1. ORGANISATIONAL SET UP

THE Kerala Engineering Research Institute is under the Directorate of Fundamental & Applied Research, at Peechi headed by the Director in the rank of Superintending Engineer with, two Divisions functioning at Peechi, i.e., the Hydraulic Research & Construction Materials & Foundation Engineering Division and another division namely the Coastal Engineering Field Studies Division at Thrissur, each headed by a Joint Director, an officer in the rank of an Executive Engineer.

The Institute is under I.D.R.B of Water Resources Department under the Chief Engineer, Investigation & Design (IDRB), Thiruvananthapuram.

The organizational set up of each Division is as follows:

I. Joint Director, Hydraulic Research

1. Hydraulics Division
2. Sedimentation Division
3. Coastal Engineering Division

II. Joint Director, CM&FE

1. Construction Materials Division
2. Soil Mechanics and Foundations Division
3. Instrumentation Division
4. Publications Division

III. Joint Director, Coastal Engineering Field Studies

1. Coastal Erosion studies Subdivision, Kozhikkode
2. Coastal Engineering Studies Subdivision, Ernakulam
3. Coastal Engineering Studies Subdivision, Kollam

These divisions attend to research works, laboratory testing and collection of field data related to their respective fields and present valuable results/analyses having significant implications in different fields of Civil Engineering and Water Resources Management. Each subdivision has a Deputy Director in the rank of an Assistant Executive Engineer as its head and one or two Assistant Directors in the rank of Assistant Engineer to assist in the research activities.

The Quality Control wing attached to this Directorate has been constituted for the purpose of quality assurance of works of Irrigation Department. The jurisdiction of this wing is all over Kerala. There are two Divisions at Thrissur and Kottarakkara, nine Subdivisions at Kannur, Kozhikode, Palakkad, Thrissur, Moovattupuzha, Kottayam, Alappuzha, Kottarakkara and Thiruvananthapuram and 18 sections, at Thiruvananthapuram, Kollam, Kottarakkara, Pathanamthitta, Alappuzha, Idukki, Kottayam, Aluva, Moovattupuzha, Koothattukulam, Angamaly, Thrissur, Palakkad, Malappuram, Kozhikode, Kalpetta, Kannur and Kasargod.

2. PERSONNEL

The Executive Officers who headed the various offices under KERI during the financial year 2015-2016 are

DIRECTOR, FUNDAMENTAL & APPLIED RESEARCH	:	Er. Flosy Paul K. from 01/04/15 to 12/06/2015
	:	Er. Ajayakumar P.V., Joint Director, CEFS, Thrissur (F.A.C) from 13/06/2015 to 31/07/2015
	:	Er. Flosy Paul K. from 01/08/15 to 30/11/15
	:	Er. Francis L., Joint Director, Hydraulic Research, KERI, Peechi (F.A.C.) from 01/12/15 to 10/01/16
	:	Er. Flosy Paul K. from 11/01/16 to 29/02/16
		Er. Jessy Ann Francis, Joint Director, CM&FE, KERI, Peechi (FAC) from 01/03/16 to 31/03/16

JOINT DIRECTOR, CONSTRUCTION MATERIALS &FOUNDATION ENGINEERING	:	Er. Lucy M Mampilly from 01/04/15 to 13/07/15 F.N.
	:	Er. Jessy Ann Francis from 13/07/2015 F.N. onwards
JOINT DIRECTOR, HYDRAULIC RESEARCH	:	Er. Laila N.R., Deputy Director, Sedimentation, KERI, Peechi (F.A.C.) from 01/04/15 to 15/05/15
	:	Er. Francis L.(from 16/05/15 to 31/03/16)
JOINT DIRECTOR, CEFS	:	Er. Ajayakumar. P.V. upto 09/03/2016
		Er. K.L. Thomas from 09/03/2016
DEPUTY DIRECTORS		
CONSTRUCTION MATERIALS DIVISION	:	Er. Jessy Ann Francis from 01/04/15 to 31/05/2015
		Er.Jaicy Joseph Palayakkara from 01/06/2015 onwards
INSTRUMENTATION DIVISION	:	Er. Sheeja A Andezhathu.
PUBLICATIONS DIVISION	:	Er. Sheeja. A Andezhathu. (F.A.C.) from 01/04/15 to17/11/15
		Er. Laila N.R. from 18/11/15 to 22/02/16
		Er. Sheeja. A Andezhathu. (F.A.C.) from 23/02/16 to 13/03/16
		Er. Laila N.R. from 14/03/16 onwards
HYDRAULICS DIVISION	:	Er. Sudha. M.S.
SEDIMENTATION DIVISION	:	Er. Laila.N.R. upto18/11/2015
		Er. Shini K.K. from 19/11/2015 onwards

COASTAL ENGINEERING DIVISION	:	Er. Aji. K.B. from 01/04/15 to 10/05/15
		Er. Sudha M.S. from 11/05/15 to 03/08/15 (FAC)
		Er. Aji K.B. on 04/08/15
		Er.Sudha M.S. from 05/08/15 to 13/09/15 (F.A.C.)
		Er. Laila N.R. from 14/09/15 to 29/09/15 (F.A.C.)
		Er. Shini K.K. from 30/09/15 to 17/11/15
		Er. Sudha M.S. from 18/11/15 to 20/01/15(F.A.C)
		Er. C.K.Jagadambika from 20/01/15 onwards
COASTAL ENGINEERING SUB DIVISION, KOZHIKODE	:	Er. Muhammed Mustafa. P. upto 31/05/15
		Er. Girish Kumar from 01/06/15 to 13/07/15 (F.A.C.)
		Er. Shyla Begum J. from 14/07/15 onwards
COASTAL ENGINEERING SUB DIVISION, ERNAKULAM	:	Er. Rema. M. upto 15/07/15
		Er. Sandhya. T. from 16/07/15 onwards
COASTAL ENGINEERING SUB DIVISION, KOLLAM	:	Er. Subairkutty up to 13/07/15
	:	Er. Anjana S. (F.A.C.) from 13/07/15 to 09/08/15
		Er. Radhalakshmi N.R. from 10/08/15 to 27/03/16
		Er. Kumari Anitha L. (F.A.C.) from 28/03/16

ASSISTANT DIRECTORS		
FUNDAMENTAL &APPLIED RESEARCH (DIRECTORATE)	:	Er. Deepa. R.
CONSTRUCTION MATERIALS & FOUNDATION ENGINEERING		Er. Saju Varghese
HYDRAULIC RESEARCH	:	Er. Joy. C. C.
COASTAL ENGINEERING FIELD STUDIES	:	Er. P.V. Bindu up to 01/01/16
		Er. Anitha B. Nair from 01/01/16
INSTRUMENTATION SECTION	:	Er. Saju Varghese (F.A.C.)
CONSTRUCTION MATERIALS DIVISION	:	Er. Sufeera O.B
	:	Er. V. R. Valsalakumary
SOIL MECHANICS & FOUNDATIONS DIVISION	:	Er. Geetha E.S.
PUBLICATIONS DIVISION	:	Er. Miny T. M.
HYDRAULICS DIVISION	:	Er. Saji Samuel from 01/04/15 to 18/01/16
		Er. Snisha T.B. (F.A.C.) from 19/01/16 onwards
	:	Er. Ajithkumar T.V. from 01/04/15 to 01/01/16.
	:	Full Additional Charge from 02/01/16 to 01/03/16.
		From 02/03/16 onwards

SEDIMENTATION DIVISION	:	Er.Shini K K upto 30/09/2015
		Er.Joy C.C. (F.A.C.) from 01/10/2015 to 01/01/2016
		Er. Ajithkumar T.V. (F.A.C.) from 02/01/2016 to 02/03/16
		Er. Joy C.C. (F.A.C.) from 03/03/16 onwards
COASTAL ENGINEERING DIVISION	:	Er. Divya .C.J.
	:	Er.Snisha T.B.
C.E.S. SECTION, KOZHIKODE.	:	Er.Sivadasan A
C.E.S. SECTION,THALASSERY	:	Er. Pradeep Kinathi
C.E.S. SECTION, PARAPPANANGADI	:	Er. Girishkumar K
C.E. SECTION, ERNAKULAM		Er. Jisha A.
C.E. SECTION , CHERTHALA	:	Er. Clament Roy. K.R
C.E. SECTION, CHAVAKKAD	:	Er. Anjana.S from 01/04/15 to 30/09/15
C.E. SECTION, KOLLAM	:	Er. Nidhi.S. from 01/10/15 to 31/12/15
		Er. Kumari Anitha L. from 01/01/2016
C.E. SECTION, THOTTAPPALLY		Er. NIDHI S up to 02/03/16
		Er. Ujin J. from 10/03/2016
C.E. SECTION, TRIVANDRUM		Er. Shibu K. Chacho

3. HUNAN RESOURCES

THE human resources of KERI comprise of both technical and nontechnical personnel. During its prime, majority of the engineers working in KERI were post graduates in different disciplines of Civil Engineering. The number of fundamental researches carried out during the period, bear witness to this. KERI was well known all over India and abroad for the research works and experimental studies carried out at the institute, especially in the field of Coastal engineering. In the past three decades, no significant fundamental studies have been carried out and the labs have gradually degenerated to the status of mere testing centers.

At present, out of the twenty five posts of Assistant Engineers, six posts are lying vacant. The number of supporting technical staff in the category of draftsman is just ten against a sanctioned strength of twenty five. In the workers category, as it happens to be a vanishing category, just two workers are available at present. Workers are hired on contract basis or on daily wages as per requirement.

However, a sincere and commendable effort is being made by the staff to take up all the projects assigned to it. The vacancy position of KERI is attached as Appendix – I.

4. FUNCTIONING OF THE INSTITUTE

THE Kerala Engineering Research Institute consists of seven divisions functioning at Peechi as well as Coastal Engineering and Field studies division and Quality Control wing of the Irrigation Department. Generally the activities of each division can be categorized as falling under Routine activities, Fundamental studies and Revamping and Modernization. The routine activities and fundamental studies conducted by each division are enumerated in this chapter.

A. HYDRAULICS DIVISION

A.1 Introduction

STUDIES on various problems in Applied Hydraulics, Irrigation Engineering and Flood Control are taken up by this division and propose solutions for the same. The major Irrigation and Hydro-Electric Projects in the state are undertaken only after doing model studies/ research studies by this division on that project. A wide range of aspects related to spillways, sluices, chutes, energy dissipating arrangement, operation of gate, flow condition in tail-race, silt excluding arrangements, hydraulic behavior of canal structures, river training works etc., are studied here and solutions to their specific problems are recommended. In addition, this division attends the meteorological observations relating to Peechi.

A.2. Activities for the year 2015-16

- Measurement of meteorological data and maintenance of a Meteorological Station at Peechi Dam site
- The proposal for the Construction of Golden Jubilee Administration Block for KERI-Centre of Excellence submitted.
- Routine works of Hydraulics Division.
- Renovation and restoration of existing model of Karappuzha & Lower periyar Dams.
- Other routine works such Model Area 1 & Model Area 2

A.2.1 Meteorological Station, KERI, Peechi

Weather observations are necessary to improve Meteorological services in the state and enhance the predictive capability of short and long-term information for weather forecasts and climatic changes. For the collection of meteorological data an Automatic Weather Station and a Manual Weather Station are functioning in Peechi dam premises.

A.2.1.1Automatic Weather Station

Time series observations are vital to improve the understanding of weather dynamics and its variability. The Automatic Weather Station plays an important role in providing short term and long-term time series weather observations. An automatic weather station is functioning in Meteorological Station since July 2014 with Remote transmission facility and a Solar Panel for uninterrupted power supply.

The Automatic Weather station collects data related to Air Temperature, Air Humidity, Barometric pressure, Ultrasonic Wind speed, Ultrasonic Wind Direction, Global radiation and Precipitation using different sensors. A Data Logger which is part of the Automatic Weather Station is collecting data in every 30 minutes and transferring it to a central server in every 2 hours using multiple protocols. These data can be accessed via internet using a software HYDRAS. The data collected can be used to gauge current weather

conditions and to predict weather forecasts like temperature high/lows, cloud cover and the probability of precipitation.

Components of Automatic Weather Station

1. Ultrasonic Wind speed, Ultrasonic Wind Direction & Compass
2. Global Radiation Sensor
3. Temperature , Humidity, Barometric Pressure Sensor
4. Rain Gauge
5. Data Logger

ULTRASONIC WIND SPEED AND DIRECTION SENSOR

RADIATION SENSOR

TEMPERATURE, HUMIDITY & PRESSURE SENSORS

RAIN GAUGE

IP DATA LOGGER

An abstract of the Weather data collected from Automatic Weather Station for the period from April 2015 to March 2016 is given in Appendix II.

A.2.1.2Manual Weather Station

Measurements of meteorological data are done by the following instruments and the readings are taken every day at 8.30 A.M.

- Temperature – Max & Min Thermometers & Bimetallic Thermograph
- Relative Humidity – Psychrometer (Dry & Wet bulb) & Hair Hygrometer
- Rainfall – Standard Rain Gauge, Self Recording Rain gauge
- Evaporation – Land Pan Evaporimeter
- Wind Direction – Wind Vane
- Wind Speed – Cup Anemometer
- Bright Sunshine – Sunshine Recorder

A.3. Revamping and Modernization works

- Purchase of "IMAGINE Expansion Pack"-Extension of ERDAS IMAGINE software.

Standard Rain Gauge

Self Recording Rain gauge

Max, Min Thermometers and Psychrometer (Dry & Wet bulb)

Hair Hygrometer

Bimetallic Thermograph

Land Pan Evaporimeter

Sunshine Recorder

Cup Anemometer

Automatic Weather station

B. COASTAL ENGINEERING DIVISION

B.1 Introduction

COASTAL Engineering Division conducted several research works on coastal protective works, experimental study of wave run up on beaches, experiments to evolve suitable artificial blocks, study on mud banks, wave action on beaches, waves and currents, littoral drifts, artificial nourishment etc. The model study of fishing gaps, design of fishing harbours like Mopla bay, Ponnani, Vizhinjam etc. were also conducted in this division during the late 70's and 80's. In order to understand the processes at work on Kerala Coast, collection of wave data and beach characteristics has been done all along the Kerala coast in the new moon day of all month. In KERI, simultaneous observations are conducted at two points at Padinjare Vemballore and Anchangadi in Kodungallur Taluk upto December, 2013. As a part of the modernization of KERI a new "Smart Station" equipment has been purchased in KERI during March, 2014 and has been transferred to this division as per the order of the Chief Engineer, IDRB, Thiruvananthapuram. So now this division is conducting several survey works and in future will take up more investigation works using the newly procured instrument.

During the year, this division has taken up the following works.

B.2 Routine activities of the Coastal Engineering Division

B.2.1 Routine activities of the Coastal Engineering Division office

The above work has been included in the action plan for meeting the various requirements of this office. Computer related accessories, Net setter and connection, stationary items has been purchased, also Maintenance and repairing of computer and related items and Cleaning and Rearranging office, repairing work of Electrical has been done. All works has been done using the allotted fund.

B.2.2 Routine activities of the office of the Director, F&AR and Joint Director, Hydraulic Research

This work was done for meeting the various requirements of the offices of the Director, F&AR and Joint Director Hydraulic Research for the routine activities. Computer and related accessories; 2KV Offline UPS and 12V 100AH 2Nos. battery to Director's office, UPS and 100AH 4Nos. battery to Joint Director's office, stationary items has been purchased. Also Maintenance and repairing of computer and related items are done. All work has been done using the allotted fund.

B.2.3 Maintenance of the model area of the Coastal Engineering Division

Routine cleaning of the surroundings and inside of model area has been done using the allotted fund. The door of the Hydraulics division store has been strengthened where the dismantled motors in the model area has been kept.

B.3 Revamping and modernization works

B.3.1 Purchase of a new laptop for the Smart Station

A lap top has been purchased for installing the softwares related to survey using smart station and for doing the processing of survey data in the field itself.

B.4 Fundamental Studies using Smart Station

B.4.1 Conducting Investigation using Smart Station for determining the current profile of Meenkara Dam.

Using Smart Station the work for determining the current profile of the Meenkara Dam has been done. The dam and the premises have been plotted and the contour plan, level plan etc. has prepared. A 3D view of the dam has also been prepared.

B.4.2 Other Investigation works using smart station

The survey of Peechi KERI Campus, Investigation of a new dam site at Muthalamada, Investigation of downstream side of Chamravattom Regulator Cum Bridge etc., has been done. The position values of the various points at Malampuzha Reservoir area where the analysis using Seismograph has been already done by the Soil Mechanics Division has also been found out.

B.4.2.1 The entire area of Peechi KERI campus has been surveyed and the various features such as office buildings, quarters, model areas, meteorological station, dam, canals, internal roads etc. has been plotted. The complete layout plan has been prepared.

B.4.2.2 As per the request of Deputy Director, Joint Water Regulation Sub Division, Department of Irrigation of Government of Kerala, Parambikulam Aliyar Project (PAP) to carry out a survey to finalize the preliminary report of Sustainable Alternative to Kuriarkutty Karappara Irrigation Project, a reconnaissance survey of proposed storage reservoir across Chulliar stream at Muthalamada has been done and plotted. Contours of the particular area has also been prepared.

B.4.2.3 As per the request of the Assistant Executive Engineer, Chamravattom Project Subdivision No.1, Eswaramangalam the survey of downstream side of Chamravattom Regulator Cum Bridge has been conducted. The upstream side survey has been done by the Sedimentation division. In this work downstream side survey along 1km length of river has been done by taking cross sections at every 100m interval. Contour plan and cross sections has been plotted.

B.5 Survey on Chandragiri River of Kasaragod District using Smart Station.

As per the direction of the Chief Engineer, IDRB survey on Chandragiri River of Kasaragod District has been done using Smart Station. The main aim of the investigation of the river basin is to prepare basin maps for identifying suitable locations for construction of check dams and regulators. This investigation proposal is important in the light of reducing water crisis in Kasaragod area.

The proposal was for conducting survey of river and banks upto 50m at every 100m interval. Survey of 19km of the river starting from the coastal area has been done covering an area of nearly 469acre in land and 1131acre in river. The data has been collected and the contour drawings, plan, cross sections and longitudinal sections has been prepared.

C. SEDIMENTATION DIVISION

C.1 Introduction

The Kerala Engineering Research Institute, (KERI) Peechi, one of the pioneering research institutions of its kind in our country, plays a vital part in fundamental and applied research studies in the field of Civil Engineering. KERI conducts studies and research in the field of Civil Engineering for the State Government, Quasi Government Institutions and Private Organizations. The institute also undertakes project funded by organizations like Central Board of Irrigation and Power (CBIP), Indian National Committee for Hydraulic Research (INCH).

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies. Such studies are conducted using modern electronic equipment called 'Integrated Bathymetric System' (IBS). In 2004, KERI completed 21 studies with this IBS including Mullaperiyar and Vembanad Lake. In order to ascertain the availability of water and to estimate the siltation a new equipment called Sub Bottom Profiler was purchased. As a pilot study using this equipment Peechi Reservoir was selected.

C.2 Works carried out during 2015

C.2.1 Sedimentation Survey of Mangalam Reservoir using Sub Bottom Profiler

C.2.1.1 Back ground of the project

The Kerala Engineering Research Institute, (KERI) Peechi, one of the pioneering research institutions of its kind in our country, plays a vital part in fundamental and applied research studies in the field of Civil Engineering. KERI conducts studies and research in the field of Civil Engineering for the State Government, Quasi Government Institutions and Private Organizations. The institute also undertakes project funded by organizations like Central Board of Irrigation and Power (CBIP), Indian National Committee for Hydraulic Research (INCH).

Sedimentation Division, of KERI conducts studies to compute the present capacity of reservoirs and other water bodies.

The main aim of conducting a bathymetric survey at Mangalam Reservoir is to make a detailed study of the siltation and sedimentation in the reservoir.

The main sources supplying the sediment, transported within the reservoirs, are the catchment, the river system, and various human activities. Sediment yield of a catchment is a result of natural processes such as soil erosion caused by water, wind and ice, reservoir shore degradation and landslides. There are nine major factors affecting sediment yield of a drainage area. They are, rainfall amount and intensity, soil type, ground cover (vegetation, litter and rock fragments), land use, topography, erosion history, runoff, sediment characteristics and channel hydraulics.

In order to ascertain the availability of water and to estimate the siltation a new equipment called **Sub Bottom profiler** was used for the study.

KERI constituted a team consisting of

1. N.R. Laila : Deputy Director
2. Shini K. K : Assistant Director
3. Joy. C.C : Assistant Director
4. Francy.V. Antony :Research Assistant

The work was started on 30/10/15 and completed on18/11/2015.

C.2.1.2Salient features

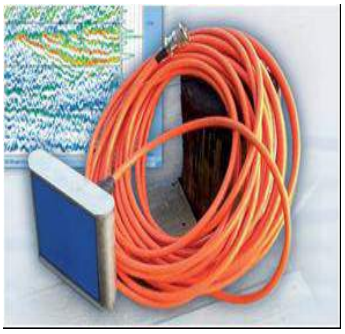
Sl. No.	Features	Description
1.	Latitude	10^{o} 31'N
	Longitude	76^{o} 32'E
2.	Year of starting	1949
3.	Year of commissioning	1956
4.	Year of completion	1966
5.	Type of dam	Straight Gravity masonry dam with earthen saddle dams
6.	Length of masonry dam	162m
7.	Length of Earthen Dam	902m
8.	Catchment area	$48.85km^2$
9.	Dead storage	$0.150Mm^3$
10.	Water spread area	3.96Sq.km.
11.	Maximum Storage	$25.494Mm^3$
12.	Maximum water level	77.88m from MSL
13.	Live Storage	223.60Cum
14.	Dead Storage level	64.20m
15.	Purpose	Irrigation

C.2.1.3 Equipments used

- **Sub Bottom Profiler**

  The system SES-2000 sub-bottom profiler, which is a mobile parametric sediment sounder, was used for bathymetric and sub-bottom profiling survey. The SES-2000 hardware component and transducers are shown in Fig 1.

Fig.1 Top- side Unit



Transducer

- **Differential Global positioning system (DGPS) - Leica MX 9525**
- **NS-415 Echo-sounder.**
- **FRP Boat (mobile station)**

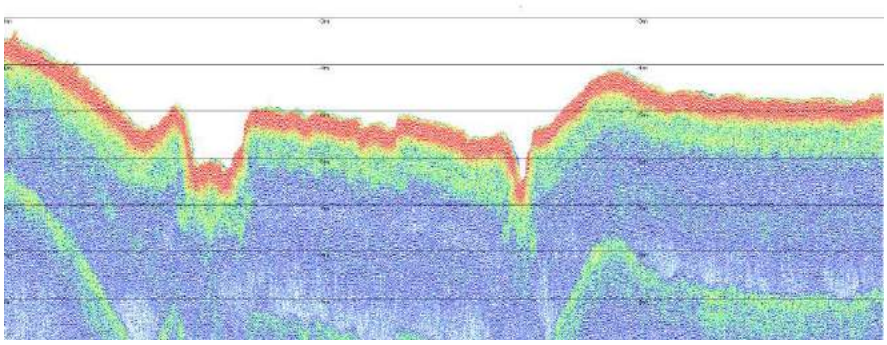
C.2.1.4 Software

- **Navisoft survey software**
- **Surfer software**
- **SESWIN for data acquisition in SES 2000**
- **I.S.E. 2.9.2 Post Processing Software**

The profiles show the depth of water at different locations along the track marked in the profile map of Mangalam reservoir, and is shown in Fig.2.

N

Fig.2 FRL Map of Mangalam Reservoir



Profile 1-1 E (668872.53, 669216.55), N (1160733.71, 1160574.19)

C.2.1.5 Estimation of Capacity

The original capacity of the reservoir at full reservoir level was 25.494Mm^3. As per IBS study the current capacity is calculated as 19.889Mm^3. Hence there is a loss of capacity of 5.605Mm^3 in 59 years. The reduction in capacity is 21.98% of the original. Rate of sedimentation is 0.095 Mm^3 (0.37%) per year.

As per IBS study in 2008 the capacity was 20.300Mm^3. Presently, the capacity has been calculated as 19.889Mm^3 and it is seen reduced by 0.411Mm^3 in the last 7years. The contour map of water spread area is shown in Fig.3 at an interval of 1m.

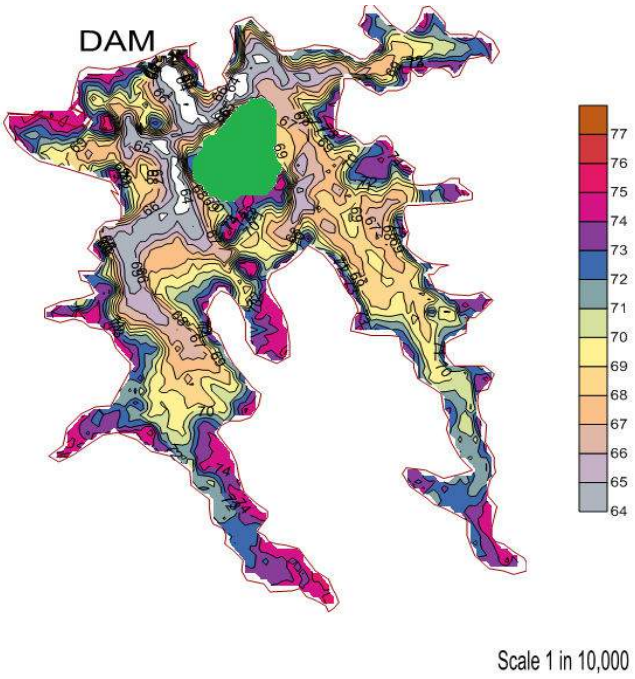


Fig.3 Contour Map of Mangalam Reservoir based on IBS Survey

Table-1
Present capacity of the reservoir

Capacity (Mm^3)		Reduction in capacity (Mm^3)	% of reduction
Original	Present (2015)		
25.494	19.889	5.605	21.98

Table - 2 compares the original capacity and current capacity of the reservoir at different water levels.

The original dead storage capacity is 0.150Mm^3. The dead storage level is at 64.20m. The reduction in capacity at this level is 73.33% of the original.

The contour map of water spread area is shown in Fig.3 at an interval of 1m.

Fig.4 shows the storage capacity curve.

Soil erosion is a cumulative factor for reservoir sedimentation. It is mainly due to various hydro meteorological factors such as intensity of rainfall, temperature etc. and manmade actions like felling of trees and cultivation by encroaching the reservoir area.

The edges of the reservoir and islands within the reservoir have eroded due to cultivation in the catchment area and the wind waves create sediment problems in the reservoir. Appropriate vegetative cover on the water edge can reduce the impact of further erosion of the banks.

Table - 3 compares the original water spread area and the current water spread area at different water levels and is represented as graph in Fig-5.

Table-2
Water Holding Capacity of Mangalam Reservoir at Different Elevations

Sl. No.	Water Level (M)	Original Water Holding Capacity (M. Cub. m)	Water Holding Capacity(IBS Survey in 2008) (M. Cub m)	Water Holding Capacity (IBS Survey in 2015) (M. Cub m)	% Reduction in capacity
1.	77.88	25..494	20.300	19.889	21.98
2.	77.00	21.639	17.600	17.329	19.91
3.	76.00	18.414	14.800	14.782	19.72
4.	75.00	15.667	12.300	12.231	21.93
5.	74.00	13.071	9.900	9.865	24.52
6.	73.00	10.720	7.900	7.868	26.60
7.	72.00	8.640	6.300	6.049	29.98
8.	71.00	6.680	4.800	4.494	32.72
9.	70.00	4.975	3.500	3.178	36.12
10.	69.00	3.570	2.400	2.097	41.26
11.	68.00	2.461	1.500	1.296	47.33
12.	67.00	1.648	0.800	0.729	55.76
13.	66.00	1.062	0.400	0.357	66.38
14.	65.00	0.581	0.100	0.100	82.78
15*	64.20	0.150	0.043	0.04	73.33

* Dead storage level

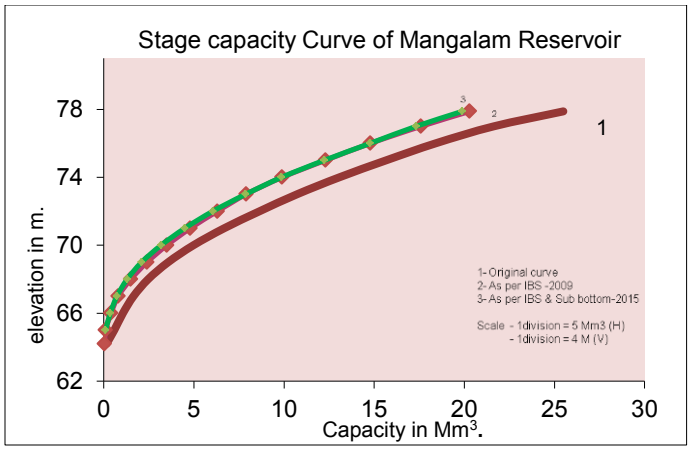


Fig. 4. Water holding capacity Vs Water level curve

Table-3
Water Spread Area of Mangalam Reservoir at Different Elevations

Sl. No.	Water level (M)	Original Water spread area (Sq.km)	Water spread area as per IBS 2008 (Sq.km)	Water spread area as per IBS 2015 (Sq.km)
1	77.88	3.96	4.06	3.00
2	77	3.45	2.86	2.80
3	76	3.26	2.67	2.15
4	75	3.07	2.49	2.12
5	74	2.86	2.16	1.99
6	73	2.63	1.79	1.70
7	72	2.4	1.57	1.57
8	71	2.16	1.39	1.35
9	70	1.93	1.21	1.15
10	69	1.63	0.99	0.9
11	68	1.32	0.75	0.64
12	67	0.99	0.54	0.43
13	66	0.66	0.35	0.29
14	65	0.33	0.20	0.16
15*	64.2	0.20	0.09	0.05

* Dead storage level

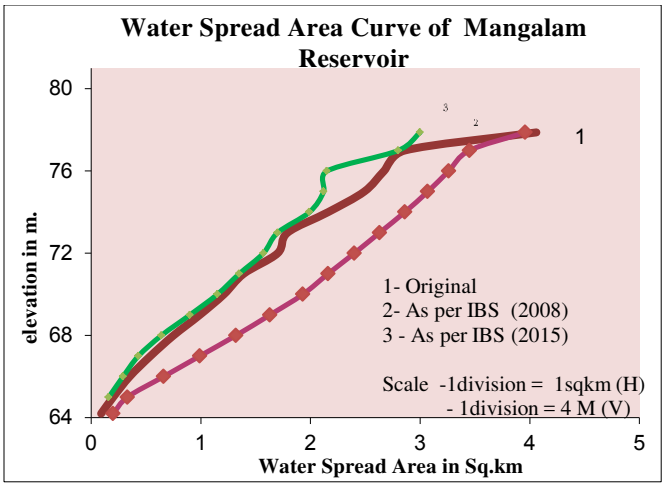


Fig.5. Water spread area Vs Water level Curve

C.2.1.6 Classification of soil sample

It had been decided to collect the core samples from 5 feet depth using the hand operated bailer method. Eight locations from 3.96km^2 of reservoir area were identified. The locations are shown in Fig.6.

Soil samples thus collected were analyzed in Soil Mechanics and Foundation Division, KERI, Peechi.

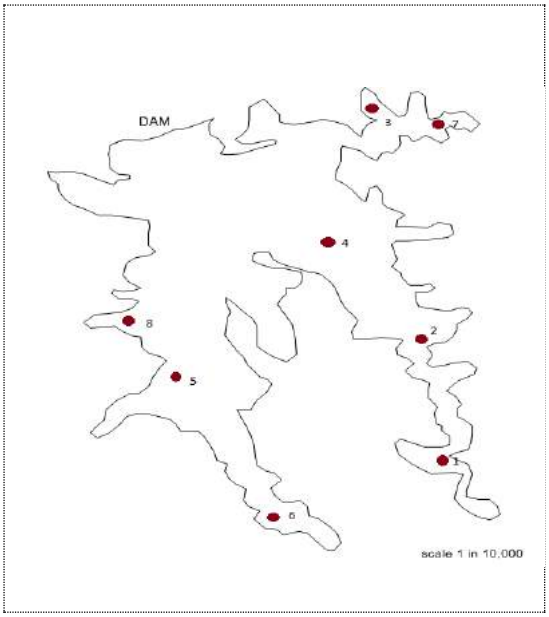


Fig. 6 Location of soil samples

Collection of soil samples

C.2.1.7 Result & Discussion

The capacity of Mangalam Reservoir has been calculated as19.889Mm^3 against the original capacity of 25.494Mm^3. From these values, the sediment deposit is deduced as 5.605Mm^3.

The average depth of sediment in 2008 was 1.3m and the annual rate of sediment up to 2008 was 2cm per annum.

- ***The average thickness of sediment deposit in the reservoir is 1.4m in 59years @ 2cm of deposition per annum.***
- ***In the last seven years the annual rate of sediment deposition is only 1.4cm per year which shows a decline or stabilization.***

As per IS classification soil particles having size from 2.46mm to 75 micron is classified as sand and the fraction having particle size below 75micron are fine grained soil particles, which are further divided as silt and clay.

On conducting grain size analysis of the eight soil samples, the following observations are made.

- *All samples except one sample are predominantly composed of sand sized particles. At three locations, which fall along the river inlet, the samples consist of more than 80% of sand sized particles.*
- *At one location, sample containing 68% of fine grained particles has been collected.*
- *At other locations, the distribution of fine grained and coarse grained samples are even.*
- ***Roughly, from the 5.605Mm^3 of sediment deposit, maximum quantity of 2.2Mm^3, might fall in the fine grained particle size. This observation is applicable to the random samples, collected and analyzed.***

C.2.1.8 Conclusion

The bathymetric survey of Mangalam Reservoir was conducted from 30th October, 2015 onwards and was completed by 7th November, 2015.

Sample collection commenced on 8th November and was completed on 17th November, 2015. The samples have been analyzed in the laboratory and the results of Bathymetric survey and soil sample analysis have been reported herein.

C.2.2. Sedimentation studies of Meenkara, Pazhassi, Karapuzha, Neyyar Reservoirs using IBS & Sub Bottom Profiler

The works are completed and reports under preparation.

D. CONSTRUCTION MATERIALS DIVISION

D.1 Introduction

CONSTRUCTION Materials Division, functioning in K.E.R.I., is basically a material testing laboratory. In addition to conducting routine tests on building materials, the division has developed the capacity for conducting fundamental and applied research in

related fields. This division takes up consultancy work such as concrete mix design and projects from clients. This division also imparts training for laboratory staff on request.

This lab is equipped with Rebound Hammer, Rebar Locator and Ultra Sonic Pulse Velocity Meter. These non destructive tests are being conducted to check the strength and deformation characteristics of the structure.

Hundred and ninety one test reports were produced from this division in 2015-16 collecting revenue of Rs.10,97,655/-. These materials were brought by various governmental as well as private entities. Materials involved in testing were; cement, concrete, bricks, rocks, tiles, paver blocks, aggregates and steel. The work also involved designing of concrete mixes done for Private and Government Agencies.

Apart from these, a fundamental study was conducted on the reliability of accelerated curing method for speedy design of concrete mixes.

D.2 Tests conducted

Details of tests conducted during the year 2015-16 are given in Appendix- III.

E. SOIL MECHANICS AND FOUNDATIONS DIVISION

E.1 Introduction

SOIL, the most unpredictable of all engineering materials also happens to be the all important material in civil engineering because all structures need to be founded on earth. In addition to being the founding medium, soil is also used as a material of construction. As in the case of other materials, properties of soil cannot be generalized since basically soil is a combination of different constituents having different properties. Therefore the study of the technical and structural aspects of soil is all important.

Major difficulties encountered in foundation work are due to the nature of soil. The investigation for any foundation engineering problem may range from a simple examination of soil to a detailed study of the soil and ground water by means of bore holes and laboratory tests on the materials encountered. The extent of the work depends on importance and foundation arrangement of structures, the complexity of the soil conditions and already available information of existing foundations on similar type of soils.

The physical characteristics of soils can be investigated by means of laboratory tests on samples taken from boreholes or trial pits. Results from lab tests can be used to derive important parameters in the design of substructure. The results of shear strength tests can be used to calculate the ultimate bearing capacity. Soil parameters so obtained by means of investigations can be utilized to design safe structures.

Soil Mechanics Laboratory under K.E.R.I. is fully equipped to determine the index as well as the engineering properties of soil samples and the engineers in charge are trained to provide recommendations if all necessary structural details are given. It covers Soil Mechanics, Soil Dynamics, and Ground improvement Techniques. The soil mechanics laboratory undertakes work from Government agency and private agencies.

Analysis of engineering problems such as bearing capacity computations, settlement analysis, stability analysis of slopes etc. are taken up by this Division. Instrumentation and analysis of seepage data from various Irrigation Projects are also taken up.

The work is spread out into the following stages.

E.1.1 Pre-Construction Stage

During investigation, the soil samples are collected and tested in the laboratory, for index properties and engineering properties like MDD, OMC/FMC, Permeability, Shear parameters, Consolidation and Swelling characteristics and relevant parameters are furnished to design the proposed structures. The laboratory is assisted by the Instrumentation Division which is equipped with field testing equipment for boring to collect undisturbed soil samples. Field tests like Plate Bearing Test, Standard Penetration Test, and Dynamic Cone Penetration Test to assess the in-situ characteristics of sub-soil are also carried out.

E.1.2 Post Construction Stage

Measurement of seepage through earth dam, inspection and investigations of causes of slips and breaches of canal and dam embankments are taken up and remedial measures are suggested.

All the tests on soil samples received from various projects of Irrigation Department, Roads and Buildings, Panchayat Raj, Public Health, Kerala State Electricity Board, Housing Board and Non-Government bodies are being tested as per the codes of Bureau of Indian Standards.

E.2 Infrastructure

The important equipments available in the laboratory are

i) Direct Shear Test Apparatus (for both large & small boxes)
ii) Tri-axial Shear Apparatus
iii) Consolidation Apparatus
iv) Uni-axial Testing Apparatus
v) Constant Head Permeability Test Apparatus
vi) Variable Head Permeability Test Apparatus
vii) Laboratory CBR Test Apparatus
viii) Field CBR Test Apparatus
ix) Fully Automatic Consolidation Apparatus
x) Fully automatic Tri-axial Shear Apparatus
xi) Fully automatic Direct Shear Apparatus

E.3 Field Investigation

1) Rehabilitation and improvements of basic facilities of Muvattupuzha valley irrigation project – Conducting Geo physical studies of Malankara Dam - Site visited

2) Pambar basin Projects – Reconstruction of Pattissery dam and canal system under Chengalar scheme – Site inspection conducted.

E.4 Conducting Pile Integrity Test Using Pile Echo Tester

1) Pile Integrity Test conducted for the project Candela of TBPL at Thrissur.

2) NABARD – RIDF –XIX Construction of Regulator across Bharathappuzha at Chenganamkunnu in Ongallur panchayathu Palakkad District – Pile Integrity test was conducted.

3) Pile Integrity test – Market shopping complex and Mini Convention centre at Kuravankonam ward in Thiruvananthapuram Corporation

4) Harichandanam Apartment at Guruvayoor, a project of TBPL. Pile Integrity test conducted on bored cast in situ piles.

E.5 Conducting Geo-Physical Exploration Using Engineering Seismograph

1) Conducting Geophysical studies with Engineering Seismograph - Malampuzha reservoir.

CASE STUDY

1) Conducting Geophysical studies with Engineering seismograph - Malampuzha reservoir

E.6 Fundamental Studies

One Fundamental study, "Conducting a study on Co-relation between Grain size distribution/Specific gravity, OMC and CBR value" has been proposed and data for the study were collected. Analysis is to be conducted.

E.7 Laboratory Investigation

Laboratory investigations on soil samples brought to the lab is a part of routine works in the division. The list of works carried out in the lab during the current year is given in Appendix–IV.

E.8 Ongoing Works

1. Pambar Basin - Chengalar Scheme – Pattissery dam – Physical and Chemical Properties of Cement Sand Bentonite core Earth Dam.
2. DRIP – Rehabilitation and improvements of basic facilities of Muvattupuzha Valley Irrigation Project – Malankara Dam
3. Investigation of Subsoil strata - Using Engineering Seismograph by Seismic refraction method -Construction of Check Dam across Bharathappuzha at Mannannur in Vaniyamkulam Panchayath.
4. Sedimentation survey of Karappuzha Reservoir using IBS and Sub Bottom Profile - Testing of Soil & Water samples.
5. Conducting Geophysical studies with Engineering seismograph - Malampuzha reservoir.

F. INSTUMENTATION DIVISION

F.1 Introduction

INSTRUMENTATION Division acts as the mobile unit of Soil Mechanics Division and conducts various field tests. Site investigation is essential for judging soil suitability for proposed engineering work and preparing adequate design. It also helps for selecting suitable and economic construction materials as well as methods. Site exploration reveals reliable information about soil and ground water which will help the Engineer for an intelligent planning.

Soil samples are taken from sites on request and are transferred to Soil Mechanics and Foundation Division for testing. The following field tests are conducted by this division.

1. Plate Load Test for finding out the bearing capacity of soil.
2. Pile Load Test for determining the bearing capacity of pile.
3. Standard Penetration Test.
4. Dynamic Cone Penetration Test.
5. Collection of disturbed and undisturbed soil samples by hand auger and machine boring.

F.2 Activities of the division during the current year

This Division took part in the following work

F.2.1 Soil Investigation Work at the proposed site for the construction of new dam at Mullaperiyar.

It has been proposed to construct a 623m long and 52m high straight concrete gravity dam across Periyar River about 366.00m downstream of the existing Mullaperiyar Dam. Soil Investigation works was carried out by KERI. The Investigation work was carried out from 28/4/15 to 18/06/15. Thirteen bore holes were drilled of which eight bore holes are in stilling basin and the remaining five are along the dam seating area, toe of the dam. Field Permeability tests have been conducted by Packer method in the boreholes. Three numbers of boring plants were used for drilling.

F.3 Infrastructure

The important equipments available in the Division are

- Equipments for hand auguring.
- Diesel boring plant

F.4 Procurement of New Machinery

1. Purchased a Rotary Type calyx drilling rig with all accessories capable of drilling soil and rock.

2. Purchased one double stage screw pump with delivery pressure 10bar and discharge head 120MLC.

Setting of Boring plant at Mullaperiyar site

Shifting boring plant from one point to other

Ready to start work

New boring plant trial run at Peechi

G. PUBLICATIONS DIVISION

G.1 Introduction

PUBLICATIONS Division acts as the information bureau of the Kerala Engineering Research institute. This division provides necessary technical information to all other divisions through its technical library containing around 10,000 books and a number of latest periodicals. An Engineering Museum consisting of the models of various completed irrigation projects, important bridges etc is operated by this division and these replicas are quite useful and informative references for the technical persons and students. The three dimensional model of Kerala, known as the relief map of Kerala is a centre of attraction for people from any sector of life. This model is built to a scale of 1/16,000 horizontal and 1/1000 vertical and is absolutely of a unique configuration and is also operated by this division. This division conducts seminars and training

programmes for the benefit of staff of the Institute. Also the division conducts Trainings and Refresher courses for the staff of the Irrigation department.

G.2 Activities of the Division

During the financial year 2015-16 the main areas of work attended by this division are:

- Maintenance and development of Library
- Editing and publishing of Annual Report 2014-15.
- Conducting Seminars for the benefit of the technical hands and staff in the institute.
- Conducting Refresher courses for the Engineers and technical staff of the department
- Operating the Engineering Museum and Relief Map of Kerala
- Routine works of Publications Division

G.3 Library Service

This division has an excellent technical library attached to it. Latest publications on topics of interest to research workers are being regularly added. The library is being used by many technical persons in different Government departments and also by a number of students from different Engineering Colleges and Polytechnics. Books are issued to officers attached to KERI using Library software. The card system is also being maintained. However facilities are extended to Engineers working in various departments and Institutions for referring the books.

The books are arranged in different shelves according to the subjects.

Library

G.3.1 Books

26 books were purchased to the library during this financial year.

G.3.2 Periodicals

A total of 11 numbers of Indian periodicals were subscribed by this division The following journals were purchased by subscription during the year.

G.3.2.1 Indian Periodicals

1 Indian Concrete Journal
2 Electronics for You
3 The Bridge & Structural Engineer
4 Indian Journal of Power & River Valley Development
5 Civil Engineering and Construction Review
6 Inside Outside
7 Master Builder

8 Down to Earth
9 Indian Journal of Geosynthetics and Ground Improvement
10 NDC-WWC journal
11 ISRM (India) journal

G.4 Publication of Annual reports

Annual Reports for 2014-15 was published and copies were sent to important institutions and personnel.

G.5 Engineering Museum

This division is attending the operation of Engineering Museum attached to the Kerala Engineering Research Institute. The working model of major completed Irrigation Projects in Kerala is exhibited in this museum. It has also got a collection of the models of important bridges.

G.6 The Relief Model of Kerala

The Relief Model is marked with all the salient features of Kerala has always been the centre of attraction of visitors who come to Peechi.

The Relief Model of Kerala

Constructed to a horizontal scale of 1/16,000 and vertical scale of 1/1,000, this model clearly shows rivers, roads, railways, location of Irrigation and power schemes, important places and district boundaries etc. in the state. In short, the model gives an idea of the topographical features of Kerala.

G.6.1 The Water a Divine Gift

The Model gives a clear idea about the functioning of multipurpose project and the manifold uses to which water can be cheaply and conveniently put to.

G.7 Seminar Programme

A total number of seven seminars were conducted during this year

Sl. No.	Title of paper	Name of speaker	Date
1	Tunnel Engineering	Er. Joy C.C., Assistant Director, O/o the Joint Director, Hydraulic Research, KERI, Peechi.	22/05/2015
2	Geostrap Reinforced Soil Wall	Mr. Saji George, Research Assistant, SM&F Division, KERI, Peechi.	29/07/2015
3	Water Scarcity- an emerging problem	Er. Divya C.J., Assistant Director, Coastal Engineering Division, KERI, Peechi.	04/09/2015
4	Tax Saving Schemes	M/s Integrated Enterprises (India), Thrissur.	18/09/2015
5	TRACES- web based application of Income Tax Department	Mr. Justine Paul P., Clerk, O/o Executive Engineer, Irrigation Division, Thrissur.	27/10/2015
6	ÎÜÏÞ{ ÍÞ×Ïáæ¿ ÍÞÕß	Sri. Davis E.D., Publications Officer, Kerala Sahitya Academy, Thrissur.	13/11/2015
7	TRACES-II, web based application of Income Tax Department	Mr. Justine Paul P., Clerk, O/o Executive Engineer, Irrigation Division, Thrissur.	18/01/2016

G.8 Training and Refresher courses for Engineers and Technical Staff of the Department

G.8.1 Training on "PRICE SOFTWARE"

The training was conducted at KERI on 28th July, 2015 for the technical staff of KERI. 18 Delegates participated in the training.

The classes were taken by Er. Sheela K.R., Assistant Executive Engineer (District Co-ordinator of PRICE), MI Sub Division, Chalakudy.

By the training the delegates got a general idea for using PRICE SOFTWARE

G.8.2 Refresher course on "Good Construction Practices" and Practical session on"GPS"

The Refresher course on "Good Construction Practices" was conducted in the morning session and practical session on "GPS" was conducted in the afternoon session of 16th December, 2015 for Engineers and Technical Staff of Irrigation Department. 65 delegates participated in the programme. The classes were taken by Sri. Suguna Nantha Gopan S.R., Executive Engineer, Kuttiyadi Irrigation Project.

G.8.3 Refresher course on "Modern Instrumentation Techniques in Water Resources"

The Refresher course was conducted on 4th and 5th January 2016 for the Engineers of Irrigation Department. 32 personnel participated in the programme. The classes were

taken by Sri. Selva Balan and Sri. Ganesh, Scientists, Central Water & Power Research Station, Pune.

G.8.4 Refresher course on "Quality Control for works

The Refresher course was conducted on 9th and 10th February, 2016 for the Technical Staff of Quality Wing. 27 persons participated in the programme. The classes were taken by Sri. K.A. Muhammed Kunju , Retired Superintending Engineer.

G.8.5 Refresher course on "Modern Hydrometric Instruments" for the Technical Staff of Hydrology wing of Irrigation Department

The Refresher course was conducted on 4th and 5th March, 2016 for the Technical Staff of Hydrology wing of Irrigation Department as per request. 28 persons participated in the programme. The classes were taken by Sri. Selva Balan. M., Scientist, Hydraulic Instrumentation Division, Central Water & Power Research Station, Pune.

H. COASTAL ENGINEERING FIELD STUDIES, THRISSUR

H.1. Introduction

THE Coastal Engineering Field Studies was formed in 1973 and is engaged in the collection of data and field studies on Coastal Erosion along the Kerala Coast. The coast of Kerala extending 574.40Km in the south west coast of India, is characterized by a narrow longitudinal barrier strip of low-lying land, sand-witched between the Arabian Sea and a continuous chain of lagoons and back waters with connection to sea at several points. This strip is formed of alluvial deposits. In considerable stretches, the space between the sea and the back waters is very narrow and even less than a few hundred

meters at many places. Any break in this narrow strip would expose the back water to the fury of the waves and could endanger the entire disappearance of the barrier beaches.

The coastal zone has the maximum concentration of population and is even many times the State average at several places. Many of the foreign exchange earning industries, residential localities, a number of district headquarters, good number of ports, fishing harbours and extensively cultivated land also exist along this narrow coastal zone.

The coastline of Kerala is subjected to severe erosion in a major portion of its length during the monsoons, when the sea becomes rough due to consistent attack of waves. The coastline is sometimes subject to tidal overflow also, when adjoining low lying lands get submerged. Erosion is very severe in the coastal areas during the south west monsoon period. During the worst monsoon period, the highest waves average 2.3m and wave periods range from 9 to 12sec. and they come mostly from west. The normal tide range varies from 0.9m in the south to 1.8m in the north. Storm tides occur all along the coast during the monsoon season. During the monsoon, the high waves coupled with storm surges, cause overflow and flooding of the low lying backshore lands all along the coast, resulting in considerable loss of property, destruction of private and Government buildings, communications, dislocation of life of lakhs of population and disruption of other activities affecting economy. The influx of saline waters through mouths of rivers also affect agriculture and industry.

New C.P. Stones have been planted throughout the Kerala Coast except about 25km length of north extreme end at Manjeswaram. The GPS Co-ordinates of all C.P. Stones have been recorded.

All aspects of the coastal erosion problems of the State, the necessity for immediate protection of vulnerable stretches, efforts made in collection of coastal data for long periods in conducting studies and in getting expert advice from all over the world and achievements made so far in tacking the erosion problem.

Many experts who visited this State, to study the behavior of the coast and also for periodical evaluation of the performance of completed sea walls, were all of the same opinion that the sea wall damage, mostly due to improper maintenance is as important as the construction of sea wall.

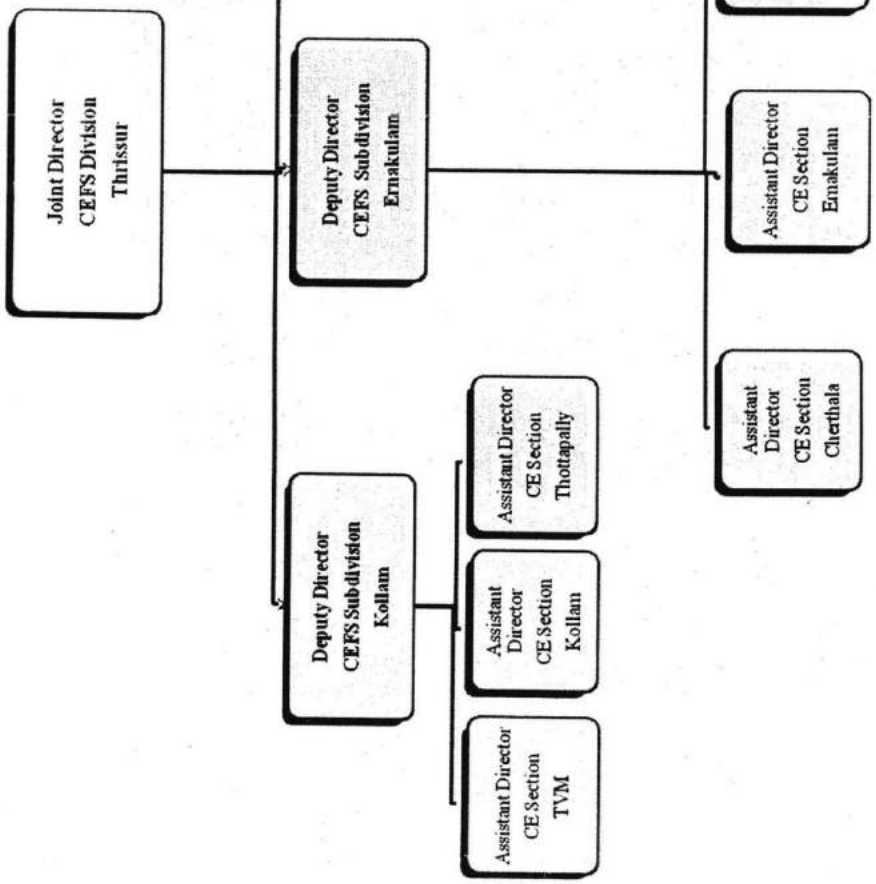
For proper construction and to understand the performance of the sea wall during and after construction, proper monitoring is necessary. This requires consideration of the field staff with the staff engaged in coastal erosion studies. Whenever a new sea wall is to be constructed, the research staff must be informed of the different stages of construction, starting from alignment of the sea wall forming filter, core, armour layers, etc, so that the performance of it during construction and after construction can be watched.

The field staff also must keep a date-war record of construction details starting from alignment, excavation, putting filter, forming core, armour layer, etc, as per lines and level. The distance and levels of stones in front of sea wall also must be watched regularly with the progress of construction of sea wall. All chainages of sea wall must be made with reference to the Km/C.P. Stone available at site.

The concerned Assistant Engineers must give all relevant details to the concerned Assistant Directors in charge of Coastal Erosion Studies from time to time, as per the above guideline and also keep a copy of the same for reference.

ORGANISATIONAL SET UP

Name of Sub Divisions and Sections Under Coastal Engineering Field Studies Division, Thrissur



H.2 General Arrangements And Field Studies

For the detailed study of the characteristics and behavior of the beach, the 574.40Km of the Kerala coast is divided into three regions viz., Southern region, Central region and Northern region. Each of these regions is under the control of Deputy Directors and further sub divided into the control of Assistant Directors. The three regions come under the Coastal Engineering Field Studies, headed by Joint Director who works under the guidance of Director, Fundamental and Applied Research, Kerala Engineering Research Institute, Peechi.

The extent of natural formation of beach, the position of protective dunes, the details of lagoons, inlets i.e., azhis are observed. Assessment of variation in tides and winds, movements of waves, littoral drift etc., are made. Also the general study of the important structures in the coast, natural bed slope and depth of water as far as possible up to the depth of closure of sea are also carried out, (which are to be examined in detail before any protection work is taken up). Thus the programme of study can be summarized as, Investigation of present conditions of sea coast by means of surveys and observations. Investigation of past history of coast from the available maps and records.

The specific factors for which specific data are being collected and obtained are as follows:

1. Shore History
2. Shoreline and shore depth changes
3. Accretion and erosion
4. Type of protection works installed and their effectiveness.
5. The direction, amount and character of littoral drift that produced the problem conditions.
6. Material characteristics composing the littoral zone.
7. Forces pertinent to the littoral zones
   a) Waves
   b) Currents
   c) Tides
8. Effects of mud banks
9. Effects of inlets

H.2.1 Sub Items Of Study

1. Fixing and maintaining Control Point Stones, K.M. Stones and Alignment stones.
    a) Connecting levels of Control points.
    b) Maintenance of existing control points, K.M.stones and Alignment stones.
    c) Planting new and replanting missing CP Stones, KM Stones , Alignment stones and Bench mark stones

2. Study of shoreline and shore depth changes
    a) Taking cross section profiles

3. Physical Surveys
    a) Topographic surveys
    b) Periodical measurements of shorelines
    c) Photograph

4. Study of littoral drift
5. Study of beach samples
6. Studies on wind, wave and tides
7. Studies on coastal protection works
8. Mud banks studies
9. Details of specific studies.
    a) Studies on sea walls

10. Other Studies
    a) Simultaneous Observations and daily observations

H.3 Details of Works

H.3.1 Planting of New Control point Stones, Alignment Stones, Kilometer Stones and Benchmark Stones along The Sea Coast

Control Point Stones and Alignment Stones are the most important reference points for all the collection of data and for carrying out the protection works. In most area, levels are also established on those stones. The regions are referred by the Control Point stones. The references in certain reaches are made on BLS i.e., Base Line Stones. Shore line measurements, fixing of levels, topographic survey and similar important factors are based on these stones. Similarly, K.M. Stones are established to ear mark each region. B.M. stones are planted along the shore as permanent level marks. The levels on Control Point Stones are further checked on the basis of the B.M. stones. Many of the Control point stones and alignment stones are seen missing and damaged due to various reasons. Balance work of 13th F. C. Award for planting new C.P. Stones, alignment stones, K.M. Stones and B.M. Stones along the sea coast under the jurisdiction of Thalassery for length of 25km has to be arranged.

H.3.2 Investigation Works

Field studies and collection of data on coastal erosion have been conducted on all sections under this Division.

H.4 Programme of Study

In coastal environment, waves, tides, currents and winds are the important parameters which need to be considered for any development. It is very much essential to understand the physics of these processes. Coastal erosion is the wearing away off land by the action of waves, current and wind. Coastal erosion is accompanied with landward recession of the sea shore and loss of land area. It is a common problem faced in almost all coastal areas. Only the magnitude and nature of erosion changes from place to place. Along the most part of Kerala Coast, the erosion observed is seasonal in nature, that is, beach gets eroded during monsoon and regains its original profile during fair weather season. However, at some places erosion is of permanent nature.

H.4.1 Simultaneous Wave Observations

Simultaneous wave observations are being conducted at 18 specified location along Kerala Coast on all new moon days to understand characteristics of wind, wave and tide details such as width of back shore, fore shore, slope of fore shore, composition of beach materials, characteristics of littoral drifts, shore history and they are recorded on standardized format.

H.4.1.1 Study of Littoral Drift

Littoral transport is the movement of sediments in the near shore zone by waves and currents. This transport of suspend and bed load particles are both in parallel to the sea shore and perpendicular to sea shore. This transport of suspended materials is called littoral drift. It has been ascertained from the past studies that the dominant direction of littoral drift in Kerala coast is from north to south. However the directions, an annual quantity of net and gross quantity are important in developing shore protection arrangements. Now only the direction of drift is being studied at selected points along the shore.

H.4.1.2 Study of Wind, Wave and Tides.

Winds are the natural generators of wave and their study is necessary. An understanding of the nature of the tidal phenomenon is necessary for the study of coastal behaviors. The top level of the coastal protection structures depend on the tidal level and their data must be collected.

Wave causes sand to move along the coast as well as on to or off a beach. Due to refraction, wave energy is concentrated in certain reaches of the coast where erosion became naturally severe. Hence the design of coastal protection structures primarily depend on wave characteristics and since these studies are essential (Predominant direction of waves is from west or north west).

H.4.1.3 Study of Mud banks

Mud banks, a phenomenon peculiar to the coast of Kerala are those in shore region where wave energy is dissipated completely as a result of the colloidal mud suspension mud bank protect the coast immediately near it, but causes erosion in the down-drift side due to diffraction of waves.

Many rivers in Kerala exhibit a continuous migrating tendency. Such migrations influence the beach characteristics in the adjacent areas considerably.

H.4.2 Periodical measurement of shore line changes

Periodical surveys are taken to determine the shore line changes of the coast. The offset measurement of the shore line with respect to Control point and Alignment stones are taken every month and recorded. It provides very important data to understand the shore line fluctuation of the coast.

H.4.3 Collection and Study of beach samples

Pre-monsoon (May) and post-monsoon beach samples are collected from specified places for testing grain size distribution and specific gravity since the erosion and accretion of coast depends up on the nature of beach material to a certain extent. Also for natural nourishment materials can be supplemented to the beach and thereby the erosion can be reduced. Beach samples are important variables determining the beach characteristics. Study of beach materials, characteristics and sources is essential for the evolution of a long term shore protection plan.

H.4.4 Report on Coastal damages and Taking photographs

The details of damages at various places in the coastal beaches have been collected from time to time and photographs are taken to understand the details of erosion, coastal damages occurred during monsoon and drastic changes in the shore line. The details of damages caused during the year 2015 are listed in Appendix–VII.

During this year, no serious damages of sea wall were reported. The sea wall at C.P. No. 0000 to 0008 is in sunken position and some reformation work is going on. The dilapidated sea walls at C.P. No. 60 and 70 are reformed. The sea wall from C.P. No. 75 to 98 is almost in a dilapidated condition and this condition is becoming worse day by day. The sea wall from C.P. No. 212 to 218 is also in the same condition. The Varkala Cliff, a beautiful place, is slowly disappearing due to severe sea attacks. Hence, some urgent protection work is needed.

H.4.5 Topographic survey along the coast of Kerala

Topographic surveys are conducted to study the topographic changes of the beach.

H.4.6 Taking cross section profile of the beach

Cross section profiles taken using leveling instrument and leveling staff (Taken up to wading depth of waters).

H.4.7 Study of River outlets and Coastal inlets

Many rivers in Kerala exhibit a continuous migrating tendency. Such migration influences the beach characteristics in the adjacent areas considerably and hence to be studied in detail. Among these, periodical measurements of shoreline changes provide very important data to shoreline fluctuation of the coast.

H.4.8 Dates and places of observations

In order to have more detailed idea of the behavior of factors affecting the shore line changes, three consecutive points are taken for reference. At a particular study reach five readings are taken in all three points at definite timing. Nearly 20 to 25Km apart straight reaches without much external disturbances are selected for taking these simultaneous observations. The places of observations with timing and C.P. Nos. are listed in Appendices V & VI.

H.4.9 Alignment fixation of sea walls

The Joint Director inspected the sites for fixing alignment of sea wall (construction and reformation) with the concerned Irrigation officials, Deputy Director and Assistant Director of the Coastal Sub Division & Sections concerned, and approved the alignments of sea walls along Kerala Coast, considering the last 5year shore line measurements and the alignment of the sea.

Alignment approval has been given to the following works by the Joint Director, Coastal Engineering Field studies, Thrissur.

Sl. No.	Name of Sub Division	Alignment approved	Essentiality Certificate issued
1	CE Sub Division, Kozhikode	4 Nos.	5 Nos.
2	CE Sub Division, Kollam	Nil	Nil
3	CE Sub Division, Ernakulam	1No.	Nil

H.5 Performance of The Division

Within the limitations of availability of funds, availability of field staff and modern instrument, this division has taken up all the possible studies in the year 2015-16. The performance can be summarized as follows.

H.5.1 Types of works

1.	Topographic survey conducted for Determining beach profiles	:	Nil
2.	Periodical measurement of shoreline changes	:	4341.95Km
3.	Simultaneous observations	:	216Set
4.	Taking photograph	:	122Nos.
5.	Soil sample collected	:	36Set
6.	Cross section profiles	:	Nil
7.	Levels connected	:	Nil
8.	C.P Stones planted	:	Nil
9.	Alignment stones planted	:	Nil
10.	Kilometer stones planted	:	Nil
11.	Bench mark stones plant	:	Nil
12.	Alignment fixed by Joint Director	:	5Nos.
13.	Details of damages at various places in the Coastal beaches collected (separately attached Statement No.3)	:	Nos.
14.	Mud bank study	:	Nil

H.6 Sub Division wise Coastal studies performance

1. Topographic Survey conducted

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

2. Periodical measurement of Shoreline changes

Kollam Sub Division	1500km
Ernakulam Sub Division	1125.95km
Kozhikode Sub Division	1716.00km

3. Simultaneous Observations

Kollam Sub Division	60 Set
Ernakulam Sub Division	36 Set
Kozhikode Sub Division	84 Nos.

4. Taking photograph

Kollam Sub Division	45Nos
Ernakulam Sub Division	22 Nos
Kozhikode Sub Division	52 Nos.

5. Soil sample collected

Kollam Sub Division	10 Set
Ernakulam Sub Division	12 Set
Kozhikode Sub Division	14 Set

6. Cross Section Profiles

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

7. Levels connected

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

8. C.P. Stones planted

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

9. Alignment Stones planted

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

10. Kilometer Stones planted

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

11. Bench Mark Stones planted

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

12. Guard Stones planted

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

13. Details of damages at various places in the Coastal beaches collected in Appendix-VII

14. Study of Mudbank

Kollam Sub Division	Nil
Ernakulam Sub Division	Nil
Kozhikode Sub Division	Nil

The Central Water Power Research Station, Pune (CWPRS) under Ministry of Water Resources, Government of India has suggested to collect the coastal data of our state as per their guidelines for submitting the same to National Coastal Data Bank of CWPRS, Pune for compilation. They had instructed that all the C.P. stones are to be marked in the coastal map of Kerala by Cartesian co-ordinates using Geo positioning system. The preparation of Coastal Atlas of Kerala is in the anvil and same has been completed for the length 79.08km from C.P. 000 to C.P. 287 under Thiruvananthapuram section and rest of work is in progress. The C.P. Stones, Alignment Stones, K.M. Stones, Bench

Marks and the salient features along the coast is recorded with respect to GPS Coordinates in this process.

The coastal data of Periodical measurements which backs to 1990 has been digitized and the digitization of available data of sled survey is in progress.

H.7. Bottleneck Facing

Coastal Engineering Field Studies (CEFS) is the one and only Institution entrusted with the collection of coastal field data and field studies connected with the erosion of the entire sea coast of Kerala, the functions assigned to which are vital and essential. But at present CEFS is provided with bare minimum facilities. The office building of CEFS Thrissur is in a pathetic condition and it is a Herculean task to protect the valuable records of collected data. Similarly it is very cumbersome to consolidate and process the valuable data collected for the last so many years manually and are being deteriorated. However the staff of Coastal Engineering Field Studies took great effort to digitize available maximum data for the past 25 years.

The Chairman, Coastal Protection and Development Advisory Committee (CPDAC) had advised the Chief Secretaries of all Coastal States to create a separate department for dealing with the Coastal Engineering works of the respective states vide Lr.No:4(5)/2000 CED dated 9/6/2000 to organize a coordinated program of collection, compilation, evaluation and publication of coastal data. Hence this wing is to be made permanent.

The staff strength of the wing is insufficient even for the routine performance. The CEFS Division is not having the posts of PA/TA., DA. The only two posts of Clerks were declared as supernumerary. Only an Assistant Director is available in Parappanangadi section for the last ten years for meeting all the activities.

Coastal Engineering Section, Thalassery coming under the control of Deputy Director, Kozhikode Sub Division extends from Mahe to Manjesweram with a length of 148km. At present only 90km is under study reach. No study is being conducted in the

remaining 58km (excluding Naval Academy and Bakel Fort). Assistant Director of each section is collecting field data and doing survey works for an average length of about 60km with the assistance of 2 Draftsmen/Overseer.

As far as Kerala Coast is concerned, the sea is turbulent, especially during monsoon and coastal erosion is a common phenomena along the sea coast for which continuous field study in all aspects is essential. But it is regretted to state that the budget provision, which was around 100 lakhs during the nineteen nineties, has got reduced considerably in the recent years to 5 lakhs bringing the survey works to almost stand still. At present the wing is collecting data on shoreline measurements, simultaneous observation, preparation of coastal damage reports with photographs and collecting soil samples only. Training programmes on Coastal Engineering and allied subjects to update and train the Technical personnel of the department regarding the latest development in this field is essential. No training has been conducted under this wing due to lack of funds. The study wing now follows old conventional method of observations like visual observations, tape measurements etc. High derivative modern instruments are now available in this field.

The Driver post for the Jeep under CEFS Division and Kollam remains vacant for a long time and it adversely affects the momentum of work schedule. The availability of vehicles is helpful in carrying out our studies as coastal areas are not easily accessible everywhere and private vehicles are reluctant for a trip to these remote areas with pathetic road conditions.

H.8. Suggestions/Recommendations

Sufficient fund has to be made available in time for conducting the entire study of coastal erosion. The coastal length coming under the jurisdiction of Thalassery section is 148km, and for studying the entire/reach an additional section is to be formed.

The location of new International Port at Vizhinjam is between C.P.45 and 55. The construction authority has formed artificial shore and road by using materials drilled

from the sea and breakwater construction is in progress. This area needs some specific studies for shoreline characteristics before and after the construction of Vizhinjam Port. Here due to terrain of land C.P. Stones have not been planted.

Some of the C.P. stones have been swallowed by the sea waves and some got destroyed by the weathering actions. As the new C.P. stones have not been planted for the continuous stretch, that profile could not be adopted for aligning sea walls etc. Hence C.P. stone planting and its timely maintenance is essential.

For getting the sufficient staff strength and for their maximum efficiency this wing is to be made permanent, considering the importance of this Division. Sufficient fund should be allocated for the training of Technical staff and for procuring the modern scientific equipments for the collection of coastal data.

5. FINANCE

In the budget for the financial year 2014-15 an outlay of Rs.85 lakh had been allotted under the Head of Account '4701-80-800-99-Development of KERI Stage II'. The proposal for the amount was grouped under three heads viz, Routine activities, modernization and revamping. The details of sanctioned amount and expenditure are given below. From the routine works carried out in the laboratories an amount of Rs.10,97,655/- has been collected as test charges and the amount was remitted in the treasury.

Details of sanctioned Amount and Expenditure

Sl. No.	Divisions	A.S. Amount in lakh
I	**Joint Director, C.M.&F.E., KERI, Peechi.**	
1	Construction Materials Division	28.85
2	Soil Mechanics and Foundations Division	5
3	Instrumentation Division	5
4	Publications Division	4
	Total amount received	**42.85**
	Expenditure	**36.68**
II	**Joint Director, Hydraulic Research, KERI, Peechi.**	
1	Coastal Engineering Division	9.20
2	Hydraulics Division	13.50
3	Sedimentation Division	17.05
	Total amount received	**39.75**
	Expenditure	**25,03,522/-**

6. SUMMARY

In the annual report for the current financial year a general introduction about the institute, organization set up, division wise functioning of the institute, implementation of modernization scheme and details regarding budget allotment and expenditure have been explained in detail.

The bottlenecks or hindrance in the development of the institute as a full fledged research organization are

- Insufficient number of technical personnel.
- Lack of well qualified engineers.
- Lack of up-gradation of technical knowledge of engineers through training.
- Insufficient number of projects/under utilization of the facilities available at the institute.

- In the case of Field studies division, sufficient fund has to be made available in time for conducting the study of coastal erosion and high derivative modern equipments has to be made available.

- The building of CEFS, Thrissur which is in a dilapidated condition has to be modified.

All these require intervention from the part of the Government and it is hoped that the upgradation of the personnel of the Institute will be taken up as a continuation of the modernization scheme.

Appendix – I

Vacancy Position as on 31/03/2016, KERI, Peechi

Sl. No.	Designation	Sanctioned Strength					No of Posts Vacant					Remarks
		O/o Director	CM&FE	Hydraulic Research	CEFS	Total	O/o Director	CM& FE	Hydraulic Research	CEFS	Total	
1	Director	1				1	1	-	-	-	1	
2	Joint Director	-	1	1	1	3	-	-	-	-	-	
3	Deputy Director	-	4	3	3	10	-	1	-	-	1	
4	Assistant Director	1	7	7	10	25	-	2	3	1	6	
5	Divisional Accountant	-	-	1	-	1	-	-	-	-	-	
6	Junior Superintendent	-	1	1	-	2	-	-	1	-	1	
7	Fair Copy Superintendent	-	-	1	-	1	-	-	-	-	-	
8	Selection Grade Typist/ UD Typist	-	2	1	-	3	-	-	-	-	-	
9	Research Assistant	1	8	7	9	25	1	6	3	-	10	
10	2nd Grade Overseer	1	4	4	15	24	1	2	4	4	11	
11	3rd Grade Overseer	-	3	2	-	5	-	3	2	-	5	
12	Scientific Assistant	-	1	1	-	2	-	1	1	-	2	
13	Tracer	-	-	1	-	1	-	-	-	-	-	
14	Blue Printer	-	-	1	-	1	-	-	1	-	1	
15	Driver	-	1	1	3	5	-	-	-	1	1	
16	Boat Driver	-	-	1	-	1	-	-	1	-	1	
17	Lab Attender	-	2	1	-	3	-	2	1	-	3	
18	Modeller	-	-	1	-	1	-	-	1	-	1	
19	Mason	-	-	1	-	1	-	-	1	-	1	
20	Worker Grade I/II	-	8	8	-	16	-	6	8	-	14	
21	Head Clerk	-	-	-	1	1	-	-	-	-	-	
21	UD Clerk	3	1	4	4	12	1	-	2	-	3	
22	LD Clerk	1	7	3	9	20	-	1	-	1	2	1 No. Deployed to LSGD
23	LD Typist	1	-	1	4	6	-	-	-	-	-	
24	Typist Clerk	-	1	1	-	2	-	1	-	-	1	
25	Office Attendant	2	6	3	13	24	-	2	-	2	4	
26	Part Time Sweeper	-	4	1	3	8	-	1	-	-	1	
27	Lab Assistant	-	1	-	-	1	-	2	-	-	2	
28	Information Assistant	-	1	-	-	1	-	1	-	-	1	
29	Assistant Surgeon	-	1	-	-	1	-	-	-	-	-	
30	Pharmacist	-	1	-	-	1	-	-	-	-	-	
31	JPHN	-	1	-	-	1	-	-	-	-	-	
32	Hospital Attendant Gr.II	-	1	-	-	1	-	-	-	-	-	
33	Nursing Assistant	-	1	-	-	1	-	-	-	-	-	

Appendix – II

Abstract of the Weather Data (AWS) from April 2015 to March 2016

STATION: K.E.R.I., PEECHI.

Latitude – 10° 31' 30", Longitude – 76° 21'59" MSL- +96.03 M.

Sl.No	Weather Elements	Range of the weather data
1.	Atmospheric pressure	Maximum Atmospheric Pressure observed was 1008.8 millibars on January, 2016 and Minimum Atmospheric Pressure was 993.3 millibars on April, 2015.
2.	Temperature	The maximum temperature was 38.5°C on March, 2016 and the minimum temperature was 19.2°C on February, 2016.
3.	Relative Humidity	Maximum relative humidity recorded was 100% in all the months and minimum relative humidity was 18.9% on March, 2016.
4.	Precipitation	Annual rainfall was 2421.1mm and the maximum rainfall was 628 mm on June, 2015.
5.	Wind-Direction	The main wind directions observed were from South West and North East directions.
6.	Wind Speed	Maximum daily mean wind speed was 1.8km/hr on January, 2016 and minimum daily mean wind speed was 0.5km/hr in July, 2015.
7.	Global Radiation	Maximum Global Radiation was 1360.3watts/m^2 on September and minimum of 366.7 watt/m^2 on November, 2015.

Appendix – III

List of tests conducted in the CM laboratory

D.3 TESTS CONDUCTED (APRIL 2015 TO MARCH 2016)

1. Testing of concrete cubes supplied by the Assistant Executive Engineer, Engineering Sub division, KAU, Vellanikkara.
2. Testing of concrete cubes supplied by the Assistant Engineer, PWD Special Building Section, Irinjalakkuda.
3. Concrete mix design carried out for KMP Consultants, Thrissur.
4. Testing of steel rods supplied by KMP Consultants, Thrissur.
5. Testing of solid blocks supplied by Bharathi Cements Corporation Pvt Ltd, Thrissur.
6. Testing of concrete cubes supplied by Blue Chip Constructions, Ernakulam.
7. Testing of steel rods supplied by the Senior Section Engineer, Southern railway, Thrissur.
8. Testing of concrete cubes supplied by the Assistant Executive Engineer, Engineering Sub division, KAU, Vellanikkara.
9. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
10. Concrete mix design carried out for M/s.K.M.Elias Constructions, Thrissur.
11. Testing of concrete cubes supplied by M/s. Tekton Builders and Contractors, Thrissur.
12. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Ayyanthole.
13. Testing of steel rods supplied by the Assistant Executive Engineer, Irrigation Investigation Subdivision, Aluva.
14. Concrete mix design carried out for the Assistant Executive Engineer, Irrigation Investigation Subdivision, Aluva.
15. Testing of concrete cubes supplied by M/s. Tekton Transcending Times, Thrissur.
16. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
17. Testing of concrete cubes supplied by the Assistant Executive Engineer, Engineering Sub division, KAU, Vellanikkara.
18. Testing of steel rods supplied by the Assistant Engineer, Trichur Central Subdivision III, Trichur.
19. Concrete mix design carried out for M/s. Nutech Constructions, Thrissur.
20. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
21. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
22. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
23. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.

24. Concrete mix design carried out for the Senior Section Engineer, Southern railway, Ernakulam.
25. Testing of steel rods for the Senior Section Engineer, Southern railway, Ernakulam.
26. Testing of concrete cubes for M/s. Tekton Builders and Contractors, Thrissur.
27. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
28. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
29. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
30. Testing of concrete cubes supplied by the Assistant Engineer, KSHB, Chalakkudy.
31. Testing of cement sample supplied by the Assistant Engineer, Trichur Central Subdivision III, Trichur.
32. Testing of steel rods supplied by the Project Manager, TEL, Thrissur.
33. Testing of concrete cubes supplied by the Assistant Executive Engineer, Engineering Sub division, KAU, Vellanikkara.
34. Concrete mix design carried out for M/s.K.M.Elias Constructions Pvt Ltd, Thrissur.
35. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
36. Testing of concrete cubes for M/s. Tekton Builders and Contractors, Thrissur.
37. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
38. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
39. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
40. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
41. Testing of concrete cubes for M/s. Tekton Builders and Contractors, Thrissur.
42. Testing of concrete cubes supplied by the Assistant Executive Engineer, Engineering Sub division, KAU, Vellanikkara.
43. Testing of concrete cores supplied by Sri.T.G.Sodaran, Thalikulangara, Choolissery.
44. Testing of concrete cores supplied by Sri.Joseph C.R, Chittilappilly(H), Peramangalam, Thrissur.
45. Testing of concrete cubes for M/s. Tekton Builders and Contractors, Thrissur.
46. Testing of concrete cubes supplied by Sri.Sebastain, mattathil (H), Chalakkudy.
47. Testing of concrete cubes for M/s. Tekton Builders and Contractors, Thrissur.
48. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
49. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
50. Testing of aggregates supplied by the Senior Section Engineer (Works), Southern railway, Thrissur.

51. Concrete mix design carried out for the Senior Section Engineer, Southern railway, Thrissur.
52. Testing of concrete cubes supplied by the Assistant Executive Engineer, KSHB, Thrissur.
53. Testing of concrete cubes supplied by St.Joseph Higher Secondary School, Velupadam.
54. Testing of brick samples supplied by the Assistant Engineer, Trichur Central Subdivision III, Trichur.
55. Testing of concrete cubes supplied by St.Joseph Higher Secondary School, Velupadam.
56. Testing of concrete cubes supplied by the Assistant Executive Engineer, Engineering Sub division, KAU, Vellanikkara.
57. Testing of concrete cubes for M/s. Tekton Builders and Contractors, Thrissur.
58. Testing of rock samples for New Mullaperiyar Dam-Drilling of additional boreholes in stilling basin of MPD as per GSI Report of 2011.
59. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
60. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
61. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
62. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
63. Testing of concrete solid blocks supplied by BSNL Civil Subdivision III, Thrissur.
64. Testing of steel rods supplied by the Assistant Executive Engineer, Irrigation Investigation Subdivision, Piravom.
65. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
66. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Mala.
67. Testing of concrete cubes supplied by Sri.Sebastain, mattathil (H), Chalakkudy.
68. Testing of concrete cubes supplied by St.Joseph Higher Secondary School, Velupadam.
69. Testing of concrete paver blocks supplied by KFRI, Peechi.
70. Testing of concrete cubes supplied by the Assistant Executive Engineer, KSHB, Thrissur.
71. Testing of concrete cubes supplied by the Assistant Engineer, PWD Special Buildings Section, Irinjalakkuda.
72. Testing of steel rods supplied by the Assistant Engineer, Head Works Section, Thumburmuzhy.
73. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
74. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
75. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
76. Testing of concrete cubes supplied by Sri.Sebastain, mattathil (H), Chalakkudy.

77. Testing of concrete cubes supplied by the Assistant Executive engineer, Engineering Subdivision, Vellanikkara.
78. Testing of cement samples for M/s. Tekton Builders and Contractors, Thrissur.
79. Testing of rock samples supplied by the District Officer, GWD, Palakkad.
80. Testing of welded joints supplied by the Assistant Engineer, Irrigation Section, Aluva.
81. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
82. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
83. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
84. Testing of concrete cubes supplied by the Assistant Engineer, PWD Special Buildings Section, Chalakkudy.
85. Testing steel rods supplied by M/s. Shoppers international Mall, Thrissur.
86. Testing of concrete cubes supplied by the Assistant Executive engineer, Engineering Subdivision, Vellanikkara.
87. Testing of steel rods supplied by M/s. Visram Builders, Punkunnam, Thrissur.
88. Testing of fine aggregate supplied by the Assistant Executive Engineer, RBC Sub division, Kozhinjampara.
89. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
90. Testing of concrete cubes supplied by the Assistant Engineer, Section No. III, Harbour Engineering Division, Palliport, Munambam.
91. Concrete mix design carried out for the Senior Section Engineer, Southern Railway, Ernakulam.
92. Testing of steel rods supplied by the Senior Section Engineer, Southern Railway, Ernakulam.
93. Concrete mix design carried out for the Senior Section Engineer (Works), Southern Railway, Thrissur.
94. Testing of cement samples supplied by M/s. Visram Builders, Punkunnam, Thrissur.
95. Testing of aggregates supplied by the Assistant Executive Engineer (NC), Irrigation Section, Vazhani.
96. Testing of concrete cubes supplied by M/s. MRG Builders, Thrissur.
97. Testing of concrete cubes supplied by Sri.Sebastain, mattathil (H), Chalakkudy.
98. Testing of steel rods and brick samples supplied by the Assistant Executive Engineer (NC), Irrigation Section, Vazhani.
99. Testing of concrete cubes supplied by the Assistant Engineer, PWD Special Buildings Section, Chalakkudy.
100. Testing of concrete cubes supplied by M/s.CEECON Readymix Concrete Pvt Ltd, Kannampathur, Puthukkad.
101. Testing of steel rods and concrete cubes supplied by the Assistant Engineer, PWD Special Buildings Section, Kodungallur.
102. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
103. Testing of steel rods supplied by the Assistant Engineer, Irrigation Section, Aluva.

104. Testing of aggregates supplied by the Senior Section Engineer (Works), Southern Railway, Thrissur.
105. Testing of steel rods supplied by the Senior Section Engineer (Works), Southern Railway, Thrissur.
106. Testing of concrete cubes supplied by the Senior Section Engineer (Works), Southern Railway, Thrissur.
107. Concrete mix design carried out for Assistant Engineer, PWD Buildings Section, Thrissur.
108. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Kodungallur.
109. Testing of cement sample supplied by Sri.Suresh Kumar K.M, QC Lab in charge, Sobha City.
110. Testing of paver blocks supplied by M/s. Podippara Concrete Products, Peechi.
111. Testing of aggregates supplied by the Assistant Executive Engineer, RBC Sub division, Kozhinjampara.
112. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
113. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
114. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
115. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
116. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Kodungallur.
117. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Kodungallur.
118. Testing of concrete cubes supplied by Sri.Sebastain, mattathil (H), Chalakkudy.
119. Testing of steel rods supplied by the Senior Section Engineer (Works), Southern Railway, Shoranur.
120. Testing of aggregates supplied by the Senior Section Engineer (Works), Southern Railway, Shoranur.
121. Concrete mix design carried out for the Senior Section Engineer (Works), Southern Railway, Shoranur.
122. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
123. Testing of solid blocks supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
124. Testing of concrete cubes supplied by the Senior Section Engineer, Southern Railway, Kollam.
125. Testing of concrete cubes supplied Sri.C.X.Varghese, Chakkamat, Vynthala, Kochi.
126. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
127. Concrete mix design carried out for M/s.HLL Lifecare Limited, MCH, Kodungallur Project Office.

128. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
129. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
130. Testing of aggregates supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
131. Testing of wire cut bricks supplied by M/s.Ananth Dryers, Thrissur.
132. Testing of paver blocks supplied by the Assistant engineer, TC Section 1, Kodungallur.
133. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
134. Testing of aggregates supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
135. Testing of aggregates supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
136. Testing of steel rods supplied by the Director, COSTFORD, Thrissur-3.
137. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
138. Testing of paver blocks supplied by the Assistant engineer, TC Section 1, Kodungallur.
139. Concrete mix design carried out for M/s. Salim Associates Pvt Ltd, Guruvayur.
140. Testing of steel rods supplied by M/s. Lulu, Thrissur.
141. Testing of paver blocks supplied by M/s.Laxmi Concrete products, Pallikkat.
142. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
143. Testing of concrete cubes supplied by M/s.Blue chip Constructions, Ernakulam.
144. Testing of solid blocks supplied by M/s.Grand Constructions, Vilangannur.
145. Testing of concrete cubes supplied by Sri.Davis Anto, Pallippatt, Contractor, Chalakkudy.
146. Testing of concrete cubes supplied by Sri.Davis Anto, Pallippatt, Contractor, Chalakkudy.
147. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
148. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
149. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
150. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
151. Testing of concrete cubes supplied by the Assistant executive Engineer, LSGD Subdivision, Chavakkad.
152. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
153. Testing of steel rods supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
154. Concrete mix design carried out for Senior Section Engineer, Southern Railway, Quilon.

155. Testing of cement samples supplied by M/s Thrissur Builders Pvt Ltd, Thrissur.
156. Testing of paver blocks supplied by M/s. M.J.industries, vadama (P.O), Mala.
157. Testing of steel rods supplied by M/s. U.P Materials, Pudukkad.
158. Testing of rock samples supplied by M/s. Sediment Soil Investigation, Kochi.
159. Testing of aggregates supplied by Senior Section Engineer (Works), Southern Railway, Thrissur.
160. Testing of aggregates supplied by Senior Section Engineer (Works), Southern Railway, Thrissur.
161. Testing of aggregates supplied by Senior Section Engineer (Works), Southern Railway, Thrissur.
162. Testing of aggregates supplied by Senior Section Engineer (Works), Southern Railway, Thrissur.
163. Testing of aggregates supplied by Senior Section Engineer (Works), Southern Railway, Thrissur.
164. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
165. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
166. Testing of paver blocks supplied by the Assistant Engineer, TC Section No.1, Kodungallur, KSEB Ltd.
167. Concrete mix design carried out for the Project Engineer, CAPE, Wadakkanchery.
168. Concrete mix design carried out for the Assistant Executive Engineer, Irrigation Subdivision, Piravom.
169. Concrete mix design carried out for the Assistant Executive Engineer, Irrigation Subdivision, Piravom.
170. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
171. Testing of cement samples supplied by the Assistant Engineer, CDP Section1, Chimmony Dam.
172. Testing of brick samples supplied by Sri.Shajin.K, Indraneelam, Guruvayur.
173. Testing of cement samples supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
174. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
175. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
176. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
177. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
178. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
179. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
180. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy.
181. Testing of paver blocks supplied by Sri.P.I.Varghese, Padinjarekkara, Neendapara.

182. Testing of paver blocks supplied by the Assistant Engineer, TC Section No.1, Kodungallur, KSEB Ltd.
183. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
184. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
185. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
186. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
187. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
188. Testing of concrete cubes supplied by the Assistant Engineer, Irrigation Quality Control Section, Thrissur.
189. Testing of concrete cubes supplied by the Assistant Engineer, PWD Buildings Section, Chalakkudy
190. Testing of Wire cut brick supplied by M/s. Ananth Dryers, Thrissur.
191. Testing of steel rods supplied by the Assistant Executive Engineer, PWD Buildings Subdivision, Thrissur.

Appendix – IV

List of tests conducted in the SM laboratory.

E.1.0. LABORATORY INVESTIGATION

Soil samples analysis for undisturbed and disturbed samples were tested for the following works:-

1. KSSDA - Construction of seed go down and processing plant – Kannara

.2. NABARD RIDF XVI- Construction of Regulator across Payaswini River at Pandikkandam in Bedadka Panchayathu in Kasaragod District District -Testing of Soil Samples.

.3. Soil stabilization using Bagarse Ash - Holy Grace Academy of Engineering, Mala.

.4. Conducting Tri - axial Test – Part of Project of final year student from Royal College of Engineering & Technology, Akkikkavu.

.5. Soil Investigation of Manappattu Chira at Malayattoor for stability analysis

6. Investigation of Subsoil strata – Construction of Check Dam across Bharathappuzha at Mannannur in Vaniyamkulam Panchayath.

7. Construction of three storied building in Sy. No. 320/3 of Aranattukara Village for pain and palliative care society, Thrissur.

8. Investigation for the construction of water tank for Drinking water supply scheme at association complex at Alathur.

9 Chamravattom Regulator cum bridge- Investigation conducted by IIT for undermining/piping observed at the D/S of the RCB

10 Ph.D. Programme of Smt. Suma Nair, Assistant Prof., Dept. Of FPME, KCAET, Thavanur.

11. Final Year Project – Grain Size Analysis – Royal College of Engineering Technology, Akkikkavu

12. Stopping Leakage Pathazhakundu Dam – Samples taken from Dam body

13. Stopping Leakage Pathazhakundu Dam – Samples taken from Dam body

14. Modernization of quality control wing – Execution of works – Soil Analysis from Mangalam Dam.

15. Finding out the properties of slurry – Southern Rocks & Mining Company, Cheruthuruthy.

16. Soil stabilization by using Rice husk ash and bamboo leaf ash – Hydrometer analysis

17. Project work of B.Tech. students of Vidya Academy of Science & Technology, Thalakkottukara.

18. Soil investigation of samples taken from Power Grid HVDC site at Cashew research station, KAU campus, Vellanikkara, Thrissur.

19 Sedimentation Survey of Pazhassi Dam using IBS and Sub bottom Profiler – Testing soil and water samples

20. Karuvannoor River Basin – Avinissery Panchayathu – renewal of Thiruvanchirakkulam – Calssification of soil stratum

21. Sedimentation Survey of Karappuzha Reservoir using IBS and Sub bottom Profiler – Testing soil and water samples

Appendix – V

Times and Places of observation

Month	Date	Day
1. April	18/04/2015	Saturday
2. May	18/05/2015	Monday
3. June	16/06/2015	Tuesday
4. July	15/07/2015	Wednesday
5. August	14/08/2015	Friday
6. September	13/09/2015	Sunday
7. October	1210/2015	Monday
8. November	11/11/2015	Wednesday
9. December	11/12/2015	Friday
10. January	09/01/2016	Saturday
11. February	08/02/2016	Monday
12. March	08/03/2016	Tuesday

Appendix-VI

Details of Simultaneous Observations

Sl. No.	Name of Station	Time and C. P. Nos.				
		9 AM	10 AM	11 AM	11.45 AM	12.30 PM
1	Vettukadu	112	114	116	114	112
2	Anjengo	223	228	233	228	223
3	Eravipuram	317	322	327	322	317
4	Thottappilly	597	600	602	600	597
5	Alapuzha	704	707	710	707	704
6	Thankay	926	930	935	930	926
7	Kannamaly	1025	1037	1047	1037	1025
8	Kuzhupilly	1140	1147	1149	1147	1140
9	Perinjanam	1269	1274	1279	1274	1269
10	Nattika	1323	1330	1333	1330	1323
11	.Blangad	1418	1421	1428	1428	1418
12	Vakkad	1595	1599	1605	1599	1595
13	Calicut	1830	1826	NCP	1826	1830
14	Melady	2013	2009	2004	2009	2013
15	Thalassery	Back of Bishop's house	1067	1075	1067	Back of Bishop's house
16	Kanhangad	2608	2603	2598	2603	2608
17	Kasargod	531	541	550	541	531
18	Kanwatheertha	103	111	121	111	103

Appendix-VII

REPORT OF COASTAL DAMAGES
COASTAL ENGINEERING FIELD STUDIES THRISSUR 20

MONTH : MAY 2015

	LOCATION	C.P. No.	DETAILS OF DAMAGES	REMARKS
1	**CE Sub-Division, Kollam.**			
a	CE Section, Thiruvananthapuram	CP-0087 to 0095	Sea wall is damaged and sunk in this area.	On 6th, 7th & 9th of May, severe sea attacks were occurred in this area.
	"	CP-0096 to 0098	5 houses in this area were fully damaged and some other houses were damaged partially.	The damages were occurred due to the sea attack through the sunken sea wall.
b	CE Section, Kollam.	CP-0288 to 0499	Nil	No damages occurred during the month.
c	CE Section, Thottappally.	CP-0500 to 0710	Nil	No damages occurred during the month.
2	**CE Sub-Division, Ernakulam.**			
a	CE Section, Cherthala.	BLS-115 to 118 BLS-146 to 150 BLS-168 to 170	About 300m length of beach with an average width of 50m were eroded in this area and 20Nos. of coconut trees were uprooted.	Heavy sea erosion occurred at Kattoor Aayiramthai and Chennaveli. Some houses are damaged partially.
b	CE Section, Ernakulam	CP-0975 to 1187	Nil	No damages occurred during the month.
c	C.E.Section, Chavakkad.	CP-1188 to 1380	Nil	No damages occurred during the month.
	-	CP-1384 to 1385	Sea wall partially damaged in this area and 5 Nos. of coconut trees were uprooted	Sea advanced about 30m.
	-	CP-1523 to 1527	2 Nos. of houses were partially damaged.	Sea advanced about 20m.
3	**CE Sub Division, Kozhikode**			
a	C E Section Thalassery	Under planting	Nil	No damages occurred during the month.
b	C E Section Parappanangady	CP-1555 to 1742	Nil	No damages occurred during the month.
c	C E Section Kozhikodu	CP-1745 to 2120	Nil	No damages occurred during the month.

MONTH : JUNE, 2015

	LOCATION	CP NO.	DETAILS OF DAMAGES	REMARKS
1	**CE Sub-Division, Kollam.**			
a	CE Section, Thiruvananthapuram	CP-0000 to 0069	Nil	
	Panathura	CP-0070	At Panathura, due to overtopping, sea wall partially damaged	Heavy sea attack occurred from Veli to Panathura
	"	CP-0096	6 houses were completely and 10 nos were partially damaged. The stones of sea wall were scattered and sea wall is sunken	Heavy sea attack occurred from Panathura to Sanghumugham
		CP-0097 to 0137	19 houses were partially damaged	
	Veli to Perumathura	CP- 0138 to 0211	Nil	
	Paravoor Pozhi to Thazhampally	CP-0212 to 0287	Sea water in entered to the nearby houses and sea wall damaged	Heavy sea attack occurred near Perumathura breakwater
b	CE Section,Kollam.	CP-0288 to 0394	From Thanni to Eravipuram , heavy erosion occurred. The beach road in this area were eroded and a deep pit having 6 to 7 meter depth is formed from Paravoor to Eravipuram	This phenomenon was occurred in the previous year. Heavy sea attack occurred from Paravoor to Eravipuram.
		CP-0395 to 0499	Nil	Over topping of sea wall is predominant at Vellanathuruthu
c	CE Section, Thottappally.	CP-0500 to 0604	Nil	
		CP-0605 to 0710	Nil	Over topping of sea wall is occurred between Arattupuzha and Thrikkunnappuzha
2	**CE Sub-Division, Ernakulam.**			

a	CESection Cherthala.	BLS-115 to 170	Heavy sea attack occurred at Kattoor, chettikkad, Chethi, Chennaveli and Aayiramthai .A lot of coconut trees were uprooted at the non protected beaches of Chennaveli and Kattoor.The Panchayath road at Chennaveli is almost completely damaged. At Aayiramthai,Around 50m of beach is eroded, a lot of coconut trees were uprooted and 31 houses are in the threat of sea attack. Over topping has been occured at Andhakaranazhi, Pallithodu Chappakadavu and Chellanam. The sea wall in this area is partially damaged.	
b	CE Section, Ernakulam			
	Fort Kochi to South Chellanam	CP-0985 to 1020	The Fort Kochi - Chellanam area, especially the Kandakadavu and Maruvakkad area was subjected to heavy sea attack. Several houses got damaged and the whole area was waterlogged making the lives of people miserable.	Overtopping was at an alarming edge in these days
	Munambam to Puthuvype	CP-1103 to 1125	This area got affected by overtopping and underflow. Since there are no houses adjoining the sea wall, damages to building are not seen. But the beach road was fully covered with sand making the traffic through it very difficult. The shore at Cherai beach became completely eroded.	
c	C.E.Section, Chavakkad.			
	Eriyad	CP-1205 to 1212	2Nos. of houses fully damaged and 8Nos. partially damaged. Seawall in this area is already damaged. 10Nos. of coconut trees were uprooted.	Water advanced about 30m and entered in the nearby houses. Sand heaped to about 800m^2 in the shore
	Kara	CP-1213 to 1224	10Nos. of houses were partially damaged. Sea wall already damaged. 10Nos. of coconut trees were uprooted.	Water advanced about 30m and entered into the nearby houses.

	Koolimuttam	1251-1224	Sea wall about 250m completely damaged 350m partially damaged.20 Nos. of coconut trees were uprooted.	Water advanced about 30 m
	P.Vemballur	1239-1251	3Nos. of houses were partially damaged. Sea wall already damaged	Water advanced about 25 m and entered in the nearby houses.
	Thalikulam & Vadanappally	1341-1352	35Nos. of coconut trees were uprooted	Water advanced about 30 m and 5 m land eroded in to the sea.
	Vadanappally (S)	1354-1356	Sea wall of 220m in length completely damaged	Water advanced about 30 m and Tarred road about 15m length eroded in to the sea.
	Chettuva (N)	1383-1384	About 60m length sea wall completely damaged.	Water advanced about 50 m and entered into the nearby houses. The temple completely covered by sand and sand heaped in about 900m^2 area.
	Chettuva (N)	1389-1390	5Nos of houses were partially damaged. Sea wall about 70m completely damaged	Water advanced about 50 m and entered in the nearby houses. Sand heaped in about 900m2.
	Anchangadi(N)	1363-1407	Bathroom of one house fully damaged. Sea wall about 70m completely damaged. 9 Nos. of coconut trees were uprooted.	Water advanced about 50 m and entered in the nearby houses.
	Vadanappilly (N)	1363-1369	1 house partially damaged. Sea wall about 600m completely damaged. 10 Nos. of coconut trees were uprooted.	Water advanced about 30 m and entered into the land. Sand heaped in about 700m^2 area.
	Chettuva (S)	1370-1380	Sea wall about 350m completely damaged. 5 Nos. of coconut trees were fell down.	Water advanced about 50 m and entered into the nearby houses. Sand heaped in about 900m2 area.
	Ponnani	1522-1523	5 Nos. of houses fully damaged and 1No. partially damaged. Sea wall already damaged. 28Nos. of coconut trees were uprooted.	Water advanced about 50 m and entered into the nearby houses.
	Ponnani	1546-1547	1 No. Fishing Shed fully damaged.	Water advanced about 25 m and 15 m land eroded in to the sea.
	Veliancode	1506-01508	Sea wall fully damaged.	Water advanced about 25 m and 25 m land eroded in to the sea.
	Veliancode	1502-0504	Sea wall already damaged.	Water advanced about 35 m and entered into the nearby houses. Sand heaped in about 1800m^2
	Palappetty	1486-1489	About 3Nos. of coconut trees fell down and 9Nos. were uprooted.	Water advanced about 30m and entered into the beach road and

				about 10m land eroded into the sea.
	Andathodu	1479-1484	Nil	Water advanced about 30 m and entered into the beach and about 5 m land eroded into the sea. Sand heaped in about 300m^2 area.
3	**CE Sub Division, Kozhikode**			
a	C E Section, Thalassery	Under planting		
	Moosodi- Adheeka		1km of virgin beach in this area were eroded for a width of 6mts. Deep scrap is formed for a length of 100m.	
	Chambarikka Kadappuram		300m of sea wall is completely and 100m partially damaged.	The total length of affected portion comes to 1km.
	Koppal- Kovvai Kadappuram		400m of virgin beach was eroded in this area.	
	Nangi- Koppal Kadappuram		600m of virgin beach was eroded in this area.	
	Cherangai Kadappuram		300m of sea wall is completely and 800m partially damaged.	The total length of affected portion comes to 3kms.
	Manimunda Kadappuram		1km of Virgin beach in this area is eroded for a width of about 10m and casuarina plantations were uprooted.	
	Barika Kadappuram		300m of sea wall is completely and 400m partially damaged. 3Nos. of houses were damaged.	The total length of affected portion comes to 1 km.
	Chithari Kadappuram		3Nos. of houses in this area were damaged.	The total length of affected area comes to 2kms.
b	C E Section, Parappanangady			
	Pandarakadavu	CP-1664 to 1668	The sea wall in this area is collapsed. The newly planted CP-1666 was taken by the sea. Sea advanced 10 to 15m beyond the sea wall on land side.	The attack was occurred 1.5 km on the north side of the new ongoing construction of Tanur harbour
	Vallikunnu	CP-1724 to 1725	The Turtle hatching centre at CP-1724 is completely destroyed. The newly planted CP-1724was taken by the sea.	The newly planted CP-1725 and the coastal road are on the threat of being taken away by the sea.
c	**C E Section, Kozhikodu**			
		CP-2030	Coastal road damaged	

	Kolavipalam	CP-2034	250m of beach eroded and coconut trees uprooted	
	Iringal	CP-2034 to 2035	Sea waves overtopped and beach road damaged	Water advanced for a width of 60m
	Kolavipalam to Kuttyadi river mouth	CP-2037 to 2042	Sea wall for a length of 1200m collapsed. Overtopping causes damages to properties	
	Azhiyoor	CP-2111	4Nos of coconut trees were uprooted and 3Nos were under threat	Water advanced through the fishing gap
	Varakkal Temple	CP-1854 to 1858	Beach eroded for a length of 700m and a width of 10m	Water advanced for a width of 10m
	Thoppayil beach	CP-1811 to 1833	80m length of new sea wall were collapsed at Thoppayil beach. Severe sea attack occurred at this place.	
	Mukhadar, Pallikandi, Nainan valappu and Kothi beach		Severe sea attack were occurred at these places. Coastal road in between CP-1810 and 1811 were eroded. Sea water overtopped between CP-1809 and 1810	Nearby houses were affected

MONTH : JULY, 2015

	LOCATION	CP NO.	DETAILS OF DAMAGES	REMARKS
1	**CE Sub-Division, Kollam.**			
a	CE Section, Thiruvananthapuram Kollamkode to Panathura	CP-0000 to 0069	Nil	
	Panathura to Thumpa	CP-0069 to 0137	Nil	
	Veli to Perumathura	CP-0137 to 0211	Nil	
	Paravoor Pozhi to Thazhampally	CP-0212 to 0287	Nil	
b	CE Section, Kollam Paravoor Pozhi to Karithura	CP-0288 to 0394	Due to heavy rain, heavy erosion has been occurred in the reach from Eravipuram to Kakkathope and the beach road has been partially damaged and formed deep cutting.	
	Karithura to Kayamkulam Pozhi	CP-0394 to 0499	Nil	Over topping of sea wall is predominent at Vellanathuruthu
c	CE Section, Thottappally.	CP-0500 to 0604	Nil	

	Thottappally to Valiyazheekkal			
		CP-0605 to 0710	Nil	Over topping of sea wall is occurred between Arattupuzha and Thrikkunnappuzha
2	**CE Sub-Division, Ernakulam.**			
a	CESection Cherthala. Alappuzha Pier to South Chellanam	BLS-87 to 198 and CP-4366 to 4385	Nil	
b	CE Section, Ernakulam			
	Fort Kochi to South Chellanam	CP-0975 to 1072	Nil	
	Munambam to Puthuvype	CP-1112 to 1130	This stretch is highly vulnerable and subjected to heavy wave action. The land adjoining to the sea wall got considerably eroded and in many places the houses were impounded with water as the existing sea wall is in a damaged condition.	
c	C.E.Section, Chavakkad.			
	Eriyad	CP-1205 to 1212	2Nos. of houses fully damaged and 8Nos. partially damaged. Seawall in this area is already damaged. 14Nos. of coconut trees were uprooted.	Water advanced about 40 m and entered in the nearby houses. Sand heaped to about 1000 m^2 in the shore
	Kara	CP-1213 to 1224	10Nos. of houses were partially damaged and 25Nos. of coconut trees were uprooted.	Water advanced about 35m and entered into the nearby houses.
	P.Vemballur	1239-1251	3Nos. of houses were partially damaged. Sea wall already damaged	Water advanced about 35m and entered in the nearby houses.
	Koolimuttam	1251-1224	Sea wall about 250m completely damaged 350m partially damaged and 18Nos. of coconut trees were uprooted.	Water advanced about 40m
	Thalikulam & Vadanappally	1341-1352	3Nos of houses were partially damaged and 23Nos. of coconut trees were uprooted	Water advanced about 40m and beach road about 15m length eroded in to the sea.
	Vadanappally (S)	1354-1356	Sea wall of 220m in length completely damaged	Water advanced about 30m and Tarred road about 15m length eroded in to the sea.

	Vadanappilly (N)	1363-1369	1 house partially damaged. Sea wall about 600m completely damaged. 10Nos. of coconut trees were uprooted.	Water advanced about 30m and entered into the land and heaped in about 700m^2 area .
	Chettuva (S)	1370-1380	Sea wall about 350 m completely damaged and 8 Nos. of coconut trees were fell down.	Water advanced about 50m and entered into the nearby houses. Sand heaped in about 400m^2 area.
	Chettuva (N)	1383-1384	About 60m length sea wall completely damaged.	Water advanced about 50m and entered into the nearby houses. The temple completely covered by sand and sand heaped in about 900m^2 area.
	Chettuva (N)	1389-1390	5Nos. of houses were partially damaged. Sea wall about 70m completely damaged	Water advanced about 50m and entered in the nearby houses. Sand heaped in about 900m^2.
	Anchangadi	1363-1407	One house partially damaged. Sea wall about 600m completely damaged. 10 Nos. of coconut trees were uprooted.	Water advanced about 30m and entered in the nearby houses. Sand heaped in about 700m^2 area.
	Andathodu	1479-1484	Nil	Water advanced about 40m and entered in to the beach about 15m land eroded into the sea. Sand heaped in about 500m^2 area.
	Palappetty	1486-1489	12 Nos of coconut trees fell down	Water advanced about 40m and entered into the beach road and about 15m land eroded into the sea.
	Veliancode	1502-0504	1 no house partially damaged. Sea wall already damaged.	Water advanced about 45 m and entered into the nearby houses. Sand heaped in about 2000m^2 area.
	Veliancode	1507-1508	Sea wall fully damaged.	Water advanced about 40 m land eroded in to the sea.
	Ponnani	1522-1523	5Nos. of houses were fully damaged 30Nos. of coconut trees were uprooted. Sea wall already damaged.	Water advanced about 40m and entered into the nearby houses.
	Ponnani	1546-1547	1 No. Fishing Shed fully damaged.	Water advanced about 40m and 15m land eroded in to the sea.
3	**CE Sub Division,Kozhikode**			
a	C E Section, Thalassery	Under planting		

	Cherangai Kadappuram		300m of sea wall is completely damaged and sunken in to the sandy beach and another 800m partially damaged. The mud road behind the sea wall is completely washed away and vehicle transport is stopped. About 20 houses were affected by the entry of flood water. One raw of coconut trees were found in a condition that it will not withstand another sea attack.	The total length of affected portion comes to 3kms.
	Mattol North Kadappuram to Puthiyangady Kadappuram	2365-2395	500m of sea wall at various locations are found completely damaged and the rest requires reformation. The beach road is washed away by the waves. 15Nos of coconut trees were uprooted	The total length of affected portion comes to 6 km. The waves were overtopped the sea wall washed to a width of 60m from the wall.
	Chithari Kadappuram		5Nos of houses in this area were damaged. One raw of coconut trees are completely up rooted.	The total length of affected area comes to 2kms. Out of which, 600m starting from Azhi of Chithari river is severely affected.
b	C E Section, Parappanangady			
	Puthiyakadappuram	CP-1653 to 1654	The fishing gap in this area is flooded and the road is damaged.	Overtopping occurred between CP-1642 and 1646
	Thanur	CP-1662 to 1671	Sea wall collapsed towards 800m north of the ongoing construction of new fishing harbour due to severe sea attack. The beach road is also damaged.	
	Kadalundi	CP-1742 to 1743	Overtopping occurred in this reach due to erosion of sea coast	
	Ariyaillur	CP-1724	The Turtle hatching centre near NC garden is washed away and the road running parallel to the coast has been flooded.	The newly planted CP-1724 &1725 has been taken away by the sea.
		CP-1705	Erosion has been occurred through the fishing gap at CP-1705 and the road running near the coast has been damaged.	
c	**C E Section, Kozhikodu**			

	Iringal	CP-2034 to 2035	Due to heavy sea attack, very high waves overflowing 60m wide land strip and the road which is the only transportation link between the main land and Iringal beach.	60Nos of families are residing north of this point and they are in fear of cutting off their only transportation link with other part of main land
	Kolavipalam	CP-2038 to 2039	The land in this reach is flooded through fishing gap and eroded	
	Kolavipalam to Kuttyadi river mouth	CP-2037 to 2042	Sea wall for a length of 1200m collapsed. Overtopping causes damages to properties	
	Vatakara, Chorode, Onchiyam		Damages to sea wall occurred at many places in these area due to severe sea attack. Sea water entered through the fishing gap causing erosion and flooding	
	Kozhikode	CP-1838 to 1940	The beach behind the Central Marine Fisheries Research Institute is eroded due to high waves.	
	Valiyathupalli		Heavy sea attacks were occurred at Valiyathupalli beach in Koyilandi resulting damage to sea wall and road.	
	Thoppayil beach	CP-1811 to 1833	80m length of new sea wall were collapsed at Thoppayil beach. Severe sea attack occurred at this place. Adjacent virgin beach 80m in length is flooded.	
	Mukhadar, Pallikandi, Nainan valappu and Kothi beach	CP-1809 to 1832	Severe sea attack were occurred at these places. Coastal road in between CP-1810 and 1811 were eroded. Sea water overtopped between CP-1809 and 1810 at north side of Kallayi river mouth.	The area is thickly populated and a number of houses were affected

MONTH : AUGUST, 2015

	LOCATION	CP NO.	DETAILS OF DAMAGES	REMARKS
1	**CE Sub-Division, Kollam.**			
a	CE Section, Thiruvananthapuram			
	Kollamkode to Panathura	CP-0000 to 0069	Nil	No damages occurred during the month.
	Panathura to Thumpa	CP-0069 to	Nil	No damages occurred during the

		0137		month.
	Veli to Perumathura	CP-0137 to 0211	Nil	No damages occurred during the month.
	Paravoor Pozhi to Thazhampally	CP-0212 to 0287	Nil	No damages occurred during the month.
b	CE Section, Kollam			
	Paravoor Pozhi to Karithura	CP-0288 to 0394	Nil	No damages occurred during the month.
	Karithura to Kayamkulam Pozhi	CP-0394 to 0499	Nil	No damages occurred during the month.
c	CE Section, Thottappally.			
	Thottappally to Valiyazheekkal	CP-0500 to 0604	Nil	No damages occurred during the month.
	Alappuzha pier to Thottappally	CP-0604 to 0710	Nil	No damages occurred during the month.
2	**CE Sub-Division, Ernakulam.**			
	CESection Cherthala.			
a	Alappuzha Pier to South Chellanam	BLS-87 to 198 and CP-4366 to 4385	Nil	No damages occurred during the month.
b	CE Section, Ernakulam			
	Fort Kochi to South Chellanam	CP-0975 to 1072	Nil	No damages occurred during the month.
	Munambam to Puthuvype	CP-1073 to 1187	Nil	No damages occurred during the month.
c	C.E.Section, Chavakkad.			
	Thalikulam & Vadanappally	1341-1352	35Nos. of coconut trees were fell down.	Water advanced about 40m and beach road about 12m length eroded in to the sea.
	Vadanappally (S)	1354-1356	Sea wall of 220m in length completely damaged	Water advanced about 30m and Tarred road about 15m length eroded in to the sea.
	Palappetty	1502	1 No. house fully damaged, Sea wall already damaged, 13Nos of coconut trees were uprooted	Water advanced about 60m and entered in the nearby land about 26m & beach road eroded about 25m.
3	**CE Sub Division, Kozhikode**			
a	C E Section, Thalassery	Under planting	Nil	No damages occurred during the month.
b	C E Section Parappanangady	CP-1555 to 1742	Nil	No damages occurred during the month.
c	C E Section Kozhikodu	CP-1745 to 2120	Nil	No damages occurred during the month.

MONTH : OCTOBER, 2015

	LOCATION	CP NO.	DETAILS OF DAMAGES	REMARKS
1	**CE Sub-Division, Kollam.**			
a	CE Section, Thiruvananthapuram			
	Kollamkode to Panathura	CP-0000 to 0069	Nil	No damages occurred during the month.
	Panathura to Thumpa	CP-0069 to 0137	Nil	No damages occurred during the month.
	Veli to Perumathura	CP-0137 to 0211	Nil	No damages occurred during the month.
	Paravoor Pozhi to Thazhampally	CP-0212 to 0287	Nil	The Varkkala cliff had slided
b	CE Section, Kollam			
	Paravoor Pozhi to Karithura	CP-0288 to 0394	Nil	No damages occurred during the month.
	Karithura to Kayamkulam Pozhi	CP-0394 to 0499	Nil	No damages occurred during the month.
c	CE Section, Thottappally.			
	Thottappally to Valiyazheekkal	CP-0500 to 0604	Nil	No damages occurred during the month.
	Alappuzha pier to Thottappally	CP-0604 to 0710	Nil	No damages occurred during the month.
2	**CE Sub-Division, Ernakulam.**			
	CESection Cherthala.			
a	Alappuzha Pier to South Chellanam	BLS-87 to 198 and CP-4366 to 4385	Nil	No damages occurred during the month.
b	CE Section, Ernakulam			
	Fort Kochi to South Chellanam	CP-0975 to 1072	Nil	No damages occurred during the month.
	Munambam to Puthuvype	CP-1073 to 1187	Nil	No damages occurred during the month.
c	C.E.Section, Chavakkad.	CP-1188 to 1549	Nil	No damages occurred during the month.
3	**CE Sub Division, Kozhikode**			
a	C E Section, Thalassery	Under planting	Nil	No damages occurred during the month.
b	C E Section Parappanangady	CP-1555 to 1742	Nil	No damages occurred during the month.

c	C E Section Kozhikodu (Kolavipalam in Payyoli Panchayath)	CP-2033 to 2036	Sea attack occurred and shore is in continuous state of erosion. Several coconut trees were uprooted. People residing nearby area got affected.	

MONTH : JANUARY, 2016

	LOCATION	CP NO.	DETAILS OF DAMAGES	REMARKS
1	**CE Sub-Division, Kollam.**			
a	CE Section, Thiruvananthapuram			
	Kollamkode to Panathura	CP-0000 to 0069	Nil	No damages occurred during the month.
	Panathura to Thumpa	CP-0069 to 0137	Nil	No damages occurred during the month.
	Veli to Perumathura	CP-0137 to 0211	Nil	No damages occurred during the month.
	Paravoor Pozhi to Thazhampally	CP-0212 to 0287	Nil	No damages occurred during the month.
b	CE Section, Kollam			
	Paravoor Pozhi to Karithura	CP-0288 to 0394	Nil	Huge waves overtopped the sea wall in most of the reaches and water entered to the coast and road. This phenomenon was most predominant near CP No.296, 298, Thangasseri and Thirumullavaram.
	Karithura to Kayamkulam Pozhi	CP-0394 to 0499	Nil	Huge waves overtopped the sea wall in most of the reaches and water entered to the coast and road.
c	CE Section, Thottappally.			
	Thottappally to Valiyazheekkal	CP-0500 to 0604	Nil	No damages occurred during the month.
	Alappuzha pier to Thottappally	CP-0604 to 0710	Some houses were damaged.	Overtopping and huge waves are damaged the coast at Karoor near CP 635 to 640
2	**CE Sub-Division, Ernakulam.**			
a	CE Section Cherthala.			
	Alappuzha Pier to South Chellanam	BLS-87 to 198 and CP-4366 to 4385	Nil	No damages occurred during the month.
b	CE Section, Ernakulam			

	Fort Kochi to South Chellanam	CP-0975 to 1072	About 50m width of coast got water logged due to advancement of sea.	The reach was experienced an unusual advancement of sea in to the land about 50m and the area got water logged. This phenomenon was occurred just after the new moon day and it persisted for a week.
	Munambam to Puthuvype	CP-1073 to 1187	The beach road was fully covered with sand, which adversely affected the vehicular traffic. At CP 1133, about 60m of sea wall got damaged.	The shore got considerably washed out due to the advancement of sea water subsequent to the new moon day. The most affected portion was Aniyil from CP1125 to 1133.
c	CE Section, Chavakkad.			
	Azhikode	CP-1188 to 1193	Nil	Water advanced about 30m
	Kara to P.Vemballur	CP-1219 to 1233	Sea wall partially damaged	Water advanced about 35m
	Chettuva(N) to Puthenkadappuram	CP-1385 to 1430	Sea wall partially damaged	Water advanced about 20m
3	**CES Sub Division, Kozhikode**			
a	CES Section, Thalassery	Under planting		No damages occurred during the month.
b	CES Section Parappanangady	CP-1555 to 1742	The area affected are CP 1662 to 1668 in Tanur and 1705 to 1733 in Kadalundikadavu few houses were flooded.	High tide, flood and wave overtopping occurred on head lands near Tanur harbour & Kadalundikadavu destroyed few houses because of "swell wave attack" which occurred on 22.01.2015 mid night. The height of wave ranged from 2.3 to 2.7m
c	CES Section Kozhikodu	CP-2033 to 2036	Nil	High tide, turbulent waves of sea overtopped the sea wall between CP 1747 and 1751 at Kadalundi at mid night on22.01.2015 and up to 23.01.2015 forenoon

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