas along [Stream] downstream of the dam. For sunny-day and design flood breaches, the following actions should be taken:

- Barricading all bridges that could possibly be flooded to prevent access to the affected area. These bridges include the [Stream] crossings of [Highway or Road]. See the Inundation Map in Annexure 2 to determine appropriate barricade locations.
- The District Disaster Management office can assist with the notification of all persons and agencies involved, with the possibility of additional support—including contacting others not accessible by radio or telephone.
- District officials 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.

- 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 can be found in the Annexure 2 tables of this EAP, and a complete list of relief camps (shelters) is included in Annexure 4

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 Additional Chief 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, Dam Division) and the Superintending Engineer. 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, Dam Division) will review and complete all items on the Annual EAP Evaluation Checklist in Annexure 10. 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 11.
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 12 and following the deadline given in Table 8.

**Table 8 : EAP Exercise / Testing Techniques**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Schedule</th>
<th>Reporting Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>Annual</td>
<td><strong>Pre-Event : Submit Agenda to Stakeholders 30 days before meeting</strong></td>
</tr>
<tr>
<td>(Stakeholder’s)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Consultation

- **Post-Event:** Update Form 2 (Annexure 11), within 30 days after meeting

### Tabletop Exercise

- **Pre-Event:** Submit Exercise Plan and Schedule to participants 90 days before meeting
- **Post-Event:** Update Form 2 (Annexure 11), 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 12*. 
Emergency Action Plan for Kanhirapuzha Dam  
July 2019

WATCH CONDITION NOTIFICATION FLOW CHART (Internal Alert)

Observer of Event  
Name: Assistant Executive Engineer  
Email: kpipsubdn3@gmail.com  
Mobile No: 9605009696  
Office No: 0492-238110

Dam Site  
Name: Assistant Executive Engineer  
Email: kpipsubdn3@gmail.com  
Mobile No: 9605009696  
Office No: 0492-238110

Event Level Determination / Escalation  
Based on Annexure 5 (Action Sheets)  
Blue Alert

Civil Works  
Name: Executive Engineer  
Email: eekpip1@gmail.com  
Mobile No: 9447523349  
Office No: 0492-4238227

Mechanical Works  
Name: Executive Engineer  
Email: eekpip1@gmail.com  
Mobile No: 9447523349  
Office No: 0492-4238227

Expert Panel  
Name: Chief Engineer  
Email: cep1kkd@gmail.com  
Mobile No: 9497655116  
Office No: 0495-2345395

Observers of Event  
Name: CWRDM, Kozhikode  
Email: ed@cwrdm.org  
Office No: 0495 2351800, 801

Name: CSMRS  
Email:  
Office No:+91-11-26967985

Name: NIT, Calicut  
Email: civilhod@nitc.ac.in  
Mobile No: 9447705289  
Office No:+914952286200

Evacuation Warnings  
Name: Executive Engineer  
Email: eekpip1@gmail.com  
Mobile No: 9447523349  
Office No: 0492-4238227

Available Resources  
Suggested Phone Message (Blue Alert):  
- This is (name, position)  
- An unusual event has been detected at Kanhirapuzha Dam. The EAP has been activated, currently at Blue Alert  
- The situation is being monitored to determine if any evacuation warnings will be necessary. We will keep you apprised of the situation  
- I can be contacted at the following number [Phone No], if you cannot reach me. Please call the alternative number[Alt No.]

NOTES:  
(1), (2), (3) …  Denotes Call Sequence / Priority  
Compulsory Communication  
Alternative Communication
FAILURE CONDITION NOTIFICATION FLOW CHART (External Alert)

Observer of Event

Dam Site Office
Name: Assistant Executive Engineer
Email: kppisuhy3@gmail.com
Mobile No: 9605090969
Office No: 04924-238110

Name: Assistant Engineer
Email: aekpip2018@gmail.com
Mobile No: 7012870408
Office No:

Name: Assistant Engineer
Email: aekpip2018@gmail.com
Mobile No: 9605090969
Office No: 04924-238110

Superintending Engineer Office
Name: Superintending Engineer
Email: sespekld@yahoo.co.in
Mobile No: 9447360820
Office No: 0491-2577425

Name: Executive Engineer
Email: sespekld@yahoo.co.in
Mobile No: 9447360820
Office No: 0491-2577425

Emergency Planning Manager
Name: Executive Engineer
Email: eekpip1@gmail.com
Mobile No: 9447523349
Office No: 0492-4238227

Name: Assistant Executive Engineer
Email: kpipsubdn3@gmail.com
Mobile No: 9605009696
Office No: 04924-238110

Chief Engineer Office
Name: Chief Engineer
Email: cep1kkd@gmail.com
Mobile No: 9447375516
Office No: 0495-2385595

Name: Executive Engineer
Email: cep1kkd@gmail.com
Mobile No: 9447360820
Office No: 0491-2577425

Central Dam Safety Organisation
Name: Chief Engineer
Email: cidbrnm@gmail.com
Mobile No: 9446897575
Office No: 0471-2383972

Name: Director
Email: cdbrnm@gmail.com
Mobile No: 9958975928
Office No: 011-26192633

State Dam Safety Organisation
Name: Chief Engineer
Email: cidbrnm@gmail.com
Mobile No: 9447780159
Office No: 0471-2784091

Name: Director
Email: cdbrnm@gmail.com
Mobile No: 9958975928
Office No: 011-26192633

Civil Works
Name: Superintending Engineer
Email: sespekld@yahoo.co.in
Mobile No: 9447360820
Office No: 0491-2577425

Name: Executive Engineer
Email: sespekld@yahoo.co.in
Mobile No: 9447360820
Office No: 0491-2577425

Mechanical Works
Name: Superintending Engineer
Email: semechekm@gmail.com
Mobile No: 9447060226
Office No: 0484 2424580

Name: Executive Engineer
Email: eemechmpza@gmail.com
Mobile No: 9447881410
Office No: 0491 2815185

State Collector
Name: District Collector
Email: dsdpkld@kerala.nic.in
Mobile No: 9447633445
Office No: 0491-2505266

Name: Section Officer
Email: keralasdma@gmail.com
Mobile No: Office No: 0471-2331645

Relief Authorities

See District wise Notification Flow Charts for further details

Suggested Phone Message (Orange Alert):
- This is [Name, Position]. I am making this call in accordance with the Kanhirapuzh Dam Emergency Action Plan.
- We have an Emergency at Kanhirapuzh Dam. The EAP has been activated, currently at Orange Alert. We are implementing predetermined actions as per the evacuation map infron of the EAP. The situation is being monitored to determine if any evacuation warnings will be necessary. Reference your copy of the EAP to prepare for possible evacuation.
- I can be contacted at the following number [Phone No]. If you cannot reach me, please call the alternative number[Alt No.]

Suggested Phone Message (Red Alert):
- This is an EMERGENCY. This is (name, position).
- Kanhirapuzh Dam is failing. The downstream area must be evacuated immediately according to the evacuation map in your copy of Emergency Action Plan. The EAP has been activated, currently at Red Alert.
- I can be contacted at the following number [Phone No]. If you cannot reach me. Please call the alternative number[Alt No.]

NOTES:
(1), (2), (3) ... Denotes Call Sequence / Priority
Compulsory Communication
Alternative Communication
PALAKKAD DISTRICT - FAILURE CONDITION NOTIFICATION FLOW CHART (External Alert)

**Dam Owners Officials**
- **Emergency Planning Manager**
  - Name: Executive Engineer
  - Email: eekpip1@gmail.com
  - Mobile No: 9447523549
  - Office No: 0492-4238227
- **Assistant Executive Engineer**
  - Email: kippuds3@gmail.com
  - Mobile No: 9605090696
  - Office No: 04924-238110

**District Representatives**
- **District Collector**
  - Email: deplkd@kerala.nic.in
  - Mobile No: 9497633445
  - Office No: 0491-2505266
- **Deputy Collector**
  - Email: 8347610093
  - Office No: 0491-2505008

**Police Department**
- **Superintendent of Police**
  - Email: spplkd.poi@kerala.gov.in
  - Mobile No: 9497908077
  - Office No: 0491-2534011
- **Deputy Superintendent of Police**
  - Email: dyspagalypkd poi@kerala.gov.in
  - Mobile No: 9497990094

**Tehsil Representatives**
- **Tehsildar**
  - Email: 9447735016
  - Office No: Manarkkad

**Health / Hospitals**
- **District Medical Officer**
  - Email: idsppkd@yahoo.co.in
  - Mobile No: 9946105487
  - Office No: 0491-2505264

**Fire Department**
- **Fire Station, Palakkad**
  - Email: dopkd.fso@kerala.gov.in
  - Mobile No: 9491-2505701

**SDRF / Army / Navy Forces**
- **Commandant RRRF**
  - Email: cmmndt@kerala.gov.in
  - Office No: 0483-2783396
  - Office No: 0483-2783397
- **Supreme Defense Reserve Force (SDRF)**
  - Email: cmdtsraf.pol@kerala.gov.in
  - Mobile No: 94465 68222

**State DMA**
- **Member Secretary**
  - Email: keralasdma@gmail.com
  - Mobile No: 9400202927
  - Office No: 0471-2331345
- **Section Officer**
  - Email: keralasdma@gmail.com
  - Mobile No: 0471-2331645

**Media**
- **Press Club, Palakkad**
  - Email: spplkd.pol@kerala.gov.in
  - Mobile No: 9497996977
  - Office No: 0491-2534011
- **Manorama Channel**
  - Mobile No: 88482 282471
  - Office No: 0491-25381552
- **Mathrubhoomi**
  - Mobile No: 0491-2521900

**NOTES:**
(1), (2), (3) ... Denotes Call Sequence / Priority
Compulsory Communication
Alternative Communication
Annexure – 1
Vicinity Map
Inundation maps showing 1) maximum water depth, 2) maximum water velocity, and 3) maximum water-surface elevation were prepared for each of the three flooding cases considered (non-flood failure, overtopping and large controlled release). An additional map showing the time of arrival of the flood wave since the start of failure (that is, since the initiation of breaching) is provided for each of the dam breach floods (overtopping and piping).

NOTE: Because of the method, procedures, and assumptions used to determine the flooded areas; the limits of flooding shown and flood wave travel times are approximate and should be used only as a guideline for establishing evacuation zones. Areas inundated in an actual event will depend on actual failure conditions and may differ from areas shown on the maps.
Annexure – 2 A

Inundation Map – Large Controlled Release
Annexure – 2 B

Inundation Map – Non Flood Failure
KANHIRAPUZHA, KERELA
NON - FLOOD FAILURE
MAXIMUM DEPTH (m)

Depth (Max)
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- Settlements
- Roads

Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_16
Date: July 2016
Annexure – 2 C

Inundation Map – Overtopping
KANHIRAPUZHA, KERELA

OVERTOPPING FAILURE
MAXIMUM WATER SURFACE
ELEVATION (m-msl)

WSE (Max)

- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- Settlements
- Contour
- Roads

Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_16
Date: July 2015

1/2
Emergency Action Plan for Kanhirapuzha Dam

KANHIRAPUZHA, KERELA
OVERTOPPING FAILURE
MAXIMUM VELOCITY (m/s)

Velocity (Max)
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10

Settlements
Railways
Roads

Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_16
Date: July 2016
Emergency Action Plan for Kanhirapuzha Dam     July 2019

KANHIRAPUZHA, KERALA
OVERTOPPING FAILURE
MAXIMUM VELOCITY (m/s)

<table>
<thead>
<tr>
<th>Velocity (Max)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>Blue</td>
</tr>
<tr>
<td>2 - 4</td>
<td>Green</td>
</tr>
<tr>
<td>4 - 6</td>
<td>Yellow</td>
</tr>
<tr>
<td>6 - 8</td>
<td>Red</td>
</tr>
<tr>
<td>8 - 10</td>
<td>Pink</td>
</tr>
</tbody>
</table>

Settlements

Railways

Roads

Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSQ_MAP_DS_16
Date: July 2016
Annexure – 3

Flood Hazard Reference Values

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance(^{(a)}) from dam (km)</th>
<th>Overtopping Failure</th>
<th>Non Flood Failure</th>
<th>Large Controlled Release</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum depth(^{(b)}) (m)</td>
<td>Maximum velocity(^{(b)}) (m/s)</td>
<td>Flood wave arrival time(^{(c)}) (hh:mm)</td>
</tr>
<tr>
<td>Kanhirapuzha</td>
<td>0.35</td>
<td>6</td>
<td>4</td>
<td>00:30:00</td>
</tr>
<tr>
<td>Kallamkuzhi</td>
<td>2.85</td>
<td>14</td>
<td>4</td>
<td>01:15:00</td>
</tr>
<tr>
<td>Kanjiram</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>01:40:00</td>
</tr>
<tr>
<td>Chooriyodu</td>
<td>4.08</td>
<td>12</td>
<td>4</td>
<td>02:00:00</td>
</tr>
<tr>
<td>Thachampara</td>
<td>4.36</td>
<td>6</td>
<td>2</td>
<td>02:30:00</td>
</tr>
<tr>
<td>Chirakkalpadi</td>
<td>4.56</td>
<td>12</td>
<td>2</td>
<td>02:35:00</td>
</tr>
<tr>
<td>Kottiyyodu</td>
<td>5.38</td>
<td>10</td>
<td>2</td>
<td>02:40:00</td>
</tr>
<tr>
<td>Notnanmala</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>02:45:00</td>
</tr>
<tr>
<td>Mannarkkad</td>
<td>7.5</td>
<td>4</td>
<td>2</td>
<td>04:00:00</td>
</tr>
<tr>
<td>Kumaramputhur</td>
<td>11.36</td>
<td>4</td>
<td>2</td>
<td>04:15:00</td>
</tr>
</tbody>
</table>

\(^{(a)}\) Approximate distance downstream from dam measured along stream centreline
\(^{(b)}\) Maximum value near the specified location, which usually occurs near the centre of the stream
\(^{(c)}\) Flood wave arrival time is the time since the initiation of the dam breach until the settlement is inundated.
## Local Evacuation Plan

<table>
<thead>
<tr>
<th>Evacuation Priority</th>
<th>Location</th>
<th>Nearby Shelters or relief camp identified</th>
<th>Responsible for Evacuation</th>
<th>Tile id in Evacuation Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kanjirapuzha</td>
<td>GUPS, Pottassery</td>
<td></td>
<td>(1/2)</td>
</tr>
<tr>
<td>2</td>
<td>Thirukkalur</td>
<td>GLPS, Thirukkalur</td>
<td></td>
<td>(1/2)</td>
</tr>
<tr>
<td>3</td>
<td>Mannarkkad</td>
<td>GHS, Manarkkad</td>
<td></td>
<td>(1/2)</td>
</tr>
<tr>
<td>4</td>
<td>Thachampara</td>
<td>Deshabandhu HS, Thachampara</td>
<td></td>
<td>(1/2)</td>
</tr>
<tr>
<td>5</td>
<td>Vazhampuram</td>
<td>GUPS, Vazhampuram</td>
<td></td>
<td>(1/2)</td>
</tr>
<tr>
<td>6</td>
<td>Karakurissi</td>
<td>GVHSS, Karakurissi</td>
<td>District Police Chief, Palakkad</td>
<td>(1/2)</td>
</tr>
<tr>
<td>7</td>
<td>Pottassery</td>
<td>GLPS, Pottassery</td>
<td></td>
<td>(2/2)</td>
</tr>
<tr>
<td>8</td>
<td>Pottassery</td>
<td>GUPS, Pottassery</td>
<td></td>
<td>(2/2)</td>
</tr>
<tr>
<td>9</td>
<td>Kumaraputhur</td>
<td>GLPS, Kumarputhur</td>
<td></td>
<td>(2/2)</td>
</tr>
<tr>
<td>10</td>
<td>Kumaramputhur</td>
<td>GUPS, Kumaramputhur</td>
<td></td>
<td>(2/2)</td>
</tr>
<tr>
<td>11</td>
<td>Pallikkurup</td>
<td>Sabari HS, Pallikkurup</td>
<td></td>
<td>(2/2)</td>
</tr>
</tbody>
</table>
## ANNEXURE -4

Emergency Level Determination – Action Data Sheet Index

Annex Table 9– Emergency Level Determination – Action Data Sheet Index

<table>
<thead>
<tr>
<th>Event / General Observation</th>
<th>Specific Observation/ Condition</th>
<th>Emergency Level</th>
<th>Action Data Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unexpected Failure</td>
<td>Dam unexpectedly and without warning begins to fail</td>
<td>RED</td>
<td>Sheet A1</td>
</tr>
<tr>
<td>Spillway Release Increasing</td>
<td>High intensity rainfall in the catchment area of reservoir: Forecast of heavy rain by IMD; large inflow to reservoir; may need to open gates in an emergency</td>
<td>BLUE</td>
<td>Sheet B1</td>
</tr>
<tr>
<td>Reservoir Water Surface</td>
<td>Large inflow to reservoir; Water level is one meter below FRL; controlled release through spillway</td>
<td>ORANGE</td>
<td>Sheet B2</td>
</tr>
<tr>
<td>Elevation</td>
<td>Large inflow to reservoir; Water level has crossed FRL; Large controlled release through spillway</td>
<td>RED</td>
<td>Sheet B3</td>
</tr>
<tr>
<td>Embankment Overtopping</td>
<td>Potential Embankment Overtopping, Reservoir water surface elevation is one meter below the top of the dam</td>
<td>ORANGE</td>
<td>Sheet C2</td>
</tr>
<tr>
<td></td>
<td>Water from the reservoir is flowing over the top of the dam</td>
<td>RED</td>
<td>Sheet C3</td>
</tr>
<tr>
<td>Seepage</td>
<td>Seepage through the dam body. New or minor seepage at toe, on slope of embankment, abutments or galleries, water flowing clear</td>
<td>BLUE</td>
<td>Sheet D1</td>
</tr>
<tr>
<td></td>
<td>New, seriously or rapidly increasing seepage flow rate at toe, on slope of embankment, abutments or galleries, water flowing clear.</td>
<td>ORANGE</td>
<td>Sheet D2</td>
</tr>
<tr>
<td></td>
<td>Serious seepage at toe, on slope embankment, abutments or galleries. Incontrollable muddy water flowing, failure of dam is imminent</td>
<td>RED</td>
<td>Sheet D3</td>
</tr>
<tr>
<td>Sinkholes</td>
<td>Sinkholes anywhere in embankment or within 150 m downstream from the toe. No seepage or flowing water</td>
<td>BLUE</td>
<td>Sheet E1</td>
</tr>
<tr>
<td></td>
<td>Sinkholes with seepage or flowing water anywhere in the embankment or within 150 m downstream from the toe.</td>
<td>ORANGE</td>
<td>Sheet E2</td>
</tr>
<tr>
<td></td>
<td>Sinkholes rapidly enlarging with muddy water anywhere in the embankment or within 150 m downstream from the toe.</td>
<td>RED</td>
<td>Sheet E3</td>
</tr>
<tr>
<td>Embankment Cracking /</td>
<td>Crack in the embankment crest or slopes greater than ½ cm or ¼ inch wide and considerable length, without seepage</td>
<td>BLUE</td>
<td>Sheet F1</td>
</tr>
<tr>
<td>Movement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Action Plan for Kanhirapuzha Dam</td>
<td>July 2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crack in the embankment crest or slopes greater than ( \frac{1}{2} ) cm or ( \frac{1}{4} ) inch wide and considerable length, with active movement / slippage and / or seepage through cracks</td>
<td>ORANGE Sheet F2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudden or rapidly proceeding slides of the embankment slopes. Cracks that extends to reservoir elevation</td>
<td>RED Sheet F3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concrete / Masonry Structure Cracking</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor cracks (bigger than ( \frac{1}{4} ) cm) in the masonry / concrete structure, without leakage</td>
<td>BLUE Sheet G1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enlarging cracks (bigger than ( \frac{1}{4} ) cm) and active movement in the masonry / concrete structure, with leakage passing through</td>
<td>ORANGE Sheet G2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enlarging cracks with sudden or rapidly proceeding movements / displacements in the masonry / concrete structure, with severe leakage passing through</td>
<td>RED Sheet G3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instrumentation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrumentation readings are beyond pre-determined / thresholds values</td>
<td>BLUE Sheet H1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Malfunction of Radial / Sluice Gate (s)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gates(s). No leakage or uncontrolled discharge is detected. Flood cannot be routed without damaged / non-operational gate(s)</td>
<td>BLUE Sheet I1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gates(s). Considerable leakage or uncontrolled discharge is detected. Flood cannot be routed without damaged / non-operational gate(s)</td>
<td>ORANGE Sheet I2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gates(s). Unexpected high discharge is occurring. Flood cannot be routed without damaged / non-operational gate(s)</td>
<td>RED Sheet I3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Earthquake</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurable earthquake felt or reported and dam appears to be stable</td>
<td>BLUE Sheet J1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthquake resulting in visible damage to the dam or appurtenances which can cause a potential dangerous situation</td>
<td>ORANGE Sheet J2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthquake resulting in uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage</td>
<td>RED Sheet J3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unverified bomb threat or verified damage to the dam / appurtenances with no impacts in the functioning of the dam</td>
<td>BLUE</td>
<td>Sheet K1</td>
<td></td>
</tr>
<tr>
<td>Verified bomb threat that if carried out, could result in damage the dam / appurtenances that impacts the functioning of the dam OR verified damages due to vandalism that impacts the normal operation of the dam</td>
<td>ORANGE</td>
<td>Sheet K2</td>
<td></td>
</tr>
<tr>
<td>Detonated bomb resulting in visible damage to the dam or appurtenances OR verified damages due to vandalism causing or uncontrolled water release</td>
<td>RED</td>
<td>Sheet K3</td>
<td></td>
</tr>
</tbody>
</table>
Emergency Action Plan for Kanhirapuzha Dam

<table>
<thead>
<tr>
<th>RED ALERT</th>
<th>Description: UNEXPECTED FAILURE</th>
<th>SHEET A1</th>
</tr>
</thead>
</table>

RECOMMENDED ACTIONS

**Emergency Planning Manager**

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Activate the Emergency Operation Center

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE Evacuation

D. Stay a safe distance away from the dam. The immediate concern is the safety of downstream public.

E. Record all information, observations and actions on an Event Log Form (Form 1).

**Site Engineers**

F. Stay a safe distance away from the dam

G. Observe conditions in site periodically and provide decision support as appropriate.

**Superintending Engineer / Chief Engineer**

H. Communicate and keep informed the Secretary of Water Resources Department

**Dam Safety Organisation’s Staff**

I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions CONTINUOUSLY and determine if:

A. The event warrants downgrade if there is no longer an impending threat of dam failure with no additional rainfall occurring YET there is damage to the dam that prevents safe impoundment of water. All contacts on Event Level 1 Notification Flow Chart shall be notified of downgrade to Event Level 3

B. Event may be Terminated only when either:
   - There is no longer an impending threat of dam failure with no additional rainfall occurring and it has been determined by Dam Safety staff safe to impound water or;
   - The dam has failed AND there is no longer a threat to the downstream public

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. TERMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
**Emergency Action Plan for Kanhirapuzha Dam**

**July 2019**

<table>
<thead>
<tr>
<th>BLUE ALERT</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPILLWAY RELEASE: High intensity rainfall in the catchment area of reservoir; Forecast of heavy rain by IMD; large inflow to reservoir; may need to open gates in an emergency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECOMMENDED ACTIONS</th>
</tr>
</thead>
</table>

**Emergency Planning Manager**

| A. | Implement the “Watch Condition Notification Flowchart” using pre-scripted message |
| B. | Make careful observation and inspection of every part of the dam; this should be done to monitor without compromising the safety of anyone performing the tasks |
| C. | Record all information, observations and actions on an Event Log Form (Form 1). |
| D. | Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately |

**Site Engineers**

| E. | Observe conditions in site periodically and provide decision support as appropriate. |
| F. | Provide corrective actions or work as required. |

**Superintending Engineer / Chief Engineer**

| G. | Direct Specific and appropriate procedures for reservoir operations |

**Dam Safety Organisation’s Staff**

| H. | Provide decision support and technical support to the Emergency Planning Manager as appropriate. |

**RE-EVALUATION / DECISION**

Evaluate conditions CONTINUOUSLY and determine if:

| A. | The event can be terminated when the intensity of rainfall is dwindling as per the forecast. |
| B. | The event warrants escalation to orange alert if the reservoir level reaches one meter below FRL |

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. TERMINATION</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Go to Termination and Follow-up</td>
<td>Go to SHEET B2 (ORANGE Alert)</td>
</tr>
</tbody>
</table>
**Emergency Action Plan for Kanhirapuzha Dam**

**July 2019**

<table>
<thead>
<tr>
<th>ORANGE ALERT</th>
<th>Description:</th>
<th>SHEET B2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPILLWAY RELEASE: Large inflow to reservoir; Water level is one (1) meter below FRL; Controlled Release through spillway</td>
<td></td>
</tr>
</tbody>
</table>

### RECOMMENDED ACTIONS

**Emergency Planning Manager**

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Make careful observation and inspection of every part of the dam; this should be done without compromising the safety of anyone performing these tasks. Monitor water level in the reservoir in every hour

D. Record all information, observations and actions on an Event Log Form (Form 1).

E. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

**Site Engineers**

F. Observe conditions in site periodically and provide decision support as appropriate.

G. Provide corrective actions or work as required.

**Superintending Engineer / Chief Engineer**

H. Direct Specific and appropriate procedures for reservoir operations

**Dam Safety Organisation’s Staff**

I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate conditions CONTINUOUSLY and determine if:

A. The event warrants downgrade to BLUE alert if “Spillway flows are decreasing with no additional rainfall occurring”.

B. The event remains at the current Event Level (No change in situation)

C. The event warrants escalation to RED alert if the integrity of the dam appears to be threatened by sudden or rapidly proceeding movements / displacements.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to the SHEET A1 (BLUE ALERT)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET B3 (RED Alert)</td>
</tr>
</tbody>
</table>
# Emergency Action Plan for Kanhirapuzha Dam

**July 2019**

**RED ALERT**

<table>
<thead>
<tr>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPILLWAY RELEASE</strong>: Large inflow to reservoir; Water level has crossed FRL; Large Controlled Release through spillway</td>
</tr>
</tbody>
</table>

**SHEET B3**

## RECOMMENDED ACTIONS

### Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.

D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public.

E. Record all information, observations and actions on an Event Log Form (Form 1).

### Site Engineers

F. Observe conditions in site periodically and provide decision support as appropriate.

### Superintending Engineer / Chief Engineer

G. Direct Specific and appropriate procedures to open / close spillway’s gates during the reservoir operations

### Dam Safety Organisation’s Staff

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

## RE-EVALUATION / DECISION

Evaluate conditions CONTINUOUSLY and determine if:

A. The event warrants downgrade to BLUE alert if “Spillway flows are decreasing with no additional rainfall occurring”.

B. The event remains at the current Event Level (No change in situation)

C. Event may be Terminated only when either:
   - Spillway flows has stopped with no additional rainfall occurring and it has been determined by Dam Safety Organisations Staff that it is safe to impound water or;
   - The dam has failed AND there is no longer a threat to the downstream public

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>D. EVENT LEVEL DOWNGRADE</th>
<th>E. EVENT / LEVEL REMAINS THE SAME</th>
<th>F. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to the SHEET A2 (ORANGE ALERT)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
## Event Description:
Potential Embankment Overtopping. Reservoir water surface elevation is one (1) meter below the top of the dam

### RECOMMENDED ACTIONS

#### Emergency Planning Manager
- A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
- B. Identify the areas that would be potentially impacted by the emergency events.
- C. Make careful observation and inspection of every part of the dam; this should be done without compromising the safety of anyone performing these tasks. Monitor water levels and spillway area for erosion every 15 minutes.
- D. Record all information, observations and actions on an Event Log Form (*Form 1*).
- E. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

#### Site Engineers
- F. Observe conditions in site periodically and provide decision support as appropriate.
- G. Provide corrective actions or work as required.

#### Superintending Engineer / Chief Engineer
- H. Direct Specific and appropriate procedures for reservoir operations

#### Dam Safety Organisation’s Staff
- I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate conditions CONTINUOUSLY and determine if:

- A. The event warrants downgrade to BLUE alert if rainfall has stopped and slowing down additional inflow to the reservoir. Reservoir level are below FRL.
- B. The event remains at the current Event Level (No change in situation)
- C. The event warrants escalation to RED if water begins to overtop the embankment

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>G. EVENT LEVEL DOWNGRADE</th>
<th>H. EVENT / LEVEL REMAINS THE SAME</th>
<th>I. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declare BLUE alert and Monitor conditions until reservoir levels go below FRL</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET C3 (RED Alert)</td>
</tr>
</tbody>
</table>
Emergency Action Plan for Kanhirapuzha Dam

RED ALERT

Description:
Embankment Overtopping. Water from the reservoir is flowing over the top of the dam

SHEET C3

RECOMMENDED ACTIONS

Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
B. Identify the areas that would be potentially impacted by the emergency events.
C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.
D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public
E. Record all information, observations and actions on an Event Log Form (Form 1).

Site Engineers

F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.

Superintending Engineer / Chief Engineer

G. Direct Specific and appropriate procedures to open / close spillway’s gates during the reservoir operations

Dam Safety Organisation’s Staff

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions CONTINUOUSLY and determine if:

A. The event remains at the current Event Level (No change in situation)
B. Event may be Terminated only when either:
   ▪ Spillway flows has stopped with no additional rainfall occurring and it has been determined by Dam Safety Organisations Staff that it is safe to impound water or;
   ▪ The dam has failed AND there is no longer a threat to the downstream public

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
BLUE ALERT

Event Description:
Seepage through the dam body. New or minor seepage at toe, on slope of embankment, abutments or galleries, water flowing clear.

SHEET D1

RECOMMENDED ACTIONS

Emergency Planning Manager
A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message
B. Make careful observation and inspection of every part of the dam; this should be done to monitor without compromising the safety of anyone performing the tasks. Monitor water levels and seepage points for cloudy discharge or increased flow rates every two hours. Attempt to determine source of seepage.
C. Record all information, observations and actions on an Event Log Form (Form 1).
D. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

Site Engineers
E. Observe conditions in site periodically and provide decision support as appropriate. Try to channel and measure flow.
F. Use wooden stakes or flagging to delineate seepage area. Look for upstream whirlpools.

Superintending Engineer / Chief Engineer
G. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

Dam Safety Organisation’s Staff
H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions CONTINUOUSLY and determine if:
A. The event can be terminated if seepage flow has been remedied and it has been determined by Dam Safety Organisations Staff to impound water.
B. The remains at the current Event Level. (No change in situation)
C. The event warrants escalation to ORANGE alert if the reservoir level reaches one meter below FRL

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. TERMINATION</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to Termination and Follow-up</td>
<td>Continue recommended actions on this sheet</td>
<td>Go to SHEET D2 (ORANGE Alert)</td>
</tr>
</tbody>
</table>
### Event Description:
Seepage through the dam body. New, seriously or rapidly increasing seepage flow rate at toe, on slope of embankment, abutments or galleries, water flowing cloudy.

### RECOMMENDED ACTIONS

#### Emergency Planning Manager
- A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message.
- B. Identify the areas that would be potentially impacted by the emergency events.
- C. Make careful observation and inspection of every part of the dam; this should be done without compromising the safety of anyone performing these tasks. Monitor water levels and spillway area for erosion every 15 minutes.
- D. Record all information, observations and actions on an Event Log Form (Form 1).
- E. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately.

#### Site Engineers
- F. Observe conditions in site periodically and provide decision support as appropriate.
- G. If condition permit: plug the inflow from upstream side with available material (bentonite or plastic sheeting). Place an invert filter (layered sand and gravel) over the exit area to hold soil material in place.
- H. Construct a large ring dike around the seepage area as appropriate.
- I. Provide oversight to corrective actions or work as required.

#### Superintending Engineer / Chief Engineer
- J. Study an emergency lowering of the reservoir.

#### Dam Safety Organisation’s Staff
- K. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION
Evaluate conditions at least twice daily, or whenever conditions change significantly.
- A. The event warrants downgrade to BLUE alert if water level in the reservoir is lowered below level of seepage.
- B. The event remains at the current Event Level (No change in situation)
- C. The event warrants escalation to RED if water begins to overtop the embankment.

All contracts on Notification Flow chart shall be updated of changes.

Based on this evaluation, follow the appropriate action:

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to SHEET D1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET D3 (RED Alert)</td>
</tr>
</tbody>
</table>
**RED ALERT**

**Event Description:**
Seepage through the dam body. Serious seepage at toe, on slope of embankment, abutments, or galleries. Incontrollable muddy water flowing, failure of the dam is imminent.

**SHEET D3**

**RECOMMENDED ACTIONS**

**Emergency Planning Manager**

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.

D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public

E. Record all information, observations and actions on an Event Log Form (Form 1).

**Site Engineers**

F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.

G. Construct a large ring dike around the seepage area as appropriate

**Superintending Engineer / Chief Engineer**

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

**Dam Safety Organisation’s Staff**

I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

**RE-EVALUATION / DECISION**

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

A. The event warrants downgrade to BLUE alert if seepage has stopped and water level in reservoir is lowered below level of seepage.

B. The event remains at the current Event Level (No change in situation)

C. Event may be Terminated only when either:
   - The dam has failed AND there is no longer a threat to the downstream public

All contracts on Notification Flow chart shall be updated of changes

**Based on this evaluation, follow the appropriate action**

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
BLUE ALERT

Event Description:
Sinkholes anywhere in the embankment or within 150 m. downstream from the toe. No seepage or flowing water

RECOMMENDED ACTIONS

Emergency Planning Manager

A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message
B. Make careful observation and inspection of every part of the dam; this should be done to monitor without compromising the safety of anyone performing the tasks.
C. Monitor water levels and change in diameter or depth of sinkhole every two hours. Attempt to determine source of sinkhole.
D. Record all information, observations and actions on an Event Log Form (Form 1).
E. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

Site Engineers

F. Photograph and record the location, size and depth of the depression/sinkhole. Carefully walk the entire embankment and downstream area looking for additional sinkholes, movement or seepage.
G. Use wooden stakes or flagging to delineate seepage area. Look for upstream whirlpools.

Superintending Engineer / Chief Engineer

H. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

Dam Safety Organisation’s Staff

I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly:

A. The event can be terminated if seepage flow has been remedied and it has been determined by Dam Safety Organisations Staff to impound water.
B. The event remains at the current Event Level. (No change in situation)
C. The event warrants escalation to ORANGE alert if the reservoir level reaches one meter below FRL

All contracts on Notification Flowchart shall be updated of changes

Based on this evaluation, follow the appropriate action

D. TERMINATION

Go to Termination and Follow-up

E. EVENT / LEVEL REMAINS THE SAME

Continue recommended actions on this sheet

F. EVENT LEVEL ESCALATION

Go to SHEET E2 (ORANGE Alert)
Emergency Action Plan for Kanhirapuzha Dam

Orange Alert

Event Description:
Sinkholes with seepage or flowing water anywhere in the embankment or within 150 m downstream from the toe.

Recommended Actions

Emergency Planning Manager
A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
B. Identify the areas that would be potentially impacted by the emergency events.
C. Make careful observation and inspection of every part of the dam; this should be done without compromising the safety of anyone performing these tasks.
D. Monitor water levels and change in diameter or depth of sinkhole every two hours.
E. Record all information, observations and actions on an Event Log Form (Form 1).
F. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

Site Engineers
G. Observe conditions in site periodically and provide decision support as appropriate.
H. If condition permit: plug the inflow from upstream side with available material (bentonite or plastic sheeting). Place an invert filter (layered sand and gravel) over the exit area to hold soil material in place.
I. Construct a large ring dike around the seepage area as appropriate to reduce the flow rate
J. Provide oversight to corrective actions or work as required.

Superintending Engineer / Chief Engineer
K. Study an emergency lowering of the reservoir.

Dam Safety Organisation’s Staff
L. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

Re-evaluation / Decision
Evaluate conditions at least twice daily, or whenever conditions change significantly.

D. The event warrants downgrade to BLUE alert if water level in the reservoir is lowered below level of seepage.
E. The event remains at the current Event Level (No change in situation)
F. The event warrants escalation to RED if the sinkhole enlarges or new sinkholes begin to form.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>D. Event Level Downgrade</th>
<th>E. Event / Level Remains the Same</th>
<th>F. Event Level Escalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to SHEET E1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET E3 (RED Alert)</td>
</tr>
</tbody>
</table>
RED ALERT
Event Description: Sinkholes rapidly enlarging with muddy water anywhere in the embankment or within 150 m downstream from the toe.

RECOMMENDED ACTIONS

Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
B. Identify the areas that would be potentially impacted by the emergency events.
C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.
D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public
E. Record all information, observations and actions on an Event Log Form (Form 1).

Site Engineers

F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.
G. Construct a large ring dike around the seepage area as appropriate

Superintending Engineer / Chief Engineer

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

Dam Safety Organisation’s Staff

I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

D. The event warrants downgrade to BLUE alert if seepage has stopped and water level in reservoir is lowered below level of seepage.
E. The event remains at the current Event Level (No change in situation)
F. Event may be Terminated only when either:
   ▪ The dam has failed AND there is no longer a threat to the downstream public.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. EVENT LEVEL DOWNGRADE</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. TERMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
**BLUE ALERT**

<table>
<thead>
<tr>
<th>Event Description:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment Cracking. Cracks in the embankment crest or slopes greater than ½ cm or ¼ inch wide and considerable length, without seepage</td>
<td>SHEET F1</td>
</tr>
</tbody>
</table>

## RECOMMENDED ACTIONS

### Emergency Planning Manager

A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message

B. Make careful observation and inspection of every part of the dam; this should be done to monitor without compromising the safety of anyone performing the tasks.

C. Monitor water levels and crack widths for movement or seepage.

D. Record all information, observations and actions on an Event Log Form (Form 1).

E. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

### Site Engineers

F. Photograph and record the location, depth, length, width and offset of each crack that has been discovered. Stakes should be placed at the ends of the cracks, and the distance between the stakes measured and recorded. Compare observations with earlier results.

G. Closely monitor the crack for changes and scraping.

### Superintending Engineer / Chief Engineer

H. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

### Dam Safety Organisation’s Staff

I. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

## RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly:

A. The event can be terminated if its determined that the dam no longer poses an immediate threat to downstream by Dam Safety Organisations Staff.

B. The event remains at the current Event Level. (No change in situation)

C. The event warrants escalation to ORANGE alert if the reservoir level reaches one meter below FRL

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. TERMINATION</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to <strong>Termination and Follow-up</strong></td>
<td>Continue recommended actions on this sheet</td>
<td>Go to <strong>SHEET F2</strong> (ORANGE Alert)</td>
</tr>
</tbody>
</table>
Event Description:
Embankment Cracking with movement. Cracks in the embankment crest or slopes greater than 1/2 cm or 1/4 inch wide and considerable length with active movement and or seepage through cracks.

RECOMMENDED ACTIONS

**Emergency Planning Manager**

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message  
B. Identify the areas that would be potentially impacted by the emergency events.  
C. Make careful observation and inspection of every part of the dam; this should be done without compromising the safety of anyone performing these tasks.  
D. Monitor water levels and development of new cracks or movement hourly.  
E. Record all information, observations and actions on an Event Log Form (Form 1).  
F. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

**Site Engineers**

G. Observe conditions in site periodically and provide decision support as appropriate.  
H. If condition permit: Stabilize slides on the downstream slope by weighting the toe area below the slide with additional soil, rock or gravel.  
I. Provide oversight to corrective actions or work as required.

**Superintending Engineer / Chief Engineer**

J. Study an emergency lowering of the reservoir.

**Dam Safety Organisation’s Staff**

K. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions at least twice daily, or whenever conditions change significantly.

G. The event warrants downgrading to BLUE alert if water level in the reservoir is lowered below level of embankment fill. Event may not be terminated until repairs are made.  
H. The event remains at the current Event Level (No change in situation)  
I. The event warrants escalation to RED Alert if the sinkhole enlarges or new sinkholes begin to form. All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>G. EVENT LEVEL DOWNGRADE</th>
<th>H. EVENT / LEVEL REMAINS THE SAME</th>
<th>I. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to SHEET F1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET F3 (RED Alert)</td>
</tr>
</tbody>
</table>
**Event Description:**
Embankment Cracking and active movement. Sudden or rapidly proceeding slides of the embankment slopes. Cracks that extends to the reservoir elevation

<table>
<thead>
<tr>
<th>RED ALERT</th>
<th>SHEET F3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RECOMMENDED ACTIONS</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.

D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public

E. Record all information, observations and actions on an Event Log Form (Form 1).

### Site Engineers

F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.

### Superintending Engineer / Chief Engineer

G. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### Dam Safety Organisation’s Staff

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

A. The event warrants downgrade to BLUE alert if there is no longer an immediate threat of dam failure and water level in reservoir is lowered below bottom level of embankment fill.

B. The event remains at the current Event Level (No change in situation)

C. Event may be Terminated only when either:
   - The dam has failed AND there is no longer a threat to the downstream public.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

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<thead>
<tr>
<th>D. EVENT LEVEL DOWNGRADE</th>
<th>E. EVENT / LEVEL REMAINS THE SAME</th>
<th>F. TERMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
BLUE ALERT

Event Description:
Concrete / Masonry Structure Cracking. Minor cracks (bigger than ¼ cm) in the masonry / concrete structure, without leakage

RECOMMENDED ACTIONS

Emergency Planning Manager
A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message
B. Make careful observation and inspection of every part of the dam; this should be done to monitor without compromising the safety of anyone performing the tasks.
C. Monitor water levels in the reservoir. Install a measurement device to monitor progress / movement in crack(s)
D. Classify and describe the type of crack pattern and evaluate possible causes.
E. Record all information, observations and actions on an Event Log Form (Form 1).
F. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

Site Engineers
G. Photograph and record the location, direction (longitudinal, vertical, diagonal etc), depth, length, width and offset of each crack that has been discovered. Compare observations with earlier results.
H. Closely monitor the crack for changes and look for structural damage, including misalignment, settlement, vertical and horizontal displacement.

Superintending Engineer / Chief Engineer
I. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

Dam Safety Organisation’s Staff
J. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly:
A. The event can be terminated if its determined that the dam no longer poses an immediate threat to downstream by Dam Safety Organisation’s Staff.
B. The event remains at the current Event Level. (No change in situation)
C. The event warrants escalation to ORANGE alert if cracks are enlarging AND leakage begins to flow from cracks.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

A. TERMINATION
   Go to Termination and Follow-up

B. EVENT / LEVEL REMAINS THE SAME
   Continue recommended actions on this sheet

C. EVENT LEVEL ESCALATION
   Go to SHEET G2 (ORANGE Alert)
## ORANGE ALERT

**Event Description:**
Concrete / Masonry Structure Cracking. Enlarging cracks (bigger than ¼ cm) and an active movement in the masonry / concrete structure, with leakage passing through

**SHEET G2**

### RECOMMENDED ACTIONS

#### Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Make careful observation and inspection of every part of the dam; this should be done without compromising the safety of anyone performing these tasks. Look closely for changes in the spillways and outlet structures that may be affected by the structural. Items to check include vertical, horizontal and lateral displacements, structural cracking, and tilting of spillway walls.

D. Monitor water levels and development of new cracks or movement hourly.

E. Record all information, observations and actions on an Event Log Form (Form 1).

F. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

#### Site Engineers

G. Observe conditions in site periodically and provide decision support as appropriate.

H. If condition permit : Dump large rock on downstream of moving concrete structure monolith to resist the movement. Lower burlap on upstream face of crack(s) to reduce flow of soil particles.

I. Provide oversight to corrective actions or work as required.

#### Superintending Engineer / Chief Engineer

J. Study an emergency lowering of the reservoir.

#### Dam Safety Organisation’s Staff

K. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate conditions at least twice daily, or whenever conditions change significantly.

A. The event warrants downgrade to BLUE alert if water level in the reservoir is lowered to safe level. f. Event may not be terminated until repairs are made and causes of cracking / movement has been determined.

B. The event remains at the current Event Level (No change in situation)

C. The event warrants escalation to RED alert if the sinkhole enlarges or new sinkholes begin to form. All contracts on Notification Flow chart shall be updated of changes.

#### Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>J. EVENT LEVEL DOWNGRADE</th>
<th>K. EVENT / LEVEL REMAINS THE SAME</th>
<th>L. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to SHEET G1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET G3 (RED Alert)</td>
</tr>
</tbody>
</table>
Event Description: Concrete / Masonry Structure Cracking. Enlarging cracks with sudden or rapidly proceeding movements / displacements in the masonry / concrete structure, with severe leakage passing through

RECOMMENDED ACTIONS

Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.

D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public

E. Record all information, observations and actions on an Event Log Form (Form 1).

Site Engineers

F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.

Superintending Engineer / Chief Engineer

G. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

Dam Safety Organisation’s Staff

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

A. The event warrants downgrade to BLUE alert if there is no longer an immediate threat of dam failure and water level in reservoir is lowered below bottom level of embankment fill.

B. The event remains at the current Event Level (No change in situation)

C. Event may be Terminated only when either:

   ▪ The dam has failed AND there is no longer a threat to the downstream public.

All contracts on Notification Flow chart shall be updated of changes

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<tr>
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<th>C. TERMINATION</th>
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</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
**Event Description:** Instrumentation readings are beyond predetermined / threshold values.

### RECOMMENDED ACTIONS

**Emergency Planning Manager**

A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message

B. Make careful observation and inspection of every part of the dam related with the instruments measurements.

C. Monitor water levels and instrument readings for changes or anomalies.

D. Record all information, observations and actions on an Event Log Form (*Form 1*).

E. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions.

F. If instrumentation readings at the dam are determined to indicate a potentially dangerous situation, go to re-evaluation / decision section and follow relevant steps immediately

**Site Engineers**

G. Contact the Quality assurance / monitoring division to inform the anomalies.

H. Closely monitor the instruments performance and increase frequency readings to determine negative / dangerous trends.

**Superintending Engineer / Chief Engineer**

I. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

**Dam Safety Organisation’s Staff**

J. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly:

A. The event can be terminated if instrumentation readings back to normal or if instrument reading determined to be invalid.

B. The event remains at the current Event Level. (No change in situation)

C. The event warrants escalation if instrumentation readings at the dam site are determined to indicate a potentially dangerous situation.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>D. TERMINATION</th>
<th>E. EVENT / LEVEL REMAINS THE SAME</th>
<th>F. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to <strong>Termination and Follow-up</strong></td>
<td>Continue recommended actions on this sheet</td>
<td>Monitor conditions until damaged is repaired</td>
</tr>
</tbody>
</table>
### RECOMMENDED ACTIONS

**Emergency Planning Manager**
- A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message
- B. Make careful observation and inspection of every part of spillway mechanism
- C. Monitor water levels and flood forecasting reports continuously. Verify the rest of spillways gates are operative.
- D. Record all information, observations and actions on an Event Log Form (*Form 1*).
- E. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions.
- F. If leakage or uncontrolled release is detected at the dam and indicate a potentially dangerous situation, go to re-evaluation / decision section and follow relevant steps immediately.
- G. If forecasting reports bring about the need to operate the damaged/non-operational gate(s), go to re-evaluation / decision section and follow relevant steps immediately.

**Site Engineers**
- H. Contact the Hydro-Mechanical / Maintenance Division to inform the anomalies.
- I. Monitor and supervise any remedial action and inform the Emergency Planning Manager about the progress.
- J. Assure gauge stations and forecast data is transmitted with a higher frequency than during normal operations.

**Superintending Engineer / Chief Engineer**
- K. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

**Dam Safety Organisation’s Staff**
- L. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly:
- A. The event can be terminated if instrumentation readings back to normal or if instrument reading determined to be invalid.
- B. The event remains at the current Event Level. (No change in situation)
- C. The event warrants escalation if:
  - Considerable leakage or uncontrolled discharge is detected.
  - Forecast data indicates that’s is impossible handle the flood without the operation of the damaged / non-operational gates.

All contracts on Notification Flowchart shall be updated of changes.

Based on this evaluation, follow the appropriate action:

<table>
<thead>
<tr>
<th>G. TERMINATION</th>
<th>H. EVENT / LEVEL REMAINS THE SAME</th>
<th>I. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to Termination and Follow-up</td>
<td>Continue recommended actions on this sheet</td>
<td>Go to SHEET I2 (ORANGE Alert)</td>
</tr>
</tbody>
</table>
Event Description:
Malfunction of Spillway / Sluice Gate (s). Structural member of a gate, gate operator broken or severely damage, which prevents operation or malfunction of the gate(s). Considerable leakage or uncontrolled discharge is detected. Flood cannot be routed without damaged / non-operational gate(s)

RECOMMENDED ACTIONS

Emergency Planning Manager
A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
B. Identify the areas that would be potentially impacted by the emergency events.
C. Make careful observation and inspection of every part of spillway mechanism.
D. Monitor water levels and flood forecasting reports continuously. Verify the rest of spillway’s gates are operative.
E. Record all information, observations and actions on an Event Log Form (Form 1).
F. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions. If conditions change significantly, go to re-evaluation / decision section and follow relevant steps immediately

Site Engineers
G. Observe conditions in site periodically and provide decision support as appropriate.
H. Provide oversight to corrective actions or work as required.

Superintending Engineer / Chief Engineer
I. Study an emergency lowering of the reservoir.

Dam Safety Organisation’s Staff
J. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION
Evaluate conditions at least twice daily, or whenever conditions change significantly.

A. The event warrants downgrade to BLUE alert if leakage was stopped but still repair actions should be done. Event may not be terminated until repairs are made.
B. The event remains at the current Event Level (No change in situation)
C. The event warrants escalation to RED alert if the leakage is rapidly increasing through the gate(s) or the failure of the gate(s) is imminent. Unexpected discharges during non-flood season should be considered as high risk events where an escalation in the level of alert is necessary.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

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<thead>
<tr>
<th>A. EVENT LEVEL</th>
<th>B. EVENT / LEVEL</th>
<th>C. EVENT LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOWNGRADE</td>
<td>REMAINS THE SAME</td>
<td>ESCALATION</td>
</tr>
<tr>
<td>Go to SHEET I1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET I3 (RED Alert)</td>
</tr>
</tbody>
</table>
## Emergency Action Plan for Kanhirapuzha Dam

### Event Description:
Failure of Spillway / Sluice Gate(s). Structural member of a gate, gate Operator broken or severely damaged, which prevents operation or malfunction of the gate(s). Unexpected high discharge is occurring. Flood cannot be routed without damaged / non-operational gate(s).

### RECOMMENDED ACTIONS

#### Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events. During non-flood season special attention should be done for those areas where the river stream has been encroached.

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.

D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public.

E. Record all information, observations and actions on an Event Log Form (Form 1).

#### Site Engineers

F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.

#### Superintending Engineer / Chief Engineer

G. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

#### Dam Safety Organisation’s Staff

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

A. The event warrants downgrade to BLUE alert if there is no longer an immediate threat of dam failure and water level in reservoir is lowered below the crest level of spillway.

B. The event remains at the current Event Level (No change in situation)

C. Event may be Terminated only when either:
   - The gate(s) have failed AND there is no longer a threat to the downstream public.

All contracts on Notification Flow chart shall be updated of changes.

Based on this evaluation, follow the appropriate action

<table>
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<tr>
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<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
BLUE ALERT

Event Description:
Earthquake. Measurable earthquake felt or reported and dam appears to be stable

SHEET J1

RECOMMENDED ACTIONS

Emergency Planning Manager
A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message
B. Make careful observation and inspection of every part of the dam. This should be done without compromising the safety of anyone performing these tasks.
C. Be prepared for additional aftershocks.
D. Record all information, observations and actions on an Event Log Form (Form 1).
E. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions.
F. If inspection has determined a potentially dangerous situation, go to the re-evaluation / decision section below and follow relevant steps immediately.

Site Engineers
G. Conduct a comprehensive site inspection of the dam and appurtenant elements and prepare a report with the most important findings.
H. Monitor and supervise any remedial action and inform the Emergency Planning Manager about the progress.
I. Observe conditions in site periodically and provide decision support as appropriate.

Superintending Engineer / Chief Engineer
J. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.

Dam Safety Organisation’s Staff
K. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

RE-EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly:
A. The event can be terminated if the dam is determined to be stable and a sufficient amount of time has passed. Additional aftershocks are not expected.
B. The event remains at the current Event Level. (No change in situation)
C. The event warrants escalation if inspection has determined a potentially dangerous situation

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>A. TERMINATION</th>
<th>B. EVENT / LEVEL REMAINS THE SAME</th>
<th>C. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to Termination and Follow-up</td>
<td>Continue recommended actions on this sheet</td>
<td>Go to SHEET J2 (ORANGE Alert)</td>
</tr>
</tbody>
</table>
## ORANGE ALERT

<table>
<thead>
<tr>
<th>Event Description:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake. Earthquake resulting in visible damage to the dam or appurtenances which can cause a potential dangerous situation</td>
<td></td>
</tr>
</tbody>
</table>

### RECOMMENDED ACTIONS

**Emergency Planning Manager**

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message  
B. Identify the areas that would be potentially impacted by the potential failures of the damaged areas.  
C. Be prepared for additional aftershocks  
D. Make careful observation and inspection of every part of the dam, this should be done without compromising the safety of anyone performing these tasks.  
E. Monitor water levels and development of new damages or movements hourly.  
F. Record all information, observations and actions on an Event Log Form ([Form 1](#)).  
G. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions.  
H. If visible damages aggravate rapidly, go to re-evaluation / decision section and follow relevant steps immediately.  

**Site Engineers**

I. Observe conditions in site periodically and provide decision support as appropriate.  
J. If condition permit: conduct a comprehensive site inspection of the dam and appurtenant elements and prepare a report with the most important findings.  
K. Provide oversight to corrective actions or work as required.  

**Superintending Engineer / Chief Engineer**

L. Analyse and decide if an emergency lowering of the reservoir.

**Dam Safety Organisation’s Staff**

M. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### RE-EVALUATION / DECISION

Evaluate conditions at least twice daily, or whenever conditions change significantly.

A. The event warrants downgrade to BLUE alert if water level in reservoir is lowered below bottom level of embankment / dam damaged section. Event may not be terminated until repairs are made.  
B. The event remains at the current Event Level (No change in situation)  
C. The event warrants escalation to RED alert if one or multiple of the following conditions have been observed: uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage are observed.  

All contracts on Notification Flow chart shall be updated of changes

**Based on this evaluation, follow the appropriate action**

<table>
<thead>
<tr>
<th>D. EVENT LEVEL DOWNGRADE</th>
<th>E. EVENT / LEVEL REMAINS THE SAME</th>
<th>F. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to SHEET J1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET J3 (RED Alert)</td>
</tr>
</tbody>
</table>
## Event Description:
Earthquake resulting in uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage.

## RECOMMENDED ACTIONS

### Emergency Planning Manager
- A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
- B. Identify the areas that would be potentially impacted by the emergency events.
- C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.
- D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public.
- E. Record all information, observations and actions on an Event Log Form (Form 1).

### Site Engineers
- F. Observe conditions from a safe place at dam site periodically and provide decision support as appropriate.

### Superintending Engineer / Chief Engineer
- G. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### Dam Safety Organisation’s Staff
- H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

## RE-EVALUATION / DECISION
Evaluate the situation as events progress, or whenever conditions change. Determine whether:

- A. The event warrants downgrade to BLUE alert if there is no longer an immediate impending threat of dam failure and water level in reservoir is lowered below the seepage / leakage zone level in the dam. The action shall be confirmed by the Dam Safety Organisation’s staff.
- B. The event remains at the current Event Level (No change in situation)
- C. Event may be Terminated only when:
  - The dam has failed AND there is no longer a threat to the downstream public.

All contracts on Notification Flowchart shall be updated of changes.

Based on this evaluation, follow the appropriate action:

<table>
<thead>
<tr>
<th>G. EVENT LEVEL DOWNGRADE</th>
<th>H. EVENT / LEVEL REMAINS THE SAME</th>
<th>I. TERMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
BLUE ALERT

Event Description:
Security Threat / Sabotage / Vandalism. Unverified bomb threat or verified damage to the dam / appurtenances with no impacts in the functioning of the dam

<table>
<thead>
<tr>
<th>RECOMMENDED ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emergency Planning Manager</strong></td>
</tr>
<tr>
<td>A. Implement the “Watch Condition Notification Flowchart” using pre-scripted message</td>
</tr>
<tr>
<td>B. Notify Local Law enforcement authorities to help evaluate the situation.</td>
</tr>
<tr>
<td>C. Make careful observation and inspection of every part of the dam. This should be done without compromising the safety of anyone performing these tasks.</td>
</tr>
<tr>
<td>D. Record all information, observations and actions on an Event Log Form (Form 1).</td>
</tr>
<tr>
<td>E. Contact the Superintending Engineer / Chief Engineer at least daily to report the observations and conditions.</td>
</tr>
<tr>
<td>F. If inspection has determined a potentially dangerous situation, go to the re-evaluation / decision section below and follow relevant steps immediately.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site Engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. Access the dam only if area has been cleared by Law Enforcement (in case of bomb threat).</td>
</tr>
<tr>
<td>H. Observe conditions in site periodically and provide decision support as appropriate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Superintending Engineer / Chief Engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Review all pertinent information in order to recommend appropriate actions to the Emergency Planning Manager in conjunction with Dam Safety Organisation’s staff. Provide oversight to corrective actions or works as required. Observe conditions in site periodically and provide decision support as appropriate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dam Safety Organisation’s Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Provide decision support and technical support to the Emergency Planning Manager as appropriate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RE-EVALUATION / DECISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate conditions at least daily, or whenever conditions change significantly:</td>
</tr>
<tr>
<td>D. The event can be terminated if the dam is determined to be stable and damages have been repaired. Local law enforcement authority has confirmed there is no threat in the dam structure and surroundings.</td>
</tr>
<tr>
<td>E. The event remains at the current Event Level. (No change in situation)</td>
</tr>
<tr>
<td>F. The event warrants escalation if inspection has determined a potentially dangerous situation</td>
</tr>
</tbody>
</table>

All contracts on Notification Flow chart shall be updated of changes

<table>
<thead>
<tr>
<th>Based on this evaluation, follow the appropriate action</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. TERMINATION</td>
</tr>
<tr>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
Emergency Action Plan for Kanhirapuzha Dam     July 2019

<table>
<thead>
<tr>
<th>ORANGE ALERT</th>
<th>Event Description:</th>
<th>SHEET J2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORANGE ALERT</td>
<td>Security Threat / Sabotage / Vandalism. Verified bomb threat that if carried out, could result in damage in the dam / appurtenances that impacts the functioning of the dam. Verified damages due to vandalism that impacts the normal operation of the dam.</td>
<td>SHEET J2</td>
</tr>
</tbody>
</table>

**RECOMMENDED ACTIONS**

**Emergency Planning Manager**

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message
B. Notify Local Law Enforcement authorities to help evaluate the situation.
C. Identify the areas that would be potentially impacted by the potential failures of the damaged areas.
D. Make careful observation and inspection of every part of the dam, this should be done without compromising the safety of anyone performing these tasks.
E. Record all information, observations and actions on an Event Log Form (Form 1).
F. Contact the Superintending Engineer / Chief Engineer hourly to report the latest observations and conditions.
G. If inspection has determined a potentially dangerous situation, go to the re-evaluation / decision section and follow relevant steps immediately.

**Site Engineers**

H. Access the dam only if area has been cleared by Law Enforcement (in case of bomb threat).
I. If condition permit: conduct a comprehensive site inspection of the dam and appurtenant elements and prepare a report with the most important findings.
J. Provide oversight to corrective actions or work as required.

**Superintending Engineer / Chief Engineer**

K. Analyse and decide if an emergency lowering of the reservoir is required.

**Dam Safety Organisation’s Staff**

L. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

**RE-EVALUATION / DECISION**

Evaluate conditions at least twice daily, or whenever conditions change significantly.

D. The event warrants downgrade to BLUE alert if water level in reservoir is lowered below bottom level of embankment / dam damaged section. Event may not be terminated until repairs are made.
E. The event remains at the current Event Level (No change in situation)
F. The event warrants escalation to RED alert if one or multiple of the following conditions have been observed: uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage are observed..

Based on this evaluation, follow the appropriate action

<table>
<thead>
<tr>
<th>G. EVENT LEVEL DOWNGRADE</th>
<th>H. EVENT LEVEL REMAINS THE SAME</th>
<th>I. EVENT LEVEL ESCALATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to SHEET J1 (Blue Alert)</td>
<td>Continue recommended action on this sheet</td>
<td>Go to SHEET J3 (RED Alert)</td>
</tr>
</tbody>
</table>
## Event Description:
Security Threat / Sabotage / Vandalism. Detonated bomb resulting in visible damage to the dam and appurtenances OR uncontrolled water release due to sabotage / vandalism damages.

## RECOMMENDED ACTIONS

### Emergency Planning Manager

A. Implement the “Failure Condition Notification Flowchart” using pre-scripted message

B. Identify the areas that would be potentially impacted by the emergency events.

C. Recommend to the District Collectors and Disaster Management Authorities IMMEDIATE EVACUATION downstream of the dam and affected areas as per Local Evacuation Plan.

D. Stay at safe distance away from the dam. The immediate concern is the safety of the downstream public.

E. Record all information, observations and actions on an Event Log Form (Form 1).

### Site Engineers

F. Advise Emergency Planning Manager of dangerous conditions at the dam as appropriate.

### Superintending Engineer / Chief Engineer

G. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

### Dam Safety Organisation’s Staff

H. Provide decision support and technical support to the Emergency Planning Manager as appropriate.

## RE-EVALUATION / DECISION

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

A. The event warrants downgrade to BLUE alert if there is no longer an immediate impending threat of dam failure and water level in reservoir is lowered to safe level. The action shall be confirmed by the Dam Safety Organisation’s staff and Local Law Enforcement Authority.

B. The event remains at the current Event Level (No change in situation)

C. Event may be Terminated only when:
   - The dam has failed AND there is no longer a threat to the downstream public.

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action:

<table>
<thead>
<tr>
<th>EVENT LEVEL DOWNGRADE</th>
<th>EVENT / LEVEL REMAINS THE SAME</th>
<th>TERMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor conditions until damage is repaired</td>
<td>Continue recommended action on this sheet</td>
<td>Go to Termination and Follow-up</td>
</tr>
</tbody>
</table>
FORM 1

UNUSUAL OR EMERGENCY EVENT LOG
(To be completed during the emergency)

Dam Name : District :

When and how was the event detected :

Weather Condition :

General description of the emergency situation :

Emergency Level determination: Made by:

Action and Event Progression

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Action / Event Progression</th>
<th>Recorded by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Annexure 5

Sample Public Announcements

Note: These messages are communicated to downstream residents to alert the public of impending danger. The Irrigation Department should coordinate with the India Meteorological Department, the Kerala State Disaster Management Authority, and the District Magistrates/Collectors for Thrivananthapuram District prior to release. Messages can be communicated via radio, television, bulk SMSs of local mobile networks, and other media outlets.

Announcement for a Slowly Developing "Watch" Condition (BLUE Emergency Level)

Executive Engineer, KPIP Division No.I, Kanhirapuzha has declared a BLUE Level "Watch" condition for Kanhirapuzha Dam, Project Identification Code KL07HH0033 as of [time and date]. [Briefly describe the problem or condition.] Although there is no immediate danger of the dam failing, [Describe what actions are being taken to monitor and control the situation.] [State the quantity of any releases from the reservoir.]

Announcement for a Worsening "Watch" Condition (BLUE Emergency Level)

Executive Engineer, KPIP Division No.I, Kanhirapuzhahas declared a BLUE Level "Watch" condition for Kanhirapuzha Dam, Project Identification Code KL07HH0033 as of [time and date]. [Briefly describe the problem or condition.] Although there is no immediate danger of the dam failing a possibility now exists that the dam will fail if correction efforts are unsuccessful. Describe what actions are being taken to monitor and correct the situation. [State the quantity of any releases from the reservoir]. Additional news will be made available as soon as it is received.

Announcement for a Probable "Failure" Condition (ORANGE Emergency Level)

Urgent! This is an emergency message. Executive Engineer, KPIP Division No.I, Kanhirapuzhahas announced that KanhirapuzhaDam, Project Identification Code KL07HH0033 is probably going to fail. [Describe what actions are being taken to monitor and control the situation.] It is possible that the dam will fail in [##] hours. Residents in low lying areas along the [Stream], the [Stream], and the [Stream], as well as the town of [Name], should prepare for immediate evacuation. Additional news will be made available as soon as it is received.

Announcement of an Impending "Failure" Condition (RED Emergency Level)

Emergency! This is an emergency message. KanhirapuzhaDam, Project Identification Code KL07HH0033 is going to fail at any moment. Residents who have not yet done so should immediately evacuate the city of [Name] and low-lying areas along the [Stream], the [Stream], and the [Stream]. The flood waters have already reached [Highway] and [Road]. Additional news will be made available as soon as it is received.

Announcement of an Ongoing "Failure" Condition (RED Emergency Level)

Emergency! This is an emergency message. KanhirapuzhaDam, Project Identification Code KL07HH0033 failed at [time and date]. Residents who have not yet done so should immediately evacuate the city of [Name] and low-lying areas along the [Stream], the [Stream], and the [Stream]. The flood waters have already reached [Highway] and [Road]. Additional news will be made available as soon as it is received.
## Annexure 6
### Evidence of Distress

<table>
<thead>
<tr>
<th>General Observation</th>
<th>Specific Observation</th>
<th>Emergency Condition level</th>
<th>Emergency Action</th>
<th>Equipment, Material and Supplies</th>
<th>Data to record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boils</td>
<td>Small boils, no increase of water flow, flowing clear water</td>
<td>BLUE</td>
<td>Closely check all of downstream toe, especially in the vicinity of boil for additional boils, wet spots, sinkholes, or seepage. Closely monitor entire area for changes or flow rate increases.</td>
<td>None</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td></td>
<td>Large or additional boils near previously identified ones, without increasing flow rate, but carrying small amount of soil particles.</td>
<td>BLUE</td>
<td>Initiate 24-hour surveillance. Monitor as described above. Construct sandbag ring dikes around boils, to cover them with water to retard the movement of soil particles. Filter cloth may be used to retard soil movement, but do not retard the flow of water.</td>
<td>Sandbags, filter cloth</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td></td>
<td>Large or additional boils near previously identified ones, increasing flow rate, carrying soil particles.</td>
<td>ORANGE</td>
<td>Continue 24-hour surveillance. Continue monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Issue a warning to downstream residents.</td>
<td>Sandbags, pump</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td></td>
<td>Rapidly increasing size of boils and flow increasing and muddy water.</td>
<td>RED</td>
<td>Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the boil area.</td>
<td>Dozer, shovels, source of earth till</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td>Seepage</td>
<td>Minor seepage of clear water at toe, on slope of embankment, or at the abutments.</td>
<td>BLUE</td>
<td>Closely check entire embankment for other seepage areas. Use wooden stakes or flagging to delineate seepage area. Try to channel and measure flow. Look for upstream whirlpools.</td>
<td>Wooden stakes, flagging</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td></td>
<td>Additional seepage areas observed flowing clear water and/or increasing flow rate.</td>
<td>BLUE</td>
<td>Initiate 24-hour surveillance. Monitor as described above. Construct measuring weir and channel all seepage through weir. Attempt to determine source of seepage.</td>
<td>Dozer, shovels</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td>Slides or severe erosion</td>
<td>General Observation</td>
<td>Specific Observation</td>
<td>Emergency Condition level</td>
<td>Emergency Action</td>
<td>Equipment, Material and Supplies</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>---------------------</td>
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</tr>
<tr>
<td>Slide or erosion involv- ing large mass of material, crest of embankment is degraded, progressively increasing in size.</td>
<td>Slide or erosion involv- ing large mass of material, crest of embankment is severely</td>
<td>ORANGE</td>
<td>Continue monitoring and remedial actions as described above. Place additional material at the toe of the slope to stop the slide.</td>
<td>Dozer, shovels, source of fill material, pump</td>
<td>Distance between stakes</td>
</tr>
<tr>
<td>Slide or erosion involving large mass of material, crest of embankment is degraded, no movement or very slow continuing movement.</td>
<td>Slide or erosion involving large mass of material, crest of embankment. No further movement of slide and embankment crest not degraded.</td>
<td>BLUE</td>
<td>Examine rest of embankment for other slides. Place stakes in slide material and adjacent to it for determining if further movement is taking place.</td>
<td>Stakes, tape measure</td>
<td>Distance between stakes</td>
</tr>
<tr>
<td>Skin slide or slough on slope of embankment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional seepage areas with rapid increase in flow and muddy water.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seriously or rapidly increasing seepage, under-seepage, or drain flow.</td>
<td></td>
<td>ORANGE</td>
<td>Continue 24-hour monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Construct a large ring dike around the seepage area.</td>
<td>Dozer, shovels, source of fill material</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td>Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the seepage area.</td>
<td></td>
<td>RED</td>
<td></td>
<td>Dozer, shovels, source of fill material</td>
<td>Site and location, approximate flow</td>
</tr>
<tr>
<td>Emergency Action Plan for Kanhirapuzha Dam</td>
<td>July 2019</td>
<td></td>
<td></td>
<td></td>
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<td>------------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sinkholes</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Degraded, movement of slide is continuing and may reach pool level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinkholes anywhere on the embankment or within 150 metres downstream from the toe.</td>
<td>BLUE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carefully walk the entire embankment and downstream area looking for additional sinkholes, movement, or seepage.</td>
<td>Stakes, flagging Size, location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.</td>
<td>BLUE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initiate 24-hour surveillance. Monitor as above. Construct sandbag dike around the seepage exit point to reduce the flow rate. Start filling sandbags and stockpile near sinkhole.</td>
<td>Dozer, shovels, pump Size, location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.</td>
<td>ORANGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continue monitoring and remedial action as described above. Utilize sandbags to increase the freeboard on the dam if necessary.</td>
<td>Sandbags, dozer, pump Size, location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinkholes rapidly getting worse, seepage flowing muddy water and increasing flow.</td>
<td>RED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream evacuation. Utilize all available equipment and personnel to attempt to construct a large ring dike around the area.</td>
<td>Dozer, shovels, pump Size, location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Settlement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obvious settlement of the crest of the embankment, especially adjacent to concrete structures.</td>
<td>BLUE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Look for bulges on slope or changes in crest alignment.</td>
<td>None Size, location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settlement of crest of embankment that is progressing, especially adjacent to</td>
<td>BLUE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initiate 24-hour surveillance. Mobilize all available resources for repair operations to increase freeboard. Fill and stockpile sandbags. Identify any boils near settlement points for flowing material and pursue action for</td>
<td>Sandbags, dozer, shovels, source of fill material Size, location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Observation</td>
<td>Specific Observation</td>
<td>Emergency Condition level</td>
<td>Emergency Action</td>
<td>Equipment, Material and Supplies</td>
<td>Data to record</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------</td>
<td>---------------------------</td>
<td>-------------------</td>
<td>----------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Cracking</td>
<td>Cracks in the embankment crest or on slopes.</td>
<td>BLUE</td>
<td>Walk on entire crest and slope and check for additional cracking.</td>
<td>Stakes, tape measure</td>
<td>Size, location</td>
</tr>
<tr>
<td></td>
<td>Numerous cracks in crest that are enlarging, especially those perpendicular to the center line of the dam.</td>
<td>BLUE</td>
<td>Initiate 24-hour surveillance. Carefully monitor and measure cracking to determine the speed and extent of the problem. Mobilize to fill cracks. Cracks parallel to the center line indicate a slide. Follow remedial action for slides.</td>
<td>Stakes, tape measure, dozer, shovels, source of fill material</td>
<td>Size, location</td>
</tr>
<tr>
<td></td>
<td>Large cracks in the crest that are rapidly enlarging, especially those perpendicular to the center line of the</td>
<td>ORANGE</td>
<td>Continue monitoring and remedial action as described above.</td>
<td>Dozer, shovels, source of fill material</td>
<td>Size, location</td>
</tr>
<tr>
<td>Settlement of crest of embankment that is rapidly progressing especially adjacent to concrete structures or if any corresponding seepage is flowing muddy water or increasing flow.</td>
<td></td>
<td>ORANGE</td>
<td>Continue monitoring and remedial actions as described above. Use sandbags to increase the freeboard on the dam if necessary.</td>
<td>Sandbags, shovels, dozer, source of fill material</td>
<td>Size, location</td>
</tr>
<tr>
<td>Progressing settlement that is expected to degrade the embankment to reservoir level</td>
<td></td>
<td>RED</td>
<td>Downstream evacuation. Utilize all available equipment and personnel to build up the crest in the area that is settling. Identify any boils near settlement points for flowing material and pursue action for boils</td>
<td>Dozer, shovels, source of fill mate-</td>
<td>Size, location</td>
</tr>
<tr>
<td>Event Description</td>
<td>Level</td>
<td>Action Description</td>
<td>Equipment, Material and Supplies</td>
<td>Data to record</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>Dam</td>
<td>RED</td>
<td>Downstream evacuation. Continue remedial actions as described above.</td>
<td>Dozer, shovels, source of fill material</td>
<td>Size, location</td>
<td></td>
</tr>
<tr>
<td>Cracking that extends to pool elevation.</td>
<td>RED</td>
<td>Immediately install measuring device to monitor movement.</td>
<td>Crack Monitors, stakes, tape measure</td>
<td>Size, location</td>
<td></td>
</tr>
<tr>
<td>Minor cracking and/or movement.</td>
<td>BLUE</td>
<td>Initiate 24-hour surveillance. Lower burlap on upstream face of crack to reduce flow of soil particles.</td>
<td>Burlap, rock, dozer, shovels</td>
<td>Size, location, flow rate</td>
<td></td>
</tr>
<tr>
<td>Significant cracking and/or movement.</td>
<td>BLUE</td>
<td>Initiate 24-hour surveillance. Lower burlap on upstream face of crack to reduce flow of soil particles.</td>
<td>Burlap, rock, dozer, shovels</td>
<td>Size, location, flow rate</td>
<td></td>
</tr>
<tr>
<td>Serious cracking and/or movement.</td>
<td>ORANGE</td>
<td>Prepare for evacuation. Continue monitoring and remedial action as described above.</td>
<td>Dozer, rock, burlap, crack monitors</td>
<td>Size, movement, flow rate</td>
<td></td>
</tr>
<tr>
<td>Major cracking and/or movement.</td>
<td>RED</td>
<td>Downstream evacuation. Dam failure is imminent. Continue monitoring and remedial actions as described above.</td>
<td>Dozer, shovels, rock</td>
<td>Size, location, flow rate</td>
<td></td>
</tr>
<tr>
<td>Whirlpool in the lake in the vicinity of the embankment.</td>
<td>RED</td>
<td>Downstream evacuation. Attempt to plug the entrance of the whirlpool with riprap from the slope of the embankment. Search downstream for an exit point and construct a ring dike to retard the flow of soil particles.</td>
<td>Dozer, fill material, sandbags, filter cloth, straw, rocks</td>
<td>Size, location, flow rate</td>
<td></td>
</tr>
<tr>
<td>Structural member of a gate or gate operator broken or severely damaged so as to prevent operation of the gate</td>
<td>ORANGE</td>
<td>Initiate 24-hour surveillance. Immediately place stop logs in front of gate and initiate necessary actions to get gate repaired.</td>
<td>Crane and welder</td>
<td>Type of problem, location</td>
<td></td>
</tr>
<tr>
<td>Rapidly rising lake.</td>
<td>BLUE</td>
<td>Initiate 24-hour surveillance of lake level and rainfall. Generate inflow forecasts every 12 hours.</td>
<td>Equipment, Material and Supplies</td>
<td>Lake level, rainfall</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Observation</th>
<th>Specific Observation</th>
<th>Emergency Condition level</th>
<th>Emergency Action</th>
<th>Equipment, Material and Supplies</th>
<th>Data to record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Action Plan for Kanhirapuzha Dam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overtopping</td>
<td>Water flowing over the dam and lake continuing to rise. No significant erosion of downstream embankment.</td>
<td>Prepare for evacuation. Continue monitoring. Generate inflow forecasts every 3 hours.</td>
<td>Dozer, fill material, sandbags, filter cloth, rocks</td>
<td>Lake level, rainfall</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td><strong>ORANGE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water flowing over the dam, the lake continuing to rise, and significant erosion of downstream embankment with development of head-cuts encroaching on the dam crest, or significant movement of sections of concrete or masonry portions of the dam.</td>
<td>Immediate evacuation. Dam failure is imminent or ongoing.</td>
<td>Cameras.</td>
<td>Status of breach formation. Width of breach as it enlarges.</td>
<td></td>
</tr>
<tr>
<td><strong>RED</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Annexure – 7
### Dam Description

**Official Dam Name**
- Kanhirapuzha Dam

**Name of Stream**
- Kanhirapuzha River

**Dam Location**
- 43 km North West of Palakkad Town, Kerala

**Latitude / Longitude**
- 10° 58’ N / 76° 32’ E

**Seismic Zone**
- III

**Year of Starting of Dam Construction**
- 1961

**Year of First Impoundment**
- 1980

**Year of Commissioning of Dam Project**
- Partially commissioned in 1980

**Name of Immediate Upstream Dam**
- Nil

**Name of Immediate Downstream Dam**
- Nil

**Dam Owner**
- Irrigation Department, Kerala (Executive Engineer)

**Phone Number**
- 04924-238227

**Dam Owner’s Address**
- KPIP Division No.1, Kanhirapuzha, Palakkad, Kerala

### Embankment

- **Type**: Composite Dam
- **Year Constructed**: 1980
- **Length**: 2127.60 m
  - (Earthen 1896 m & Masonry 231.6 m)
  - **Maximum Height**: 30.78 m
  - **Top Width**: Earthen 6.40 m and Masonry 4.30 m
  - **Top of Embankment Elevation**: 100.28 m
  - **Drainage Area** (Catchment Area): 70 sq. km.

### Main Spillway

- **Type**: Ogee Crest
- **Location**: In Masonry Dam
- **Crest Length**: 36.60 m (3 x 12.2 m)
- **Crest Elevation**: 92.95 m
- **Capacity**: 512.50 Cumecs

### Emergency Spillway

- **Type**: NIL
- **Location**: -
- **Crest Length**: -
- **Crest Elevation**: -
- **Capacity**: -

### Inlet-Outlet Works

- **Type**: Sluice
- **Location**: 
- **Invert Elevation (Inlet)**: -
- **Invert Elevation (Outlet)**: -
- **Capacity**: -

### Reservoir

- **Elev. Top of Conservation Pool**: 97.5 meters
- **Capacity Conservation Pool (Normal Pool)**: 69.2274 millions of cubic meters
- **Capacity at Top of Dam (Maximum)**: 70.8274 millions of cubic meters
- **Surface Area**: 5.15 square kilometers

---

(1) If the dam is known by more than one name, it is recommended that all names be listed (that is, the official name appearing in the National Register of Large Dams, and other names by which the dam is commonly known.)

(2) Also give details of Dam Operator, if different from the Dam Owner.

(3) If the dam has multiple spillways, create additional subsections as necessary to include information on all spillways.
Supplies and Resources

The following equipment and supplies may be necessary for use during a dam emergency. Contact information for local contractors who can provide the following items during an emergency is listed below. For supplies owned by the dam owner, the dam owner's name and the specific location of the supplies have been denoted.

<table>
<thead>
<tr>
<th>Contractor Type</th>
<th>Name, Title, Phone</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| **Civil Works** | Name : Superintending Engineer  
Email : sespcpkd@yahoo.co.in  
Mobile No: 94473 96043  
Office No: 0491-2577425 | Services : Sand bags, earthwork, all civil works, supply of materials, Ready Mix Concrete |
| | Name : Executive Engineer  
Email : sespcpkd@yahoo.co.in  
Mobile No: 94460 24055  
Office No: 0491-2577425 | Services : Sand bags, earthwork, all civil works, supply of materials, Ready Mix Concrete |
| | Name : Executive Engineer  
Email: eekpip1@gmail.com  
Mobile No: 9447523349  
Office No: 0492 4238227 | Services : Sand bags, earthwork, all civil works, supply of materials, Ready Mix Concrete |
| **Hydro Mechanical Works** | Name : Superintending Engineer  
Email : semechekm@gmail.com  
Mobile No: 9447060226  
Office No: 0484 2424580 | Services : Mechanical Works |
| | Name : Executive Engineer  
Email : eemechmpza@gmail.com  
Mobile No: 9447881410  
Office No: 0491 2815141 | Services : Mechanical Works |
| | Name : Assistant Executive Engineer  
Email : aeemechmpza@gmail.com  
Mobile No: 93498 91097  
Office No: 0491 2815185 | Services : Mechanical Works |
| **Electrical Works** | Name : Executive Engineer PWD  
Electrical Division, Kozhikode  
Email : eeelecckd.pwd@kerala.gov.in  
Mobile No: 8086395215  
Office No: 0495 2371857 | Services : Electrical Works |
| | Name : Executive Engineer PWD  
Electrical Division, Thrissur  
Email : eeelectsr.pwd@kerala.gov.in  
Mobile No: 8086395176  
Office No: 0487 2330010 | Services : Electrical works |
| **Instrumentation** | Name : Executive Engineer  
Email : sespcpkd@yahoo.co.in  
Mobile No: 94460 24055  
Office No: 0491-2577425 | Services : Geotechnical/Geodetic/Structural and Hydrologic Instruments, Seismic Instruments |
| | Name : Executive Engineer  
Email: eekpip1@gmail.com  
Mobile No: 9447523349  
Office No: 0492 4238227 | Services : Geotechnical/Geodetic/Structural and Hydrologic Instruments, Seismic Instruments |
| **Special works / Equipments** | **Name** : Executive Engineer  
Email : sespecpkd@yahoo.co.in  
Mobile No: 94460 24055  
Office No: 0491-2577425 | **Services** : Diving & ROV services, underwater inspection, welding etc |
|---|---|---|
| **Name** : Executive Engineer  
Email: eekpip1@gmail.com  
Mobile No:9447523349  
Office No:0492 4238227 | **Services** : Diving & ROV services, underwater inspection, welding |
| **Consultants (Hydraulic, Geotechnical, Structural)** | **Name** : NIT, Calicut  
Email:civilhod@nitc.ac.in  
Mobile No:  
Office No: +91 495 2286200 | **Services** : Geotechnical / Structural / Hydraulic/Hydrology Consultancy |
| **Name** : College of Engineering, Trivandrum  
Email:itcsr@cet.ac.in  
Mobile No:  
Office No: +91 4712515572 | **Services** : Geotechnical / Structural / Hydraulic/Hydrology Consultancy |
| **Name** : Central Water & Power Research Station (CWPRS), Pune  
Email:  
Mobile No: +912024103200  
Office No: +91 2024380825 | **Services** : Geotechnical Consultancy |
| **Name** : Central Soil and Material Research Station (CSMRS), Delhi  
Email:  
Office No: +91-11-26967985  
Office No: +91-11-26961894 | **Services** : Geotechnical Consultancy |
| **Communications (Warning Systems, CCTV, Wireless Communication)** | **Name** : Executive Engineer  
Electronics Division, PWD, Thrissur  
Email: eeeelecstr.pwd@kerala.gov.in  
Office No: 0487 2327290 | **Services** : Wireless and Radio Communication Equipment. Voice Data Communication, Early Warning Systems |
| **Name** : Executive Engineer  
Electronics Division, PWD, Trivandrum  
Email: eeeelecs.pwd@kerala.gov.in  
Office No: 0471 2325793 | **Services** : Wireless and Radio Communication Equipment. Voice Data Communication, Early Warning Systems |
### Annexure 9

#### Annual EAP Evaluation Checklist

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the annual dam inspection conducted?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes, has the EAP been revised to include any signs of failures observed during the inspection?</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Was weed clearing, animal burrow removal, or other maintenance required?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes, describe actions taken and date:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The work was included and done under the DRIP work in December 2018.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the outlet gate operable?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If no, describe actions taken and date:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do the Notification Flowcharts require revision?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Note that revision of the contact information will not require EAP approval; however, the revised contact information pages will need to be redistributed as a replacement pages.)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>If yes, list the dates of the contact information revision and redistribution:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was annual training or a tabletop drill conducted?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date conducted:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are inspection and training records included in the EAP?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the EAP reviewed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes, review date:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were changes required to the EAP?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes, date of revised EAP approval:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annexure 10

Plan Review and Update

This plan will be reviewed and updated annually and tabletop drills will be carried out at least once every five years. Document these reviews below.

Date of review:     Participants:

Date of review:     Participants:

Date of review:     Participants:

Date of review:     Participants:

Date of tabletop drill:     Participants:
Annexure 11
Training Record

Use this form to record training sessions. File the completed form in the appropriate Tab of the EAP. All items in the EAP should be thoroughly reviewed during training. Appropriate [Dam Owner] employees and EAP team members should attend a training session annually (or participate in a simulated drill).

<table>
<thead>
<tr>
<th>TRAINING LOCATION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE:</td>
</tr>
<tr>
<td>TIME:</td>
</tr>
<tr>
<td>INSTRUCTOR:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS SIGN-IN:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
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</tr>
</tbody>
</table>

Type of Simulation Conducted: 
Circle Emergency Type:
Emergency water release Watch condition Possible dam failure Imminent dam failure Actual dam failure

Comments, Results of Drill:

Revisions Needed to EAP Based on Results of Drill? □
Yes □ No □ If yes, list revisions required:
Annexure – 12

List of Officials for Communication

<table>
<thead>
<tr>
<th>Authority</th>
<th>Name, Title, Phone</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>District Collector, Palakkad</td>
<td>District Collector</td>
<td>Office of the District Collector Civil Station</td>
</tr>
<tr>
<td></td>
<td>Mobile No: 8547610100</td>
<td>Kenathuparambu, Kunathurmedu, Palakkad, Kerala 678013</td>
</tr>
<tr>
<td></td>
<td>Office No:0491-2505266</td>
<td></td>
</tr>
<tr>
<td>State Emergency Operation Center, Kerala</td>
<td>Member Secretary</td>
<td>Observatory Hills Museum, Vikas Bhavan</td>
</tr>
<tr>
<td>Disaster Management Authority</td>
<td>Email : <a href="mailto:keralasdma@gmail.com">keralasdma@gmail.com</a></td>
<td>P O Thiruvananthapuram, Kerala 695033</td>
</tr>
<tr>
<td></td>
<td>Mobile No:9400202927</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Office No:0471-2331345</td>
<td></td>
</tr>
<tr>
<td>District Police Chief, Palakkad</td>
<td>Superintendent of Police</td>
<td>Office of the District Police Chief Palakkad</td>
</tr>
<tr>
<td></td>
<td>Mobile No: 9497996977</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Office No:0491-2534011</td>
<td></td>
</tr>
<tr>
<td>Deputy Collector</td>
<td>Deputy Collector (General &amp; ADM)</td>
<td>Office of the District Collector Civil Station</td>
</tr>
<tr>
<td>Palakkad</td>
<td>Mobile No: 8547610093</td>
<td>Kenathuparambu, Kunathurmedu, Palakkad, Kerala 678013</td>
</tr>
<tr>
<td></td>
<td>Office No:0491-2505008</td>
<td></td>
</tr>
<tr>
<td>Tahsildar</td>
<td>Tahsildar, Mannarkkad</td>
<td>Taluk Office, Mannarkkad</td>
</tr>
<tr>
<td></td>
<td>Mobile No: 9447735016</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Office No:0492-4222397</td>
<td></td>
</tr>
<tr>
<td>Addl. Tahsildar</td>
<td>Addl. Tahsildar, Mannarkkad</td>
<td>Taluk Office, Mannarkkad</td>
</tr>
<tr>
<td></td>
<td>Mobile No: 8547615201</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Office No: 0492-4222397</td>
<td></td>
</tr>
<tr>
<td>Fire &amp; Rescue Service</td>
<td>Fire Station, Palakkad</td>
<td>Fire Station, Palakkad Town, Palakkad</td>
</tr>
<tr>
<td></td>
<td>Phone No: 0491 2537101</td>
<td>Fire Station, Palakkad</td>
</tr>
<tr>
<td></td>
<td>Addl. Division Fire Station, Palakkad</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobile No. 9847815202</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phone No: 0491 2505701</td>
<td></td>
</tr>
<tr>
<td>Circle Inspector of Police, Mannarkkad</td>
<td>Circle Inspector of Police</td>
<td>Office of the Circle Inspector of Police, Mannarkkad</td>
</tr>
<tr>
<td></td>
<td>Mobile No. 9497987159</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Office No : 0492 4222290</td>
<td></td>
</tr>
<tr>
<td>Sub Inspector of Police, Mannarkkad</td>
<td>Sub Inspector of Police</td>
<td>Office of the Sub Inspector of Police, Mannarkkad</td>
</tr>
<tr>
<td></td>
<td>Mobile No. 9497980617</td>
<td></td>
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<tr>
<td></td>
<td>Office No : 0492 4222290</td>
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</tbody>
</table>