Emergency Action Plan
Malampuzha Dam
KL07HH0003

Prepared for:
Irrigation Department
Kerala

Prepared by:
State Project Management Unit,
IDRB, Kerala
July 2019

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 Malampuzha 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, Irrigation Division, Malampuzha, Assistant Executive Engineer, Head Works Sub Division, Malampuzha and Assistant Engineers, Dam Section, Malampuzha 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)
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PREFACE

The Malampuzha Irrigation Project is the first large scale Irrigation system attempted in the Malabar District of old Madras State. It comprises the construction of a Dam across the Malampuzha river at a place about 8 Km north east of Palakkad junction Railway station of Southern Railway in Palakkad District. The aim of Malampuzha Project was not only to bring new lands to cultivation, but also to supplement the rainfall in the season between the South West and North East monsoon in December and January.

The project constructed in erstwhile Madras State and was commissioned in 1955 before formation of Kerala state. At present designated ayacut under Malampuzha Project is 21165 Ha. The project has now become an integral part of the lives of the people of Palakkad Taluk and its surroundings, since it is the main source of water for agricultural and drinking purpose.

The dam consists of a straightly gravity masonry dam across Malampuzha river having a length of main dam 1133.85 m and a height 38.1 m and 2 nos saddle dam (length PQ 100.58 m, RS 392.27 m) and earthen dam (length 222.2 m) of total length of masonry dam 1626.71 m . The spill way has length of 56.70 m with four vertical lift type gates and four sluice for left(3) and right (1) bank canals. The storage capacity of the reservoir is 226.00 Mm3 with a design spillway capacity of 849.5 cumecs.

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 Palakkad taluk of Palakkad district and some part of Thrissur District.

Malampuzha Dam
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Palakkad

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

Disclaimer

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

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Projects - I,
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Contents

Malampuzha Dam

Project ID Code [KL07HH0003]

Approval and Implementation

This Emergency Action Plan has been prepared by State Project Management Unit in collaboration with Malampuzha 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

Malampuzha Dam
Project ID Code [KL07HH0003]
EAP Distribution List

A copy of the EAP has been provided to the following people

Authority	Name, Title, Phone	Address	Acceptance Signature
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	Superintending Engineer Mobile No: 94473 96043 Office No: 0491 2577425	Siruvani Project Circle Palakkad Email- sespcpkd@yahoo.co.in	
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District Collector, Thrissur	District Collector Office No:0487-2361020	First floor, Civil Station, Civil lines Rd, Kalayan Nagar, Ayyanthole, Thrissur	
District Collector, Malappuram	District Collector Office No:0483- 2734355	District Collector, Civil Station, Collectorate, Malappuram Email- dcm.ker@nic.in	
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	District Police Chief, Thrissur Mobile No: 9497996909 Office No: 0487-23230110	Kalyan Nagar, Ayyanthole, Thrissur Email: cptsr.pol@kerala.gov.in	
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	The District Medical Officer Thrissur (Health) Ph No: 0487-233342	St. Thomas Autonomous College, Near Bennette rd, Keerankulangara, Thrissur	
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	Contact: Village Officer, Palakkad 3 Mobile No: 08547614904	Village Office, Puthur Rd, Koppam, Palakkad	
	Contact: Village Officer, Akathethara Mobile No: 08848598074	Village Office, Olavakode Malampuzha Road, Chepilamury, Akathethara, Palakkad	
	Contact: Village Officer, Marutha	Village Office, Marutharoad,	

	Road Mobile No: 08547614908	Palakkad	
	Contact: Village Officer, Yakkara Mobile No: 08547614912	Village Office, Kenathuparambu, Kunathurmedu, Palakkad	
	Contact: Village Officer, Puduppariyaram 1 Mobile No: 08547614922	Village Office, Puthuppariyaram, Palakkad	
	Contact: Village Officer, Pirayiri Mobile No: 08547614909	Village Office, Melamuri Pudur Kottayi Rd, Uma Nagar, Thirunellayi, Palakkad	

Malampuzha Dam

Project ID Code [KL07HH0003]

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.

Date	Change Made	Signature

Emergency Action Plan Malampuzha Dam

Project ID Code [KL07HH0003]

1. Purpose

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

Malampuzha Dam and Reservoir are owned and operated by Irrigation Department, Kerala. The dam was constructed across Malampuzha River a tributary of Bharathapuzha. The dam is located at about 8 km North East of Olavakkode Railway Station. The Project was started in 1949. The dam and left bank canal were completed and the project first commissioned in 1955 and the project envisages irrigating an ayacut 2 1 1 6 5 Ha. The Project consists of a masonry dam having a water spread area of 22 Sq Km.

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 7.

2.2. Reservoir Operations

Malampuzha Project is a multipurpose project i.e. Irrigation, drinking water supply, Fisheries, Power and Tourism. The dam consists of 1626.71 m masonry dam and 222.20 m earthen dam. Gross storage of the dam is 226.00 Mm3 at the maximum water level of 115.06 m. The water spread area of the reservoir is 22 sqkm.There are two canal network originated from the dam one is Right Bank Canal having one shutter with vent way 1.52m x1.83m and other is Left Bank Canal having three shutters of vent way 1.52m x 1.83m each. Shutter operation these canal systems are done by electrically or manually. The dam has a spillway of 4 shutters of 10.97m x 4.57m each. The crest level of the spillway is 110.49 m MSL. When water level rises above crest level at different water level warning were issued to the public through news paper and media before opening spillway shutter. First warning will be

issues at 113.00 m, Second warning at 114.00 m and third and final at 114.46 m and spillway gates will be opened. Spillway shutter is operated electrically or manually.

The procedure of shutter opening will be done only after giving proper intimations to Disaster Management Cell at Palakkad Collectorate, Disaster Management Cell at Malappuram Collectorate, Taluk offices at Palakkad, police stations at Palakkad, higher officers of Irrigation Department, concerned LSGD Institutions, local visual and news medias and only in the presence of concerned Assistant Executive Engineer, Assistant Engineer as per the order from Executive Engineer.

3. Responsibilities

3.1. Dam Owner's Responsibilities

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

Table – 1 : Dam Owner's Responsibilities

Officer Designation	Responsibilities (During Preparedness and Emergency Events)
Executive Engineer (Emergency Planning Manager)	**Preparedness Responsibilities:** • Coordinate routine inspections and Dam's Operations. • Ensure effective transmission of hydro-metrological and stream flow data through different means. • Ensure proper accessibility to all vulnerable points for constant monitoring during emergency situations • Identify primary and secondary communication systems, both internal (between persons at the dam) and external (between dam personnel and outside entities). • Provide security measures at the dam (CCTV surveillance, security guards, fencing). • Ensure the availability of adequate staff at dam site during holidays, nights and round the clock in weekdays. • Ensure that the EAP is functional and staffs are familiar with their responsibilities.

- Ensure that a signboard is installed and clearly visual in different locations at dam site and operation room, with the most common evidence of distress and corresponding levels of alert and remedial actions.

- Ensure all the equipment/means at dam site to response to an emergency are easily accessible and well maintained (generators, vehicles, lanterns, radios, heavy equipment, etc)

- Ensure the installation and proper maintenance of a warning system (sirens, horns) in the critical areas within the floodplain (less than 2 hours of wave arrival time)

- Ensure the current approved version of the EAP is available to all relevant stakeholders (those who have a 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 4 (Emergency Level Determination/Action Sheets) and ANNEXURE 2 (Inundation Maps)

- Initiate/implement the Emergency Action Plan and the Emergency Operation Centre if it is deemed necessary

- Identify the areas that would be potentially impacted by

	the emergency events. • Provide updates of the situation to the District(s) Disaster Management Authority to assist them in making timely and accurate decisions regarding warnings and evacuations. • Propagate the emergency information to other relevant stakeholders. • Support the communication needs of local emergency authority.
Dam Site Engineers (Assistant Executive Engineer, Assistant Engineers, Junior Engineers)	**Preparedness Responsibilities:** • Monitor & surveillance of dam and appurtenant structures looking for evidence of distress as mentioned in **Annexure 4** • Conduct Pre and Post monsoon Inspections under the direction of the Emergency Planning Manager • Inform the Emergency Planning Manager about any irregular/unusual condition at dam site and keep him/her posted about any progression/change • Operate dam's gates/under sluices, under the express direction of Chief Engineer / Superintending Engineer / Executive Engineer • Conduct routine dam maintenance • Collect instrumentation measurements • Ensure effective working conditions of the warning system (Sirens) • Participate in exercises for test/improvement of this EAP **During Emergency Responsibilities:** • Monitor the emergency event at dam site and keep posted the Emergency Planning Manager about any change in development • Contact the supplier / contractors • Supervise the work of the labour contractors and

	machineries engaged in the site for rehabilitation / remedial works • Conduct the remedial actions as per Action Data Sheets **(Annexure 4)**
Superintending Engineer	**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 **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 - II

Chief Engineer

Preparedness Responsibilities:

- Assist the Dam Owner's officers in preparation of Action Data Sheets **(Annexure - 4)**
- Recommend specific actions in order to improve the readiness of emergency actions
- Support and Monitor the remedial construction activities such as earth moving, special investigations, etc.
- Decide depending upon the quantum of repair/reconstruction work, whether the work is to be got executed through large construction firms or purely through the department or small contractors.
- Undertake an engineering assessment of the safety hazard at the dam in collaboration with the State Dam Safety Organization

During Emergency Responsibilities:

- Advice the dam's Emergency Planning Manager / Superintending Engineer with the emergency level determination, if time permits.
- Advice the dam's Emergency Planning Manager / Superintending Engineer with remedial actions to take if Blue / Orange events occurs, and if time permits.
- Direct specific and appropriate procedures to open/close the spillway's gates during the reservoir operation.
- Play the role of "Public Affair's Officer" in case external / public notifications should be released.
- Keep close watch on the different activities being carried out by different agencies at the time of emergency

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 **Malampuzha 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 public hearing program before finalization of the Emergency Action Plan

3.3. Responsibilities for Notification

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

familiar with it and immediately notify the Emergency Planning Manager in case of cessation of his / her functions within the organization.

Table 2- Responsibilities for Notification

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

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. Responsibilities for Evacuation

Evacuation and relief actions are exclusive responsibilities of Districts Authorities, and emergency relief forces at local and state level. For Malampuzha Dam, a total of 3 Districts / Panchayats / 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.

Table 3 Districts Potentially affected by an Emergency Even in Malampuzha Dam	
Sl. No.	**District Name**
1	Palakkad
2	Malappuram
3	Thrissur

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)

3.5. Responsibilities for Termination and Follow-Up

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

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

Table 4– Termination and Follow-Up Responsibilities

Officer Designation	Responsibilities (Termination and Follow Up)
Executive Engineer (Emergency Planning Manager)	• Declare the termination of the emergency operations in coordination with District Disaster Management Authority and Relief / Response Forces. • Conduct a review process of the EAP procedures. • Identify EAP procedures that were followed effectively, as well as any ways that the EAP could be improved. • Identify the causes that could have triggered the emergency event and propose actions to improve readiness and early detection. Support from the Dam Safety Organization may be requested in this regard • For Major Emergencies, the Emergency Planning manager will maintain detailed records of cost expended and will prepare a detailed report in this regard.
Superintending Engineer / Chief Engineer	• 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 (See **Table 3)**
- State Disaster Management Authority
- Army / Navy Forces

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

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

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 require the implementation of the EAP. However, if any of them occur, the appropriate actions must be taken. **Annexure 4** of this EAP shows the most common emergency situations that may emerge in Malampuzha Dam and appurtenances, along with the corresponding specific actions to be done by each of the dam's officials. Some of these emergency situations are summarized as follows:

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

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

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

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

5.1.2. Signs of Failure

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

- Seepage Failure: Although all earthen embankments allow some minor seepage through the dam or the foundation, excessive, uncontrolled seepage can result in piping (the movement of embankment material in the seepage flow) and lead to

failure. Piping can occur for years at a slow rate. If the piping has progressed to a dangerous level, it will be evident by increased flow or the discharge of muddy water (or both). At that stage, immediate action to stop the piping is needed. Fully developed piping is difficult to control and is very likely to result in failure. A whirlpool in the reservoir is a sign of uncontrollable piping and necessitates immediate emergency action.

- Embankment or Foundation Sliding: Sliding is usually first apparent when cracks or bulges in the embankment appear. Slides with progressive movement can cause failure of the embankment.

- Structural Failure: The structural failure or collapse of any non-overflow portion of the dam, spillway or spillway gates could result in loss of the reservoir. A structural failure of a portion of the spillway could cause piping and possibly embankment failure

- Overtopping Failure: Overtopping of the embankment results in erosion of the dam crest. Once erosion begins, it is very difficult to stop.

5.2. Emergency Evaluation and Classification

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

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

- Cloudy or dirty seepage or seepage with an increase in flow, boils, piping, or bogs.

- Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.

- Any slide that degrades the crest of the embankment or that is progressively increasing in size.

- Cracking or movement of any concrete structure.

- An increase in the reservoir level leading to engagement of the spillway gate's.

- Exceptionally heavy rainfall in the catchment of the dam reservoir.

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

- Any spillway's release matching with an **ORANGE** alert in accordance with **Annexure 4**
- Large boils, increasing in size and flow rate, especially if there is flowing muddy water
- Significantly increasing seepage, especially flowing muddy water
- Slides involving a large mass of material that impairs the crest of the dam and is continuing to move
- Sinkholes with seepage flowing muddy water
- Large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam
- An increase in the reservoir level to near the top of the dam
- Near to 'Design Flood' inflow forecast

External Alert Conditions RED - These are "failure" conditions. Either the dam is in immediate danger of failing or has already failed. No time remains to implement measures to prevent failure. Evacuate immediately. Evacuation efforts will continue until the situation is stabilized. The **Emergency Planning Manager (Executive Engineer, Malampuzha Division)** 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:

- Any spillway's release matching with a **RED** alert in accordance with **Annexure 4**
- Rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones.
- Rapidly increasing seepage, especially flowing muddy water

- Slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area
- Settlement that is predicted to degrade to the reservoir level
- Cracks that extend to the reservoir level
- Significant movement or failure of any structure that forms an integral part of the dam
- Overtopping of the earthen dam
- Uncontrollable release of the reservoir

5.3. Previously Known Problems

- The leakage seen on the walls inside the gallery near the third block
- Instruments installed is not in working condition

6. PREPAREDNESS

Preparedness actions are to be taken both before and following the development of emergency conditions and should identify ways of preparing for an emergency, increasing response readiness in a uniform and coordinated manner, and helping to reduce the effects of a dam failure. The following are some steps that could prevent or delay failure after an emergency is first discovered.

6.1. Surveillance

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

6.2 Response on forecast of excessive inflow

Dam Engineers as well as **Emergency Planning Managers** will respond to the situation of excessive inflow forecast in close co-ordination with IMD especially during monsoons for

their forecast by way of controlled spillway releases as per the warning levels as per warning levels in Clause 2.2 of Reservoir Operations. Warnings will be intimated to the affected downstream authorities and 24 x 7 monitoring will be initiated.

6.3 Response during weekends and holidays

The Standard Operating Procedure with Reservoir Operation & Maintenance Manual and Gate Operation Manual are strictly followed throughout the year whether it is weekends/holidays/night. **Executive Engineer (Malampuzha Division**) 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 (Malampuzha Division)**, the **Assistant Executive Engineer (Malampuzha Division)** will take his responsibilities.

6.4 Response during periods of darkness and adverse weather

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

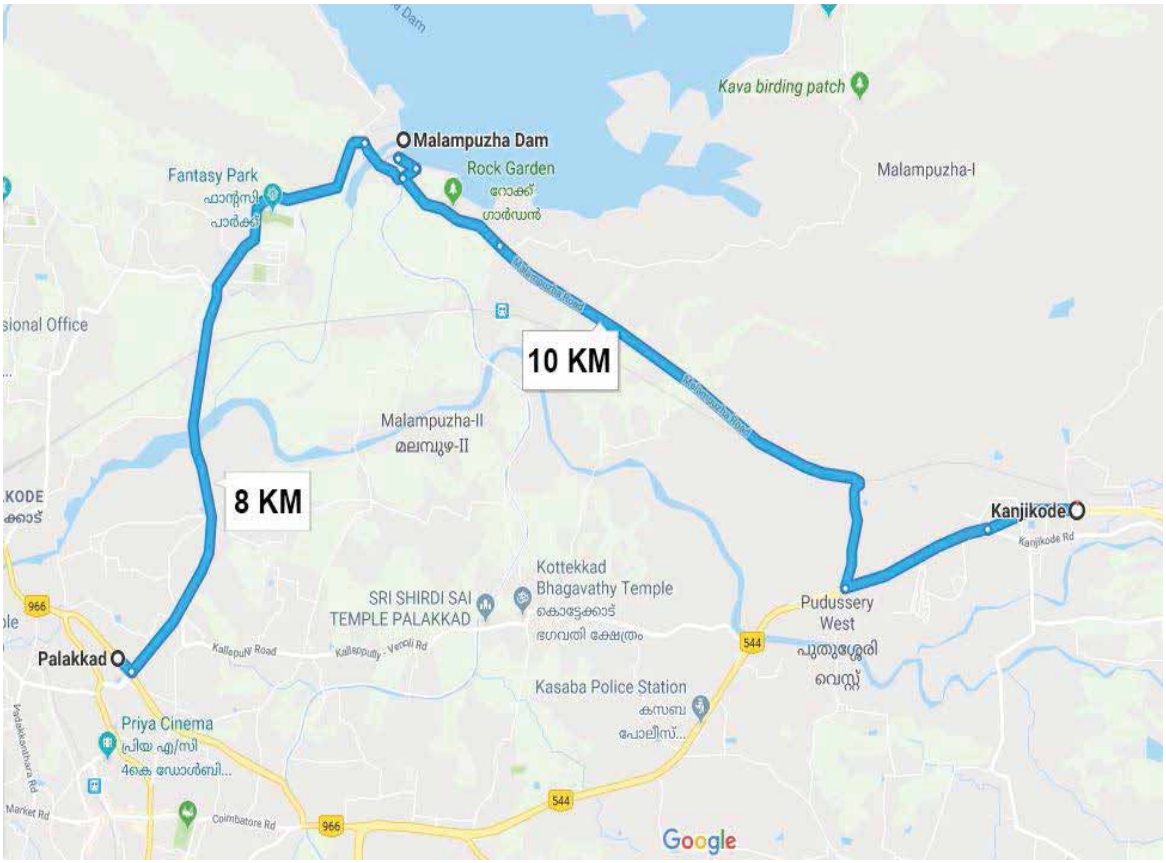
6.5. Access to the site

The following accesses to the dam are available, and depending of the emergency situation some of them should be used with caution or totally avoided

Malampuzha Dam is situated 8 km North East of Olavakkode Railway station, Palakkad.

1) From Olavakkode Junction traffic signal, turn left from Sai Hospital Junction, a good conditioned road of about 8.00 km (by crossing Nadakkavu, Akethethara Railway Gate) to Malampuzha Dam Site
2) Palakkad- Malampuzha Road, drive 5.9 km straight to Malampuzha Dam,passing by Mathrubhumi office and Mattumantha through Kadukkamkunnam Railway Overbridge
3) From Kanjikode ITI (At Kanjikode Kinar junction, opposite Kanjikode Fire Station) drive 7.1 km straight to reach Malampuzha Dam (by crossing a Railway Gate at 900 meters)

Accesses to Malampuzha Dam under Emergency Conditions



6.6. Remedial Actions

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

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

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

Seepage Failure

- Plug the flow with whatever material is available (hay, bentonite, or plastic) if the entrance is in the reservoir.
- Consider lower the water level in the reservoir
- Place an inverted filter (a protective layer of sand and gravel) on the exit area to hold the material in place.
- Continue operating at a lower level until a repair is made.

Embankment or Foundation Sliding

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

Structural Failure

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

7. SUPPLIES AND RESOURCES

7.1 Contracts

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

- Emergency Planning Manager (Executive Engineer, Malampuzha 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 5.**

7.3 Reports

Pre-monsoon and post-monsoon inspections of the dam are made every year during the month of **May and December** respectively by the Site Engineers in coordination with the **Emergency Planning Manager (Executive Engineer, Malampuzha 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 will be recorded in chronological order
- Issuance of protective action recommendations to the public
- Evacuations and casualties
- Termination of the incident

8.2. Costs of the Emergency Operations Centre

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

- Personnel costs, especially overtime
- Equipment operation

- Equipment leasing and rental
- Contract services to support emergency operations
- Specialized supplies expended in emergency operations

9. INUNDATION AREA

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

Table – 5 Scenarios included in the Emergency Action Plan

Annexure Index	Scenario	Hazard Parameters	No. of Tiles
2 A	Large Controlled Release	Depth, Velocity, Water Surface Elevation	15
2 B	Over Topping	Depth, Velocity, Water Surface Elevation, Arrival Time	20
2 C	Non-Flood Failure	Depth, Velocity, Water Surface Elevation, Arrival Time	20

After examining the results of the breach analysis of Malampuzha 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 Malampuzha river. Palakkad Muncipality, Malampuzha, Marutha, Akathethara, Puthuppariyam, Kodumbu, Pirayiriand Parali 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 Malampuzha river affecting Ottapalam and Shornur Muncipality, Kottayi, Mankara, Perungottukurissi, Mannur, Lakiddi-Peroor, Thiruvilwamala, Valathol Nagar, Desamangalam, Ongallur, Thrithala, Pattithara, Muthuthala, Paruthur, Anakkara, Kuttipuram and Irimpilyam Grama Panchayats. Hazard reference values (water surface elevation, depth, velocity and arrival time) for each of these structures are summarized in the **Annexure 3** tables and the inundation maps in **Annexure 2** for each case.

The Villages which can suffer a significant impact are listed in the Table 6 below.

Table -6 : Affected Taluk and Villages

State	District	Taluk/Villages
Kerala	Palakkad	Palghat
		Alathur
		Ottapalam
	Malappuram	Tirur
		Ponnani
	Thrissur	Vadakkancheri

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

Table 7 List of Main Crossing Structures likely to be submerged

Sl. No.	Name of Bridge / Location	Title Id in Inundation Map
1	Bridge to Kanjikode	(1/5)
2	Check Dam Malampuzha	(1/5)
3	Railway Track - Kadukkamkunnu	(1/5)
4	Akkarakkad Bridge	
5	Akkarakkad - Check Dam	
6	Mukkai Bridge	
7	Mukkai - Check Dam	
8.	Kalpathy – Check Dam	

9.	Puthiyapalam Bridge	
10.	Railway Bridge near ESI Hospital	
11.	Olavakkod Bridge near ESI Hospital	
12.	Kavilpad Bridge	
13.	Kavilpad – Check Dam	
14.	Kallekkad Kurussimala Check Dam	
15.	Kaizhakenjeri Check Dam	
16.	Kamba – Attupuram Check Dam	
17.	Parli Bridge – Shornur Road	
18.	Parli Old Bridge	
19.	Parli Check Dam	

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 Malampuzha River. These structures may suffer such impacts before the peak elevation of the flood wave.

9.1. Local Evacuation Plan

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

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

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

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

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

Based on the specific results of the dam breach analysis (wave arrival time) a local evacuation plan has been developed to assist disaster management authorities in the relief actions. The local evacuation plan can be found in the **Annexure 2** of this EAP, and Hazard reference values and complete list of relief camps (shelters) is included in **Annexure 3**

10. IMPLEMENTATION

10.1 Development

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

10.2 Updating

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

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

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

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

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

10.3. Testing

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

- **Orientation (Stakeholders' Consultation):** The Superintending Engineer will organize an orientation meeting every year with local responders and stakeholders to solicit input, established roles during emergency situation and facilitate reliable responses to the emergencies. In orientation meeting, the Emergency Planning Manager will introduce the revised EAP to local officials and emergency responders and provide those entities the opportunity to review and comment on the documents and on their roles and responsibilities, described in EAP.

- **Tabletop exercises-.** Superintending Engineer and Emergency Planning Manager will organize a table-top drill once in 2 years to discuss and review the simulated or imaginary emergency situation. The tabletop drill involves a meeting of **Emergency Planning Manager** with local and state **Disaster Management Officials** in a conference room. The drill begins with a description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures, and to resolve concerns regarding coordination and responsibilities. Any problems identified during a drill should be included in revisions to the EAP.

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

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

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

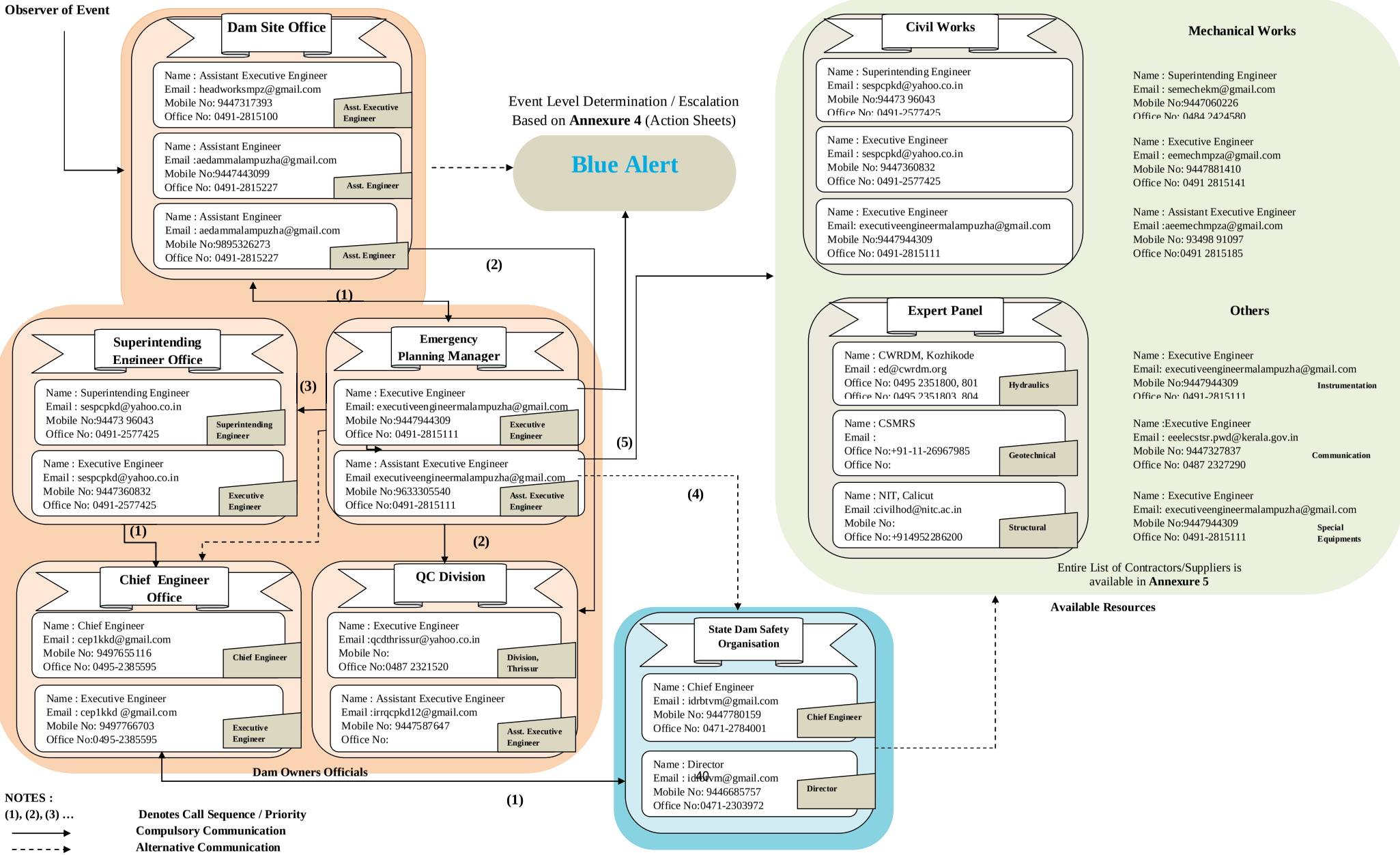
Table 8 : EAP Exercise / Testing Techniques

Exercise	Schedule	Reporting Deadlines
Orientation (Stakeholder's Consultation)	Annual	▪ Pre-Event : Submit Agenda to Stakeholders 30 days before meeting ▪ Post-Event : Update Form 2 (Annexure 10), within 30 days after meeting
Tabletop Exercise	Once every 2 years (before monsoon season)	• Pre-Event : Submit Exercise Plan and Schedule to participants 90 days before meeting • Post-Event : Update Form 2 (Annexure 10), and submit Evaluation Report within 60 days after exercise

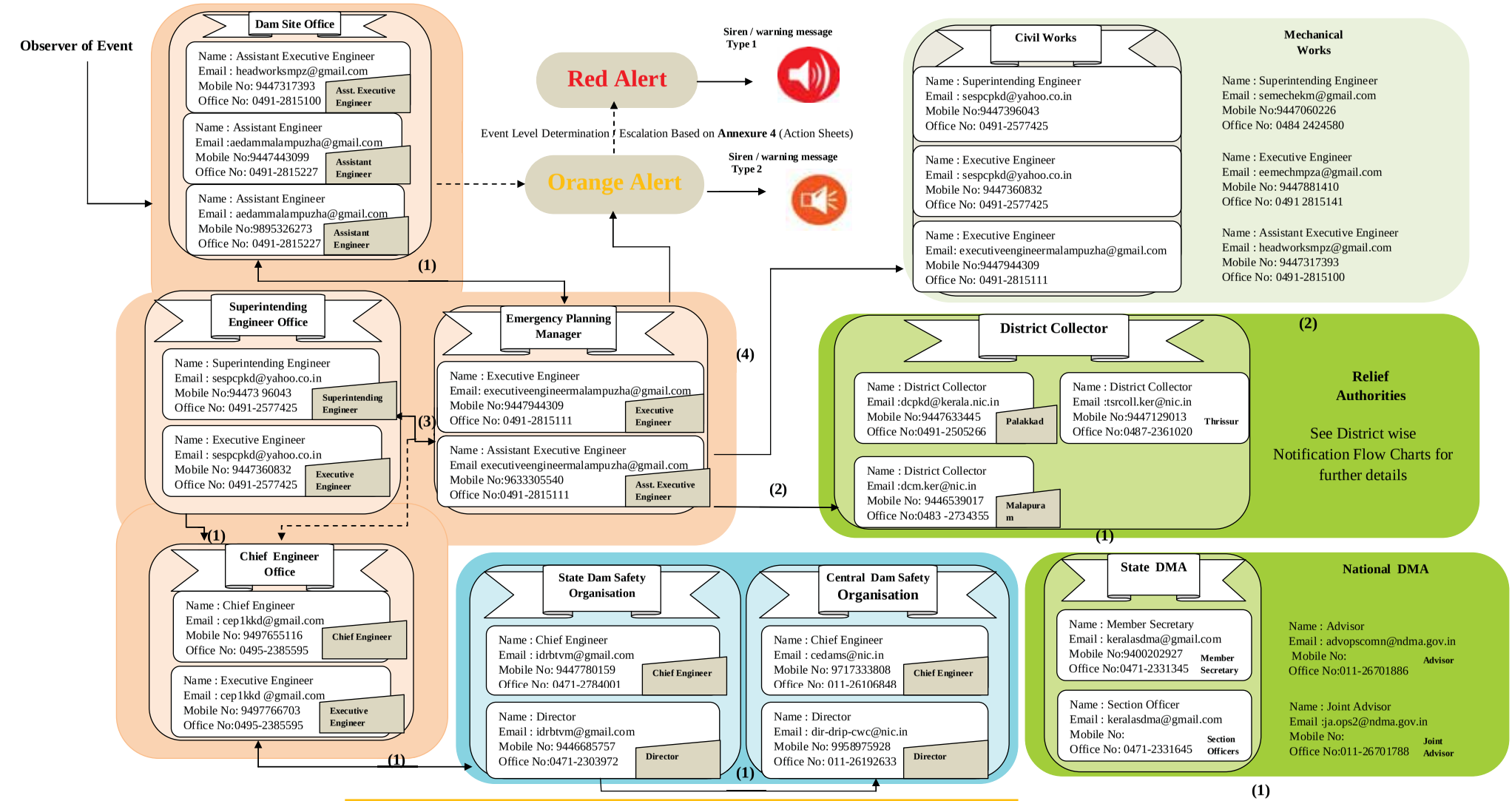
10.4. Training

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

WATCH CONDITION NOTIFICATION FLOW CHART (Internal Alert)



FAILURE CONDITION NOTIFICATION FLOW CHART (External Alert)



NOTES :

(1), (2), (3) … Denotes Call Sequence / Priority

Compulsory Communication

Alternative Communication

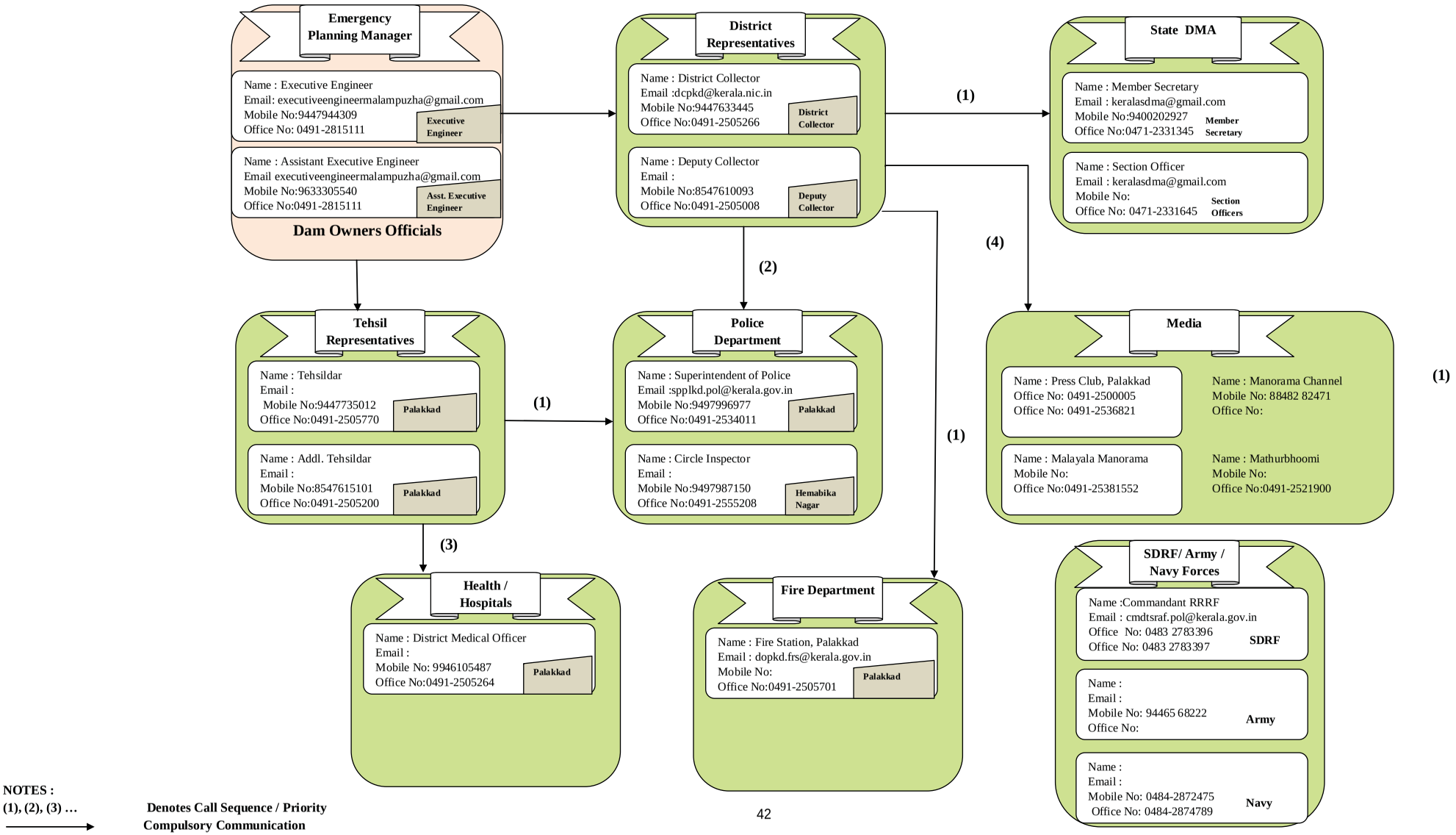
Suggested Phone Message (Orange Alert):

- This is [Name, Position]. I am making this call in accordance with the Malampuzha Dam Emergency Action Plan
- We have an Emergency at Malampuzha Dam. The EAP has been activated currently at Orange Alert. We are implementing predetermined actions to respond to a rapidly developinf situation that could result in dam failure. 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)
- Malampuzha 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.]

PALAKKAD DISTRICT - FAILURE CONDITION NOTIFICATION FLOW CHART (External Alert)



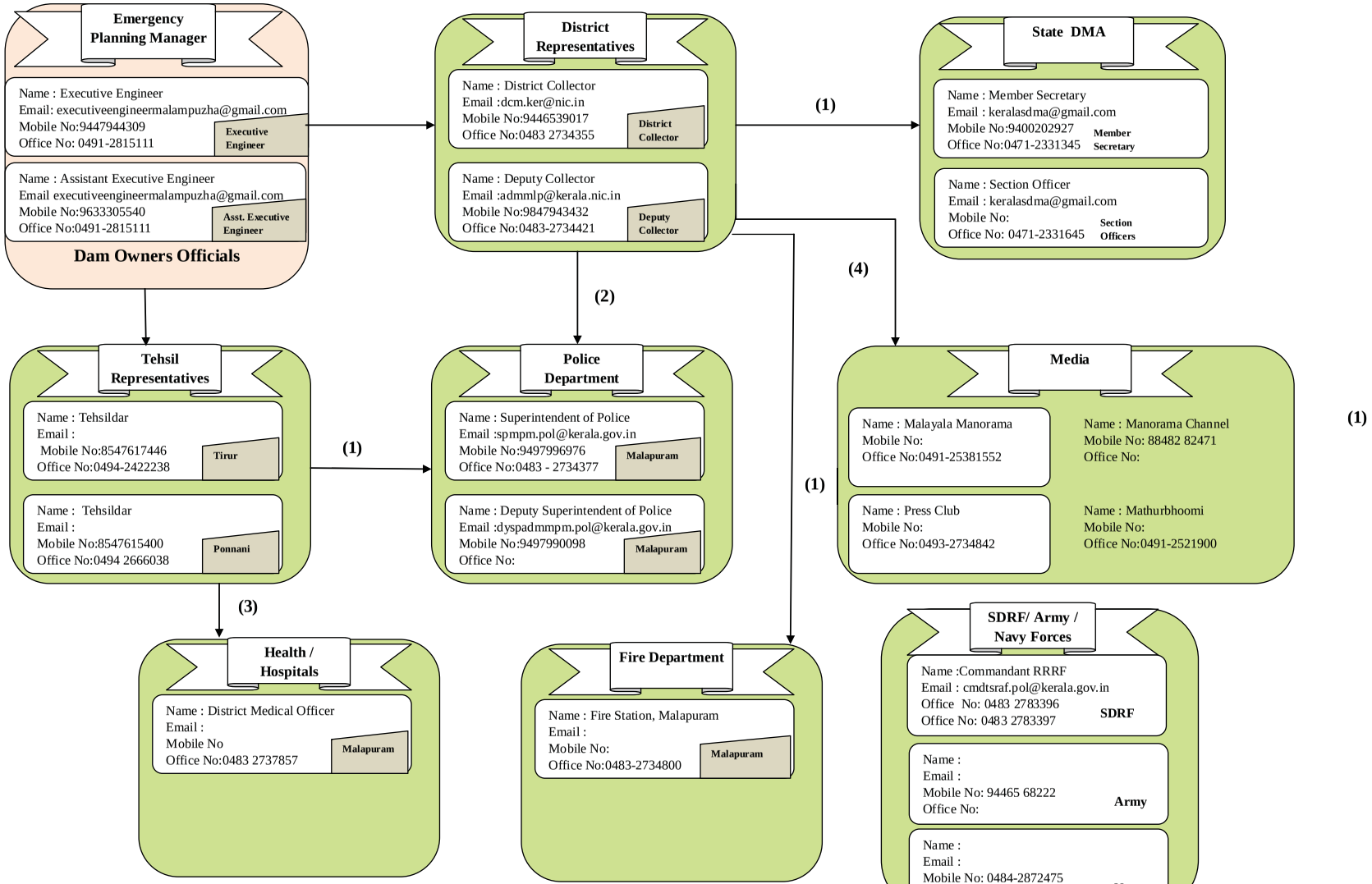
NOTES :

(1), (2), (3) … **Denotes Call Sequence / Priority**

Compulsory Communication

Alternative Communication

MALAPURAM DISTRICT - FAILURE CONDITION NOTIFICATION FLOW CHART (External Alert)



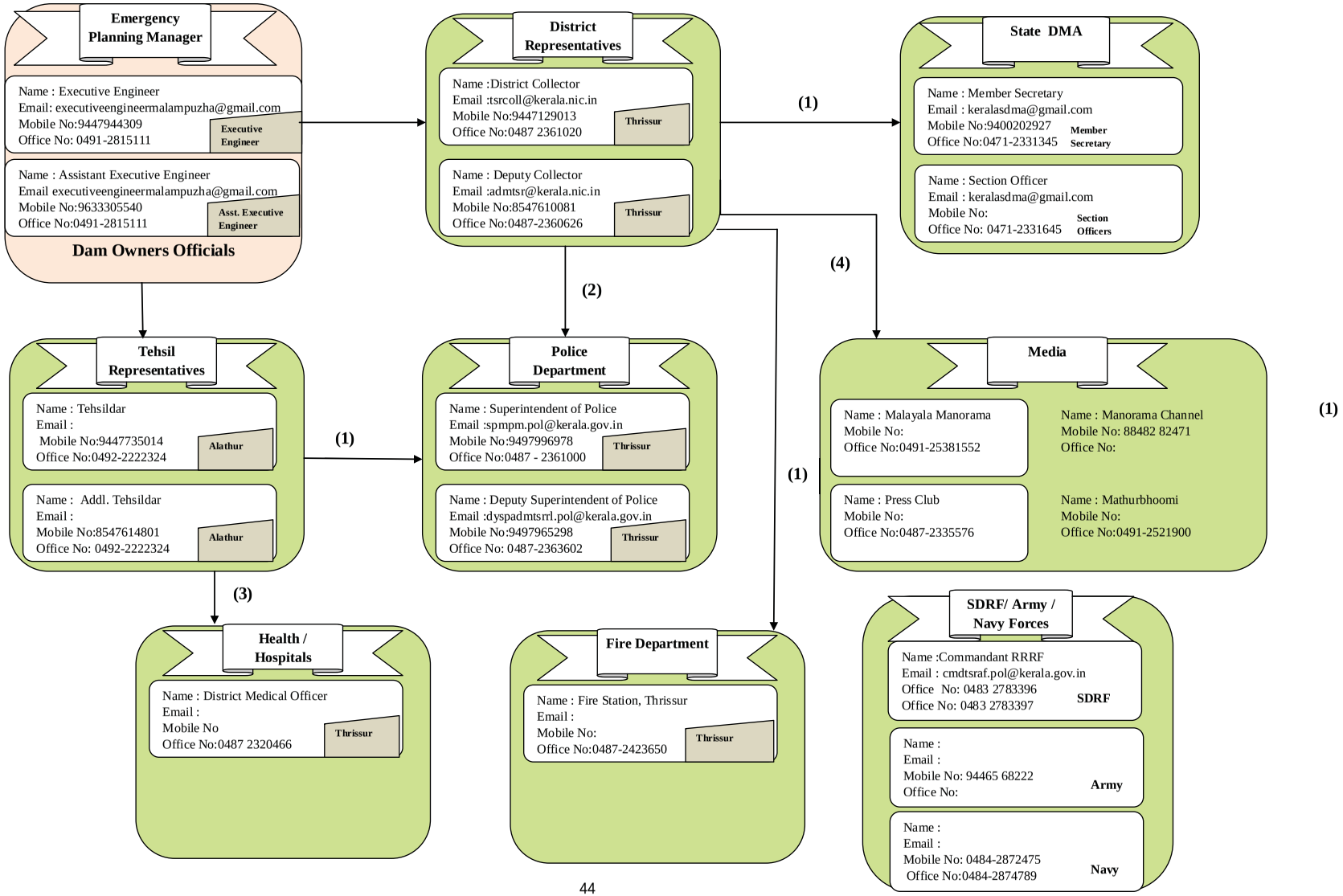
NOTES :

(1), (2), (3) … **Denotes Call Sequence / Priority**

Compulsory Communication

Alternative Communication

THRISSUR DISTRICT - FAILURE CONDITION NOTIFICATION FLOW CHART (External Alert)



NOTES :

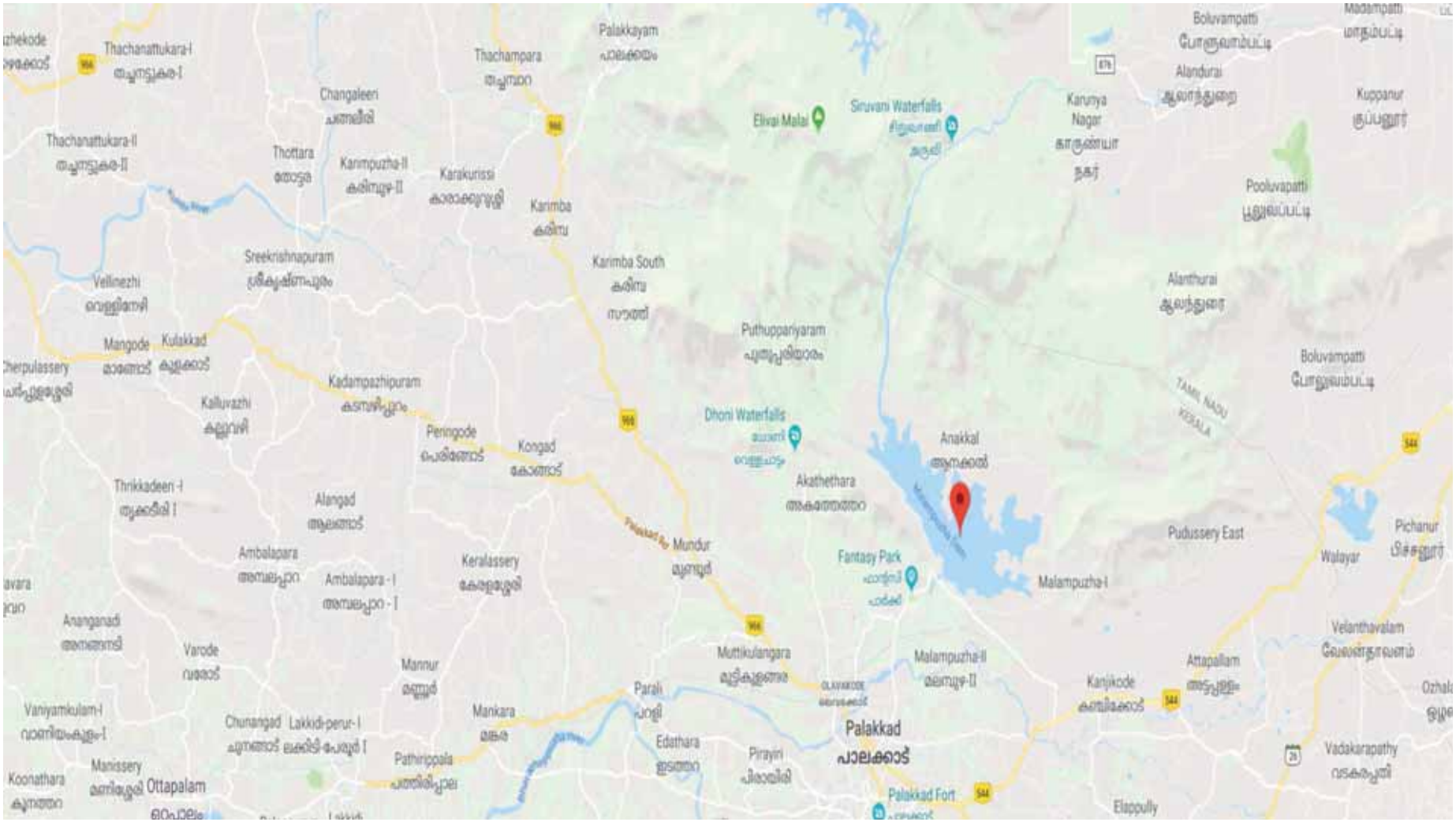
(1), (2), (3) … **Denotes Call Sequence / Priority**

Compulsory Communication

Alternative Communication

Annexure – 1

Vicinity Map



Annexure - 2

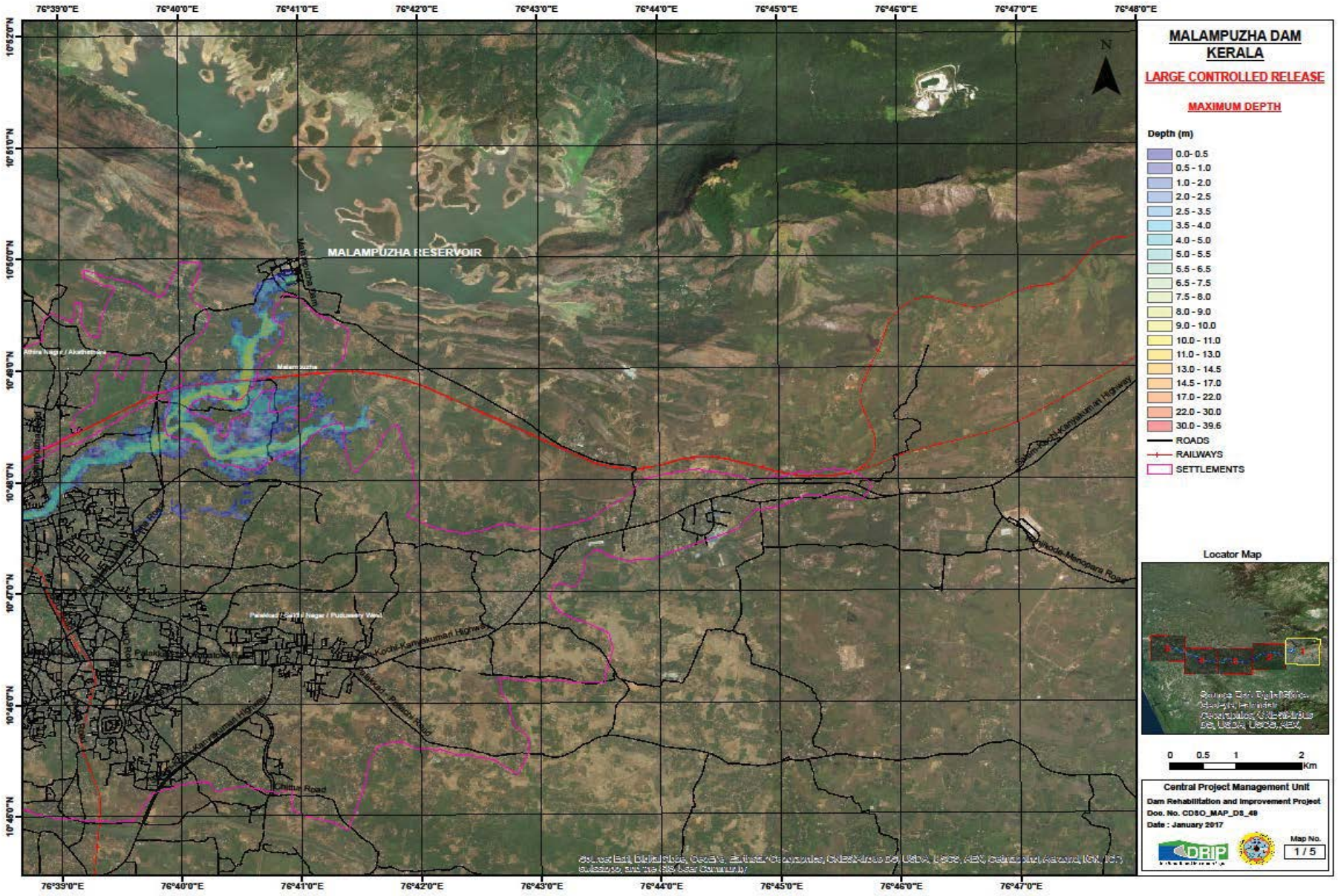
Inundation Maps

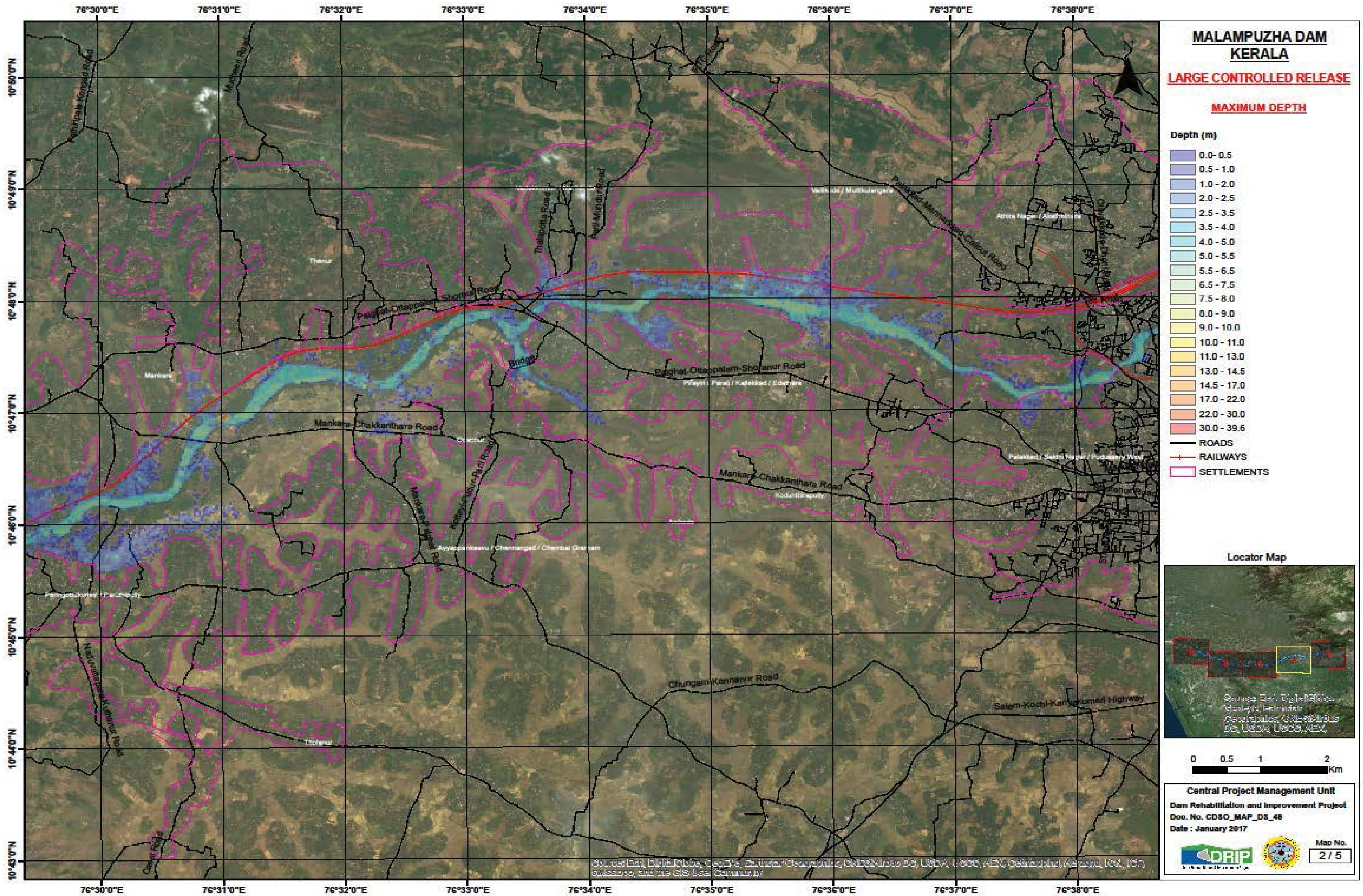
Inundation maps showing 1) maximum water depth, 2) maximum water velocity, 3) maximum water-surface elevation and 4) Arrival Time were prepared for each of the three flooding cases considered (non-flood failure, overtopping and large controlled release). An additional map showing the time of arrival 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).

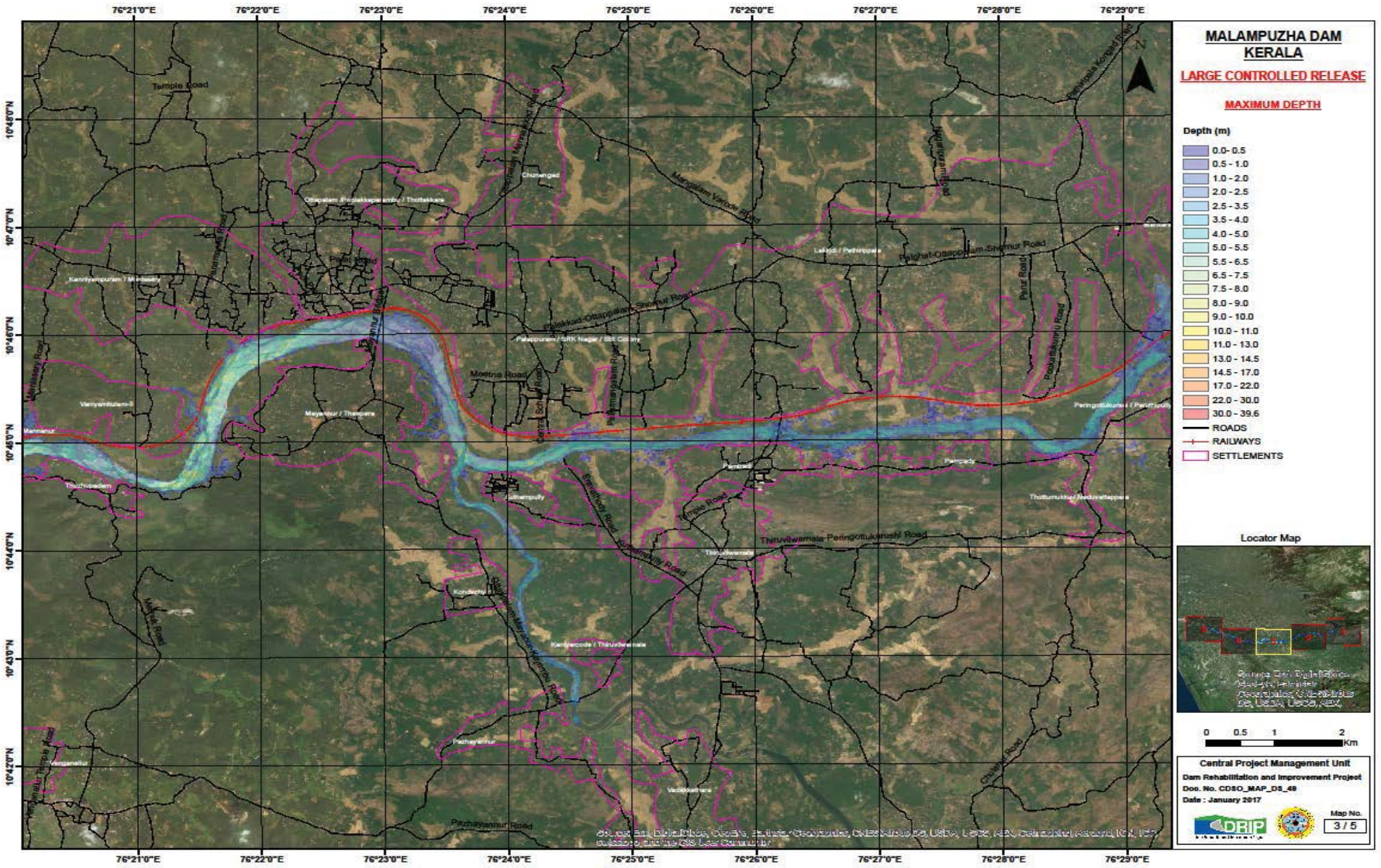
NOTE: Because of the method, procedures, and assumptions used to determine the flooded areas; the limits of flooding shown and flood wave travel times are approximate and should be used only as a guideline for establishing evacuation zones. Areas inundated in an actual event will depend on actual failure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

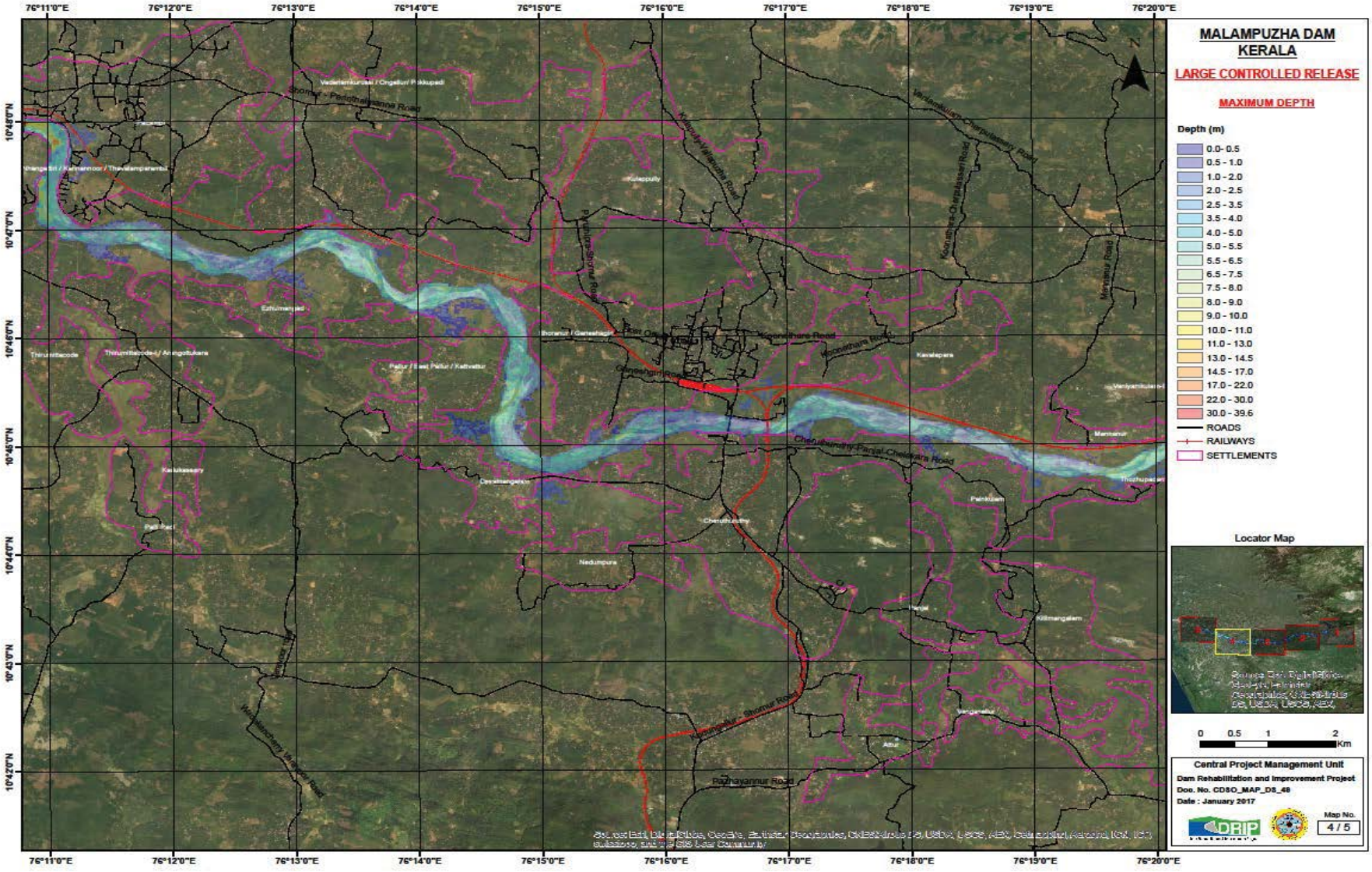
Annexure – 2 A

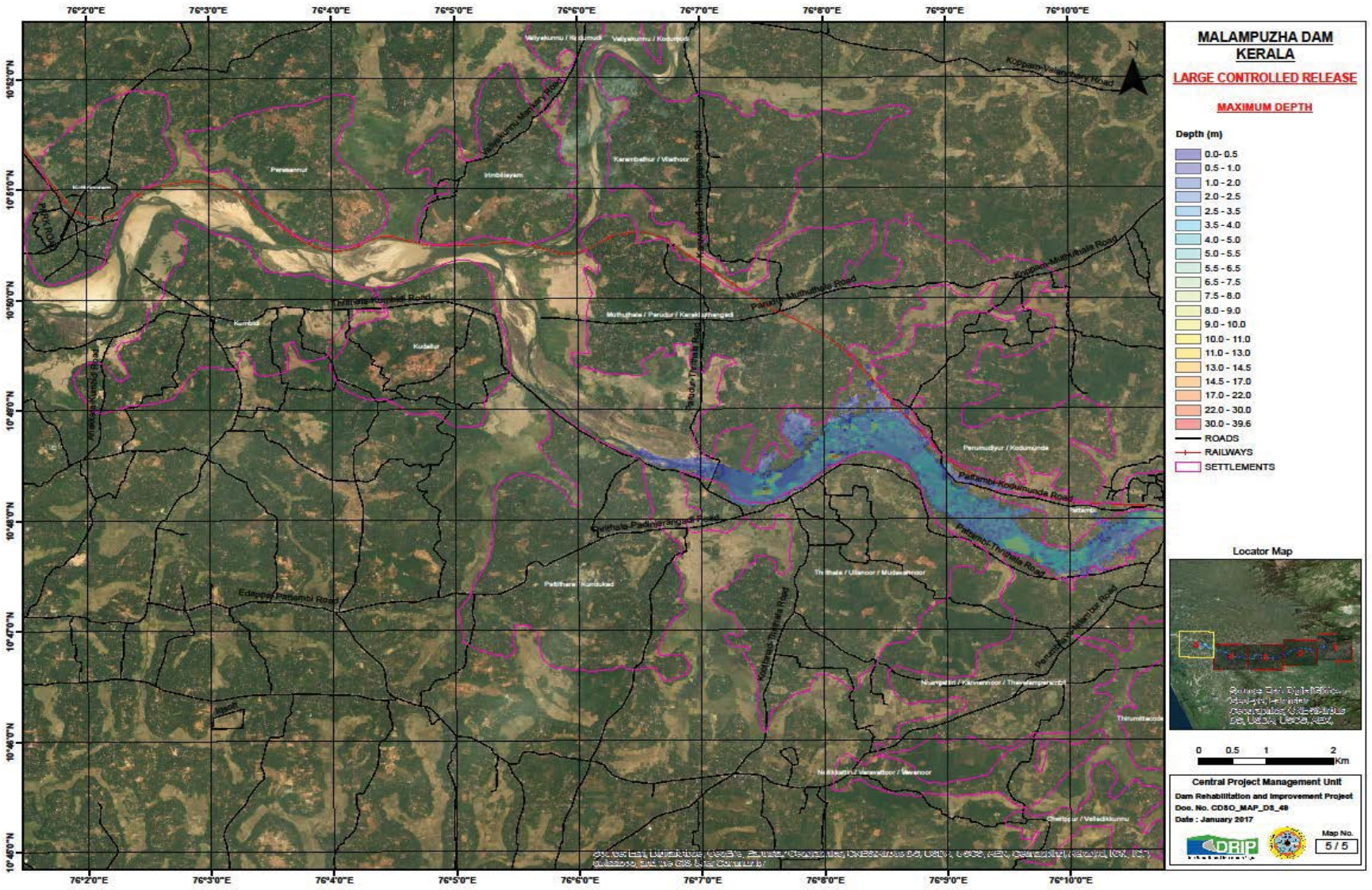
Inundation Map – Large Controlled Release

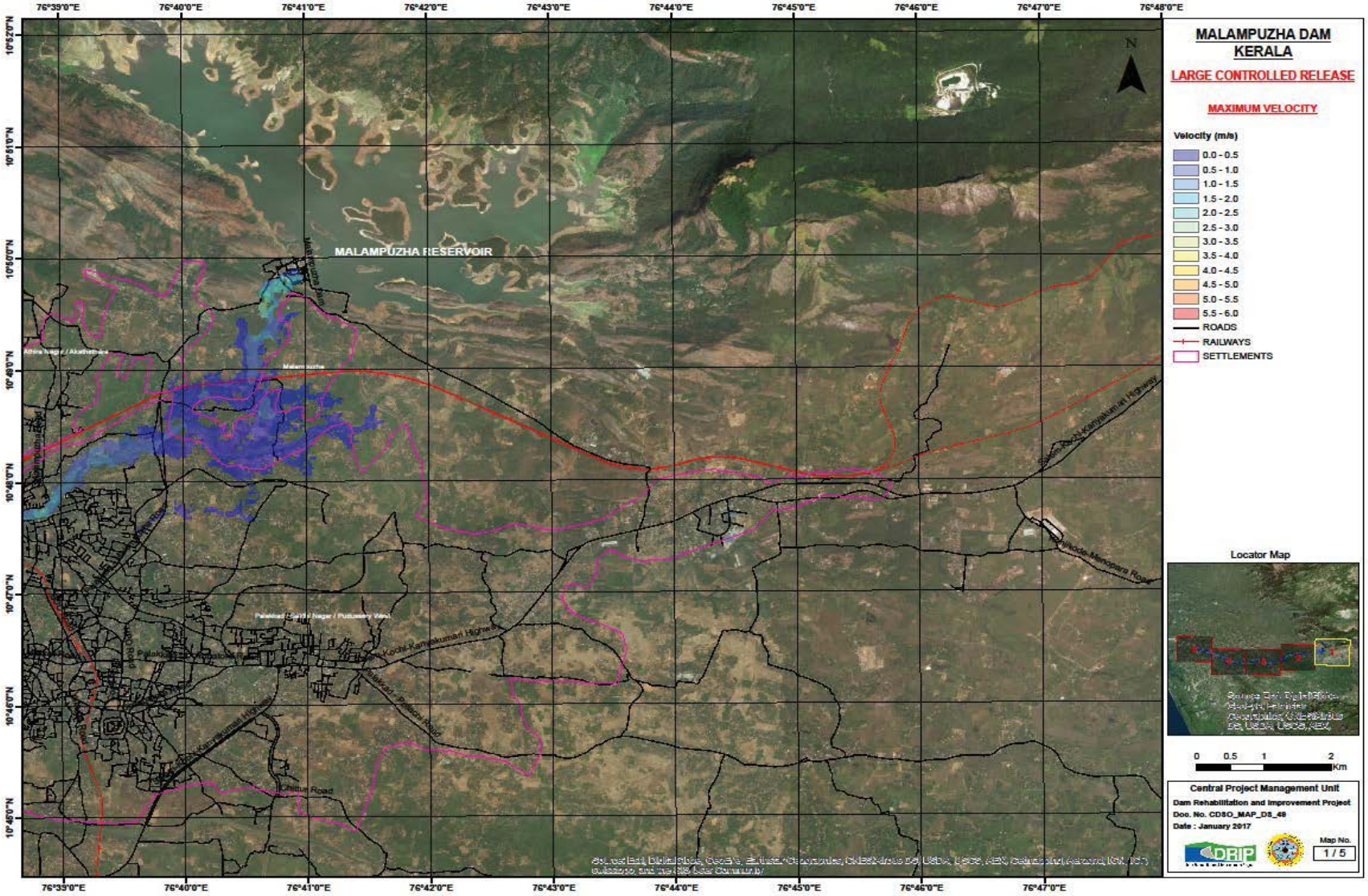

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM DEPTH
Depth (m)
0.0- 0.5
0.5 - 1.0
1.0 - 2.0
2.0 - 2.5
2.5 - 3.5
3.5 - 4.0
4.0 - 5.0
5.0 - 5.5
5.5 - 6.5
6.5 - 7.5
7.5 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 11.0
11.0 - 13.0
13.0 - 14.5
14.5 - 17.0
17.0 - 22.0
22.0 - 30.0
30.0 - 39.6
ROADS
RAILWAYS
SETTLEMENTS
MALAMPUZHA RESERVOIR
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
1 / 5
76°39'0"E
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
76°44'0"E
76°45'0"E
76°46'0"E
76°47'0"E
76°48'0"E
10°52'0"N
10°51'0"N
10°50'0"N
10°49'0"N
10°48'0"N
10°47'0"N
10°46'0"N

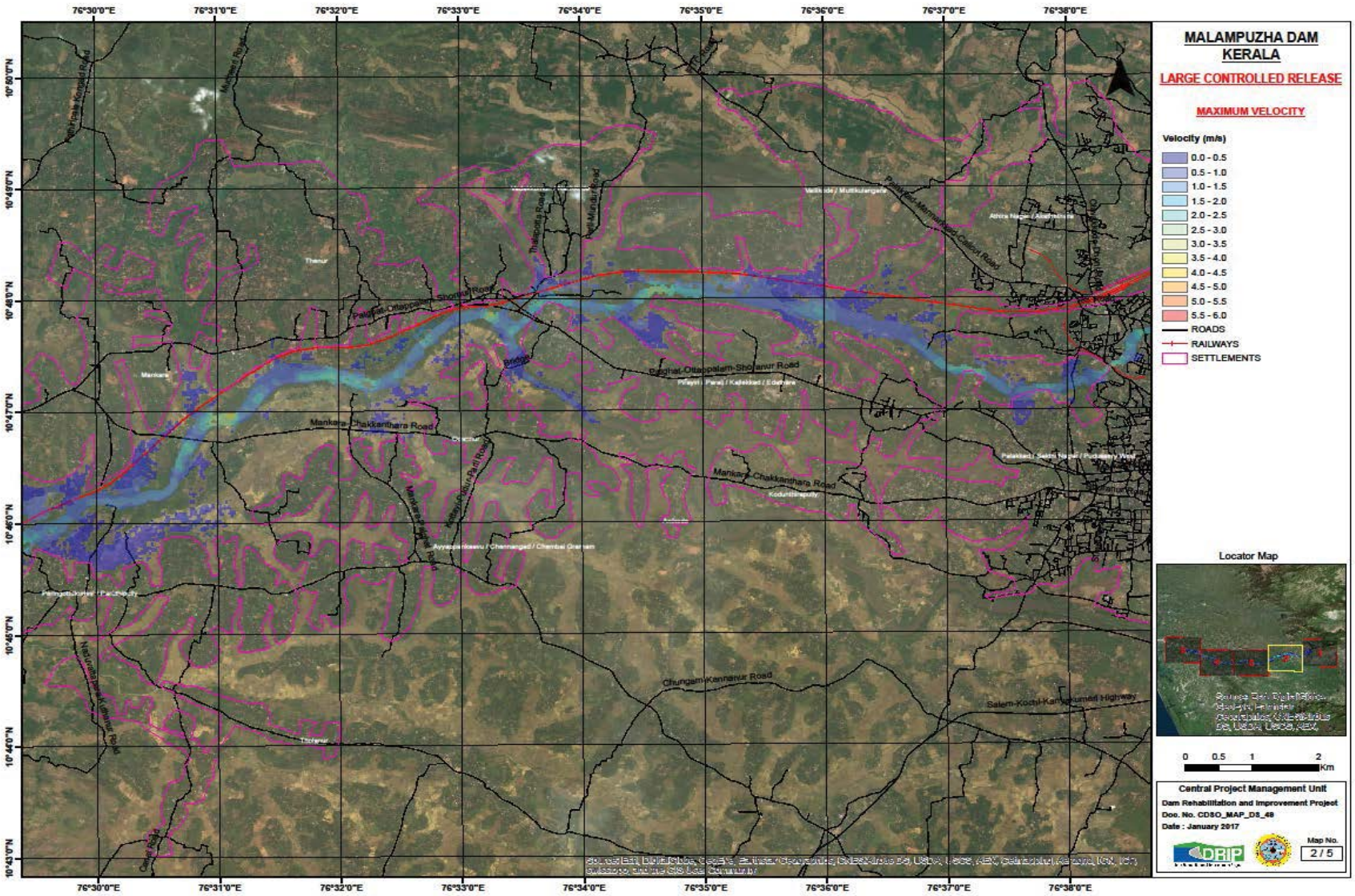

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM DEPTH
Depth (m)
0.0 - 0.5
0.5 - 1.0
1.0 - 2.0
2.0 - 2.5
2.5 - 3.5
3.5 - 4.0
4.0 - 5.0
5.0 - 5.5
5.5 - 6.5
6.5 - 7.5
7.5 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 11.0
11.0 - 13.0
13.0 - 14.5
14.5 - 17.0
17.0 - 22.0
22.0 - 30.0
30.0 - 39.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2 Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No. 2 / 5
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E
10°50'0"N
10°49'0"N
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
Palghat-Ottappalam-Shoranur Road
Mankara-Chakkanthara Road
Chungam-Kannanur Road
Salem-Kochi-Kanyakumari Highway
Palakkad-Mannarkkad-Coimbatore Road
Thalappotta Road
Bridge
Canal Road

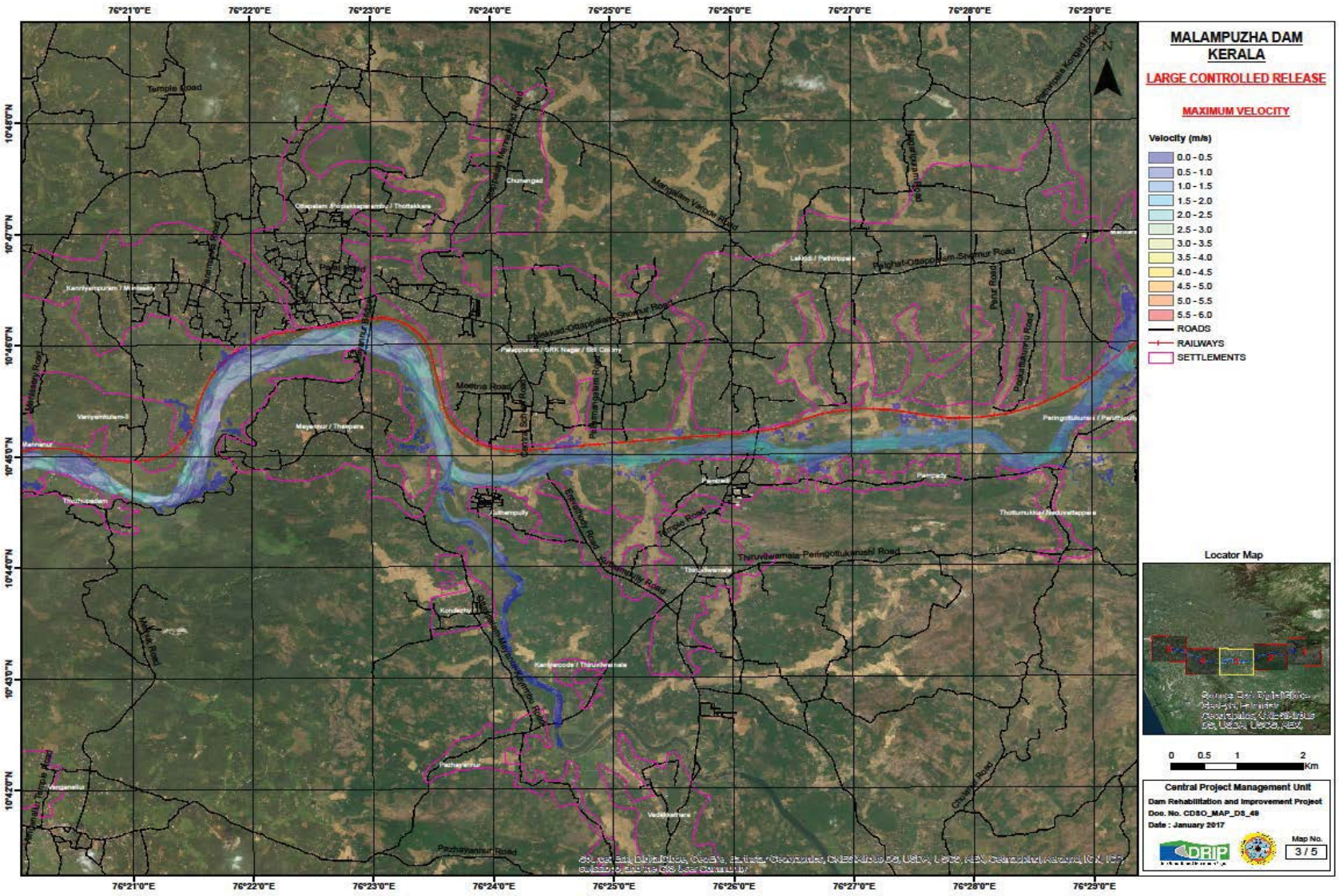

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM DEPTH
Depth (m)
0.0- 0.5
0.5 - 1.0
1.0 - 2.0
2.0 - 2.5
2.5 - 3.5
3.5 - 4.0
4.0 - 5.0
5.0 - 5.5
5.5 - 6.5
6.5 - 7.5
7.5 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 11.0
11.0 - 13.0
13.0 - 14.5
14.5 - 17.0
17.0 - 22.0
22.0 - 30.0
30.0 - 39.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
3 / 5
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E
10°49'0"N
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N

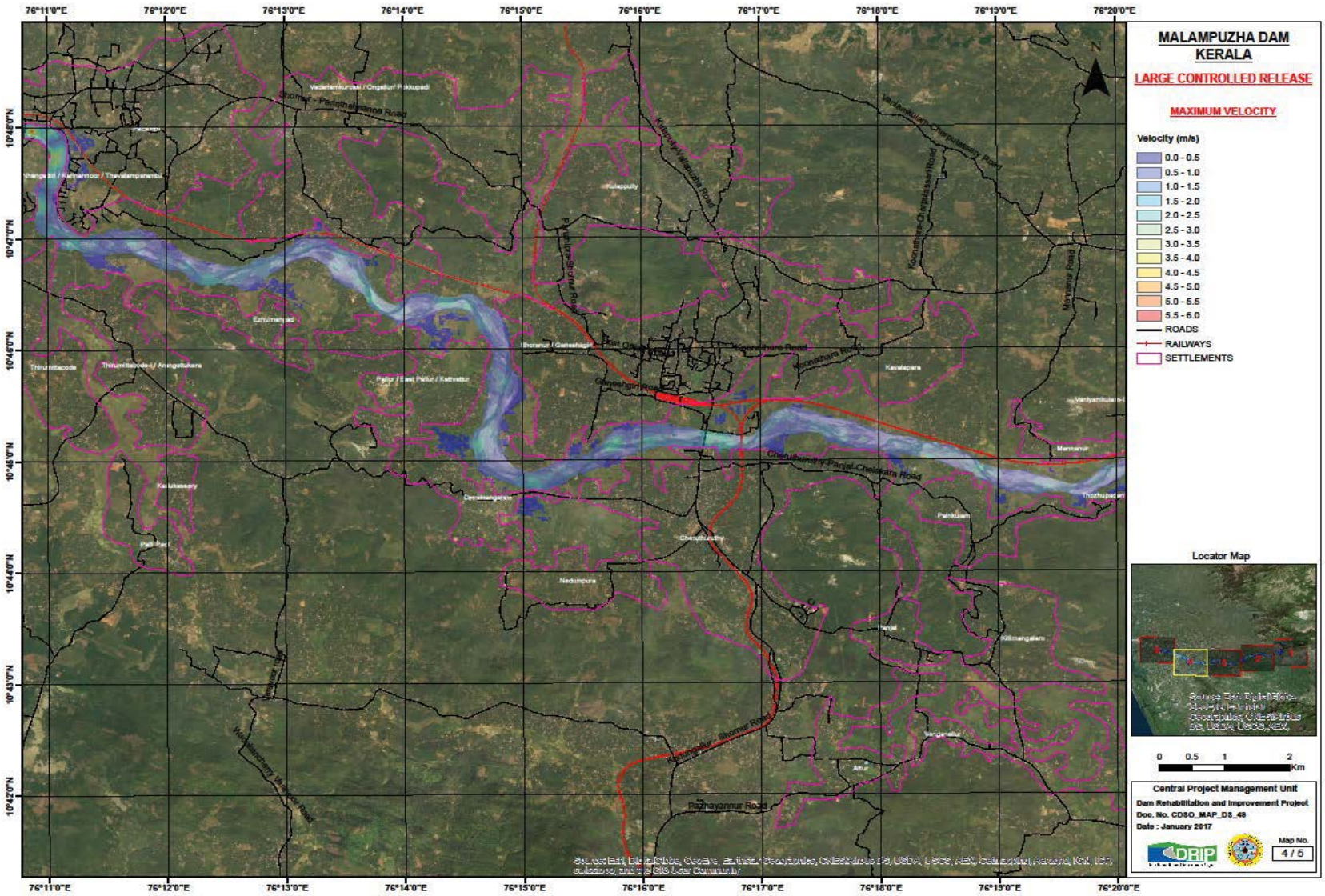

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM DEPTH
Depth (m)
0.0- 0.5
0.5 - 1.0
1.0 - 2.0
2.0 - 2.5
2.5 - 3.5
3.5 - 4.0
4.0 - 5.0
5.0 - 5.5
5.5 - 6.5
6.5 - 7.5
7.5 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 11.0
11.0 - 13.0
13.0 - 14.5
14.5 - 17.0
17.0 - 22.0
22.0 - 30.0
30.0 - 39.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
10°42'0"N

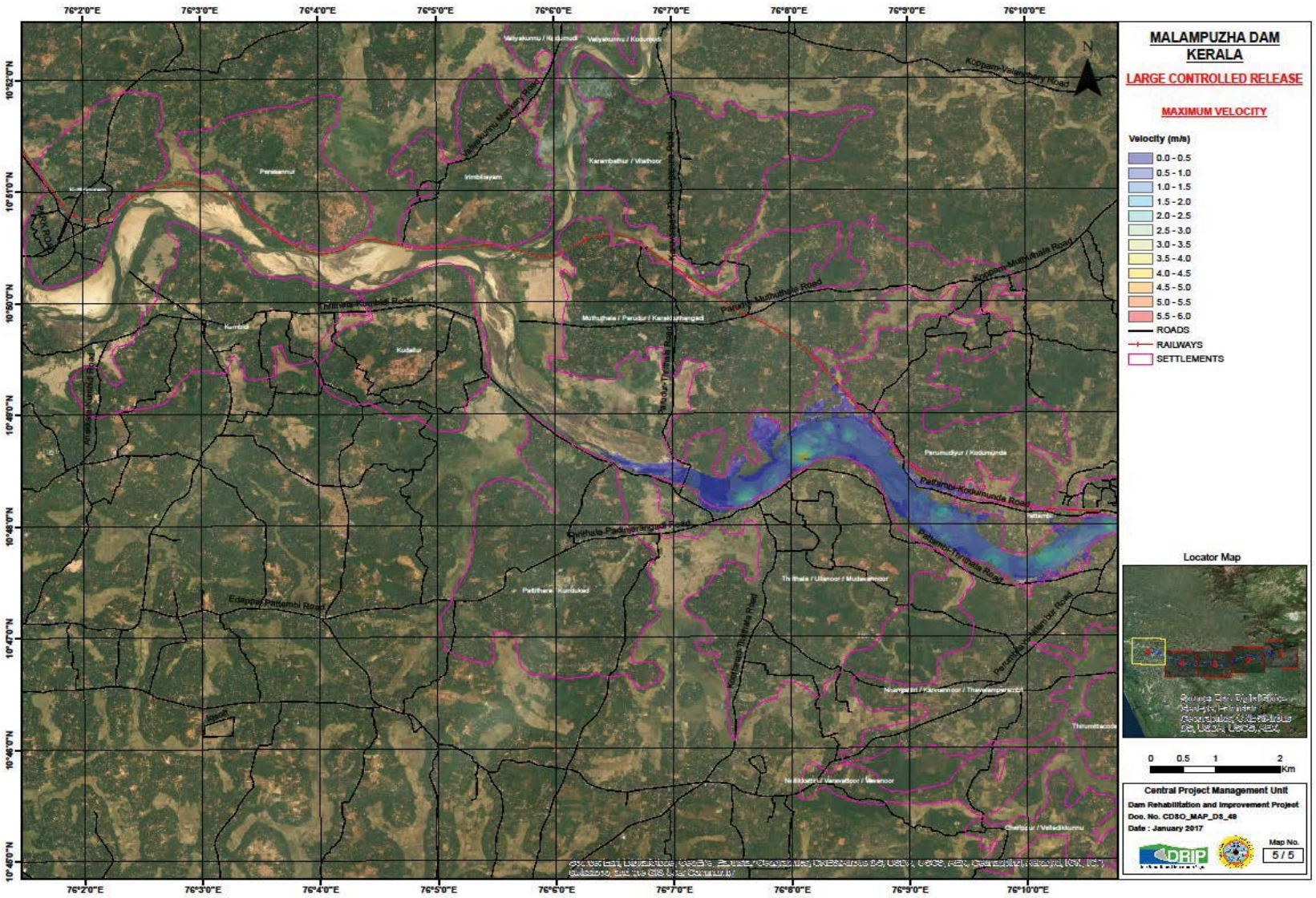

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM DEPTH
Depth (m)
0.0- 0.5
0.5 - 1.0
1.0 - 2.0
2.0 - 2.5
2.5 - 3.5
3.5 - 4.0
4.0 - 5.0
5.0 - 5.5
5.5 - 6.5
6.5 - 7.5
7.5 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 11.0
11.0 - 13.0
13.0 - 14.5
14.5 - 17.0
17.0 - 22.0
22.0 - 30.0
30.0 - 39.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
5 / 5
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E
10°52'0"N
10°51'0"N
10°50'0"N
10°49'0"N
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N


MALAMPUZHA RESERVOIR
MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 5.5
5.5 - 6.0
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
1 / 5
76°39'0"E
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
76°44'0"E
76°45'0"E
76°46'0"E
76°47'0"E
76°48'0"E


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 5.5
5.5 - 6.0
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
2 / 5
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E
Thenur
Mankara
Chungam-Kannanur Road
Salem-Kochi-Kanyakumari Highway


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 5.5
5.5 - 6.0
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
3 / 5
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E
N.0°48'0"
N.0°47'0"
N.0°46'0"
N.0°45'0"
N.0°44'0"
N.0°43'0"
N.0°42'0"


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 5.5
5.5 - 6.0
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
10°42'0"N


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 5.5
5.5 - 6.0
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
5 / 5
76°2'0"E
76°3'0"E
76°4'0"E
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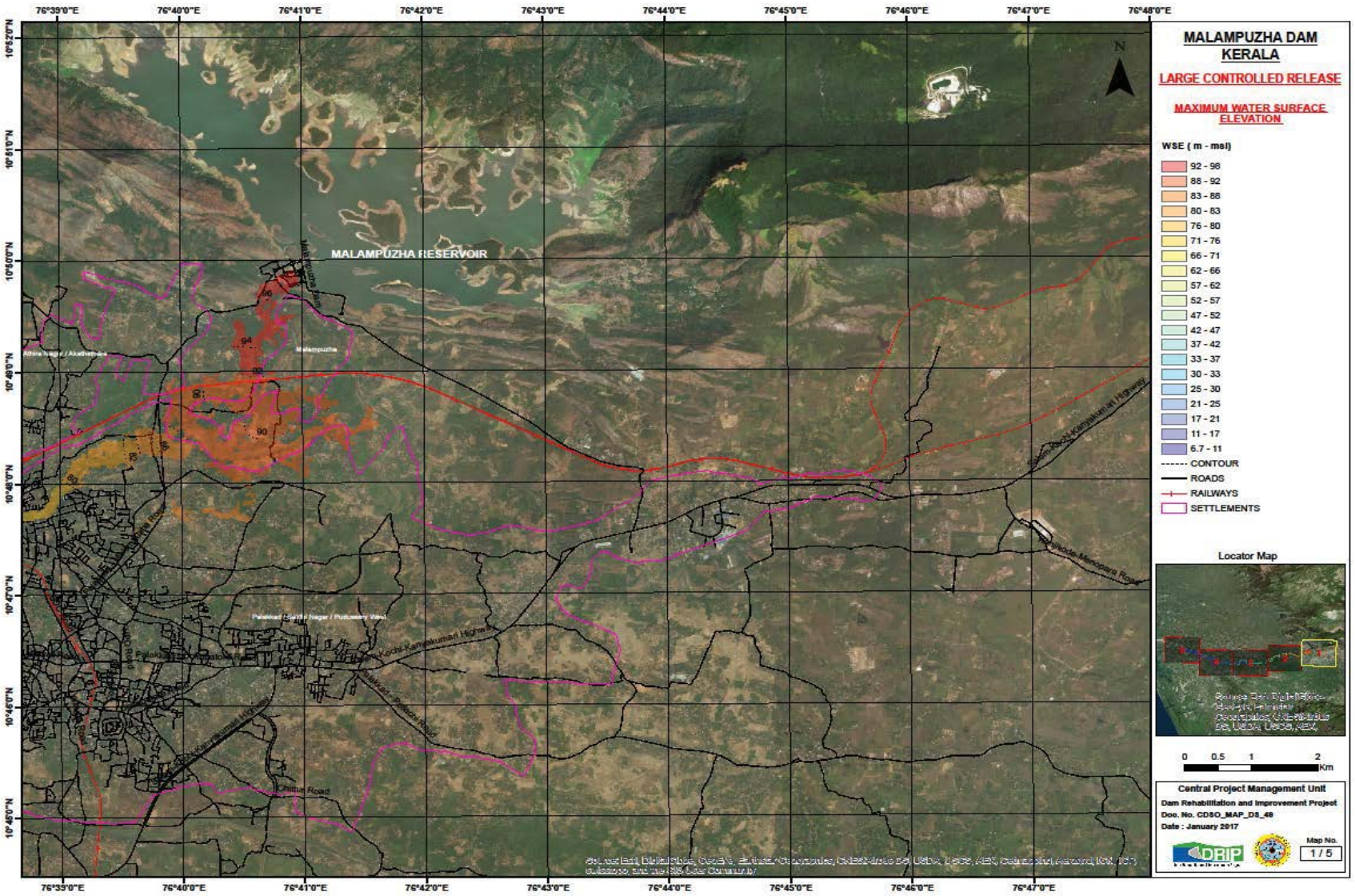
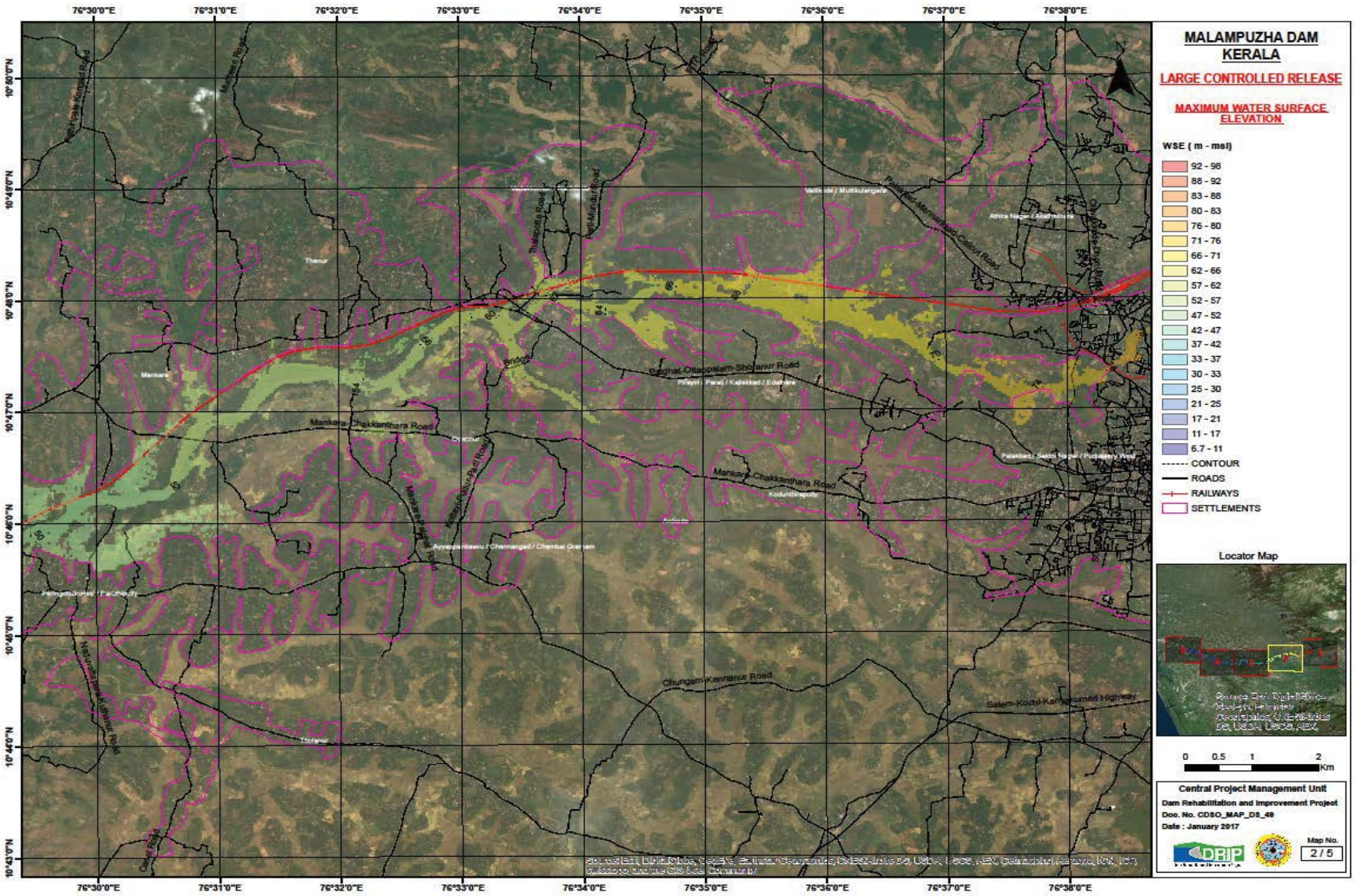
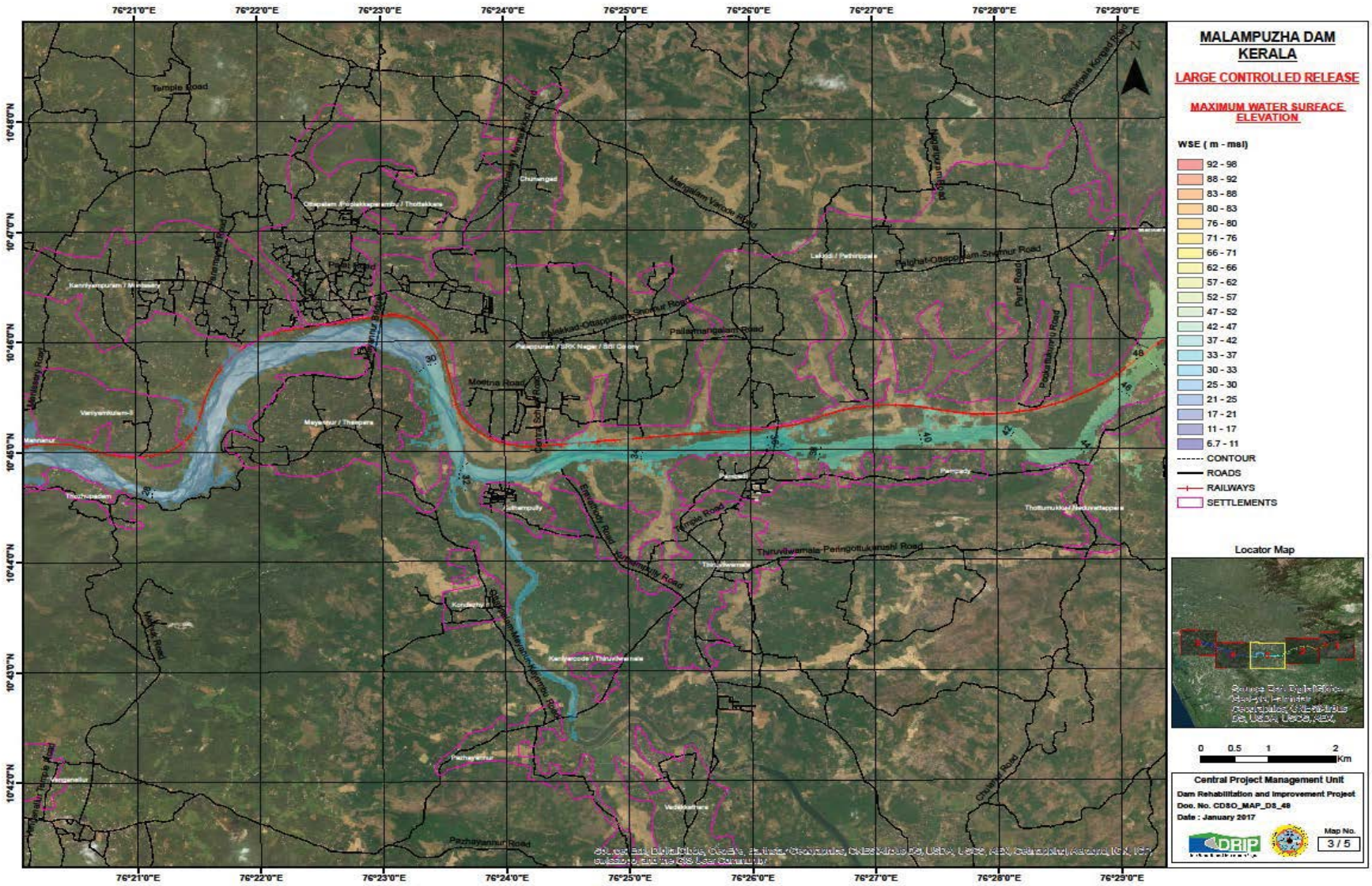
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
92 - 98
88 - 92
83 - 88
80 - 83
76 - 80
71 - 76
66 - 71
62 - 66
57 - 62
52 - 57
47 - 52
42 - 47
37 - 42
33 - 37
30 - 33
25 - 30
21 - 25
17 - 21
11 - 17
6.7 - 11
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
MALAMPUZHA RESERVOIR
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
1 / 5
76°39'0"E
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
76°44'0"E
76°45'0"E
76°46'0"E
76°47'0"E
76°48'0"E


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
92 - 98
88 - 92
83 - 88
80 - 83
76 - 80
71 - 76
66 - 71
62 - 66
57 - 62
52 - 57
47 - 52
42 - 47
37 - 42
33 - 37
30 - 33
25 - 30
21 - 25
17 - 21
11 - 17
6.7 - 11
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
2 / 5
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E
10°49'0"N
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
Thenur
Mankara
Mankara-Chakkanthara Road
Chungam-Kannanur Road
Salem-Kochi-Kanyakumari Highway
Bridge


MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
92 - 96
88 - 92
83 - 88
80 - 83
76 - 80
71 - 76
66 - 71
62 - 66
57 - 62
52 - 57
47 - 52
42 - 47
37 - 42
33 - 37
30 - 33
25 - 30
21 - 25
17 - 21
11 - 17
6.7 - 11
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2 Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
3 / 5
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E
10°48'0"N
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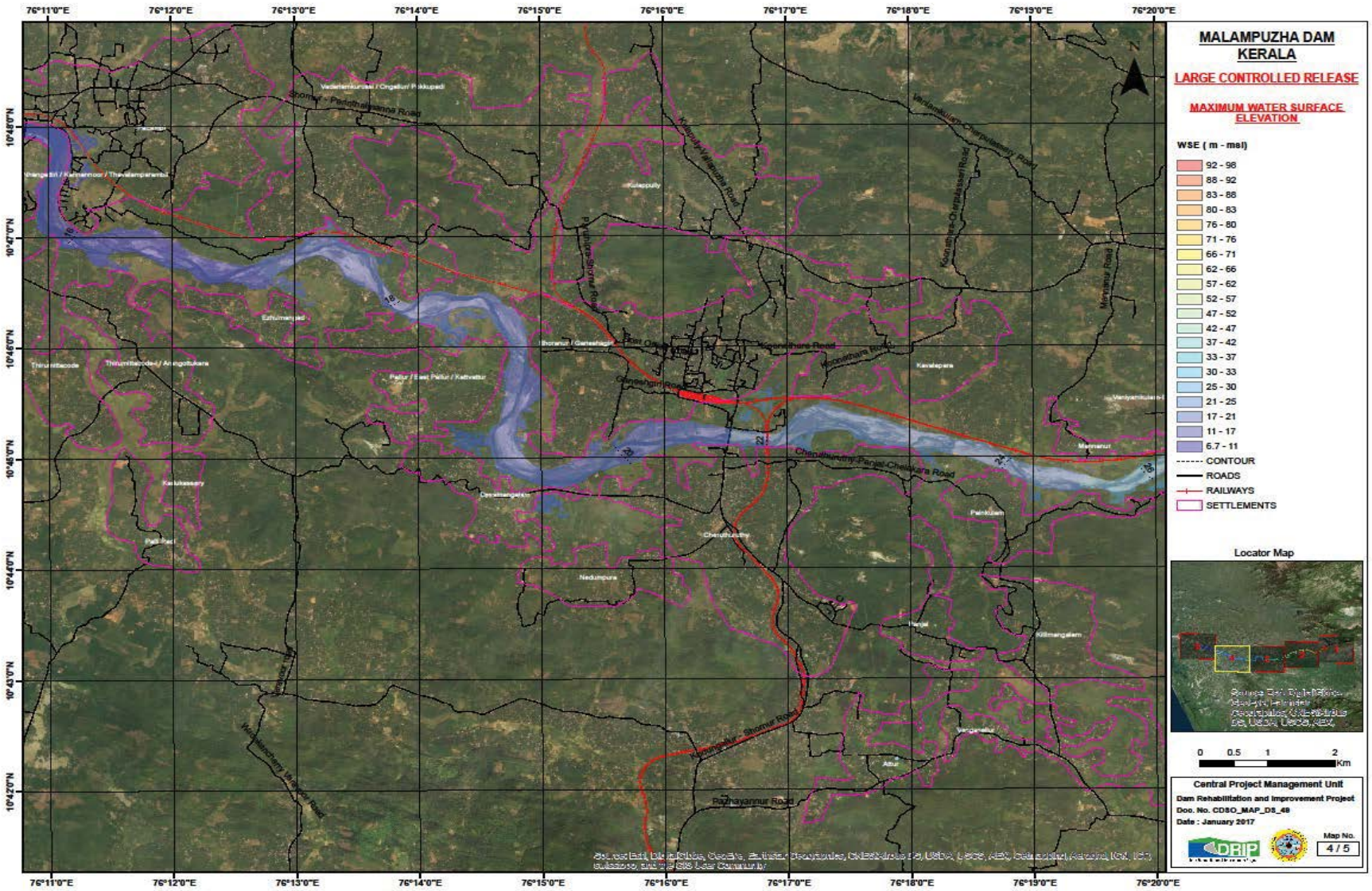
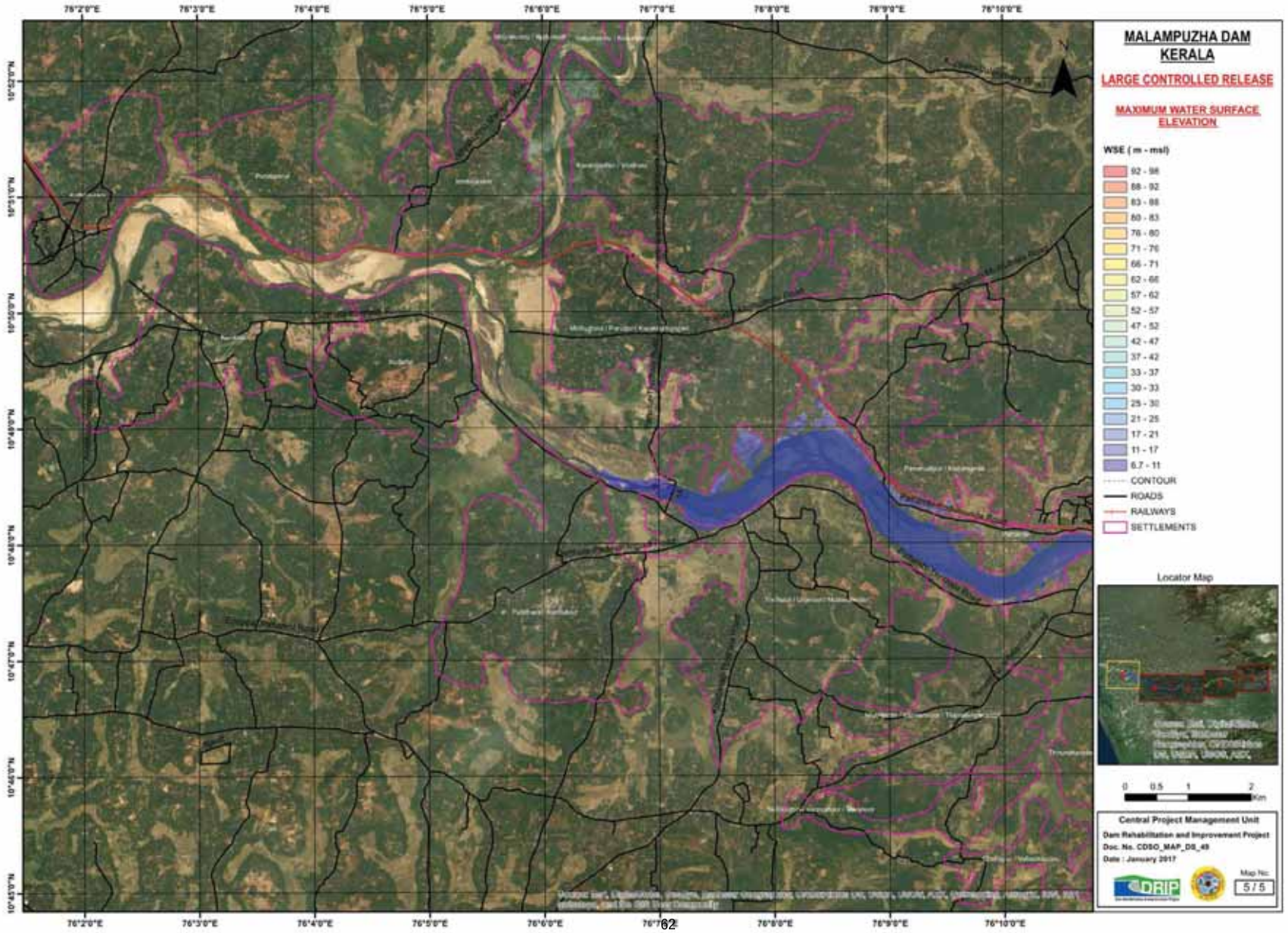
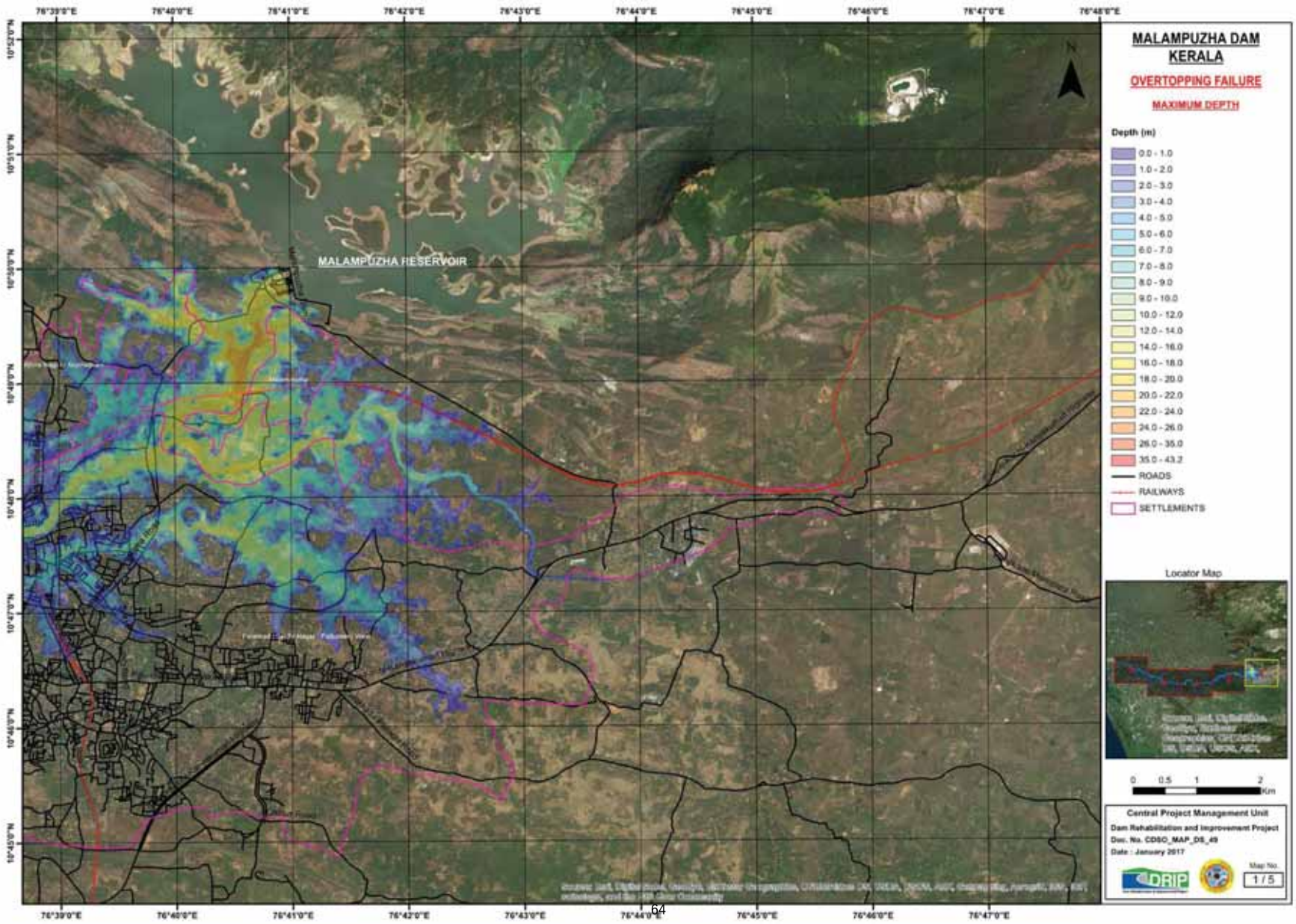
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
10°42'0"N

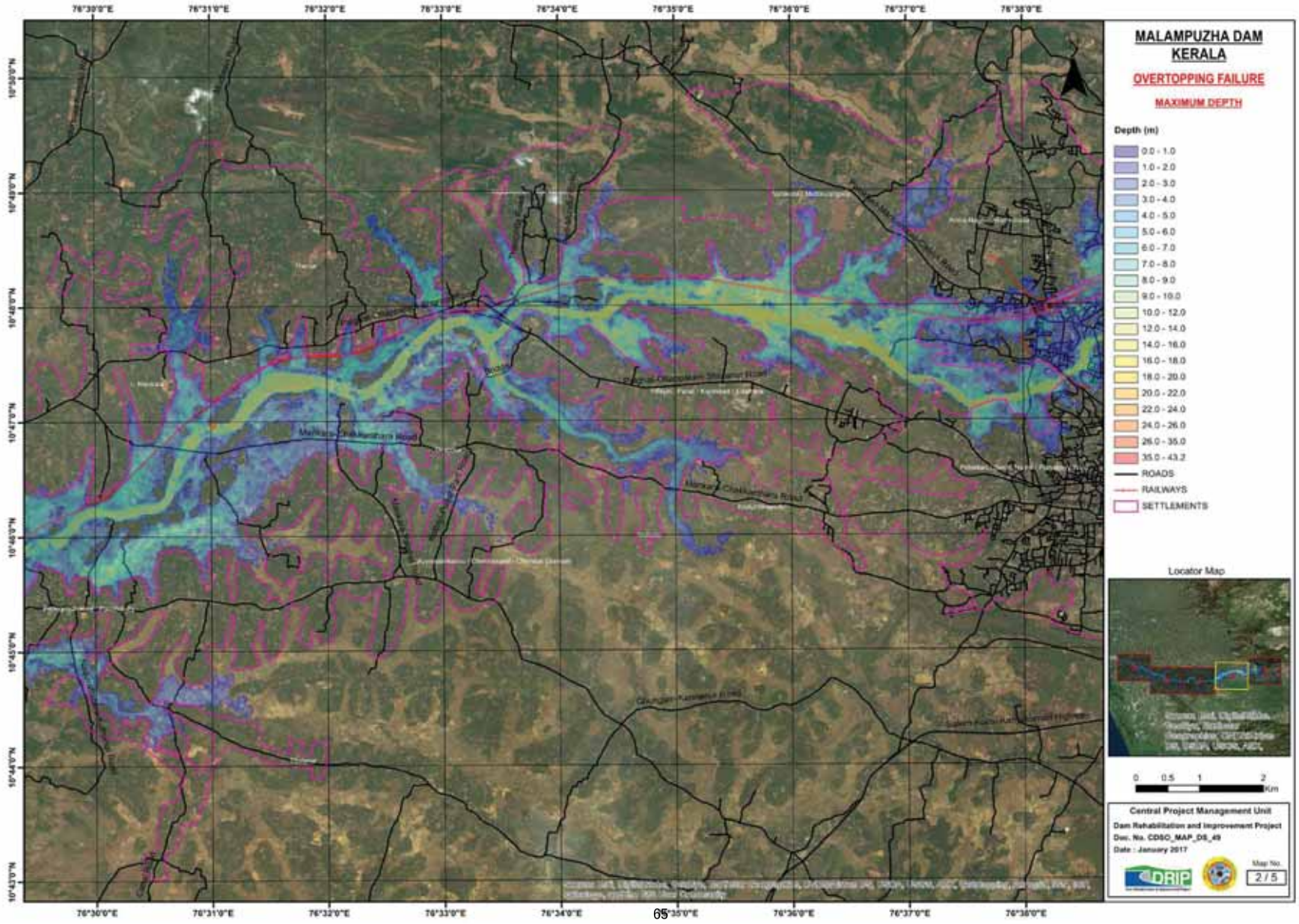

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
92 - 98
88 - 92
83 - 88
80 - 83
76 - 80
71 - 76
66 - 71
62 - 66
57 - 62
52 - 57
47 - 52
42 - 47
37 - 42
33 - 37
30 - 33
25 - 30
21 - 25
17 - 21
11 - 17
6.7 - 11
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2 Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No. 4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
10°42'0"N

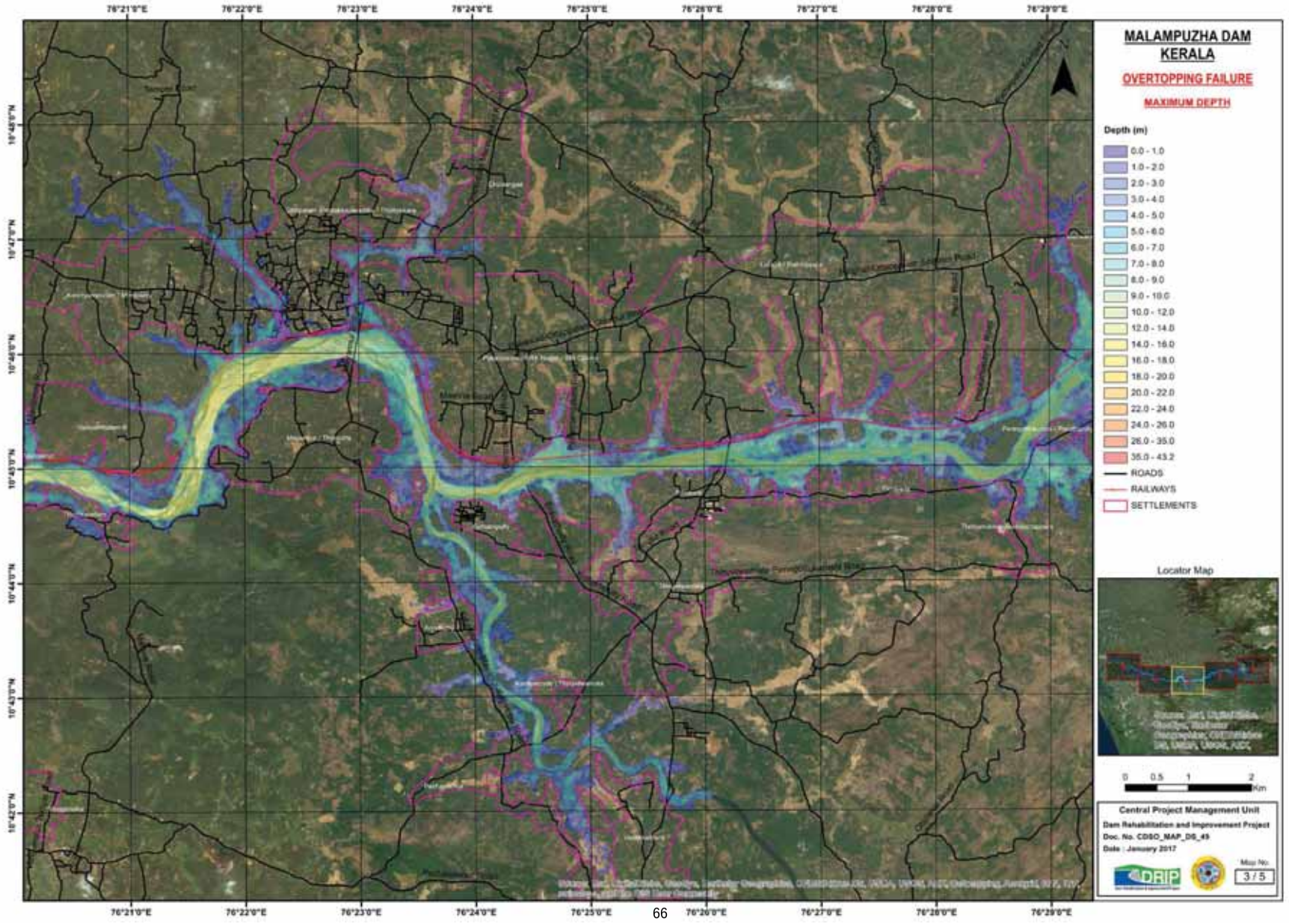

MALAMPUZHA DAM
KERALA
LARGE CONTROLLED RELEASE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
92 - 98
88 - 92
83 - 88
80 - 83
76 - 80
71 - 76
66 - 71
62 - 66
57 - 62
52 - 57
47 - 52
42 - 47
37 - 42
33 - 37
30 - 33
25 - 30
21 - 25
17 - 21
11 - 17
6.7 - 11
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
575
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E

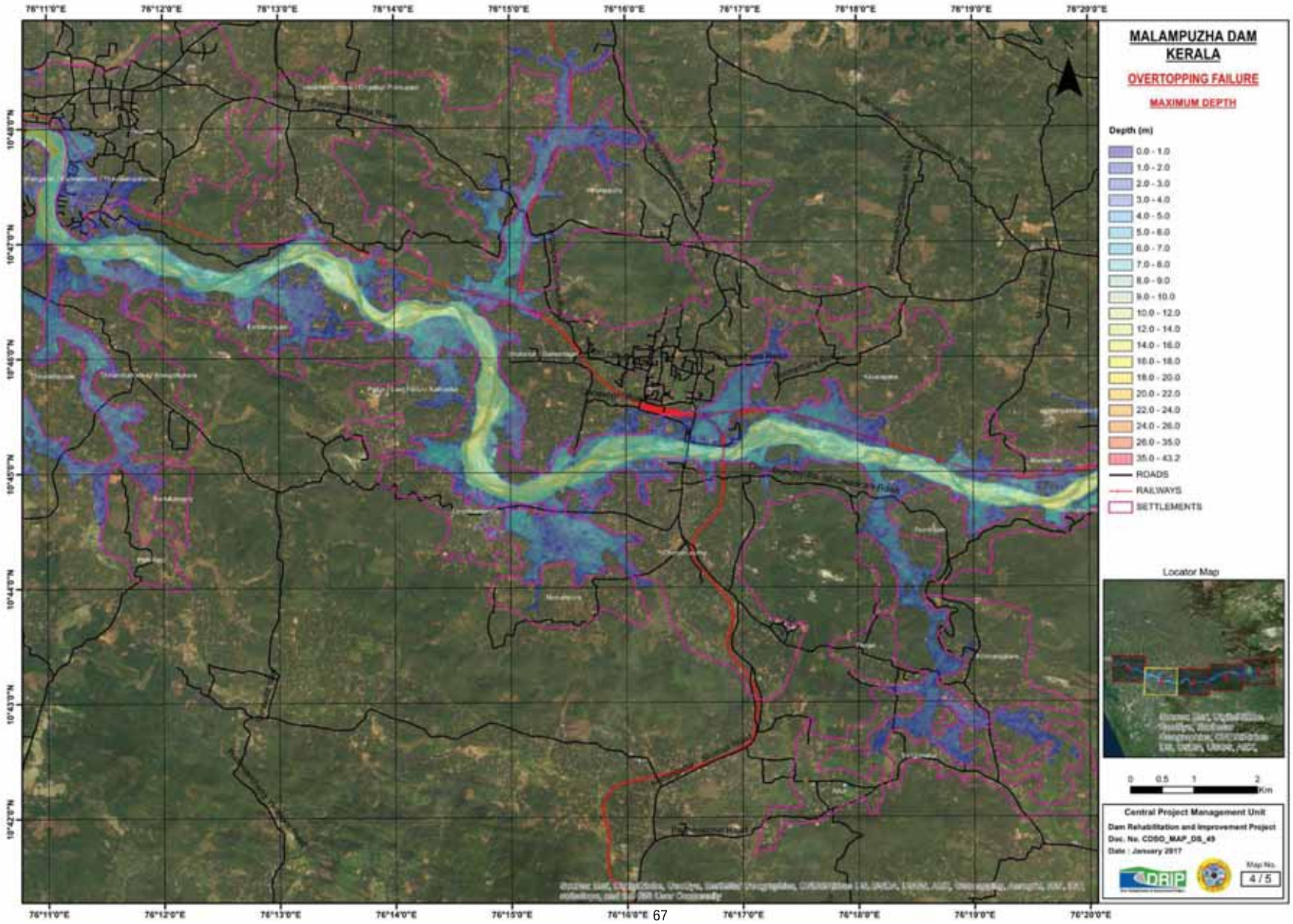
Annexure – 2 B

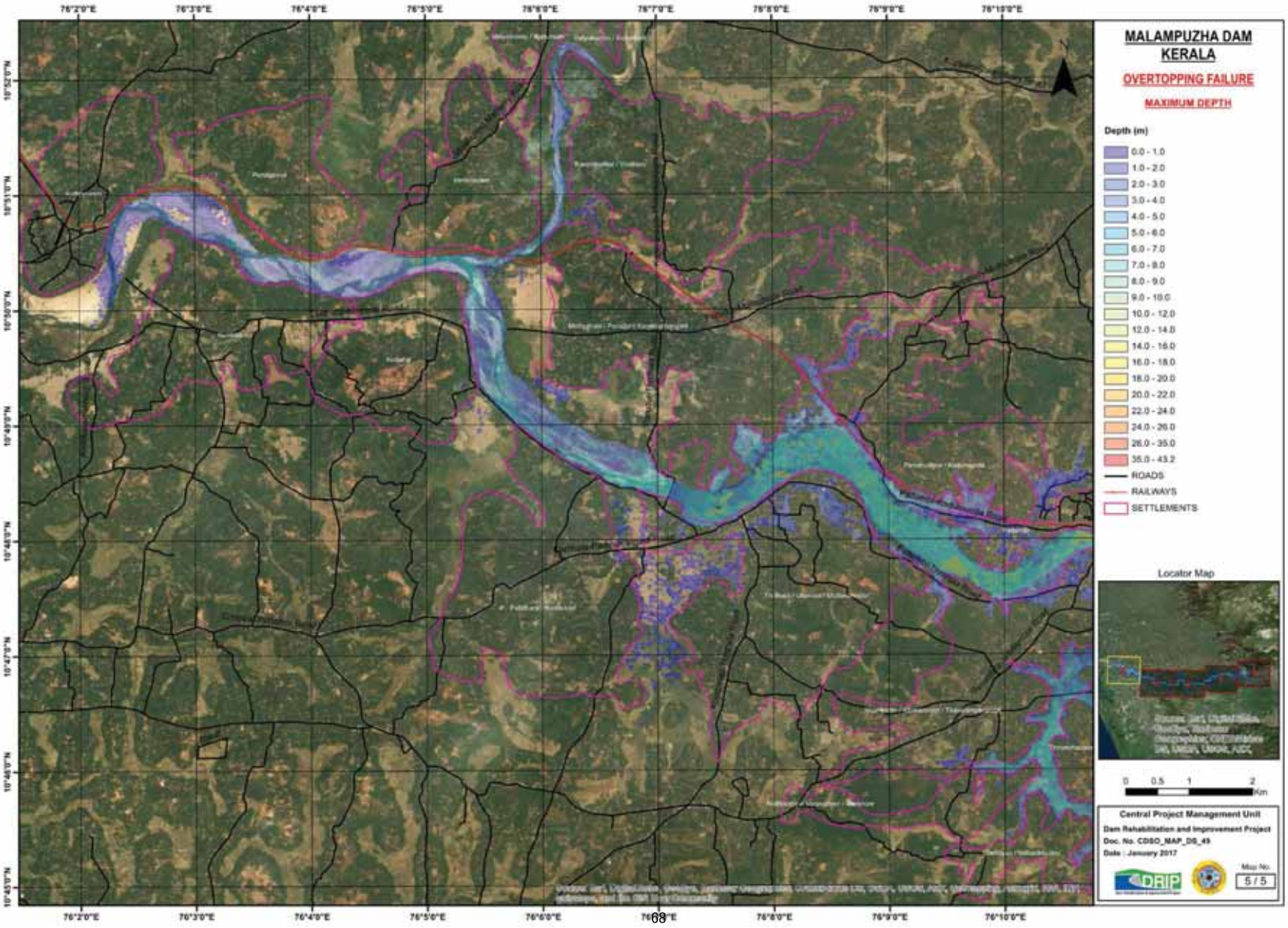
Inundation Map – Overtopping

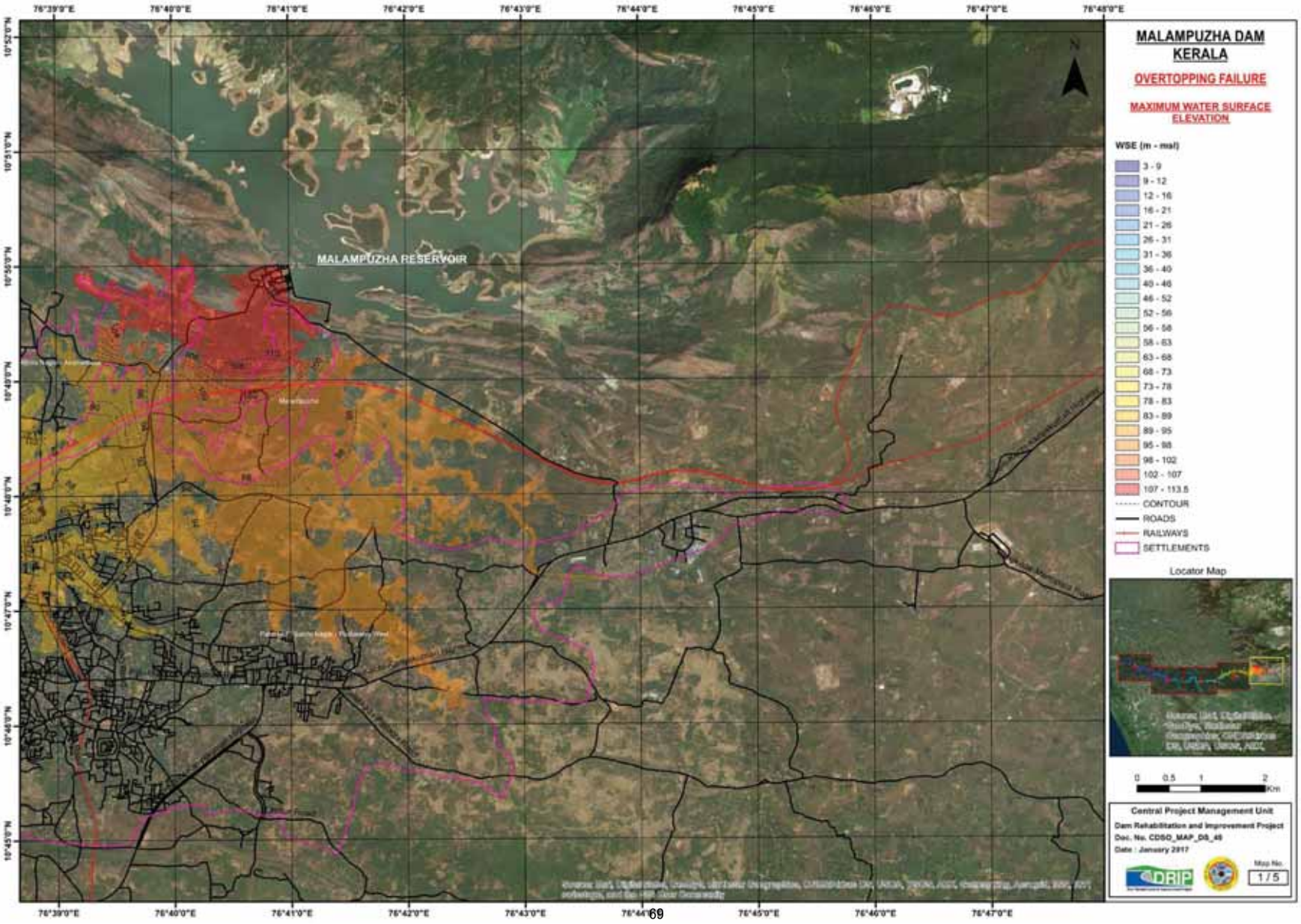

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
MALAMPUZHA RESERVOIR
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
DRIP
Map No.
1 / 5

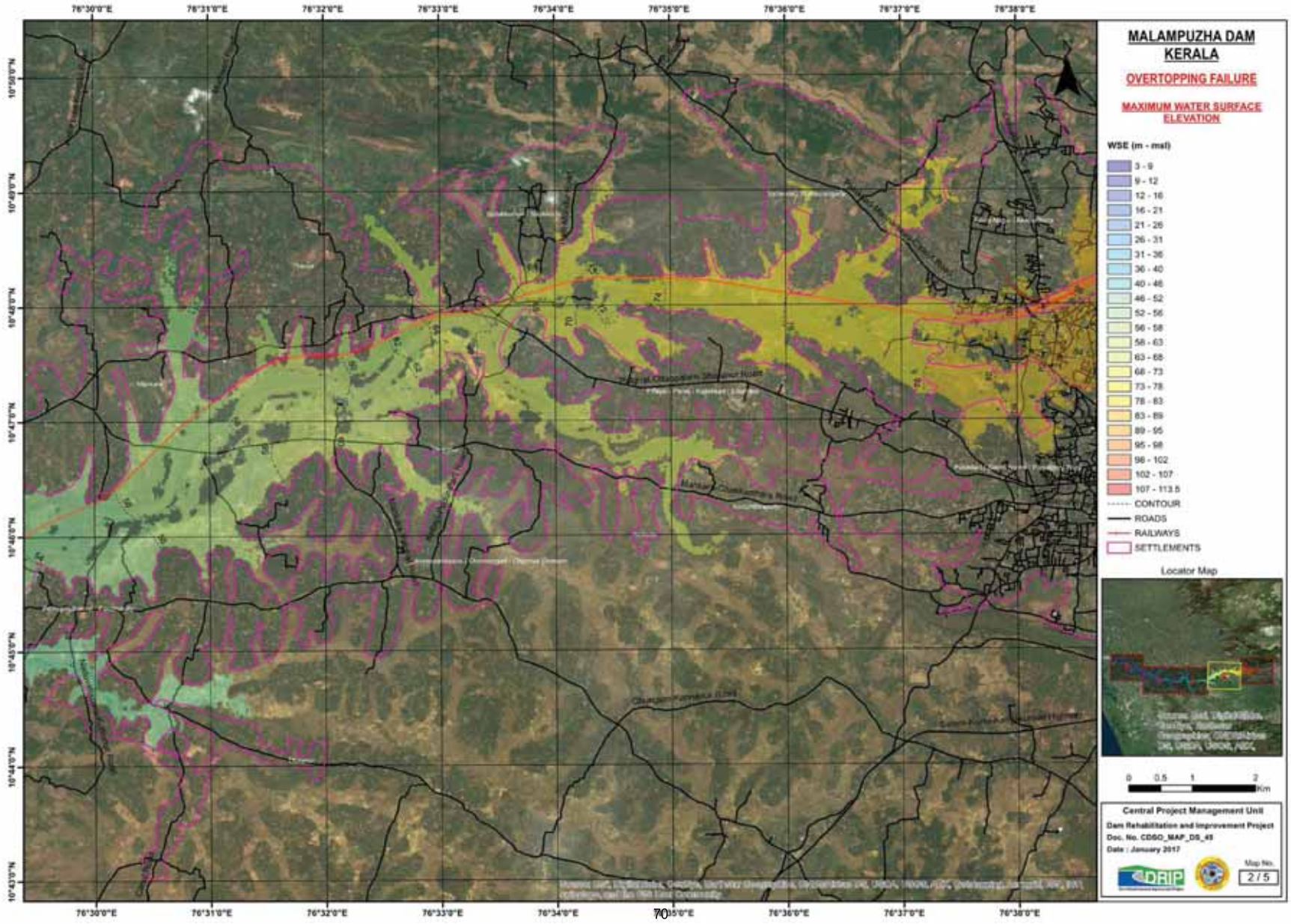

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
2 / 5
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E

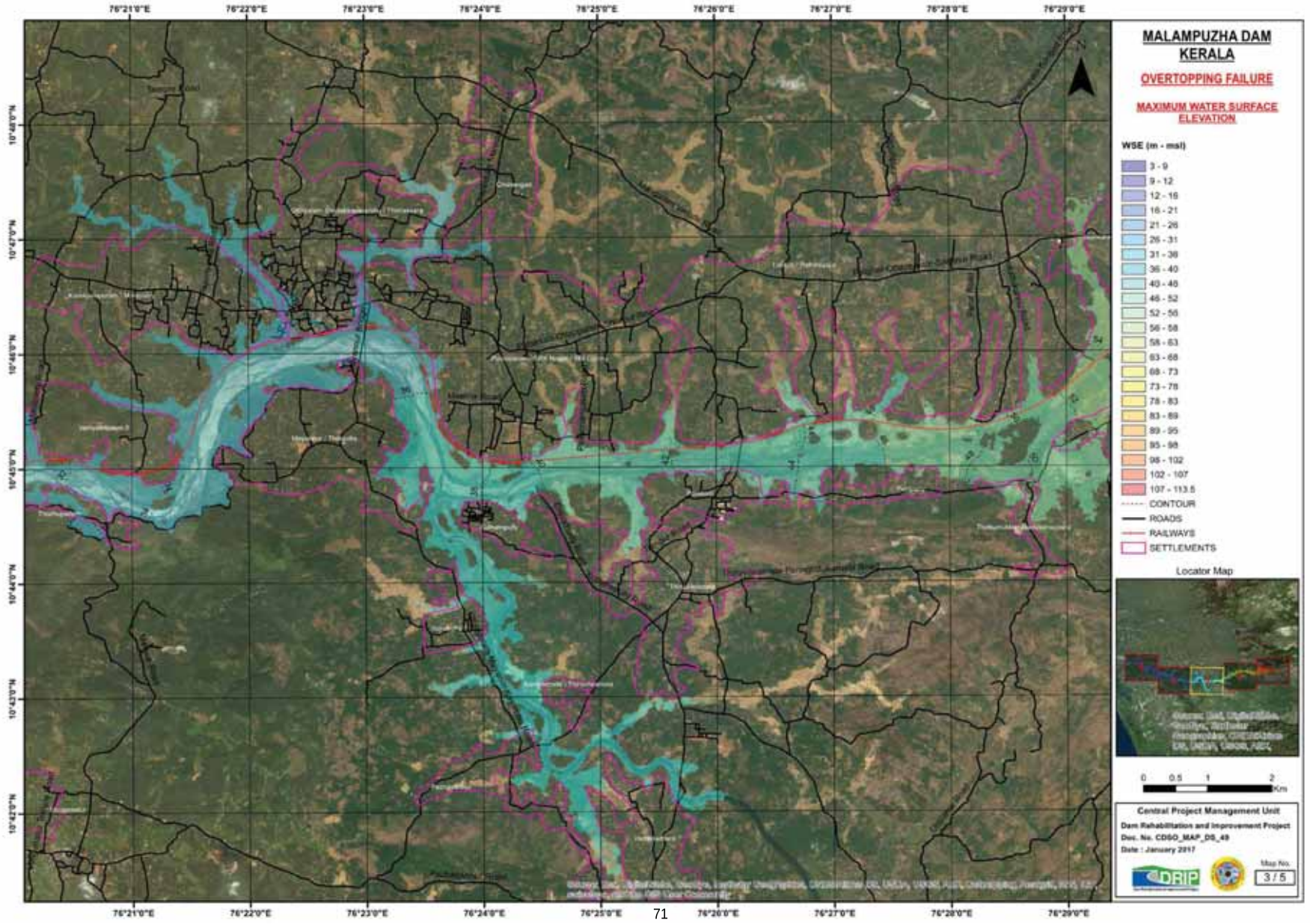

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_45
Date : January 2017
Map No.
3 / 5
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E

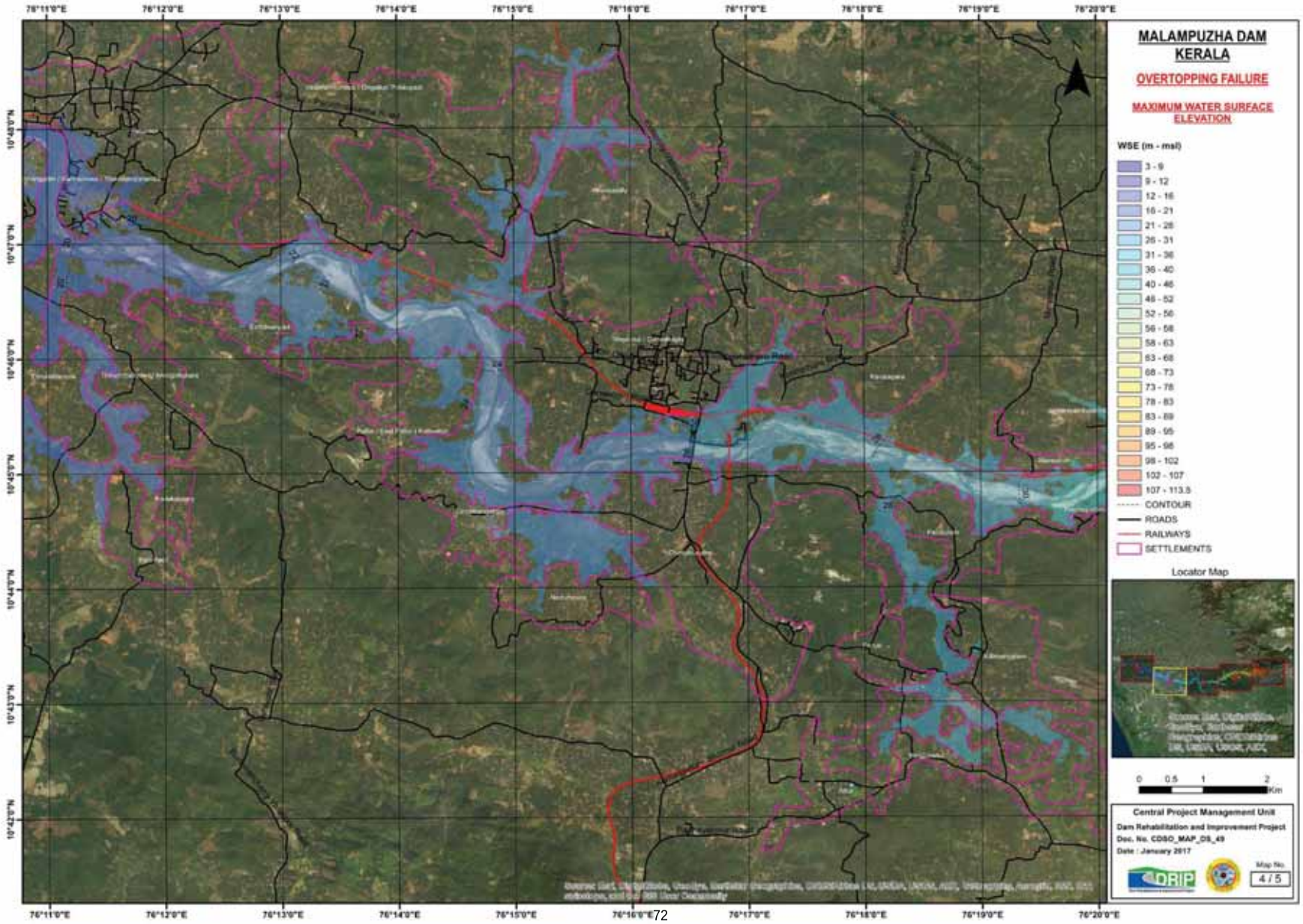

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E
10°48'0"N
10°47'0"N
10°46'0"N
10°45'0"N
10°44'0"N
10°43'0"N
10°42'0"N

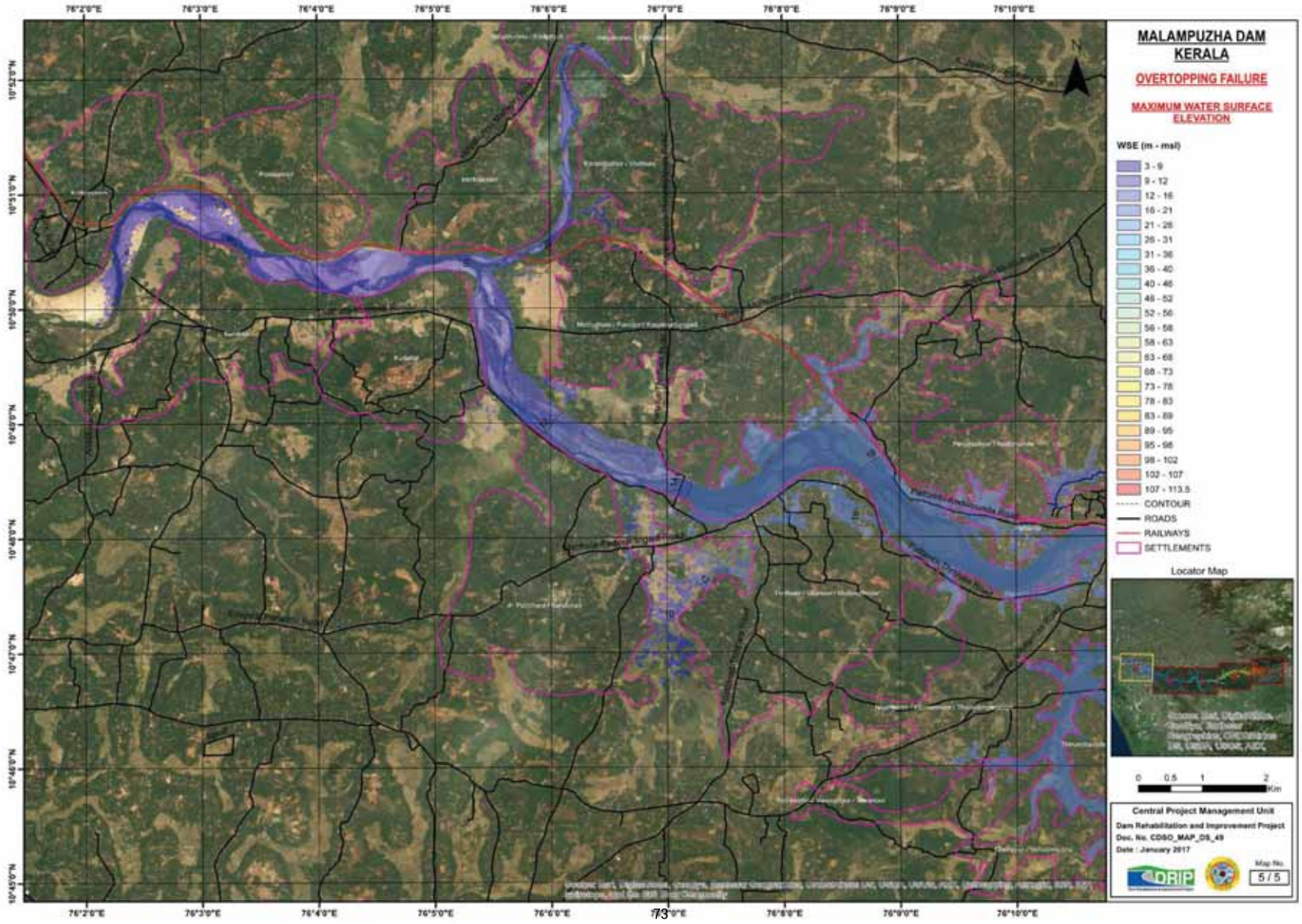

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_45
Date : January 2017
Map No.
5 / 5
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E

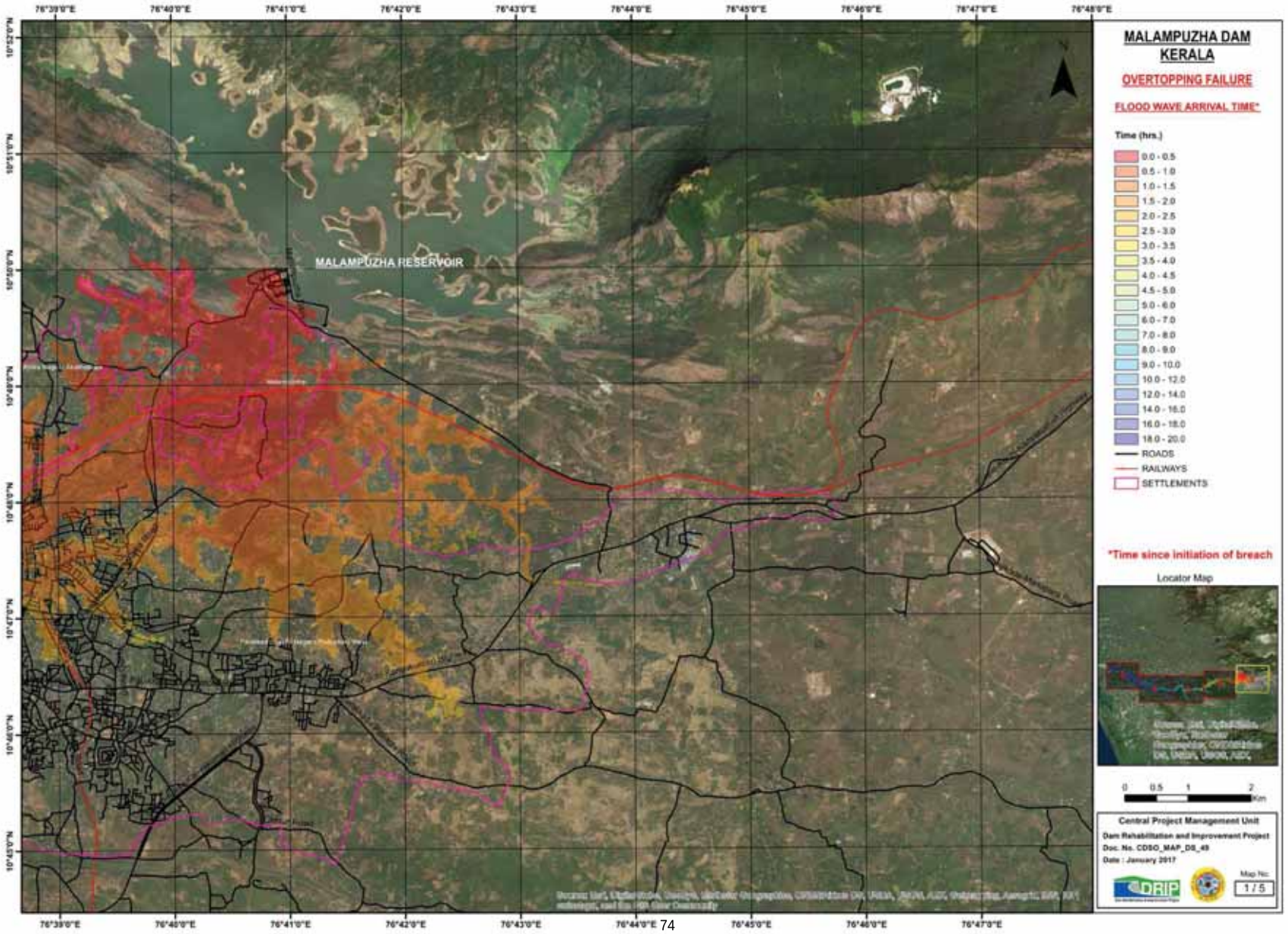

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
3 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 113.5
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
MALAMPUZHA RESERVOIR
0 0.5 1 2
KM
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_46
Date : January 2017
Map No.
1 / 5

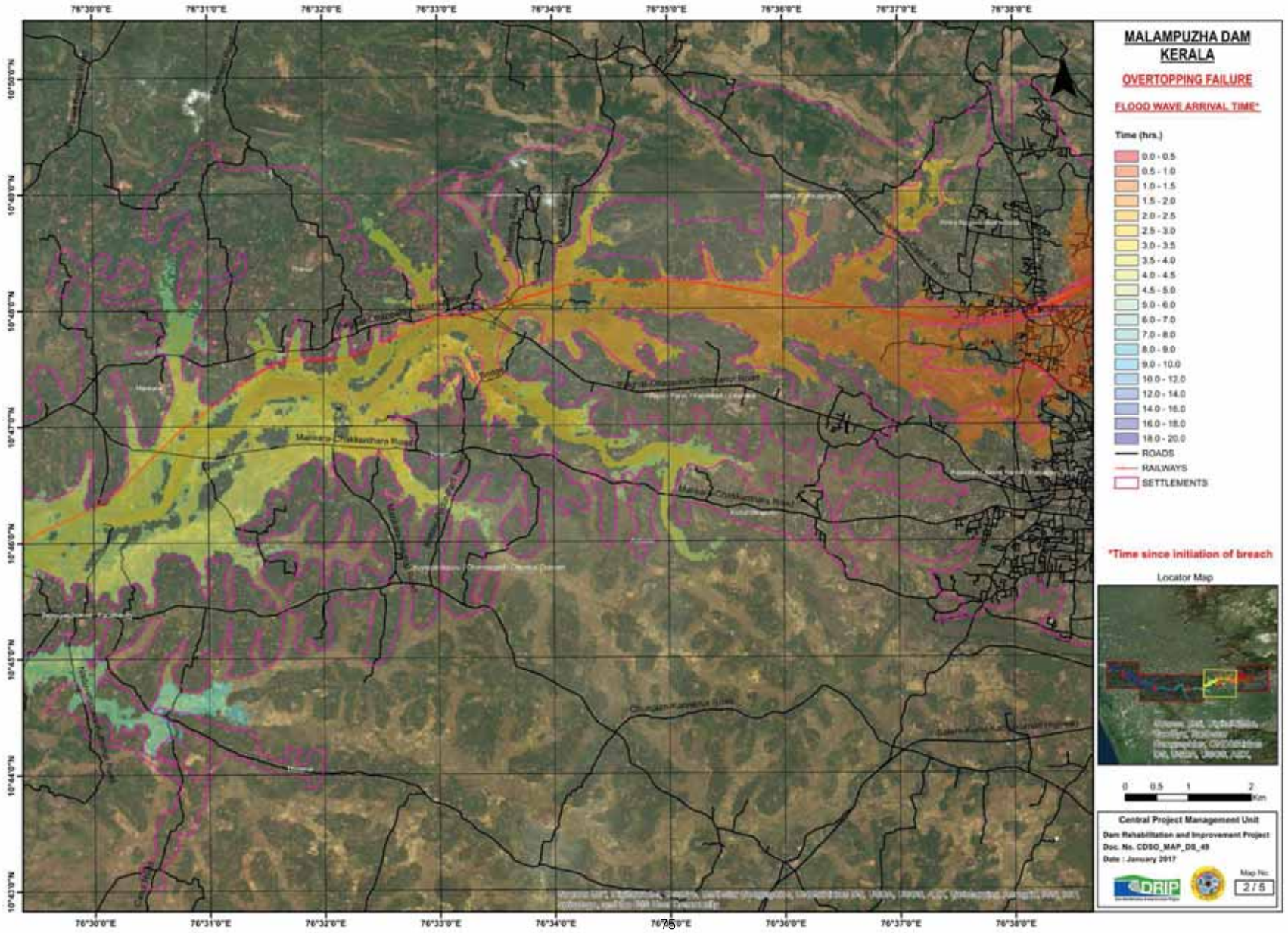

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
3 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 113.5
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_48
Date : January 2017
Map No.
2 / 5
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E

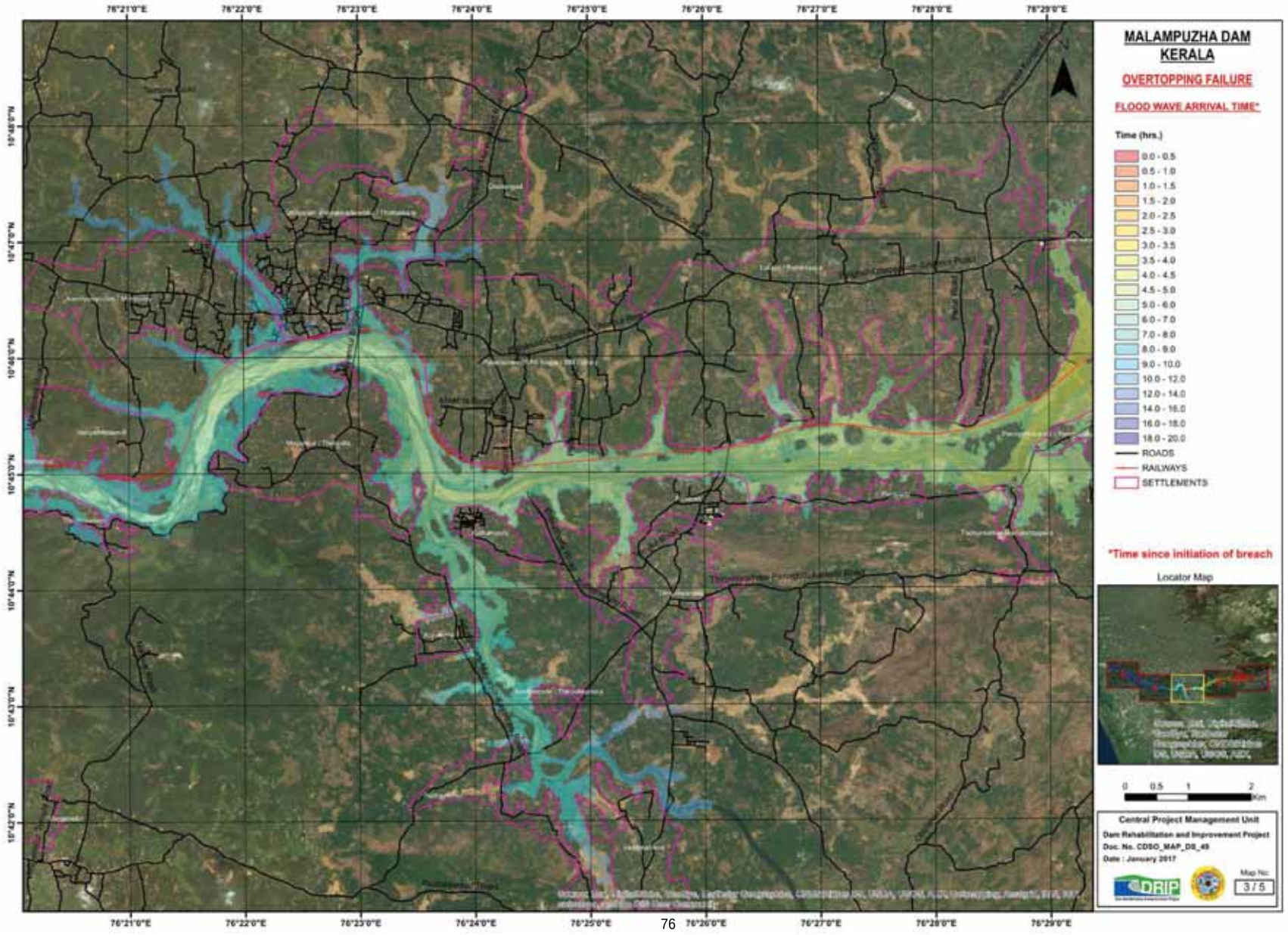

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
3 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 113.5
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
3 / 5
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E

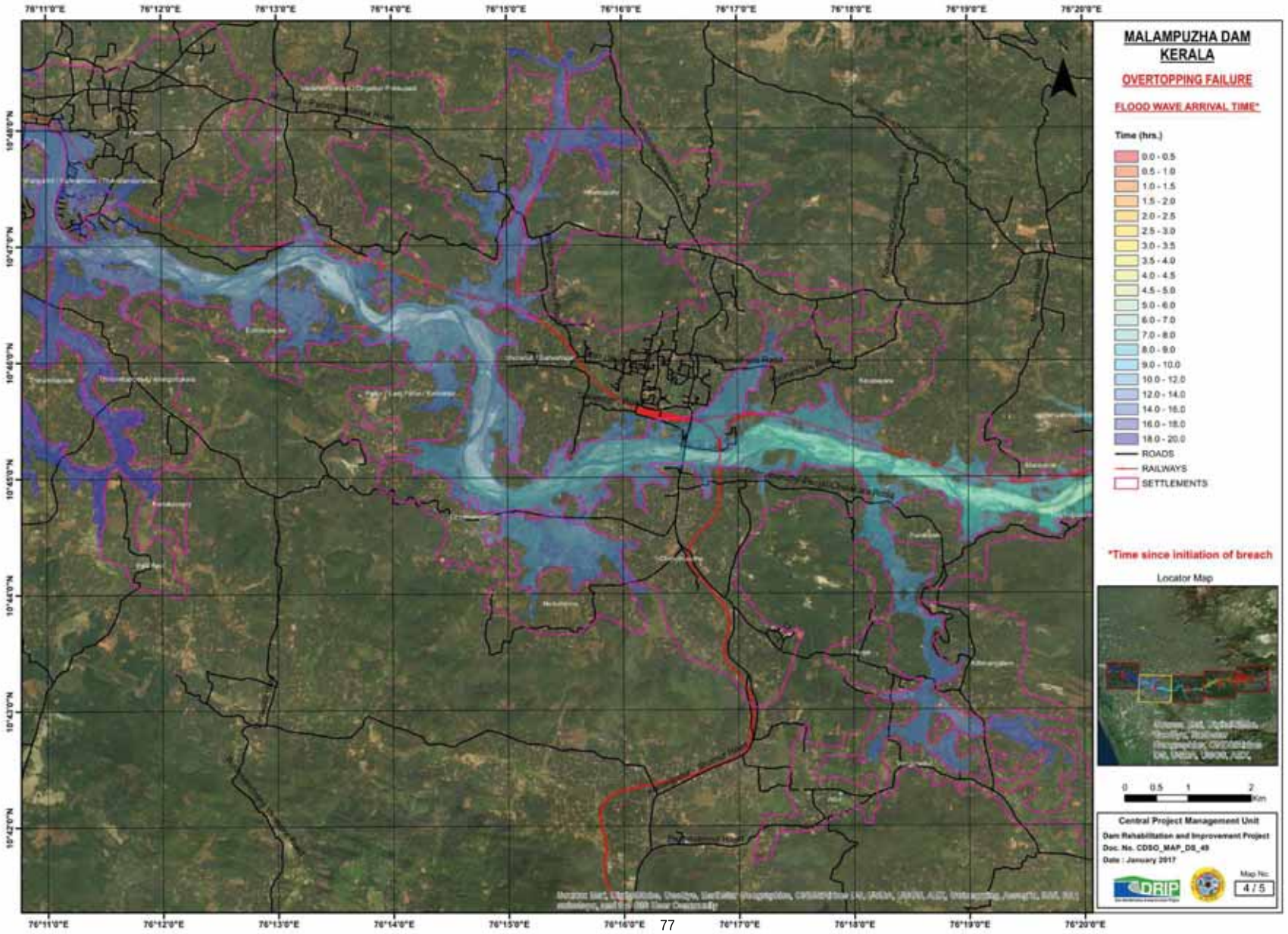

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
3 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 113.5
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E

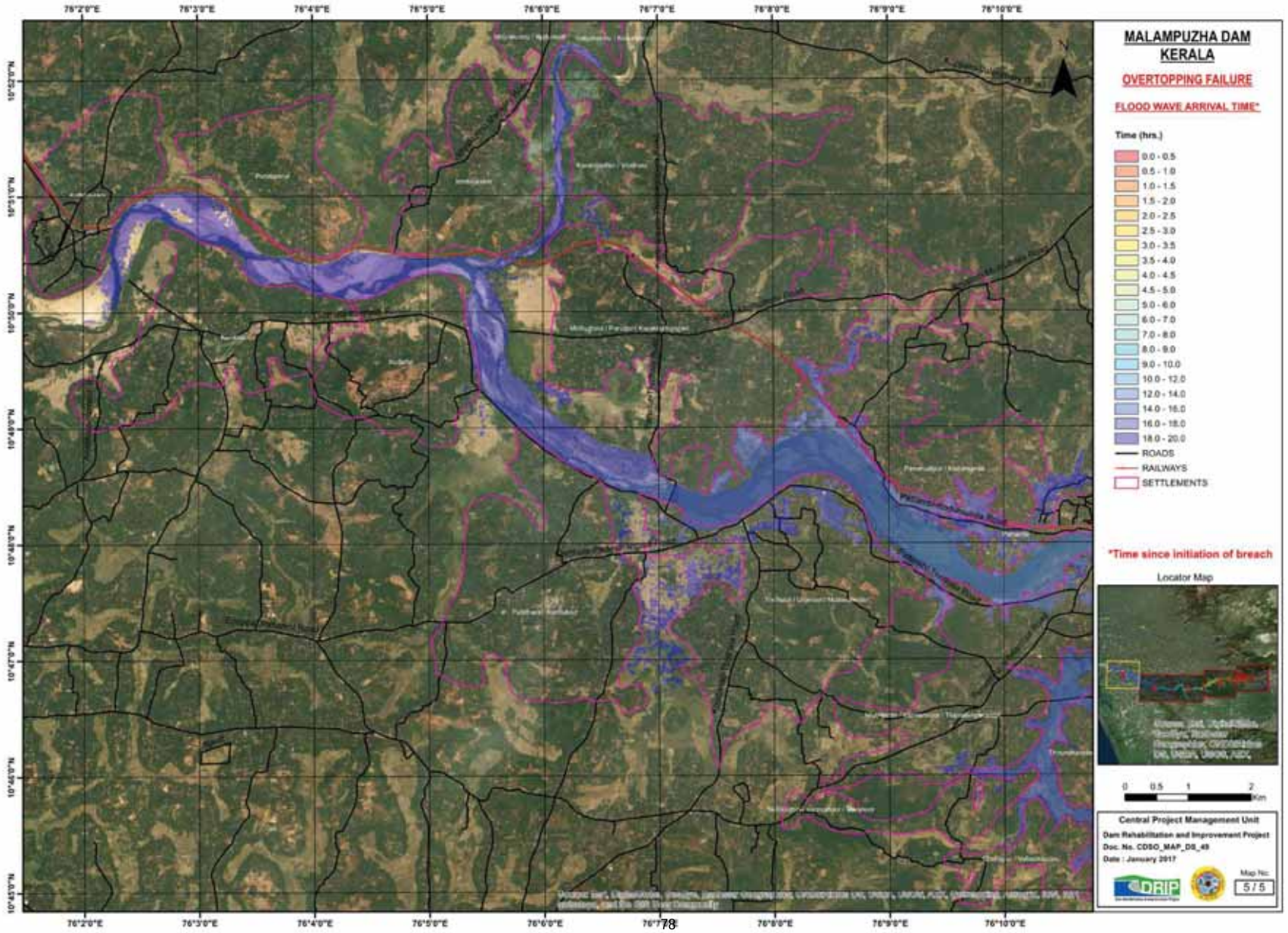

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m - msl)
3 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 113.5
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
5 / 5
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E
10°5'0"N
10°4'0"N
10°3'0"N
10°2'0"N
10°1'0"N


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
MALAMPUZHA RESERVOIR
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
1 / 5


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
275
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
3 / 5
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
575
76°2'0"E
76°3'0"E
76°4'0"E
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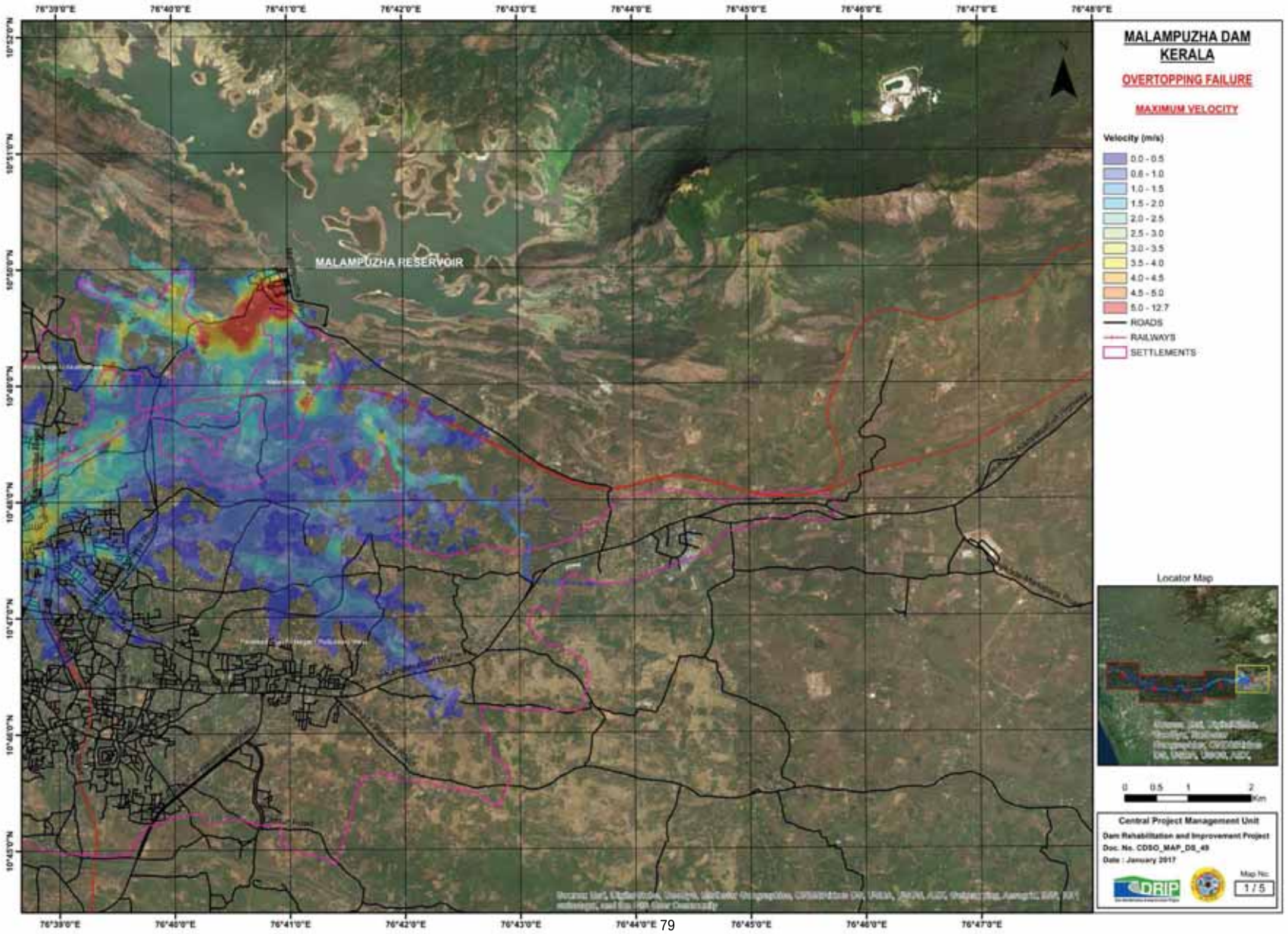
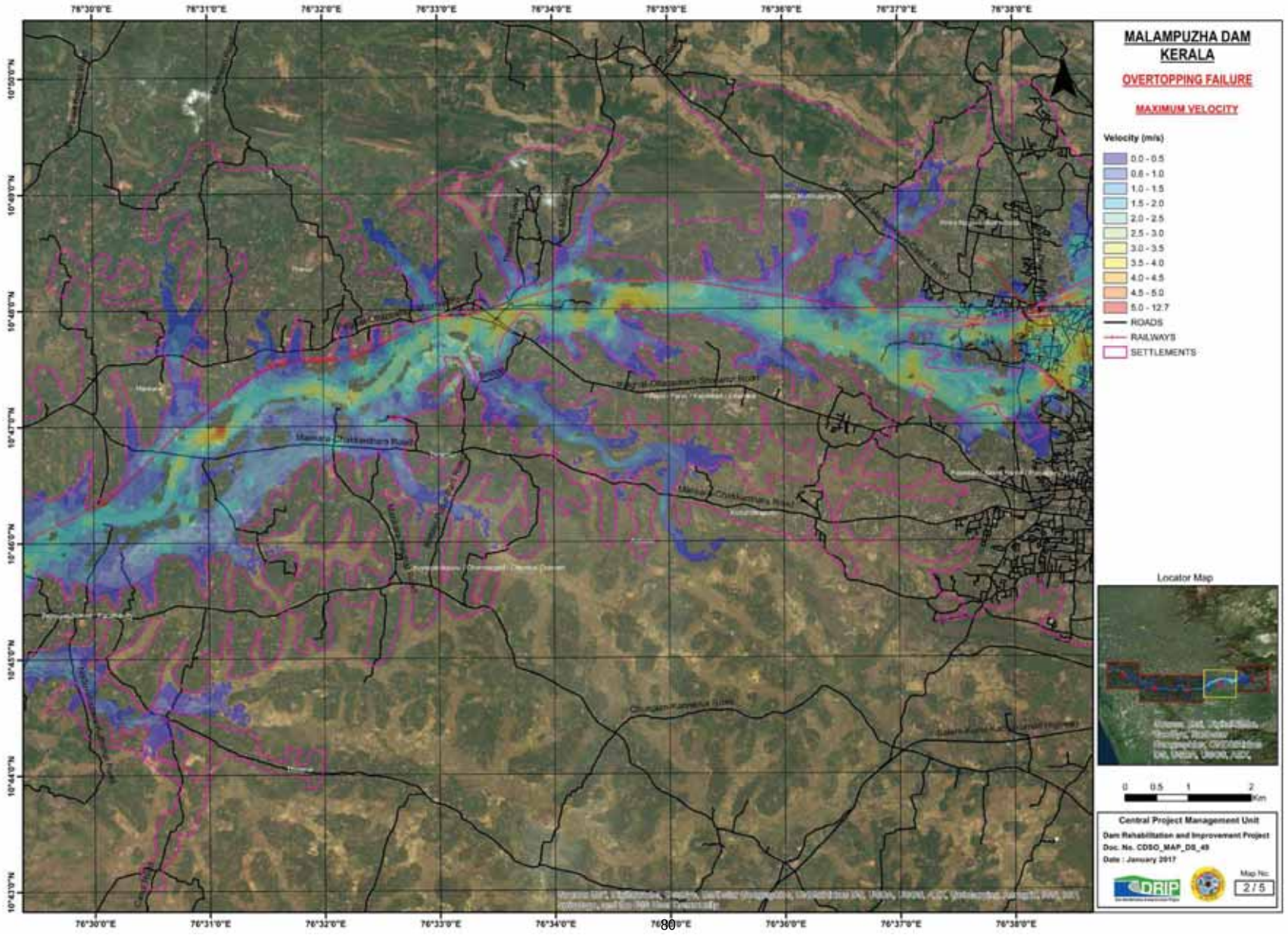
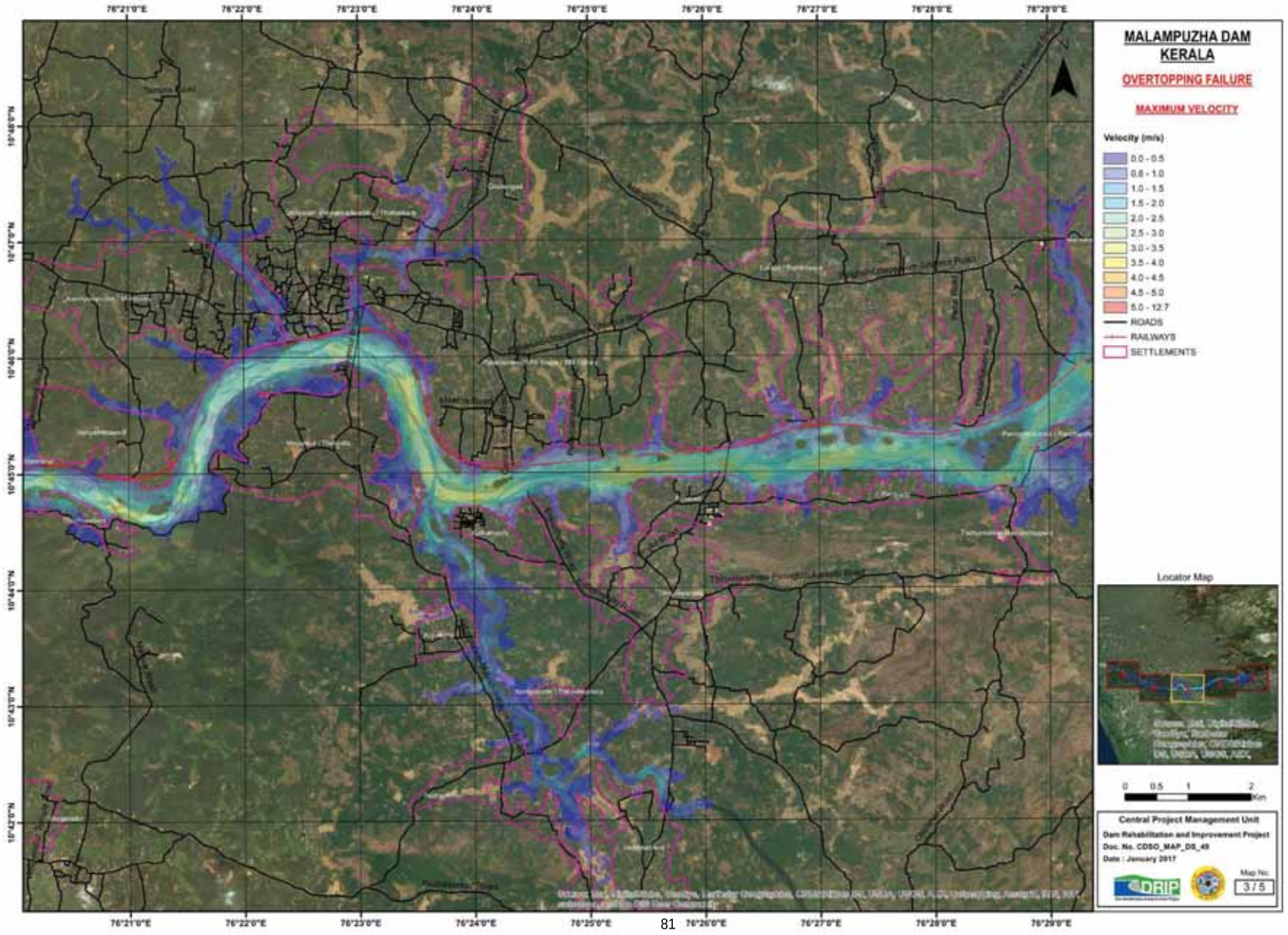
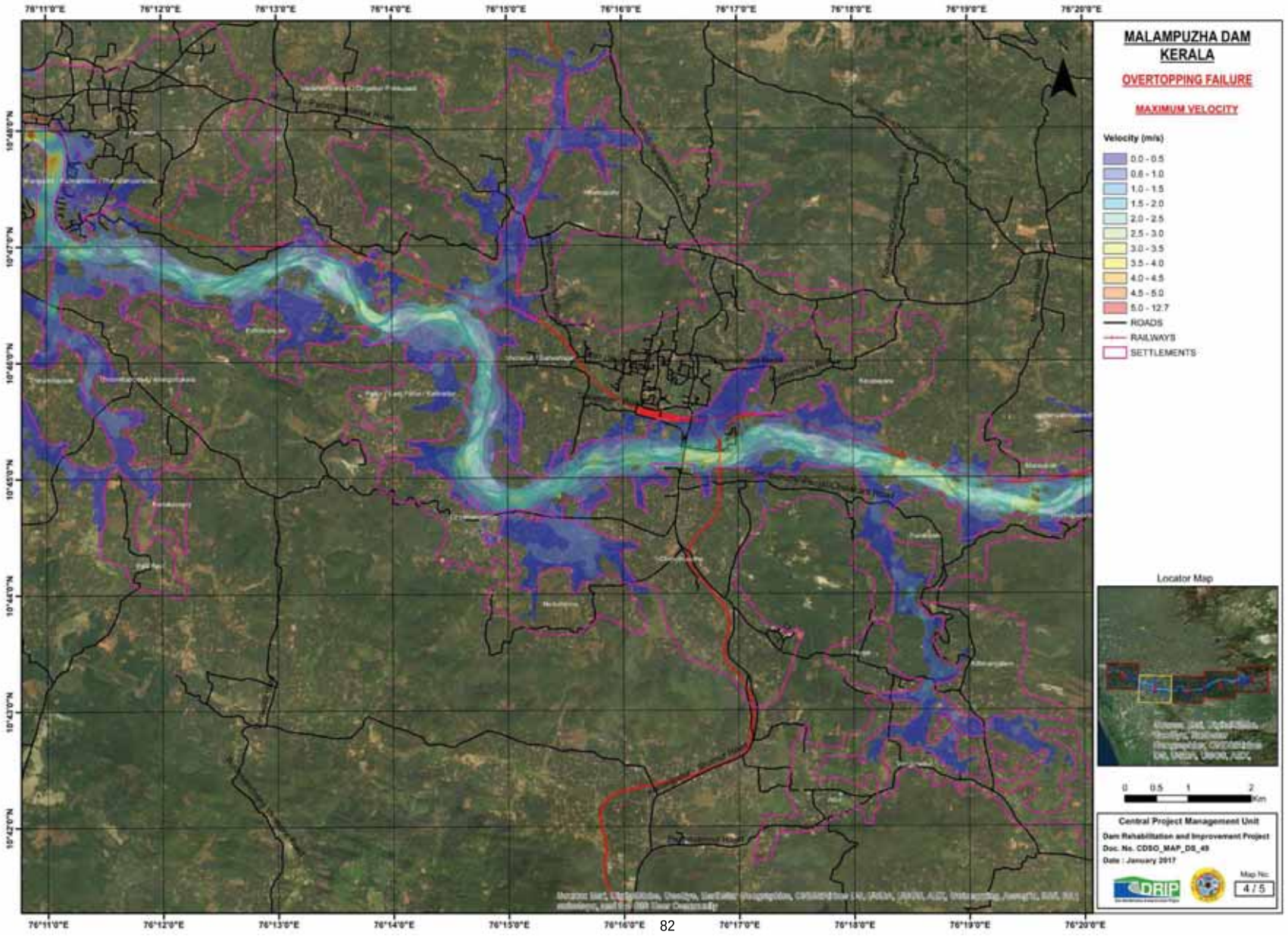
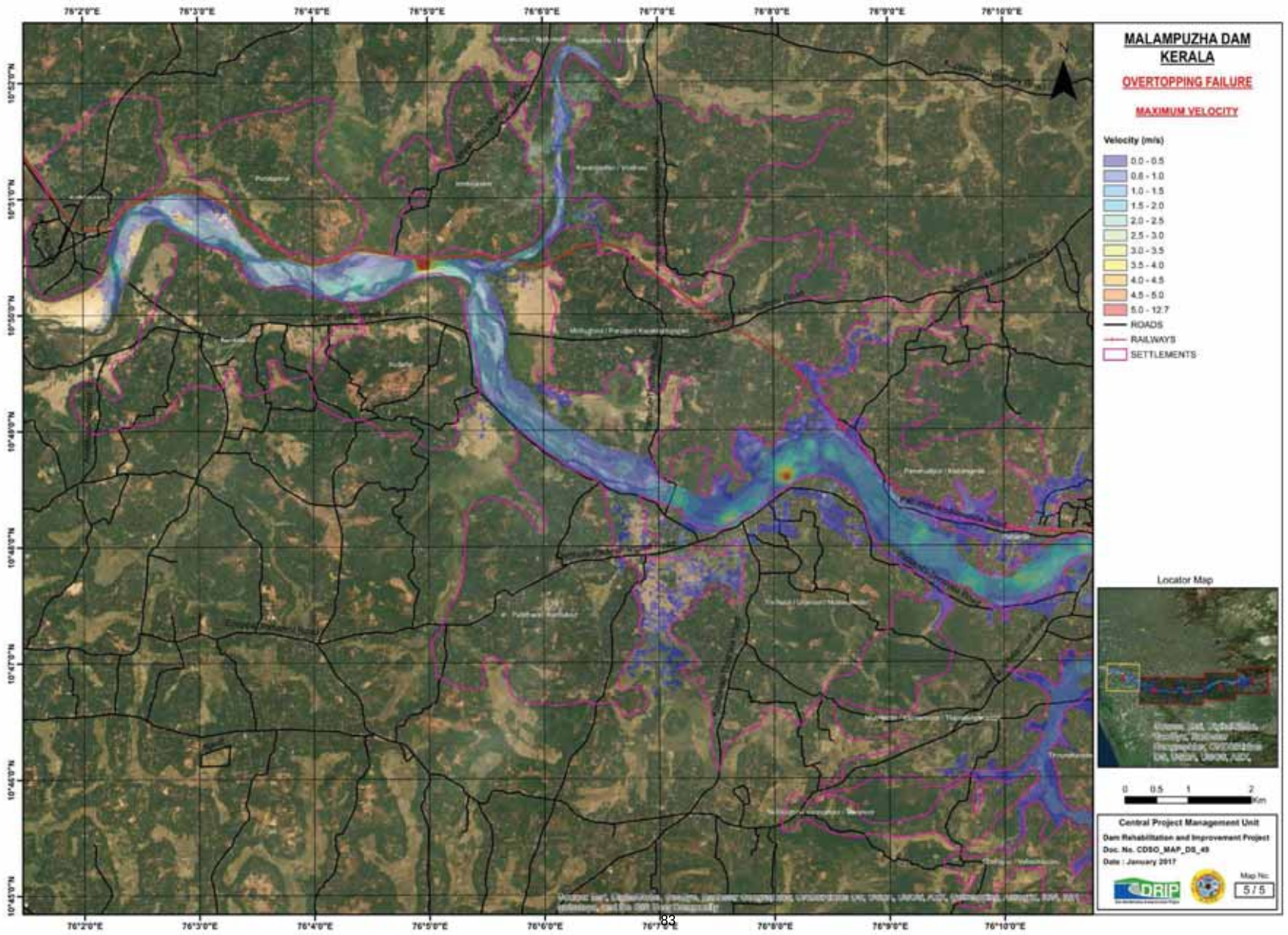
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.7
ROADS
RAILWAYS
SETTLEMENTS
MALAMPUZHA RESERVOIR
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
175
76°39'0"E
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
76°44'0"E
76°45'0"E
76°46'0"E
76°47'0"E


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.7
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
275
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E

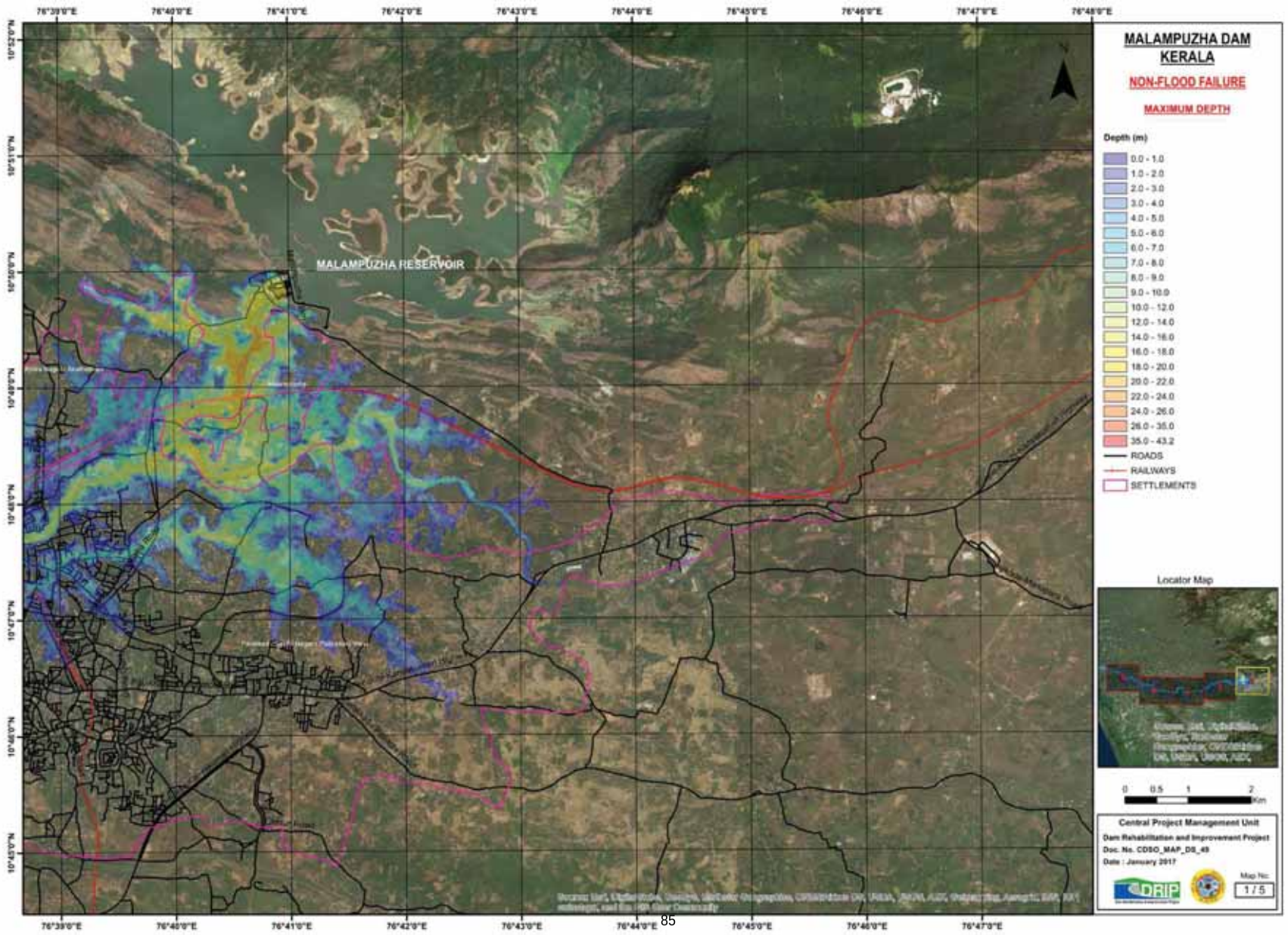

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.7
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
375
76°21'0"E
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E

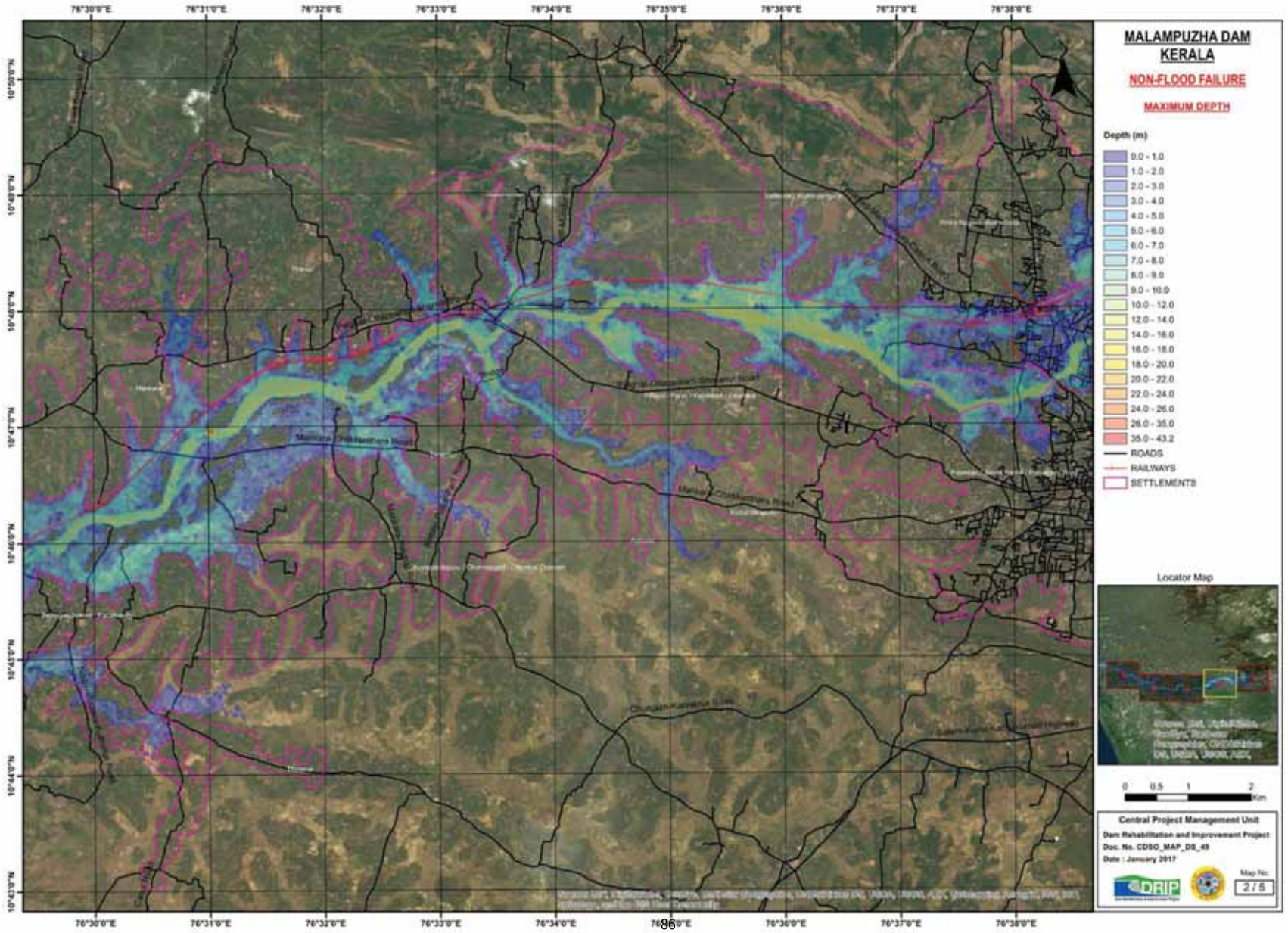

MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.7
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E


MALAMPUZHA DAM
KERALA
OVERTOPPING FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.7
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
5 / 5
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E

Annexure – 2 C

Inundation Map – Non-Flood Failure


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
MALAMPUZHA RESERVOIR
Locator Map
0 0.5 1 2 Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
1 / 5
76°39'0"E
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
76°44'0"E
76°45'0"E
76°46'0"E
76°47'0"E
76°48'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
275
76°30'0"E
76°31'0"E
76°32'0"E
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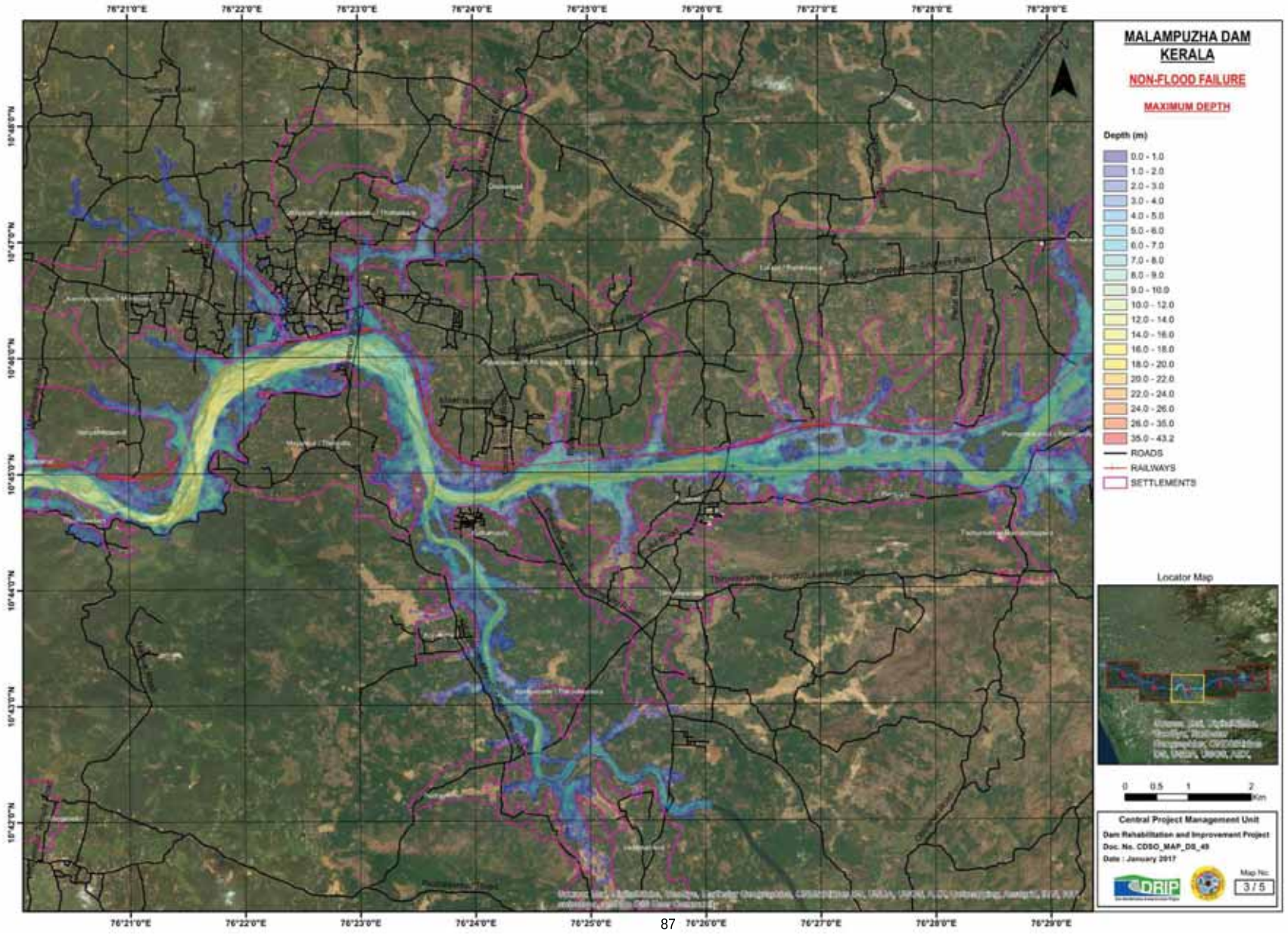
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
375
76°21'0"E
76°22'0"E
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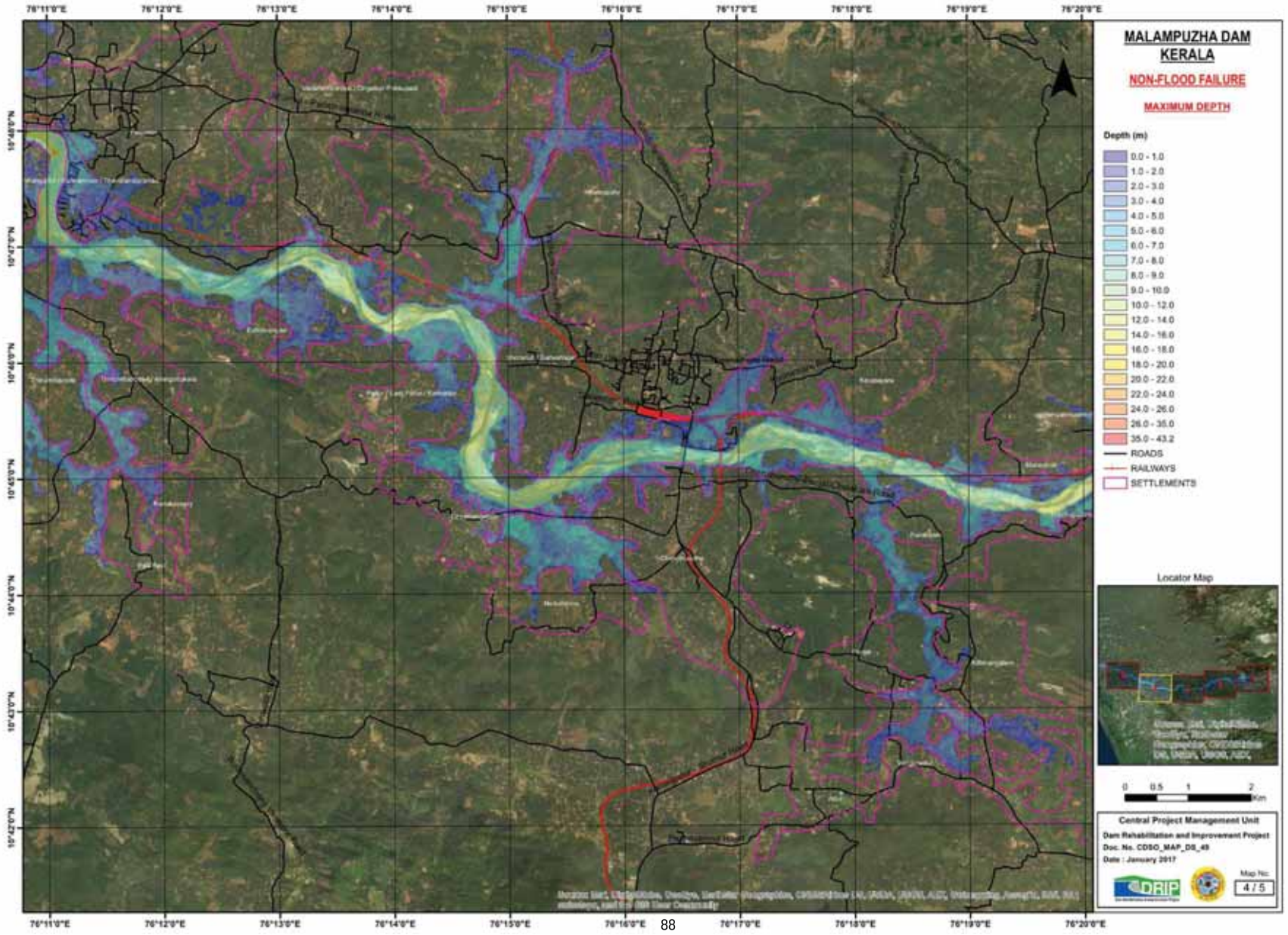
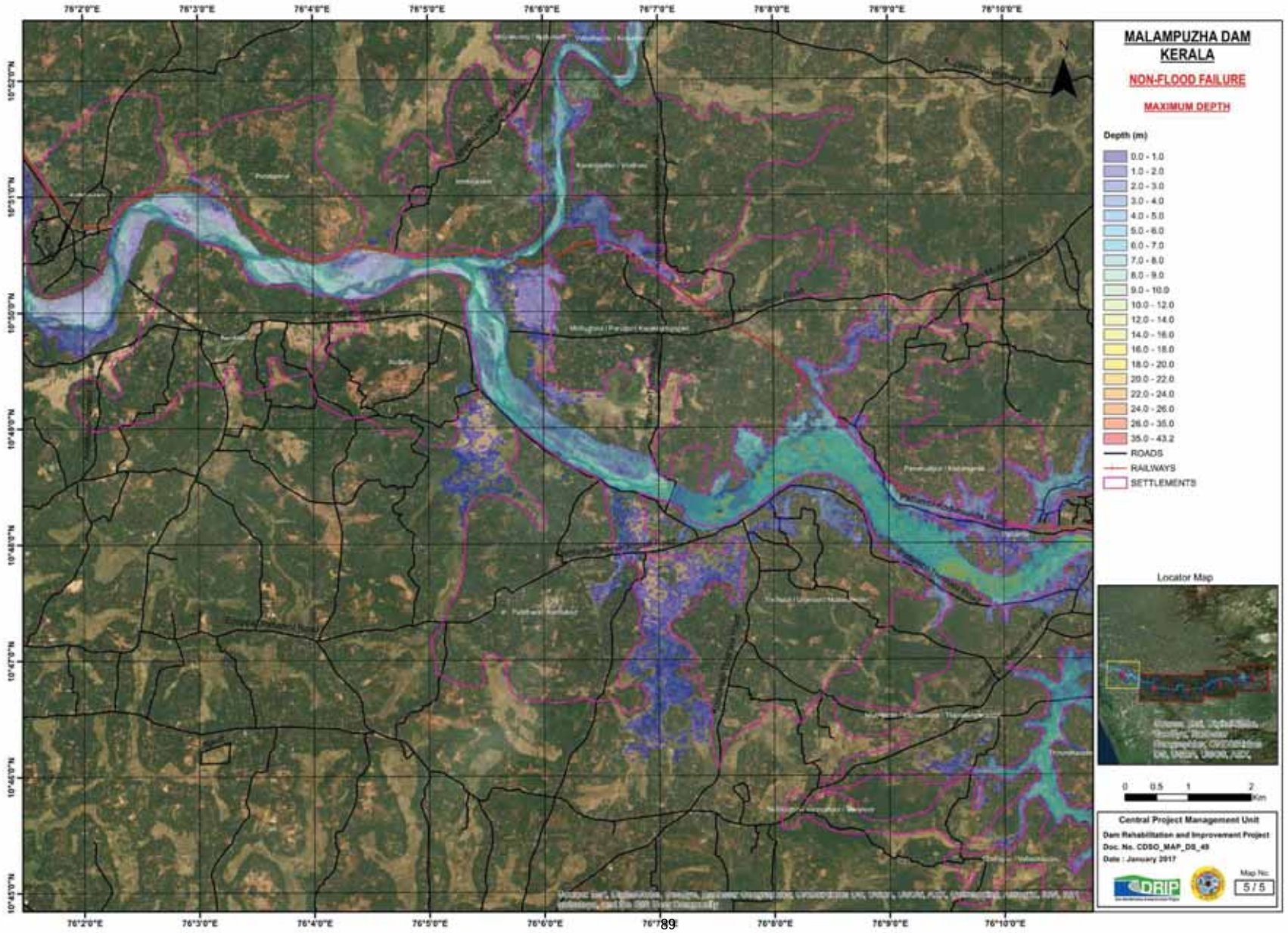
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM DEPTH
Depth (m)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 20.0
20.0 - 22.0
22.0 - 24.0
24.0 - 26.0
26.0 - 35.0
35.0 - 43.2
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
575
76°2'0"E
76°3'0"E
76°4'0"E
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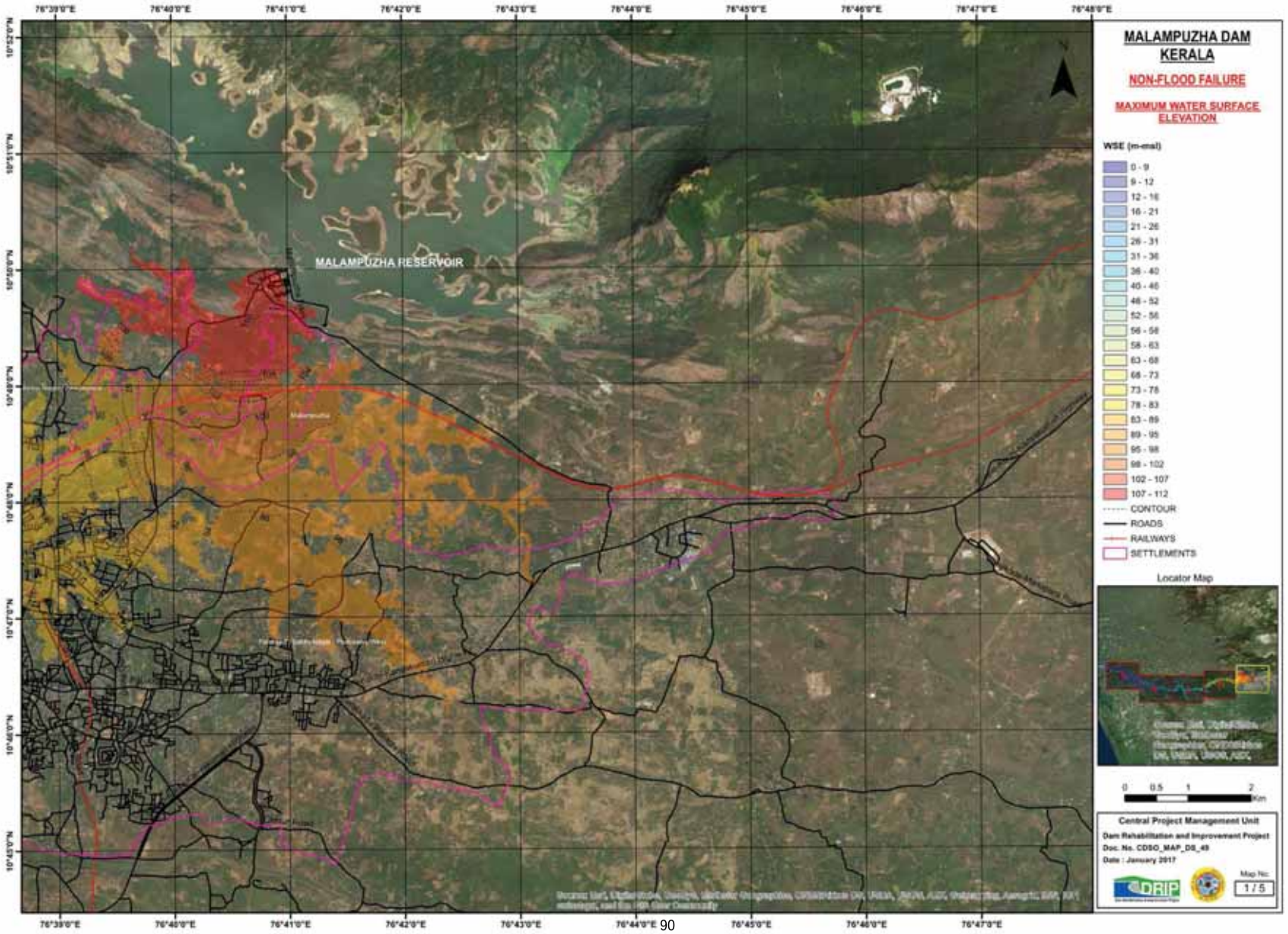
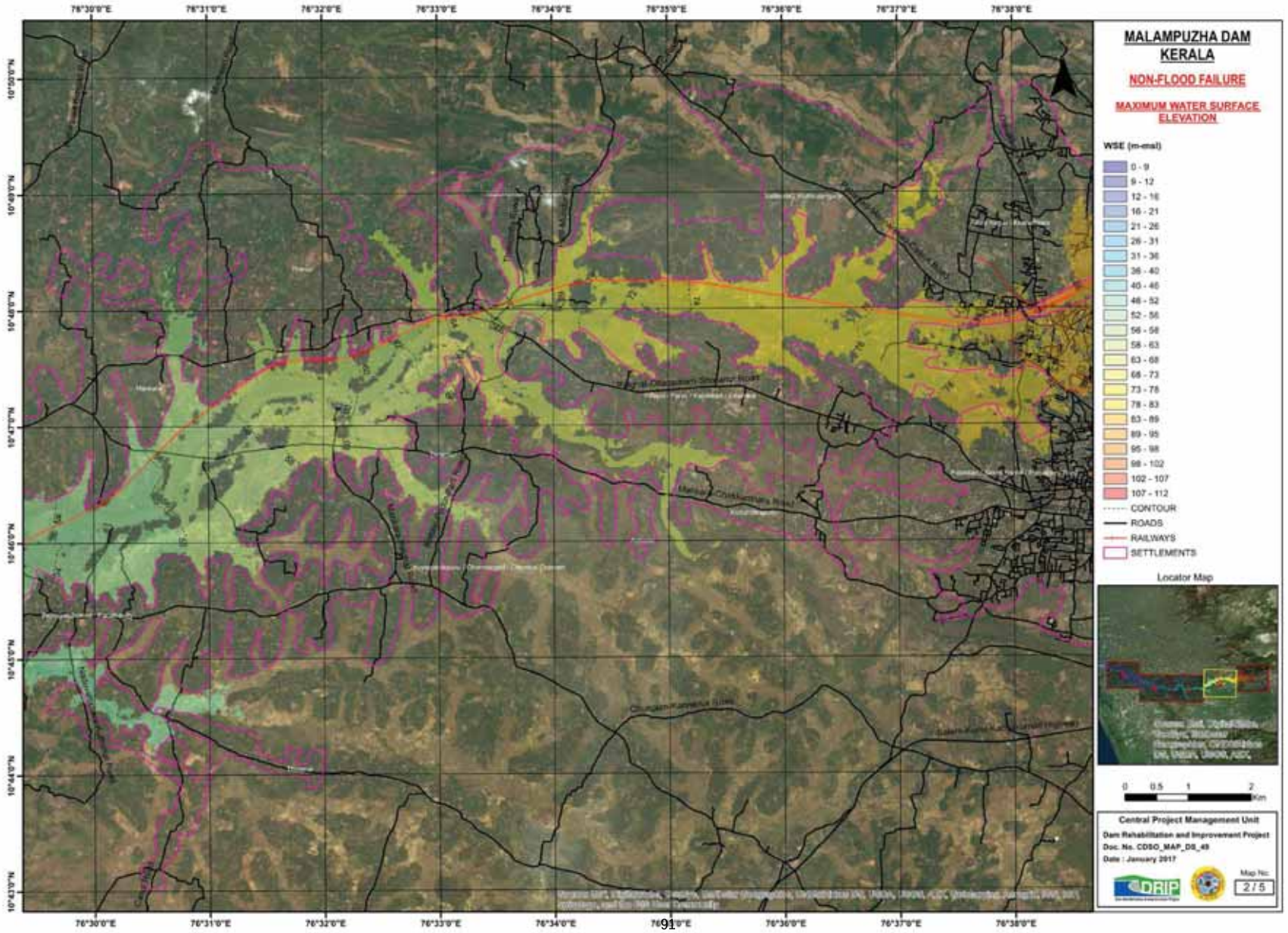
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m-msl)
0 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 112
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
MALAMPUZHA RESERVOIR
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
1 / 5


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m-msl)
0 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 112
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
275
76°30'0"E
76°31'0"E
76°32'0"E
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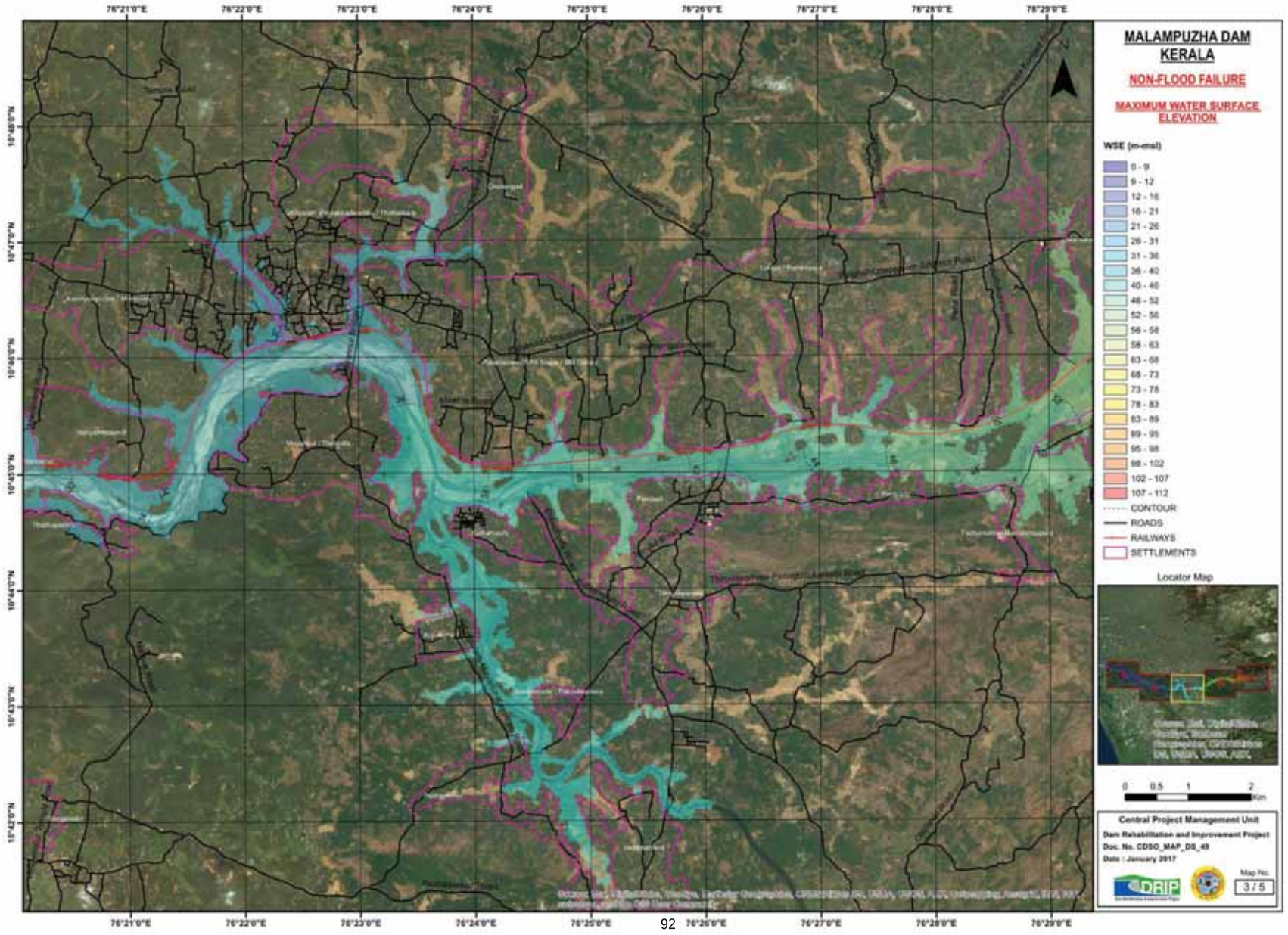
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m-msl)
0 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 112
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
375
76°21'0"E
76°22'0"E
76°23'0"E
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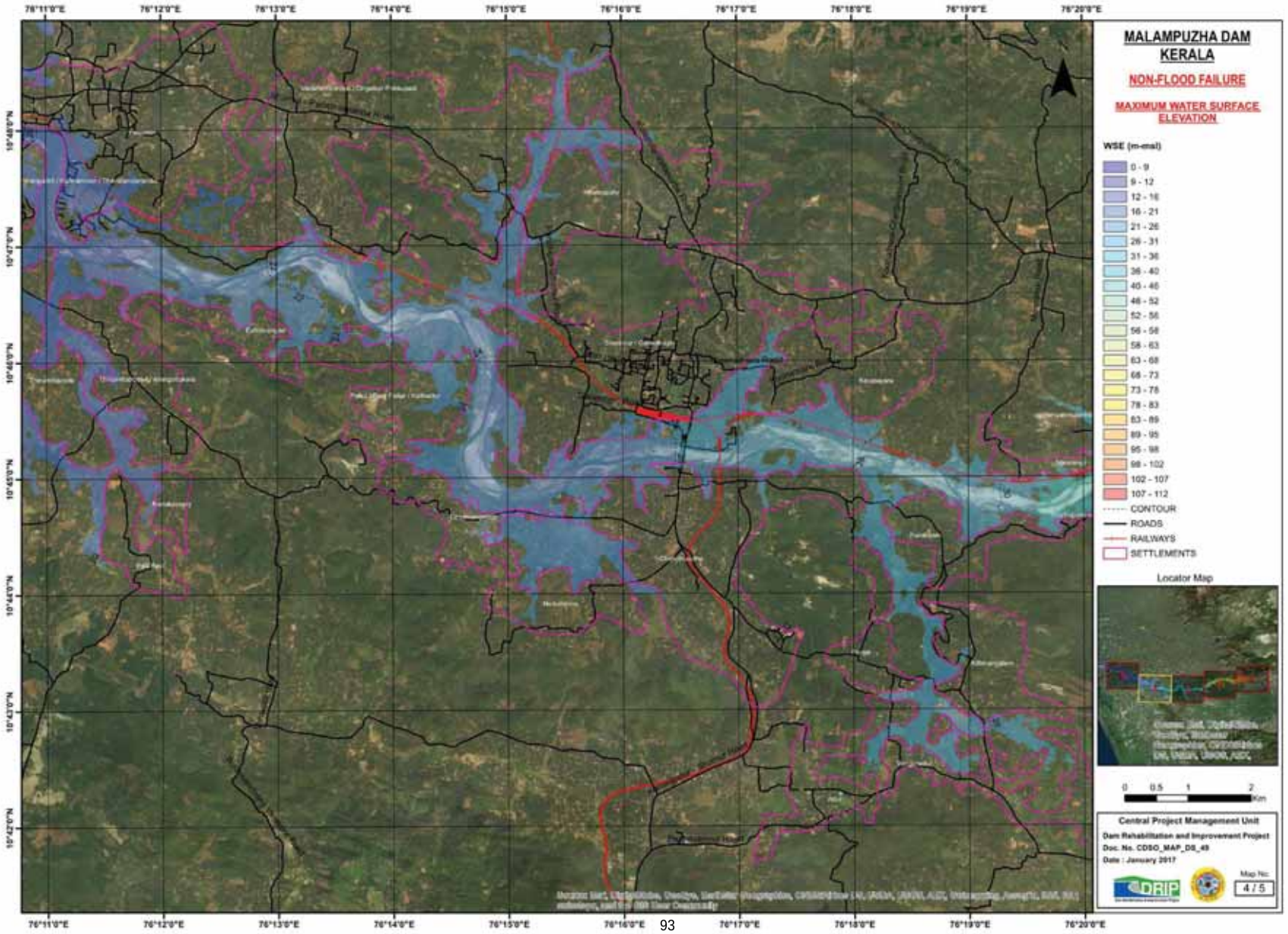
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m-msl)
0 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 112
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
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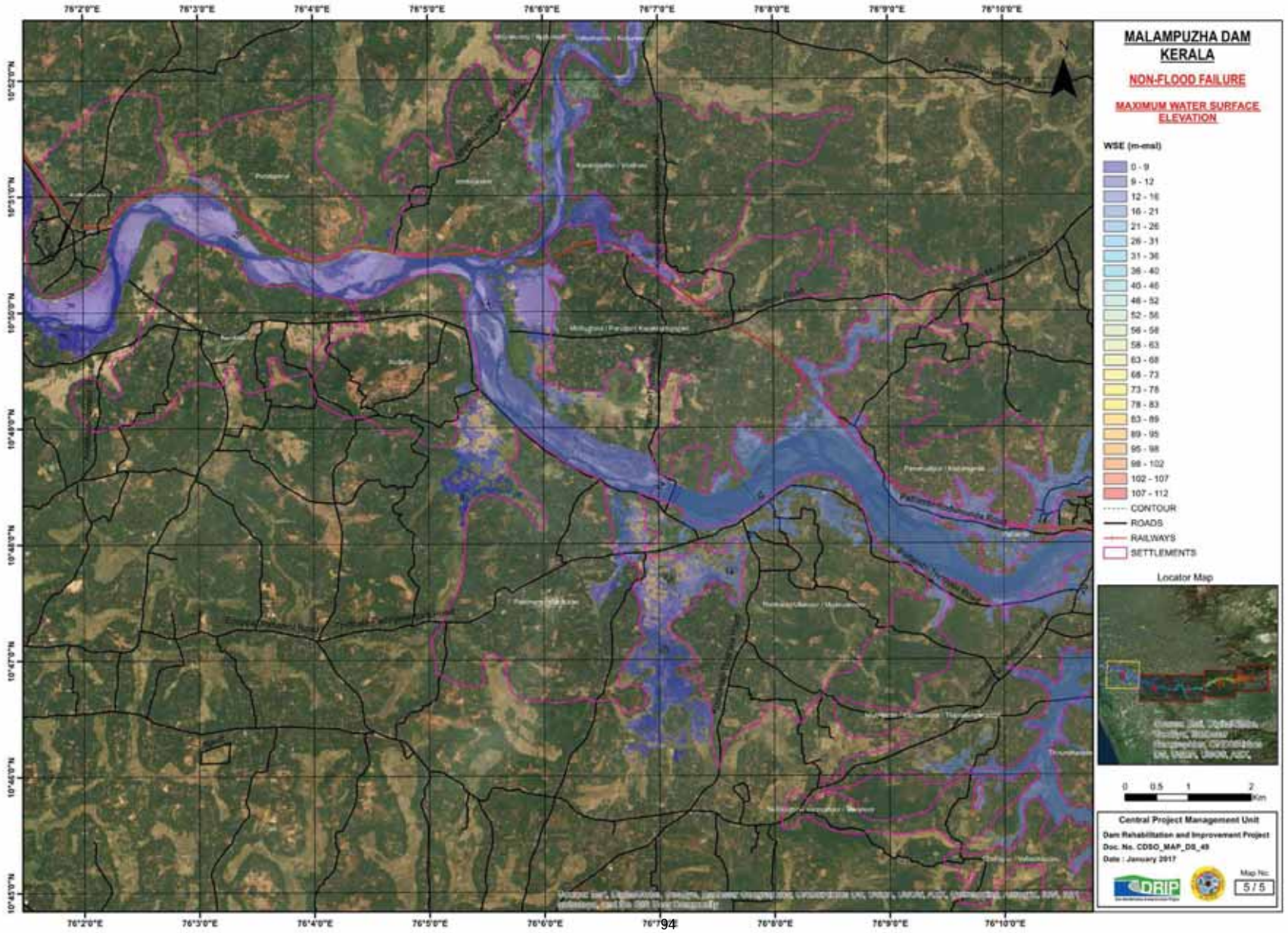
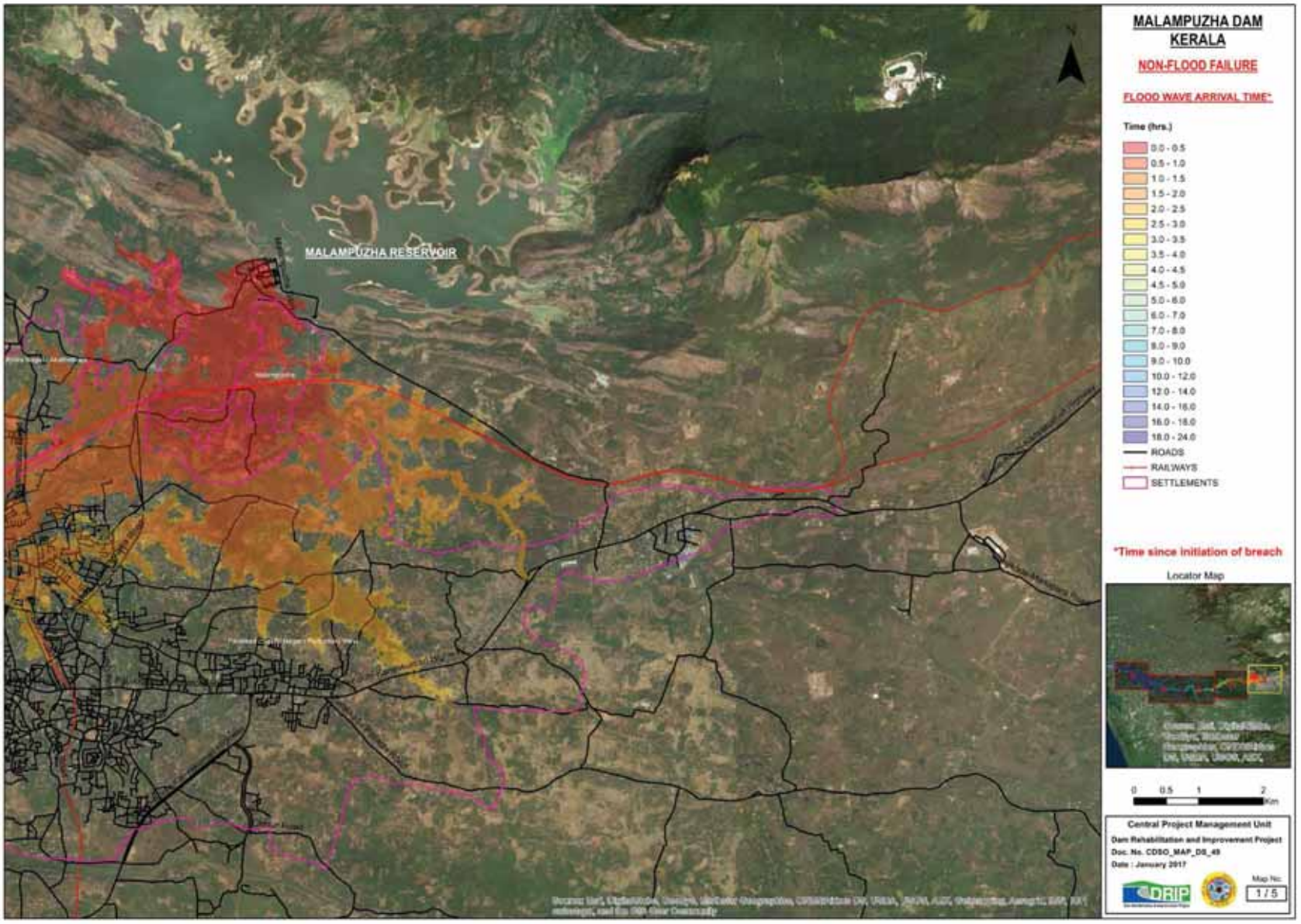
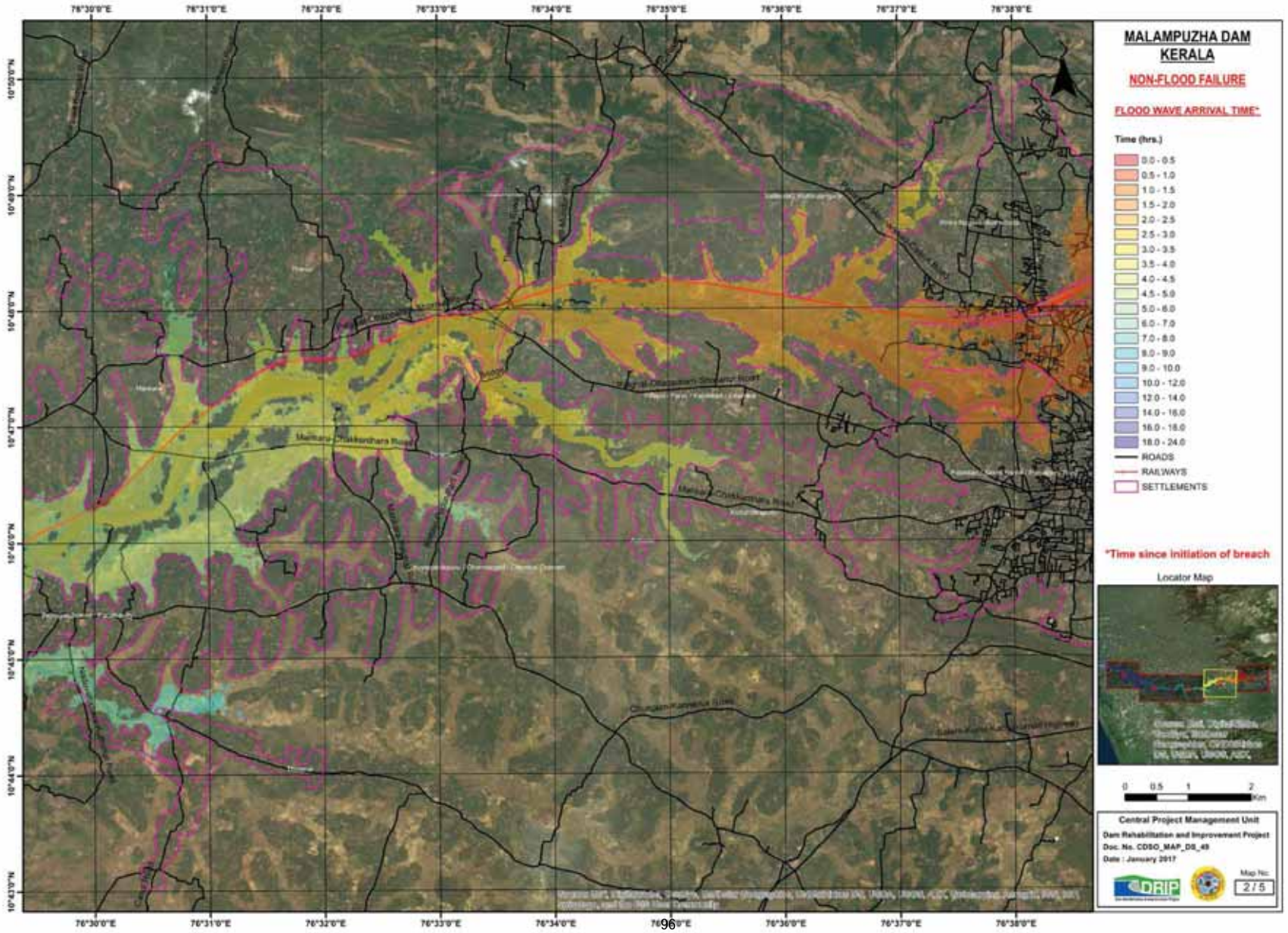
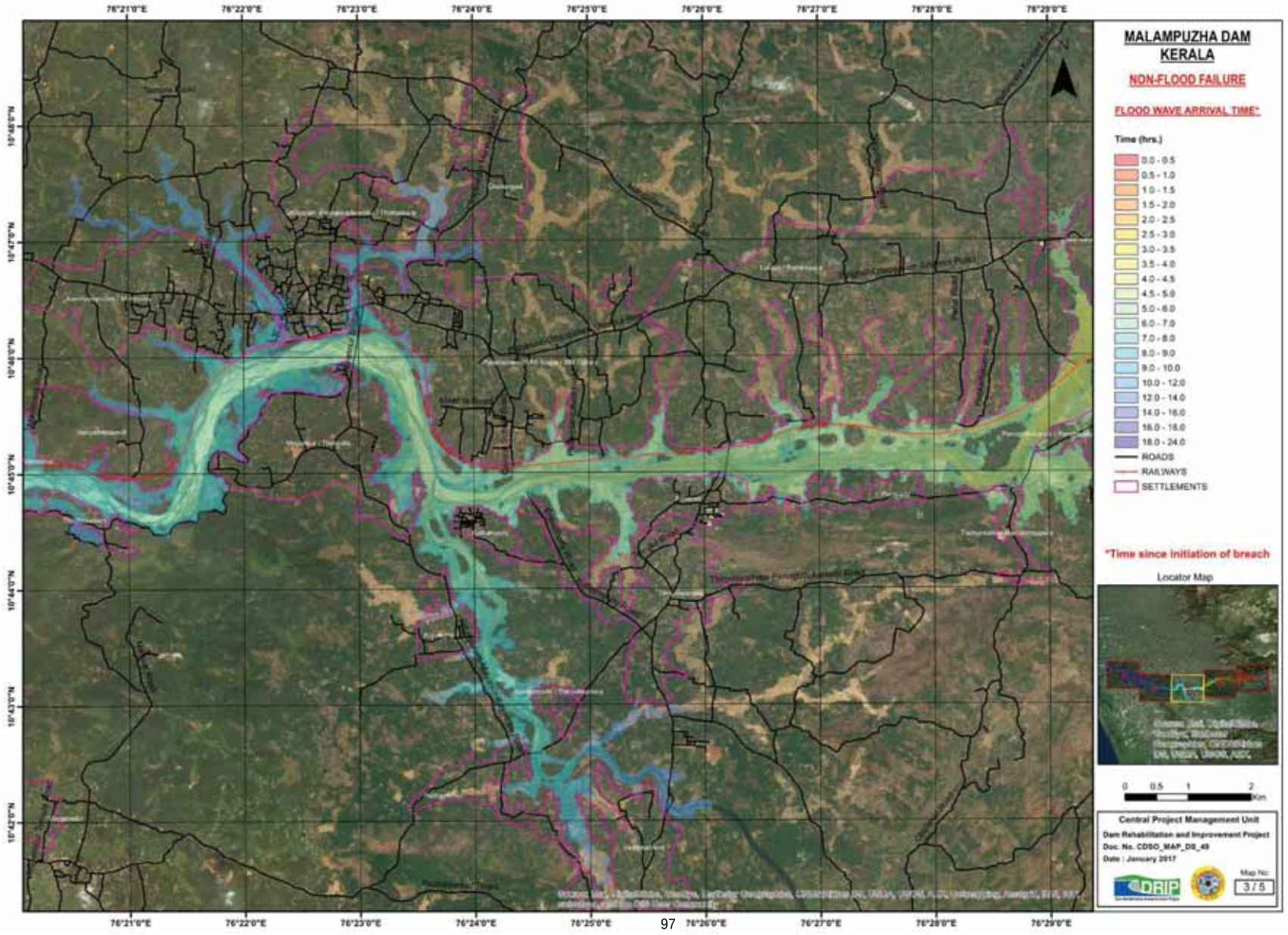
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM WATER SURFACE ELEVATION
WSE (m-msl)
0 - 9
9 - 12
12 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 40
40 - 46
46 - 52
52 - 56
56 - 58
58 - 63
63 - 68
68 - 73
73 - 78
78 - 83
83 - 89
89 - 95
95 - 98
98 - 102
102 - 107
107 - 112
CONTOUR
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
575
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E


MALAMPUZHA RESERVOIR
MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 24.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
1 / 5


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 24.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
275
76°30'0"E
76°31'0"E
76°32'0"E
76°33'0"E
76°34'0"E
76°35'0"E
76°36'0"E
76°37'0"E
76°38'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 24.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
375
76°21'0"E
76°22'0"E
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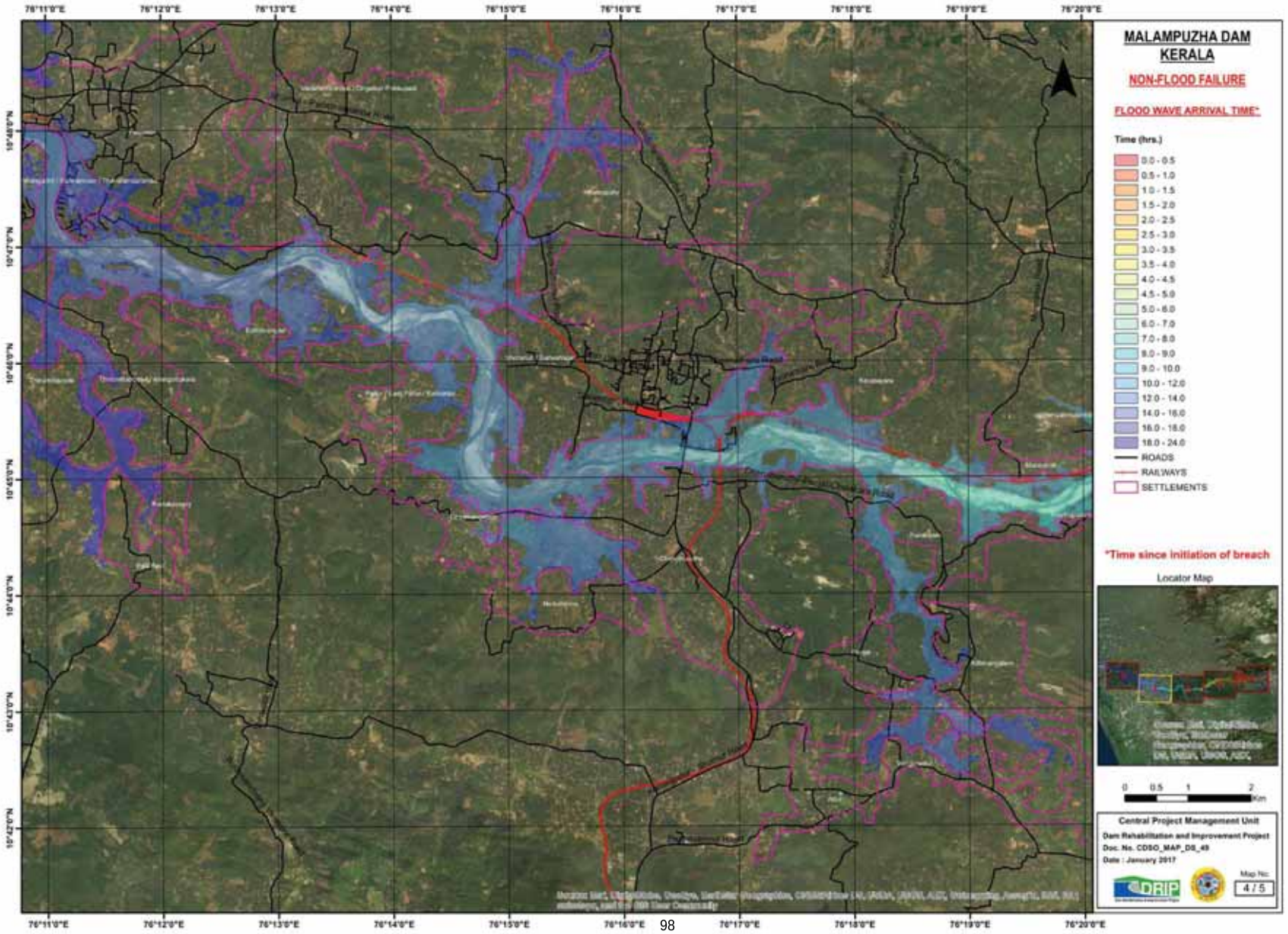
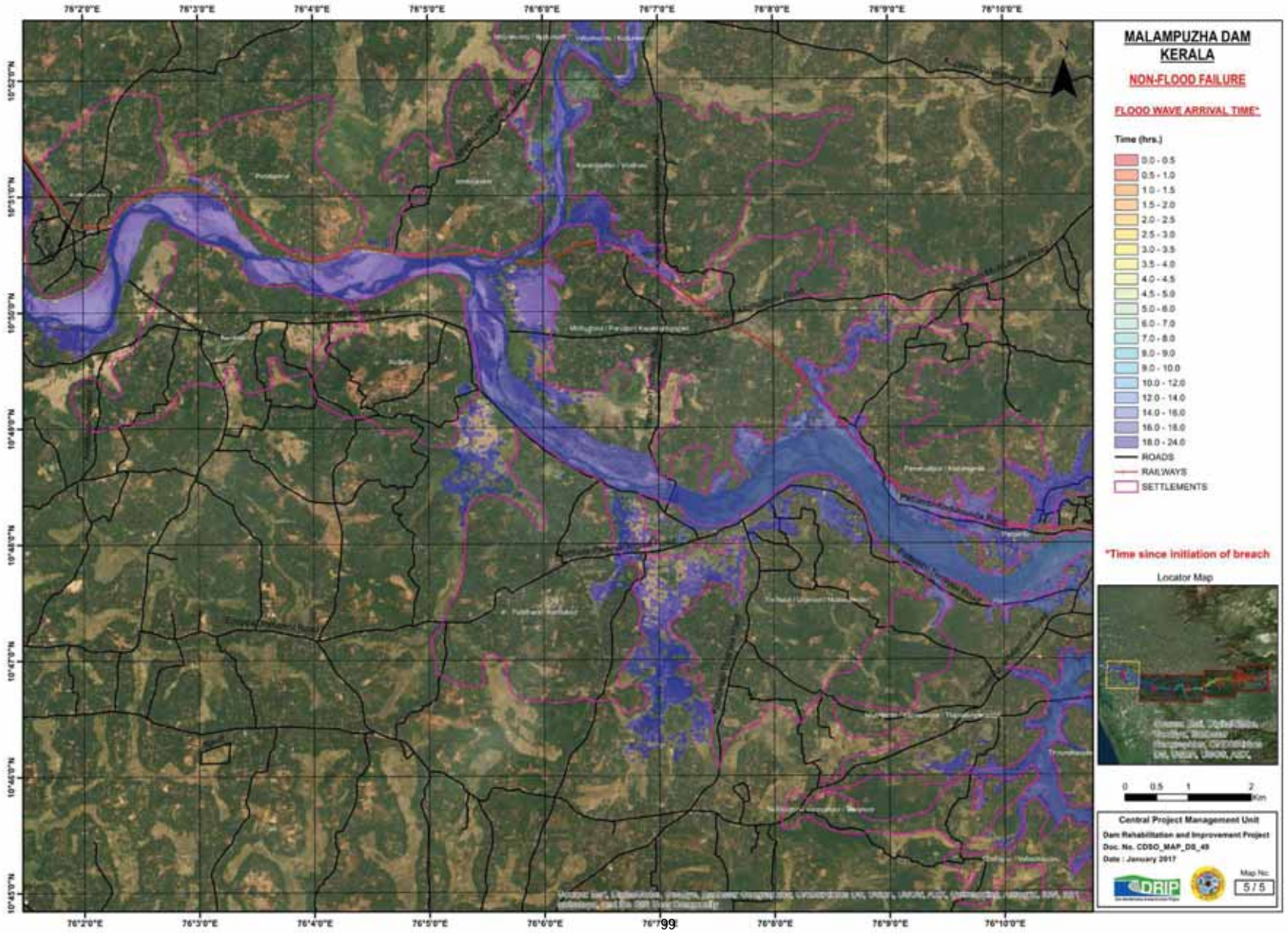
76°28'0"E
76°29'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 24.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
FLOOD WAVE ARRIVAL TIME*
Time (hrs.)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 6.0
6.0 - 7.0
7.0 - 8.0
8.0 - 9.0
9.0 - 10.0
10.0 - 12.0
12.0 - 14.0
14.0 - 16.0
16.0 - 18.0
18.0 - 24.0
ROADS
RAILWAYS
SETTLEMENTS
*Time since initiation of breach
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
575
76°2'0"E
76°3'0"E
76°4'0"E
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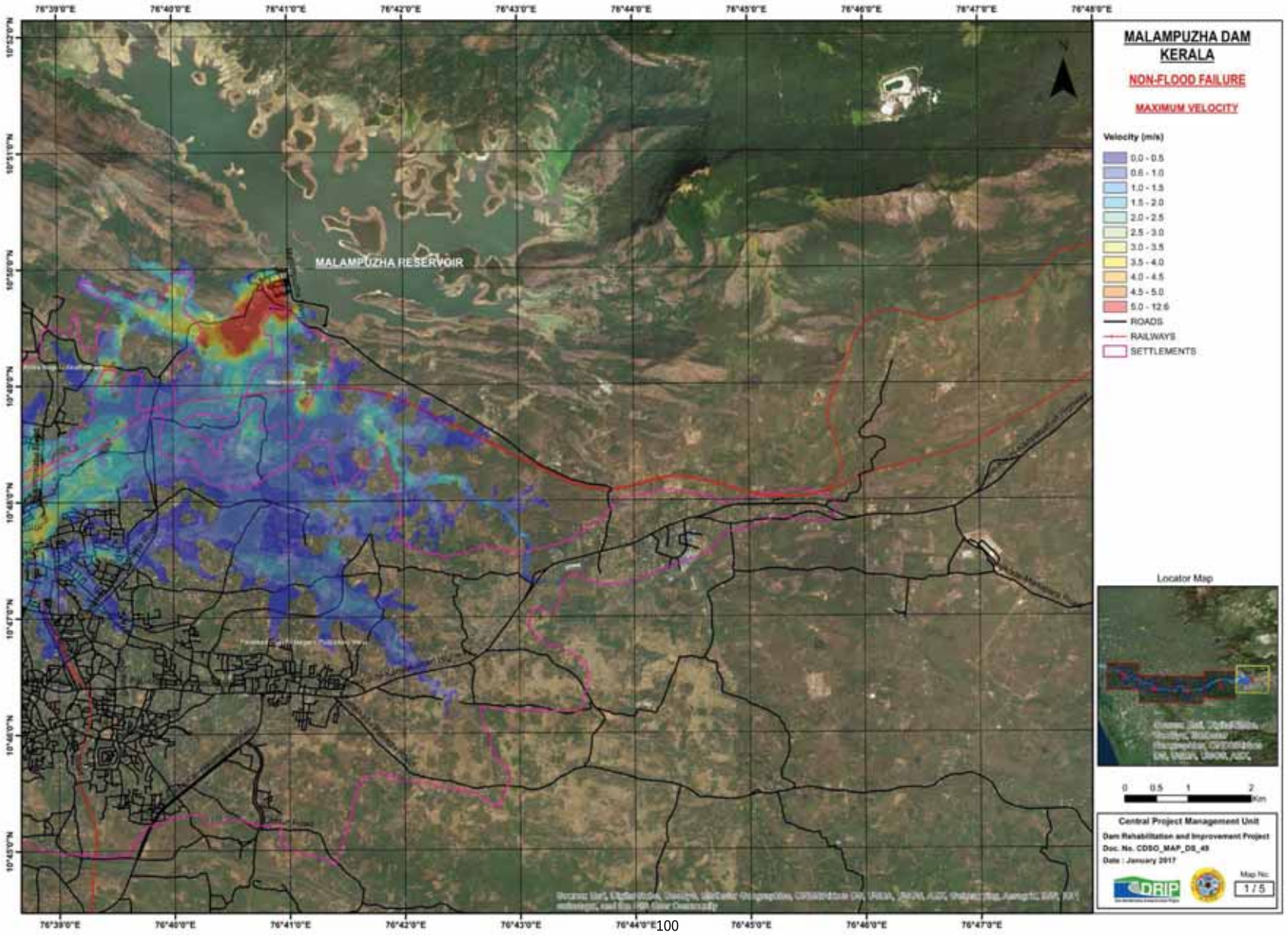
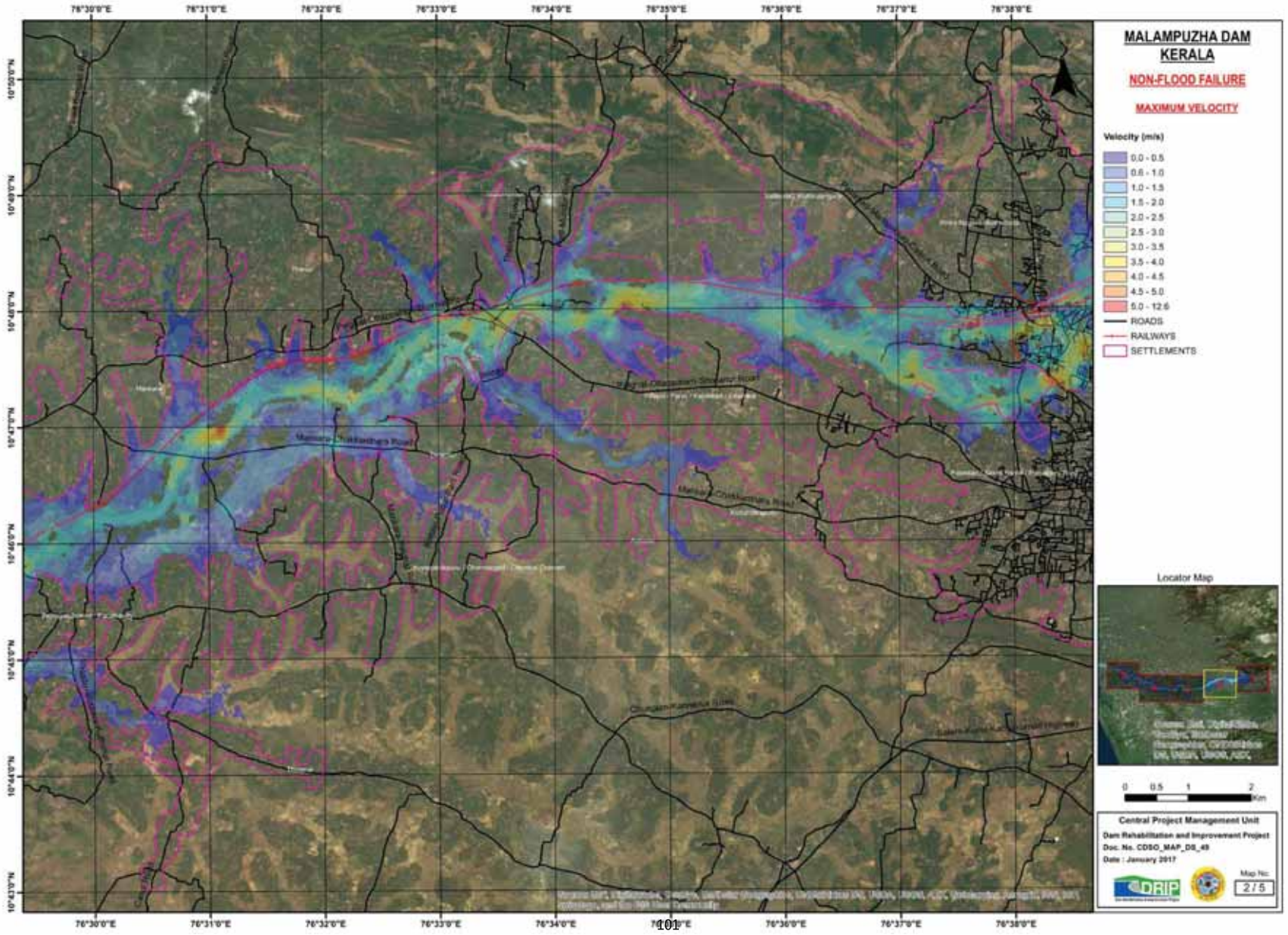
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.6
ROADS
RAILWAYS
SETTLEMENTS
MALAMPUZHA RESERVOIR
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
1 / 5
76°39'0"E
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
76°44'0"E
76°45'0"E
76°46'0"E
76°47'0"E
76°48'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
275
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76°31'0"E
76°32'0"E
76°33'0"E
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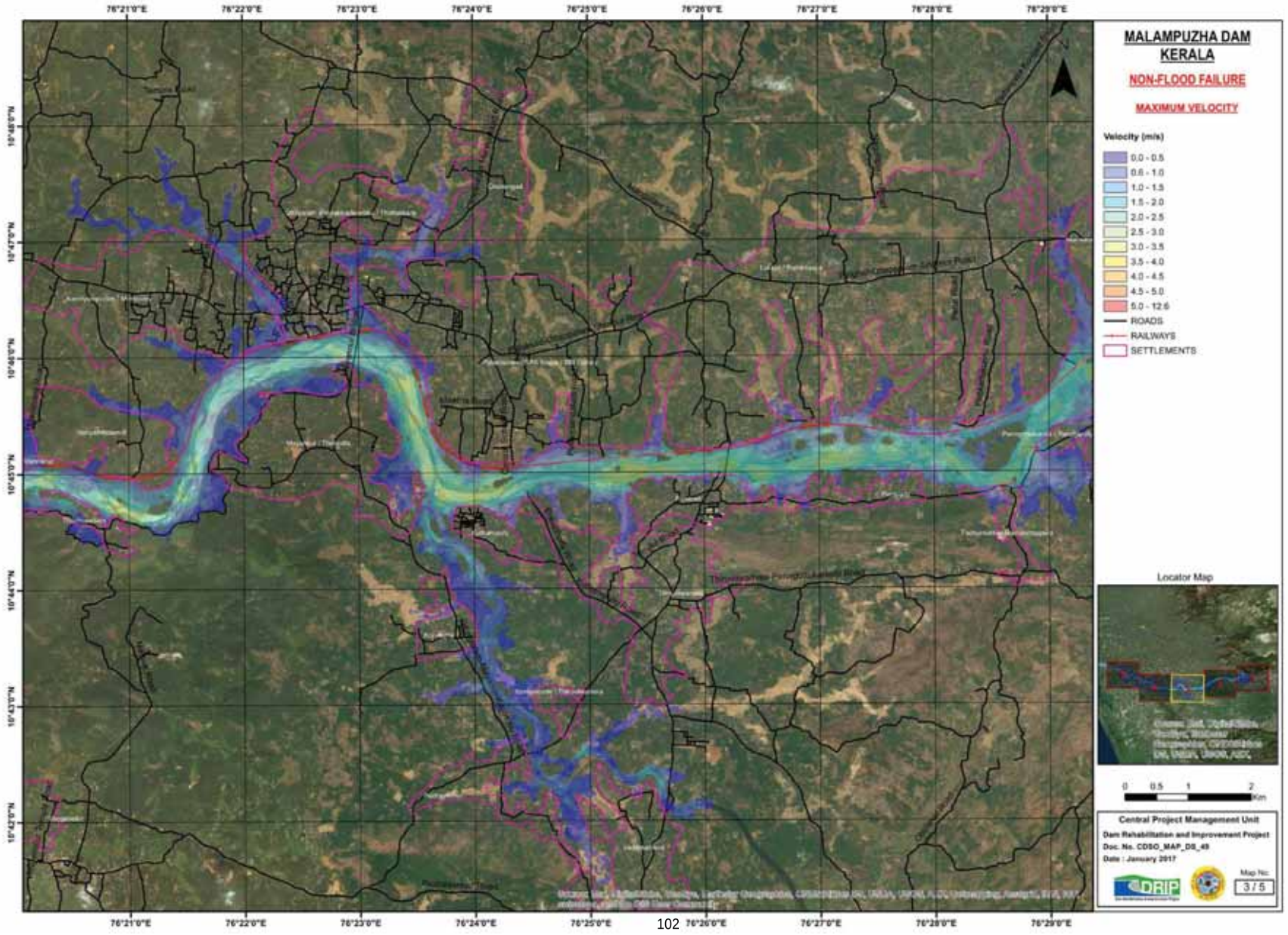
76°37'0"E
76°38'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No.
375
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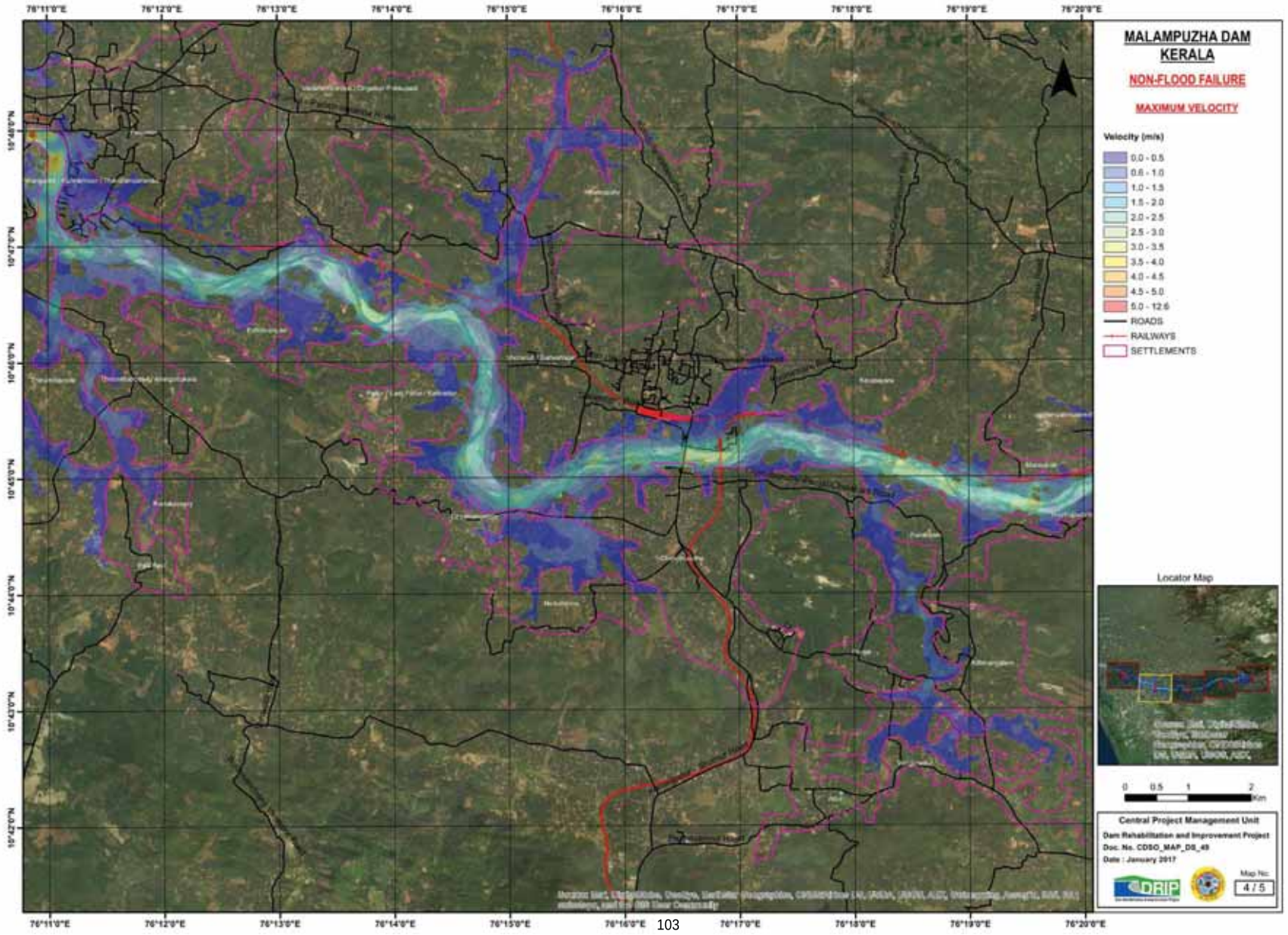
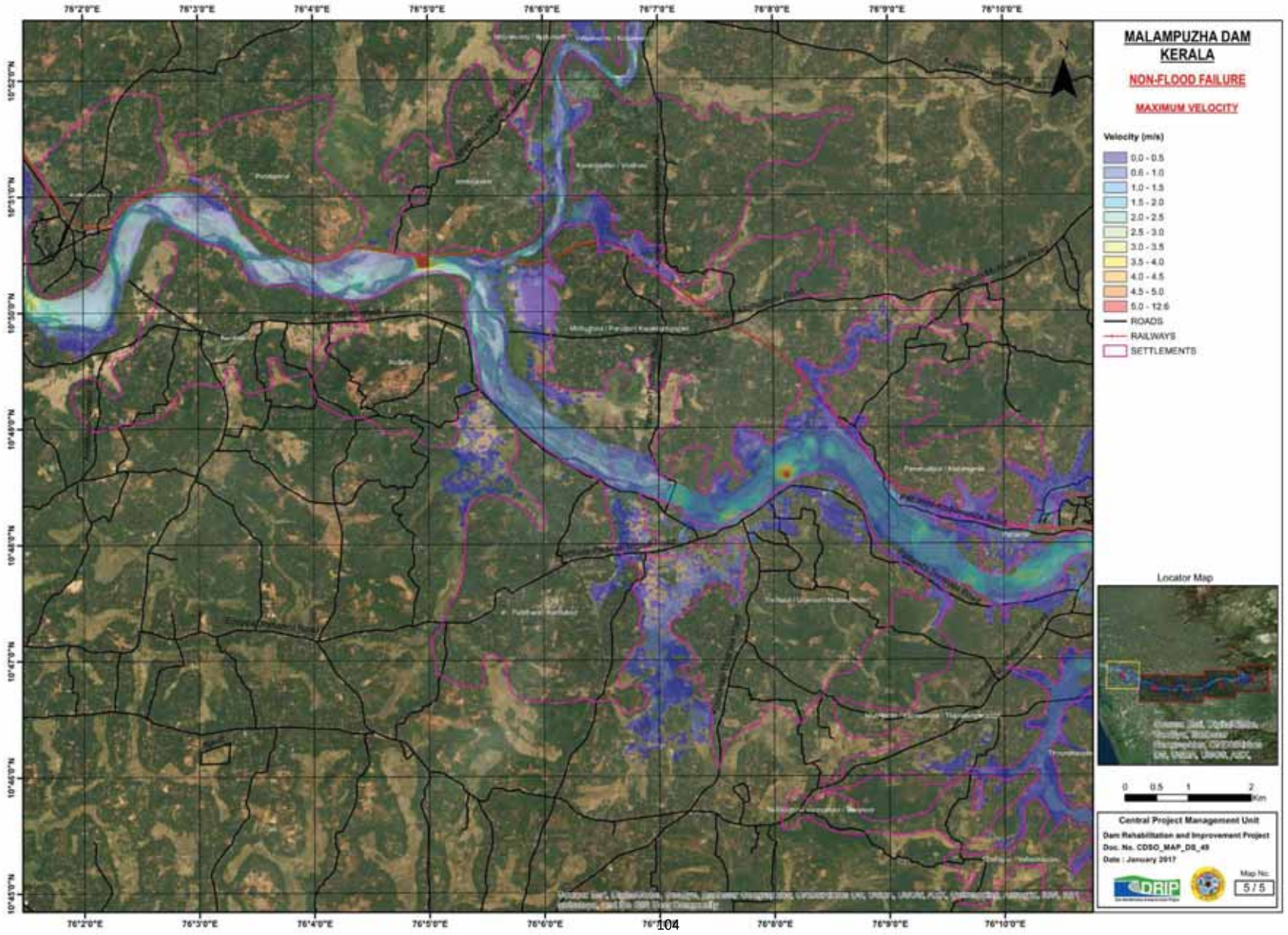
76°22'0"E
76°23'0"E
76°24'0"E
76°25'0"E
76°26'0"E
76°27'0"E
76°28'0"E
76°29'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
4 / 5
76°11'0"E
76°12'0"E
76°13'0"E
76°14'0"E
76°15'0"E
76°16'0"E
76°17'0"E
76°18'0"E
76°19'0"E
76°20'0"E


MALAMPUZHA DAM
KERALA
NON-FLOOD FAILURE
MAXIMUM VELOCITY
Velocity (m/s)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 12.6
ROADS
RAILWAYS
SETTLEMENTS
Locator Map
0 0.5 1 2
Km
Central Project Management Unit
Dam Rehabilitation and Improvement Project
Doc. No. CDSO_MAP_DS_49
Date : January 2017
Map No:
575
76°2'0"E
76°3'0"E
76°4'0"E
76°5'0"E
76°6'0"E
76°7'0"E
76°8'0"E
76°9'0"E
76°10'0"E

Annexure – 3

Flood Hazard Reference Values

Location	Distance [a] downstream from dam (km)	Estimated population [b] (People)	Potential loss of life [c] (People)	Overtopping Failure			Non-flood Failure			Large controlled Release	
				Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)
Malampuzha	0.3	1,737	635	20.30	8.18	<5min	19.43	7.93	00:05	10.10	0.92
Athira/Akathethara	1.5	10,234	423	18.65	5.09	00:10	17.63	4.67	00:10	2.02	0.09
Palakkad/Sakthi Nagar /Pudussery West	2.5	50,897	1176	17.72	4.91	00:15	16.96	4.63	01:30	8.93	3.12
Vallikode/ Muttikulangara	6.7	7,552	0	8.53	2.23	01:40	7.55	1.93	01:50	0.92	0.12
Pirayiri / Parali/ Kallekkad / Edathara	9.1	6,348	0	8.97	4.43	01:50	8.13	4.70	02:05	2.84	2.12
Kodunthirapully	10.6	1,743	0	3.12	0.55	03:45	2.50	0.43	04:10	--[f]	--
Vadakkumuri / Narikkode	11.7	4,122	0	8.08	2.88	02:20	7.27	2.72	02:30	1.73	0.72
Anikode	12.7	608	0	1.11	0.79	04:35	--	--	--	--	--
Odannur	13.8	2,730	0	6.62	3.00	02:30	6.09	2.84	02:45	0.37	1.31
Thenur	15.1	8,136	0	10.34	2.09	02:45	9.73	1.95	03:05	1.40	0.21
Ayappankaavu /Chennangad/Chembai Gramam	15.6	4,674	0	6.80	0.71	03:10	6.23	0.63	03:30	0.27	0.05
Peringottukurissi/ Paruthipully	19.0	4,574	0	7.16	2.37	04:00	6.61	2.21	04:20	1.18	0.38

Location	Distance [a] downstream from dam (km)	Estimated population [b] (People)	Potential loss of life [c] (People)	Overtopping Failure			Non-flood Failure			Large controlled Release	
				Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)
Mankara	19.3	4,938	0	5.34	0.84	03:55	4.83	0.78	04:15	0.23	0.34
Tholanur	19.5	1,950	0	5.16	1.12	05:55	4.69	0.96	06:25	--[f]	--
Lakkidi / Pathirippala	22.4	19,204	0	6.07	1.53	04:10	5.56	1.50	04:30	1.40	0.52
Thottumukku /Naduvattappara	24.2	510	0	8.33	2.73	04:35	7.85	2.61	04:55	2.40	0.93
Pampady	25.6	745	0	5.04	1.38	05:30	4.55	1.08	06:00	--	--
Pambadi	27.8	1,332	0	8.02	2.52	05:10	7.57	2.42	05:35	1.43	1.56
Palapppuram/SRK Nagar/SBI Colony	28.8	12,351	0	6.77	1.28	06:10	6.71	1.09	06:40	--	--
Thiruvilwamala	28.8	3,573	0	3.65	0.69	06:40	3.29	0.59	07:20	--	--
Chunangad	30.2	2,905	0	0.71	0.07	11:50	0.68	0.07	13:10	--	--
Vadakkethara	31.3	1,899	0	3.41	0.51	09:40	3.37	0.47	10:40	--	--
Kuthampully	31.7	580	0	5.76	2.64	6:15	5.54	2.51	06:45	0.23	1.15
Kaniyarcode/ Thiruvilwamala	31.8	299	0	--	--	---	--	--	--	--	--
Ottapalam/ Poolakkaparambu/ Thottakkara	32.1	5,635	0	7.69	1.77	07:25	7.65	1.70	08:00	--	--

Location	Distance [a] downstream from dam (km)	Estimated population [b] (People)	Potential loss of life [c] (People)	Overtopping Failure			Non-flood Failure			Large controlled Release	
				Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)
Pazhayanur	32.9	1,466	0	3.42	0.42	08:10	3.35	0.37	08:50	--[f]	--
Kondazhy	33.0	778	0	3.54	0.37	07:10	3.35	0.34	07:50	--	--
Mayannur/Teepara	33.1	4,234	0	8.52	2.17	06:40	8.48	2.08	07:05	2.05	1.35
Kanniyampuram/ Manissery	34.7	6,305	0	8.18	1.68	07:15	8.15	1.63	07:45	1.73	0.23
Vaniyamkulam-II	36.7	2,782	0	6.94	1.04	07:40	6.91	1.03	08:15	1.13	0.05
Thozhupadam	37.7	575	0	9.01	2.16	07:45	9.00	2.09	08:15	3.38	1.15
Mannanur	39.1	698	0	5.75	0.65	08:30	5.74	0.62	09:05	0.13	0.09
Painkulam	39.6	1,685	0	5.52	2.12	08:30	5.54	2.07	09:05	0.41	0.77
Venganellur	40.1	2,470	0	2.82	0.55	13:00	3.02	0.54	14:05	--	--
Killimangalam	40.6	2,262	0	2.72	0.83	12:35	3.00	0.94	13:35	--	--
Kavalapara	41.0	4,021	0	5.39	1.30	10:15	5.56	1.38	10.55	--	--
Shoranur/Ganeshagiri	42.2	10,717	0	5.51	1.35	10:00	5.78	1.31	10:40	0.15	0.21
Panjal	42.6	1,214	0	3.98	0.28	10.30	4.09	0.25	11:15	--	--
Cheruthuruthy	42.8	7,405	0	8.14	2.89	08:50	8.33	2.83	09:20	3.25	1.78
Attur	42.9	1,858	0	1.82	0.36	13:25	2.02	0.39	14:30	--[f]	--
Kulappully	43.5	7,161	0	5.52	0.60	13:10	5.78	0.58	14:00	--	--
Nedumpura	46.6	1,624	0	2.87	0.45	13.05	3.12	0.44	14:00	--	--
Vadanamkurussi/Ongallur/Pokkupadi	46.8	11,707	0	7.51	1.12	11.30	7.78	1.23	12:10	1.66	0.60

Location	Distance [a] downstream from dam (km)	Estimated population [b] (People)	Potential loss of life [c] (People)	Overtopping Failure			Non-flood Failure			Large controlled Release	
				Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)
Desamangalam	47.7	1,610	0	7.86	1.56	10:00	8.11	1.52	10:35	2.53	0.94
Pallur/East Pallur/Kattavattur	48.4	2,690	0	9.69	2.27	10.25	9.95	2.39	11:00	4.83	0.72
Ezhumangad	51.2	1,248	0	3.41	0.76	13.00	3.98	0.80	13:45	--	--
Pattambi	51.5	10,488	0	8.44	2.06	12:30	9.19	2.37	13:15	4.69	1.31
Thirumittacode-1 /Arangottukara	52.9	3,146	0	5.52	0.78	12.55	6.58	0.77	13:40	0.22	0.11
Kadukassery	53.2	529	0	2.18	0.17	19.30	3.57	0.26	20:25	--	--
Pallipadi	53.6	1,365	0	1.34	0.46	18.55	2.56	0.51	19:50	--	--
Thirumittacode	54.3	3,798	0	8.87	1.95	12.15	9.59	1.92	12:55	4.95	1.49
Nhangattiri/Kannannoor/ Thavalamparambil	54.9	9,023	0	11.66	3.95	12:25	12.37	3.79	13:05	7.85	3.01
Cherippur/Velladikkunnu	55.7	2,095	0	3.44	0.41	16:50	4.56	0.43	17:45	--	--
Perumudiyur/Kodumunda	55.9	6,399	0	7.33	0.81	15:05	7.97	0.82	15:50	--	--
Nellikkattiril/Varavattoor/ Vavanoor	56.4	2,331	0	6.46	0.86	15:20	7.56	0.85	16:10	--	--

Location	Distance [a] downstream from dam (km)	Estimated population [b] (People)	Potential loss of life [c] (People)	Overtopping Failure			Non-flood Failure			Large controlled Release	
				Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)	Flood wave arrival time [e] (hh:mm)	Maximum depth [d] (m)	Maximum velocity [d] (m/s)
Muthuthala/Parudur/Karakkuthangadi	56.6	16,263	0	4.83	0.79	15:25	5.37	0.90	16:10	1.36	0.50
Thrithala/Ullanoor/Mudavannoor/	57.9	12,077	0	7.85	2.34	14:15	8.38	2.34	15:00	4.39	1.89
Karambathur/Vilathoor	59.0	10,524	0	--	--	--	--	--	--	--	--
Pattithara/Kundukad	62.4	11,253	0	4.64	1.12	16:20	5.43	1.11	17:10	--	--
Valiyakunnu/Kodumudi	62.6	7,445	0	--	--	--	--	--	--	--	--
Irimbillayam	63.9	9,798	0	--	--	--	--	--	--	--	--
Kudallur	64.8	6,341	0	4.96	2.04	17:15	6.11	2.19	18:05	--	--
Perssannur	66.7	8,966	0	--	--	--	--	--	--	--	--
Kumbidi	66.7	9,401	0	3.94	1.18	18:30	5.67	1.37	19:20	--	--
Kuttipuram	69.9	8,974	0	--	--	--	--	--	--	--	--

[a] Approximate Shortest distance downstream from dam

[b] Estimated population within the assumed settlement boundaries

[c] Potential loss of life for the overtopping failure scenario base on the estimated population density

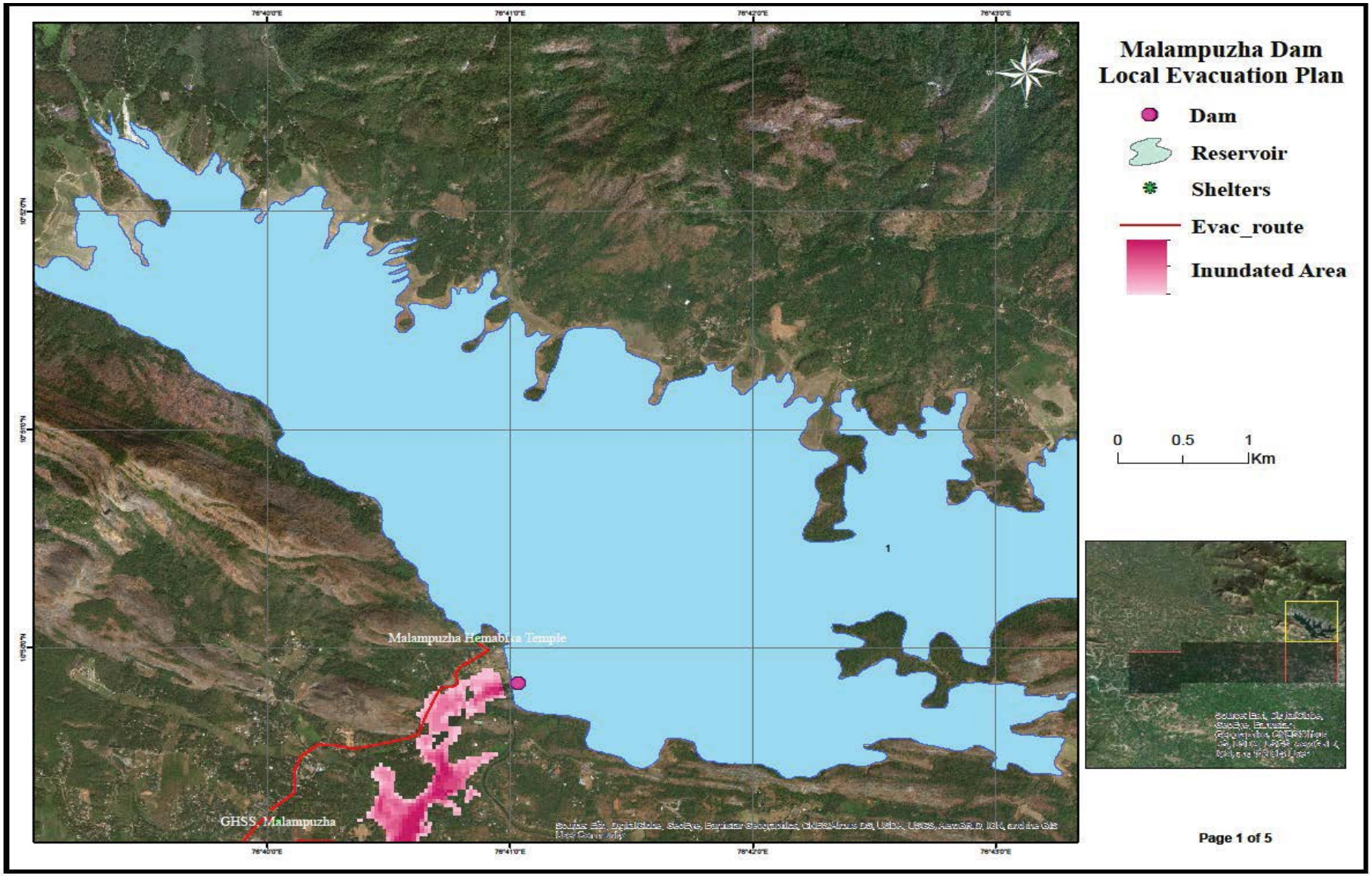
[d] Maximum value near the specified location, which usually occurs near the center of the stream

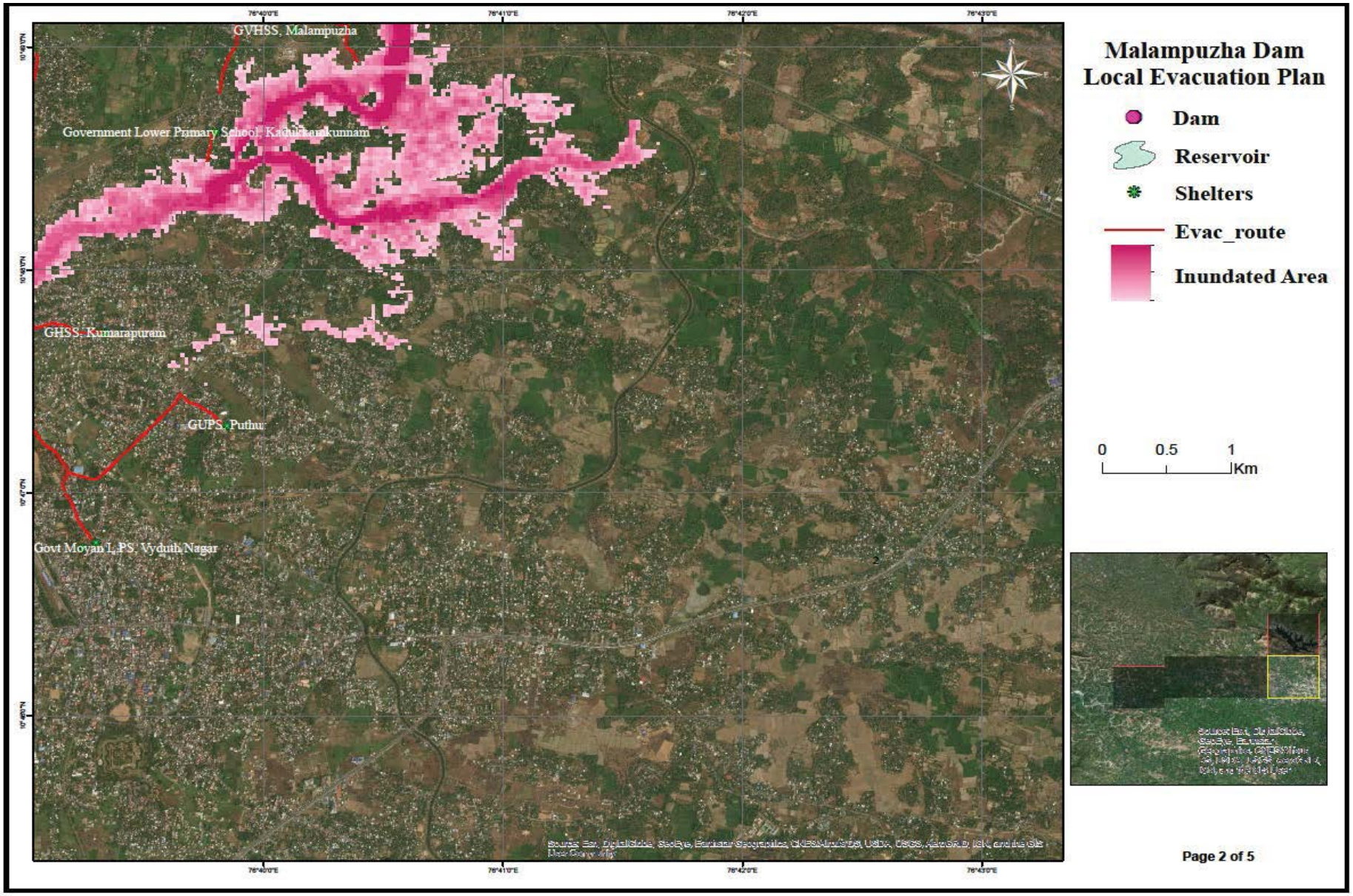
[e] Flood wave arrival time is the time since the initiation of the dam breach until the settlements inundated

[f] Location not inundated

Local Evacuation Plan

Evacuation Priority	Location	Nearby Shelters or relief camp identified	Responsible for Evacuation	Title id in Inundation Map
1	Malampuzha	Malampuzha Hemabika Temple	District Police Chief, Palakkad	(1/5)
2	Parli	Parli Govt School		(2/5)
3	Nurani	Nurani Govt School		(1/5)
4	Kadukkamkunam	Kadukkamkunam L P School		(1/5)
5	Olavakkod	Olavakkod MES School		(2/5)
6	Kavilpad	Kavilpad Government School		(2/5)
7	Vallikkod	Vallikkod Government School		(3/5)


Malampuzha Dam
Local Evacuation Plan
Dam
Reservoir
Shelters
Evac_route
Inundated Area
0
0.5
1
Km
Malampuzha Hemambika Temple
GHSS, Malampuzha
76°40'0"E
76°41'0"E
76°42'0"E
76°43'0"E
Page 1 of 5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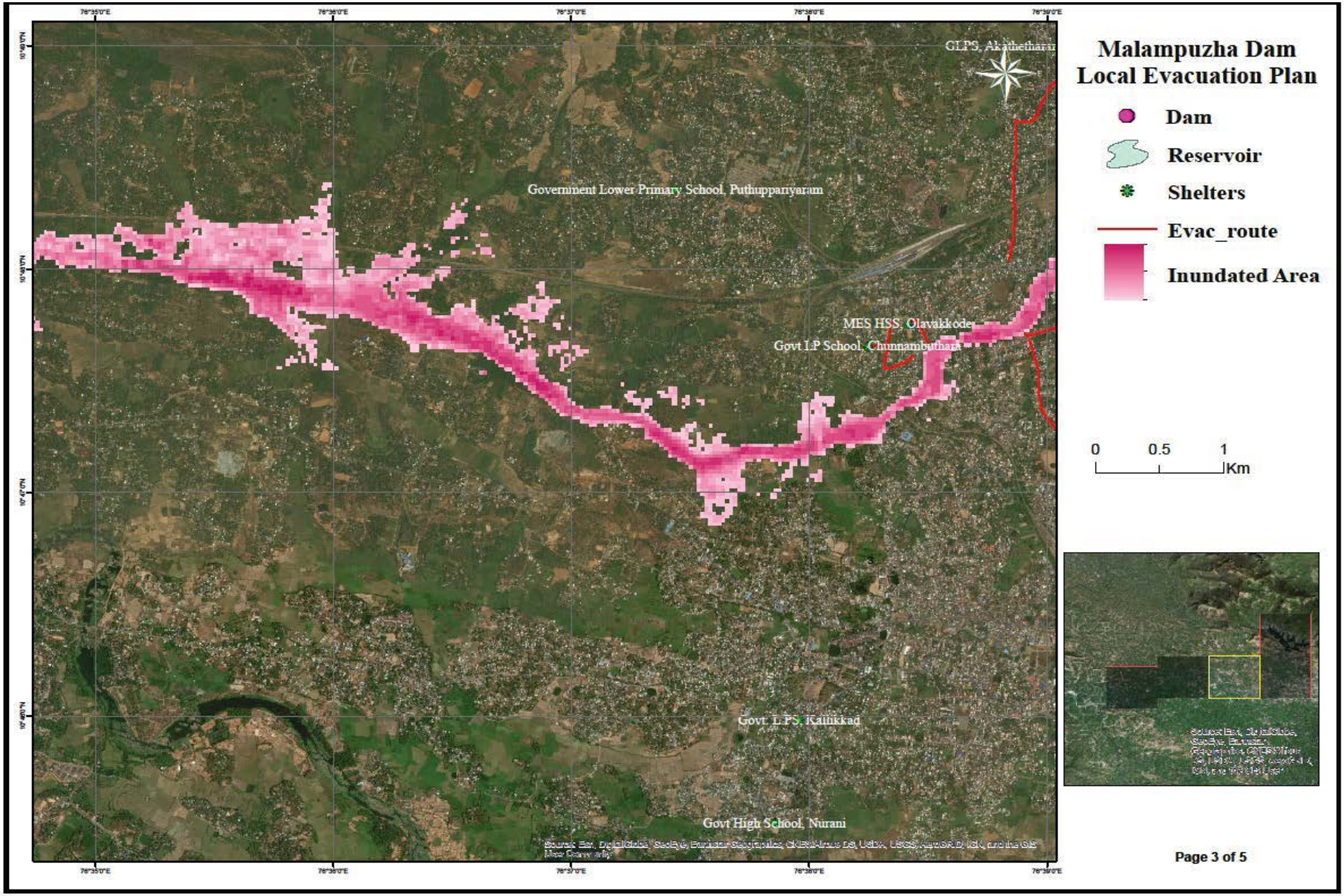
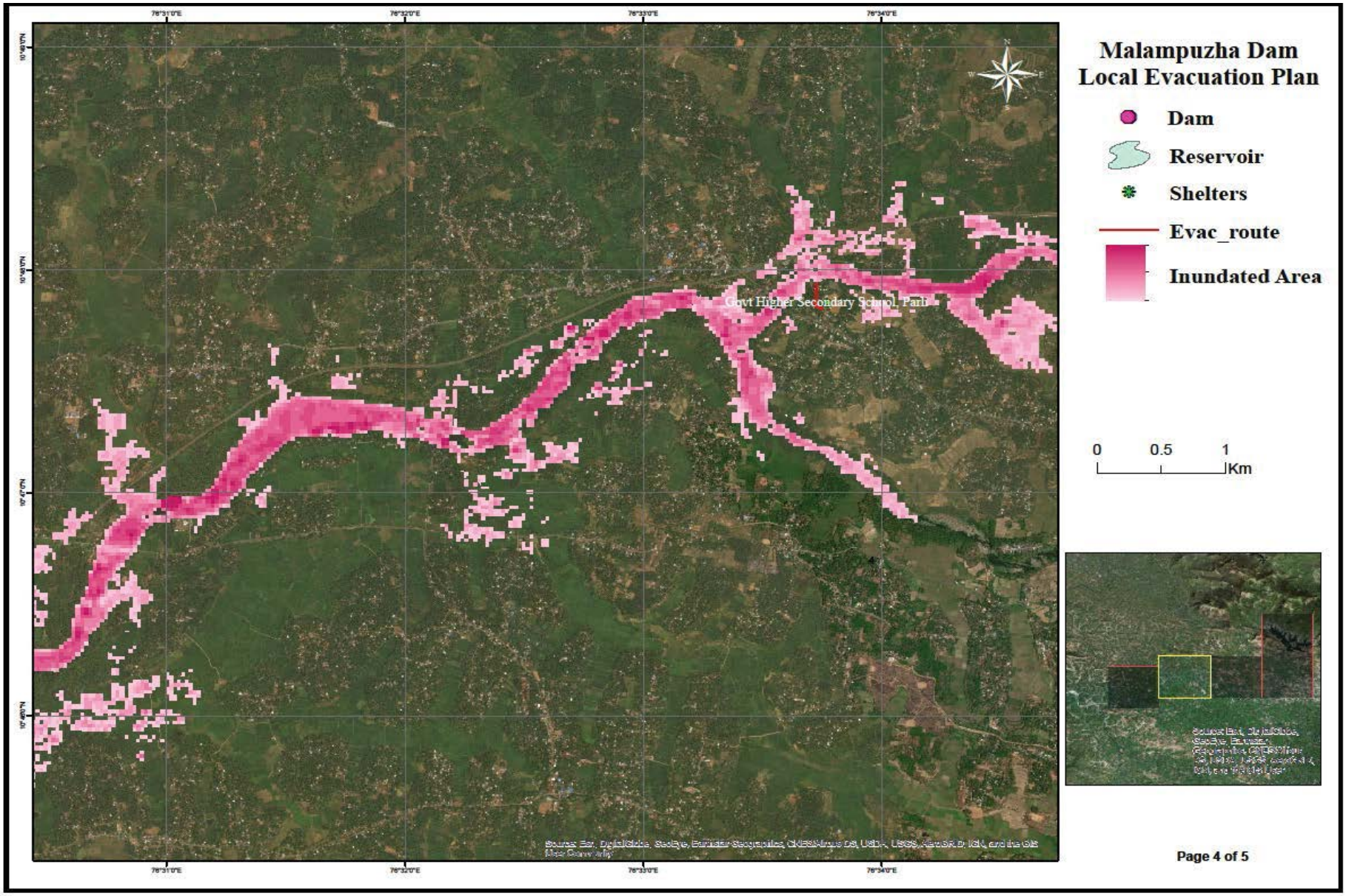
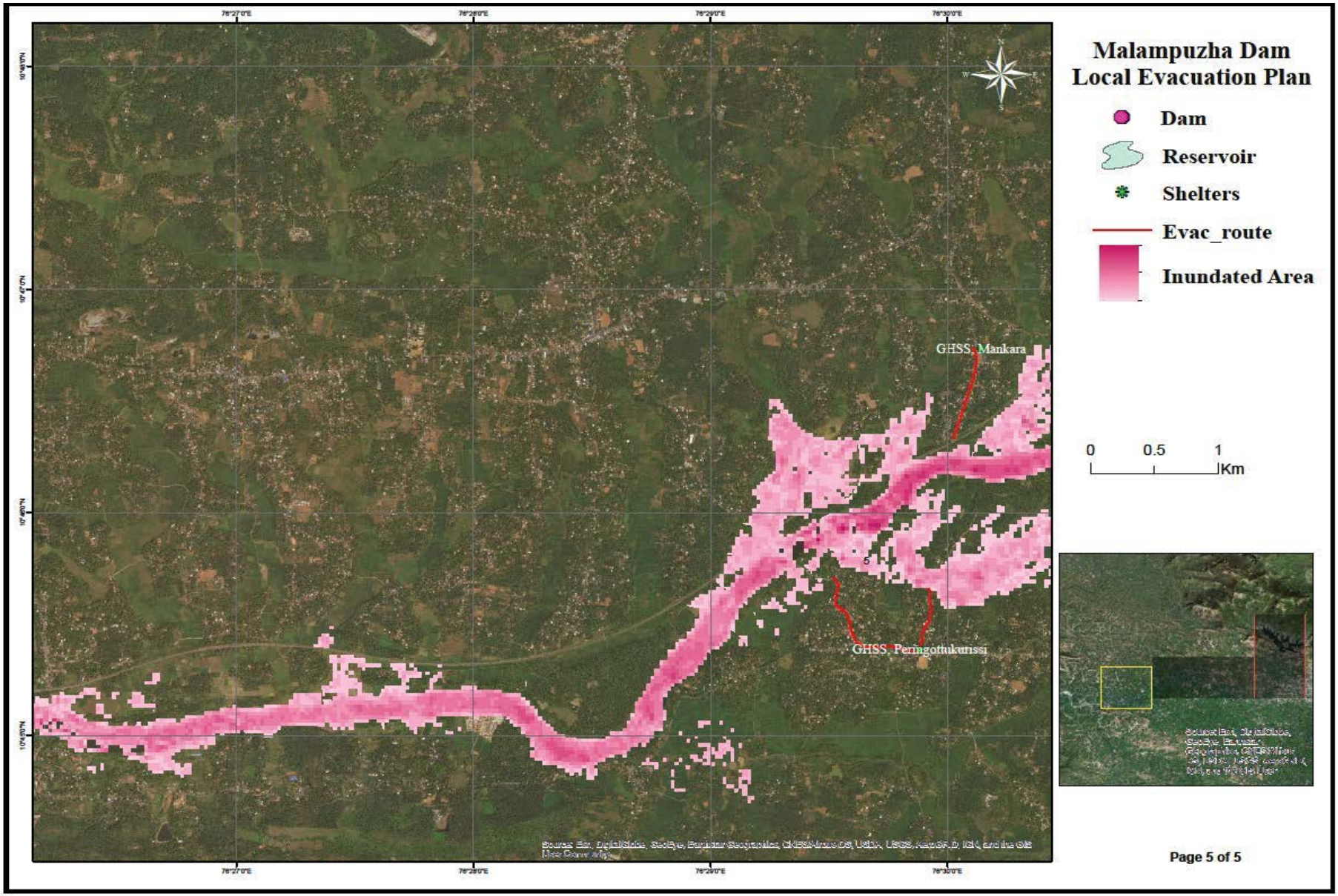
Government Lower Primary School, Kadukkankunnam
GHSS, Kumaraputram
GUPS, Puthur
Govt Moyan L.PS, Vyduth Nagar
Malampuzha Dam
Local Evacuation Plan
Dam
Reservoir
Shelters
Evac_route
Inundated Area
0 0.5 1
Km
Page 2 of 5


GLPS, Akathethara
Government Lower Primary School, Puthuppariyaram
MES HSS, Olavakkode
Govt LP School, Chunnambuthara
Govt. L.P.S. Kalikkad
Govt High School, Nurani
Malampuzha Dam
Local Evacuation Plan
Dam
Reservoir
Shelters
Evac_route
Inundated Area
0
0.5
1
Km
Page 3 of 5


Malampuzha Dam
Local Evacuation Plan
Dam
Reservoir
Shelters
Evac_route
Inundated Area
Govt Higher Secondary School, Parli
0
0.5
1
Km
Page 4 of 5


Malampuzha Dam
Local Evacuation Plan
Dam
Reservoir
Shelters
Evac_route
Inundated Area
GHSS, Mankara
GHSS, Peringothukunnu
0
0.5
1
Km
Page 5 of 5

ANNEXURE -4

Emergency Level Determination – Action Data Sheet Index

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

Event / General Observation	Specific Observation/ Condition	Emergency Level	Action Data Sheet
Unexpected Failure	Dam unexpectedly and without warning begins to fail	RED	Sheet A1
Spillway Release Increasing Reservoir Water Surface Elevation	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	BLUE	Sheet B1
	Large inflow to reservoir; Water level is one meter below FRL; controlled release through spillway	ORANGE	Sheet B2
	Large inflow to reservoir; Water level has crossed FRL; Large controlled release through spillway	RED	Sheet B3
Embankment Overtopping	Potential Embankment Overtopping, Reservoir water surface elevation is one meter below the top of the dam	ORANGE	Sheet C2
	Water from the reservoir is flowing over the top of the dam	RED	Sheet C3
Seepage	Seepage through the dam body. New or minor seepage at toe, on slope of embankment, abutments or galleries, water flowing clear	BLUE	Sheet D1
	New, seriously or rapidly increasing seepage flow rate at toe, on slope of embankment, abutments or galleries, water flowing clear.	ORANGE	Sheet D2
	Serious seepage at toe, on slope embankment, abutments or galleries. Incontrollable muddy water flowing, failure of dam is imminent	RED	Sheet D3
Sinkholes	Sinkholes anywhere in embankment or within 150 m downstream from the toe. No seepage or flowing water	BLUE	Sheet E1
	Sinkholes with seepage or flowing water anywhere in the embankment or within 150 m downstream from the toe.	ORANGE	Sheet E2
	Sinkholes rapidly enlarging with muddy water anywhere in the embankment or within 150 m downstream from the toe.	RED	Sheet E3
Embankment Cracking / Movement	Crack in the embankment crest or slopes greater than ½ cm or ¼ inch wide and considerable length, without seepage	BLUE	Sheet F1

	Crack in the embankment crest or slopes greater than ½ cm or ¼ inch wide and considerable length, with active movement / slippage and / or seepage through cracks	ORANGE	Sheet F2
	Sudden or rapidly proceeding slides of the embankment slopes. Cracks that extends to reservoir elevation	RED	Sheet F3
Concrete / Masonry Structure Cracking	Minor cracks (bigger than ¼ cm) in the masonry / concrete structure, without leakage	BLUE	Sheet G1
	Enlarging cracks (bigger than ¼ cm) and active movement in the masonry / concrete structure, with leakage passing through	ORANGE	Sheet G2
	Enlarging cracks with sudden or rapidly proceeding movements / displacements in the masonry / concrete structure, with severe leakage passing through	RED	Sheet G3
Instrumentation	Instrumentation readings are beyond pre-determined / thresholds values	BLUE	Sheet H1
Malfunction of Radial / Sluice Gate (s)	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)	BLUE	Sheet I1
	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)	ORANGE	Sheet I2
	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)	RED	Sheet I3
Earthquake	Measurable earthquake felt or reported and dam appears to be stable	BLUE	Sheet J1
	Earthquake resulting in visible damage to the dam or appurtenances which can cause a potential dangerous situation	ORANGE	Sheet J2
	Earthquake resulting in uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage	RED	Sheet J3
	Unverified bomb threat or verified damage	BLUE	Sheet K1

	to the dam / appurtenances with no impacts in the functioning of the dam		
	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	ORANGE	Sheet K2
	Detonated bomb resulting in visible damage to the dam or appurtenances OR verified damages due to vandalism causing or uncontrolled water release	RED	Sheet K3

RED ALERT	**Description:** UNEXPECTED FAILURE	**SHEET A1**

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 CONTINOUSLY 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

A. EVENT LEVEL DOWNGRADE	**B. TERMINATION**	
Monitor conditions until damage is repaired	Go to **Termination and Follow-up**	

BLUE ALERT	**Description:** 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	**SHEET B1**

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. 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 CONTINOUSLY 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

A. EVENT LEVEL DOWNGRADE	**B. TERMINATION**	C. **EVENT LEVEL ESCALATION**
Monitor conditions until damage is repaired	Go to **Termination and Follow-up**	Go to **SHEET B2** (ORANGE Alert)

ORANGE ALERT	**Description:** SPILLWAY RELEASE : Large inflow to reservoir; Water level is one (1) meter below FRL; Controlled Release through spillway	**SHEET B2**

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 CONTINOUSLY 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

A. EVENT LEVEL DOWNGRADE	B. EVENT / LEVEL REMAINS THE SAME	C. EVENT LEVEL ESCALATION
Go to the SHEET A1 (BLUE ALERT)	Continue recommended action on this sheet	Go to **SHEET B3** (RED Alert)

RED ALERT	**Description:** SPILLWAY RELEASE : Large inflow to reservoir; Water level has crossed FRL; Large Controlled Release through spillway	**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 CONTINOUSLY 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

D. EVENT LEVEL DOWNGRADE	E. EVENT / LEVEL REMAINS THE SAME	F. EVENT LEVEL ESCALATION
Go to the SHEET A2 (ORANGE ALERT)	Continue recommended action on this sheet	Go to Termination and Follow-up

ORANGE ALERT	**Event Description:** Potential Embankment Overtopping. Reservoir water surface elevation is one (1) meter below the top of the dam	**SHEET C2**

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 CONTINOUSLY 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

G. EVENT LEVEL DOWNGRADE	**H. EVENT / LEVEL REMAINS THE SAME**	**I. EVENT LEVEL ESCALATION**
Declare BLUE alert and Monitor conditions until reservoir levels go below FRL	Continue recommended action on this sheet	Go to **SHEET C3** (RED Alert)

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 CONTINOUSLY 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

A. EVENT LEVEL DOWNGRADE	**B. EVENT / LEVEL REMAINS THE SAME**	C. **EVENT LEVEL ESCALATION**
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

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 CONTINOUSLY 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

A. TERMINATION	B. EVENT / LEVEL REMAINS THE SAME	C. EVENT LEVEL ESCALATION
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Go to **SHEET D2** (ORANGE Alert)

ORANGE ALERT	**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	**SHEET D2**

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

A. EVENT LEVEL DOWNGRADE	B. EVENT / LEVEL REMAINS THE SAME	C. EVENT LEVEL ESCALATION
Go to SHEET D1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET D3** (RED Alert)

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

A. EVENT LEVEL DOWNGRADE	**B. EVENT / LEVEL REMAINS THE SAME**	**C. EVENT LEVEL ESCALATION**
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

BLUE ALERT	**Event Description:** Sinkholes anywhere in the embankment or within 150 m. downstream from the toe. No seepage or flowing water	**SHEET E1**

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 Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

D. TERMINATION	**E. EVENT / LEVEL REMAINS THE SAME**	F. **EVENT LEVEL ESCALATION**
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Go to **SHEET E2** (ORANGE Alert)

ORANGE ALERT	**Event Description:** Sinkholes with seepage or flowing water anywhere in the embankment or within 150 m downstream from the toe.	**SHEET E2**

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

D. EVENT LEVEL DOWNGRADE	E. EVENT / LEVEL REMAINS THE SAME	F. EVENT LEVEL ESCALATION
Go to SHEET E1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET E3** (RED Alert)

RED ALERT	**Event Description:** Sinkholes rapidly enlarging with muddy water anywhere in the embankment or within 150 m downstream from the toe..	**SHEET E3**

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

A. EVENT LEVEL DOWNGRADE	**B. EVENT / LEVEL REMAINS THE SAME**	C. **TERMINATION**
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

BLUE ALERT	**Event Description:** Embankment Cracking. Cracks in the embankment crest or slopes greater than ½ cm or ¼ inch wide and considerable length, without seepage	**SHEET F1**

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

A. TERMINATION	**B. EVENT / LEVEL REMAINS THE SAME**	C. **EVENT LEVEL ESCALATION**
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Go to **SHEET F2** (ORANGE Alert)

ORANGE ALERT	**Event Description:** Embankment Cracking with movement. Cracks in the embankment crest or slopes greater than ½ cm or ¼ inch wide and considerable length with active movement and or seepage through cracks.	**SHEET F2**

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 downgrade 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

G. EVENT LEVEL DOWNGRADE	H. EVENT / LEVEL REMAINS THE SAME	I. EVENT LEVEL ESCALATION
Go to SHEET F1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET F3** (RED Alert)

RED ALERT	**Event Description:** Embankment Cracking and active movement. Sudden or rapidly proceeding slides of the embankment slopes. Cracks that extends to the reservoir elevation	**SHEET F3**

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

Based on this evaluation, follow the appropriate action

D. EVENT LEVEL DOWNGRADE	E. EVENT / LEVEL REMAINS THE SAME	F. TERMINATION
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

BLUE ALERT	**Event Description:** Concrete / Masonry Structure Cracking. Minor cracks (bigger than ¼ cm) in the masonry / concrete structure, without leakage	**SHEET G1**

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	**B. EVENT / LEVEL REMAINS THE SAME**	C. **EVENT LEVEL ESCALATION**
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	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

J. EVENT LEVEL DOWNGRADE	K. EVENT / LEVEL REMAINS THE SAME	L. EVENT LEVEL ESCALATION
Go to SHEET G1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET G3** (RED Alert)

RED ALERT	**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	**SHEET G3**

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

Based on this evaluation, follow the appropriate action

A. EVENT LEVEL DOWNGRADE	**B. EVENT / LEVEL REMAINS THE SAME**	C. **TERMINATION**
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

BLUE ALERT	**Event Description:** Instrumentation readings are beyond predetermined / threshold values.	**SHEET H1**

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

D. TERMINATION	**E. EVENT / LEVEL REMAINS THE SAME**	F. **EVENT LEVEL ESCALATION**
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Monitor conditions until damaged is repaired

BLUE ALERT	**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). no leakage or uncontrolled discharge is detected. Flood can be routed without damaged / non-operational gate(s)	**SHEET I1**

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 Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

G. TERMINATION	H. EVENT / LEVEL REMAINS THE SAME	I. EVENT LEVEL ESCALATION
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Go to **SHEET I2** (ORANGE Alert)

ORANGE ALERT	**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)	**SHEET I2**

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

A. EVENT LEVEL DOWNGRADE	**B. EVENT / LEVEL REMAINS THE SAME**	**C. EVENT LEVEL ESCALATION**
Go to SHEET I1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET I3** (RED Alert)

RED ALERT	**Event Description:** Failure 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). Unexpected high discharge is occurring. Flood cannot be routed without damaged / non-operational gate(s)	**SHEET I3**

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

D. EVENT LEVEL DOWNGRADE	E. EVENT / LEVEL REMAINS THE SAME	F. TERMINATION
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

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

A. TERMINATION	B. EVENT / LEVEL REMAINS THE SAME	C. EVENT LEVEL ESCALATION
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Go to **SHEET J2** (ORANGE Alert)

ORANGE ALERT	**Event Description:** Earthquake. Earthquake resulting in visible damage to the dam or appurtenances which can cause a potential dangerous situation	**SHEET J2**

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

D. EVENT LEVEL DOWNGRADE	E. EVENT / LEVEL REMAINS THE SAME	F. EVENT LEVEL ESCALATION
Go to SHEET J1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET J3** (RED Alert)

RED ALERT	**Event Description:** Earthquake resulting in uncontrolled release of water over dam or rapidly developing flow through cracks or rapidly developing erosion through increased seepage	**SHEET J3**

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 Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

G. EVENT LEVEL DOWNGRADE	H. EVENT / LEVEL REMAINS THE SAME	I. TERMINATION
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

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	**SHEET J1**

RECOMMENDED ACTIONS

Emergency Planning Manager

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

B. Notify Local Law enforcement authorities to help evaluate the situation.

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. 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. Access the dam only if area has been cleared by Law Enforcement (in case of bomb threat).

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

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:

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..

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

F. 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

D. TERMINATION	**E. EVENT / LEVEL REMAINS THE SAME**	F. **EVENT LEVEL ESCALATION**
Go to **Termination and Follow-up**	Continue recommended actions on this sheet	Go to **SHEET J2** (ORANGE Alert)

ORANGE ALERT	**Event Description:** 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.	**SHEET J2**

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..

All contracts on Notification Flow chart shall be updated of changes

Based on this evaluation, follow the appropriate action

G. EVENT LEVEL DOWNGRADE	H. EVENT / LEVEL REMAINS THE SAME	I. EVENT LEVEL ESCALATION
Go to SHEET I1 (Blue Alert)	Continue recommended action on this sheet	Go to **SHEET J3** (RED Alert)

RED ALERT	**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.	**SHEET J3**

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

A. EVENT LEVEL DOWNGRADE	**B. EVENT / LEVEL REMAINS THE SAME**	C. **TERMINATION**
Monitor conditions until damage is repaired	Continue recommended action on this sheet	Go to Termination and Follow-up

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

Date	Time	Action / Event Progression	Recorded by

Annexure 5

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.

Contractor Type	Name, Title, Phone	Remarks
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: 9447360832 Office No: 0491-2577425	Services : Sand bags, earthwork, all civil works, supply of materials, Ready Mix Concrete
	Name : Executive Engineer Email: executiveengineermalampuzha @gmail.com Mobile No:9447944309 Office No: 0491-2815111	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, Thrissur Email :eelectsr.pwd@kerala.gov.in Mobile No: 8086395176 Office No: 0487 2330010	Services : Electrical works
	Name : Executive Engineer PWD Electrical Division, Kozhikode Email :eeeleckkd.pwd@kerala.gov.in Mobile No: 8086395215 Office No: 0495 2371857	Services : Electrical Works
Instrumentation	Name : Executive Engineer Email : sespcpkd@yahoo.co.in Mobile No: 9447360832 Office No: 0491-2577425	Services : Geotechnical/Geodetic/Structural and Hydrologic Instruments, Seismic Instruments
	Name : Executive Engineer Email: executiveengineermalampuzha @gmail.com Mobile No:9447944309 Office No: 0491-2815111	Services : Geotechnical/Geodetic/Structural and Hydrologic Instruments, Seismic Instruments

Special works /Equipments	Name : Executive Engineer Email : sespcpkd@yahoo.co.in Mobile No: 9447360832 Office No: 0491-2577425	Services : Diving & ROV services, underwater inspection
	Name : Executive Engineer Email: executiveengineermalampuzha @gmail.com Mobile No:9447944309 Office No: 0491-2815111	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	
	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: eeelecstsr.pwd@kerala.gov.in Office No: 0487 2327290	Services : Wireless and Radio Communication Equipment. Voice Data Communication, Early Warning Systems

Annexure 6

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 Thiruvananthapuram 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, Irrigation Division, Malampuzha has declared a BLUE Level "Watch" condition for Malampuzha Dam, Project Identification Code KL07HH0003 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, Irrigation Division, Malampuzha has declared a BLUE Level "Watch" condition for Malampuzha Dam, Project Identification Code KL07HH0003 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, Irrigation Division, Malampuzha has announced that Malampuzha Dam, Project Identification Code KL07HH0003 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. Malampuzha Dam, Project Identification Code KL07HH0003 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. Malampuzha Dam, Project Identification Code KL07HH0003 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 – 7

Dam Description

Official Dam Name [1] : Malampuzha Dam
Name of Stream : Malampuzha River
Dam Location : 8 km North East of Olavakkode Railway station, Palakkad
Latitude / Longitude : 10°49'49.90"N/ 76°41'1.59"E
Seismic Zone : III Year of Starting of Dam Construction : 1949
Year of First Impoundment :1955 Year of Commissioning of Dam Project : 1955
Name of Immediate Upstream Dam : Nil
Name of Immediate Downstream Dam : Nil

Dam Owner [2] : Irrigation Department, Kerala (Executive Engineer) Phone Number : Dam Owner's Address : Irrigation Division, Malampuzha, Palakkad, Kerala

Embankment

Type	: Masonry Dam with Earthen Saddle
Year Constructed	: 1955
Length	: 1848.91 m (Masonry 1626.71 m & Earthen 222.20 m)
Maximum Height	: 38.10 m
Top Width	: Earthen 6.09 m and Masonry 4.87 m
Top of Embankment Elevation	: 117.35 m
Drainage Area	:

Main Spillway [3]

Type	: Ogee Crest
Location	: Middle of Masonry Dam
Crest Length	: 55 m
Crest Elevation	: 110.49 m
Capacity	: 849.5 Cumecs

Emergency Spillway

Type	: -
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	: 100.28 meters
Capacity Conservation Pool (Normal Pool)	: 213.6 millions of cubic meters
Capacity at Top of Dam (Maximum)	: 226 millions of cubic meters
Surface Area	: 22 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.

Annexure 8

Annual EAP Evaluation Checklist

Was the annual dam inspection conducted?	□ Yes □ No	If yes, has the EAP been revised to include any signs of failures observed during the inspection?	□ Yes □ No
Was weed clearing, animal burrow removal, or other maintenance required?	□ Yes □ No	If yes, describe actions taken and date:	
Was the outlet gate operable?	□ Yes □ No	If no, describe actions taken and date:	
Do the Notification Flowcharts require revision? (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.)	□ Yes □ No	If yes, list the dates of the contact information revision and redistribution:	
Was annual training or a tabletop drill conducted?	□ Yes □ No	Circle: training drill Date conducted:	
Are inspection and training records included in the EAP?	□ Yes □ No		
Was the EAP reviewed?	□ Yes □ No	If yes, review date:	
Were changes required to the EAP?	□ Yes □ No	If yes, date of revised EAP approval:	

Annexure 9

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 10

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).

TRAINING LOCATION:	
DATE: TIME: INSTRUCTOR:	
CLASS SIGN-IN:	
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 – 11

List of Officials for Communication

Authority	Name, Title, Phone	Address
District Collector, Palakkad	District Collector Mobile No: 8547610100 Office No:0491-2505266	Office of the District Collector Civil Station Kenathuparambu, Kunathurmedu, Palakkad, Kerala 678013 Email-dcpkd@kerala.nic.in
District Collector, Thrissur	District Collector Office No:0487-2361020	First floor, Civil Station, Civil lines Rd, Kalayan Nagar, Ayyanthole, Thrissur
District Collector, Malappuram	District Collector Office No:0483- 2734355	District Collector, Civil Station, Collectorate, Malappuram Email- dcm.ker@nic.in
State Emergency Operation Center, Kerala Disaster Management Authority	Member Secretary Email : keralasdma@gmail.com Mobile No:9400202927 Office No:0471-2331345	Observatory Hills Museum, Vikas Bhavan P O Thiruvananthapuram, Kerala 695033
District Police Chief, Palakkad	District Police Chief, Palakkad Mobile No: 9497996977 Office No: 0491-2534011	Office of the District Police Chief, Palakkad Pudupalli Theruvu, Nurani, Palakkad Email: spplkd.pol@keral.gov.in
District Police Chief, Thrissur	District Police Chief, Thrissur Mobile No: 9497996909 Office No: 0487-23230110	Kalyan Nagar, Ayyanthole, Thrissur Email: cptsr.pol@kerala.gov.in
District Police Chief, Malappuram	District Police Chief, Malappuram Office No:0483-2734377 Mobile No:9497996976	Collectorate, Civil Station, Malappuram Email:spmpm.pol@kerala.gov.in
Deputy Collector Palakkad	Deputy Collector (General & ADM) Mobile No: 9447735010 Office No:0491 2505008	Collectorate Palakkad District
Deputy Collector Malappuram	Deputy Collector (General & ADM) Mobile No: 8547616002 Office No:0483 2734421	Collectorate Malapuram District,
Deputy Collector Thrissur	Deputy Collector (General & ADM) Mobile No: 8547610081 Office No:0487 2360626	Collectorate Thrissur District,
Tahsildhar, Palakkad	Contact: Tahsildar, Palakkad Ph No: 0491-2505770 Mobile : 944735012	Taluk Office, Palakkad Email: tahrpkd.rev@kerala.gov.in
Tahsildhar, Ottapalam	Contact: Tahsildar, Ottapalam Mobile No: 9447735015 Office No:0466-2244322	Taluk Office, Ottapalam Email: tahr_otp.rev@kerala.gov.in
Tahsildhar, Pattambi	Contact: Tahsildar, Pattambi Office No: 0466-2214300 Mobile : 8547618445	Taluk Office, Pattambi Email: tahr_pattambi.rev@kerala.gov.in

Tahsildhar, Thrissur	Contact: Tahsildar, Thrissur Ph No: 0487-2331443 Mobile: 8547614401	Taluk Office, Thrissur Opp.Thrissur Town Hall. Palace Rd, Chembukkav
	Fire and Rescue Chief Palakkad Phone No: 0491-2505701	Fire and Rescue services Civil Station (P.O) Palakkad Email: dopkd.frs@kerala.gov.in
	Fire and Rescue Chief, Thrissur	Fire and Rescue services Thrissur Email: adotsr.frs@kerala.gov.in
	Fire and Rescue Chief, Malappuram Phone No: 0483-2734800	Fire and Rescue services Muduparambu. P.O Malappuram Email: adompm.frs@kerala.gov.in
District Health Officers, Palakkad	The District Medical Officer Palakkad (Health) Ph No: 0491-2505264 Mobile: 9946105487	2 nd floor , Civil Station, Palakkad
District Health Officers, Thrissur	The District Medical Officer Thrissur (Health) Ph No: 0487-233342	St. Thomas Autonomous College, Near Bennette rd, Keerankulangara, Thrissur
District Health Officers, Malappuram	The District Medical Officer Malappuram (Health) Ph No: 0483-2737857	Civil Station Rd, Up Hill, Malappuarm
Circle Inspector of Police, HemabikaNagar	Circle Inspector of Police Mobile No. 9497987150 Office No : 0491 2555208	Office of the Circle Inspector of Police, HemabikaNagar
Sub Inspector of Police, Malampuzha	Sub Inspector of Police Mobile No. 9497980614 Office No : 0491 2815284	Office of the Sub Inspector of Police, Malampuzha