केवल कार्यालय प्रयोग हेतु

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भारत सरकार
केन्द्रीय जल आयोग
माही मंडल,गांधीनगर

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHI DIVISION , GANDHI NAGAR

बाढ पूर्वानुमान ऐप्राईजल रिपोर्ट वर्ष 2013
माही,साबरमति एवं बनास बेसिन

FLOOD FORECASTING APPRISAL REPORT 2013
MAHI,SABARMATI AND BANAS BASIN

Wanakbori Weir

नर्मदा एवं तापी बेसिन संगठन,गांधीनगर
जल वैज्ञानीय प्रेक्षण परिमंडल,गांधीनगर
माही मंण्डल ,गांधीनगर

NARMADA & TAPI BASIN ORGANISATION, GANDHINAGAR
HYDROLOGICAL OBSERVATION CIRCLE , GANDHINAGAR
MAHI DIVISION, GANDHINAGAR

जनवरी **2014**

JANUARY 2014

भूमिका

केन्द्रीय जल आयोग देश में बाढ पूर्वानुमान तथा बाढ नियंत्रण परियोजनाओं की योजना, अभिकल्प तथा कार्या न्वयन में महत्वपूर्ण भूमिका निभा रहा है। केन्द्रीय जल आयोग ने भारत में बाढ नियंत्रण का नेटवर्क सभी महत्वपूर्ण अंतर्राज्यीय नदी बेसिन में विकसित कर रखा है जिसकी सहायता से केन्द्रीय जल आयोग जरूरत पड़ने पर अंतर्वा ह (इन्फ्लो) तथा स्तर (लेवल), बाढ पूर्वानुमान को सूचित करता है।

माही मंडल, केन्द्रीय जल आयोग , गांधीनगर द्वारा माही,साबरमती तथा बनास बेसिन में कडाना (माही बेसिन), धरोई (साबरमती बेसिन) तथा दांतीवाडा (बनास बेसिन) बांधो के लिए अंतर्वाह बाढ पूर्वानुमान का कार्य किया जाता है। इसके अलावा बानकबोरी वेयर (माही नदी) तथा सुभाष ब्रिज अहमदाबाद (साबरमती नदी) पर जल स्तर पूर्वानुमान का काम भी माही मंडल द्वारा किया जाता है।

प्रस्तुत प्रतिवेदन (रिपोर्ट) में, माही, साबरमती तथा बनास बेसिन में दक्षिण पश्चिम मानसून **2013** के दौरान उपलब्ध जलीय मौसमीय परिस्थितियों का चित्रण किया गया है तथा साथ में बाढ पूर्वानुमान से सम्बन्धित माही मंडल की गतिविधियों का विवरण दिया गया है।

जलीय ऑकडो के हिसाब से इस माही मंडल के अंतर्गत आने वाले सभी बेसिन मे ओसत वर्षा से अधिक वर्षा हुई है। उपलब्ध ऑकडो के अनुसार माही, साबरमती तथा बनास बेसिन मे क्रमशः1135mm, 908 mm तथा 1001 mm वर्षा हुइ है। जबकि इन बेसिनो का पिछले **10** सालो (2003 से 2012 तक) के वर्षा का ओसत क्रमशः 835mm, 862mm तथा 858mm है।

2013 कुल **5** मे से **3** तक पूर्वानुमान मापदंड बढाये गये। कडाना बांध,दांतीवाडा बांध, तथा वनाकबोरी वीयर से क्रमशः **21**, **2**, तथा **16**, बाढ पूर्वॉनुमान किये गए। इस प्रकार कुल मिलाकर **39**,बाढ पूर्वॉनुमान इस माही मंडल द्वारा जारी किये गये, और इनमे से सभी पूर्वॉनुमान निर्धारित शुद्वता की सीमओ में थे। बाढ पूर्वॉनुमान की सूचना समय पर प्रसारित कर दी गई थी, ओर बाढ ज्ञापान (मेमोरेन्डम) **2013** के निदेर्शो का कडाइ से पालन किया गया था।

2013 अधिकतम जल का अंतर्वाद कडाना, धरोइ तथा दातीवाडा बॉध मे क्रमश ः **7194** क्युमेक (**02**।**08**।**2013**,**300** hrs), **26666** क्युसेक (**28**।**07**।**2013**,**2400** hrs) तथा **29129** क्युसेक (**28**।**09**।**2013**,**2000** hrs) ईस वर्षात्रृतु मे हुआ। इसी प्रकार अधिकत जल स्तर वनाकबोरी वीयर, सुभाष ब्रिज, अहमदाबाद में क्रमंशः 72.01mm(02.08.2013,1900 hrs) तथा 41.97m(06.09.2013,2100hrs) हुआ।

2013 दूरमिती (टेलीमेट्री) यंत्रों को लगाने का कार्य माही मंडल में **38** स्थलों पर पूरा हो चुका है। इस समय दूरमिति से प्राप्त होने वाले आंकडो की विश्वसनियता की जांच का कार्य प्रगति पर है तथा इस प्रणाली से सम्बन्धित कुछ कमियों के निदान का भी कार्य चल रहा है। इस प्रणाली (सिस्टम)के पूरी तरह से कार्यान्वित होने के बाद, यह आशा की जा सकती है कि बाढ सूचना के सम्बन्धित ऑकडो (डाटा)का संचालन अत्यधिक तीव्र गति से होगा तथा बाढ नियंत्रण की वर्तमान प्रणाली में एक उच्च श्रेणी की नवीनता का समावेश होगा।

बाढ मौसम की गतिविधियों से सम्बन्धित सभी अधिकारियों तथा कर्मचारियों ने पूर्ण निष्ठापूर्वक दिन और रात में सहयोग तथा समन्वयपूर्वक कार्य करके सौंपे गये कार्य को सफलतापूर्वक समाप्त किया। सभी सम्बन्धित अधिकारियों तथा कर्मचारियों के लगन तथा निष्ठापूर्वक किये गये प्रयास प्रशंसनीय तथा अभिनन्दित है जिसकी वजह से इस रिपोर्ट को इस रूप में प्रस्तुत किया जा सका।

दिनांक ः जनवरी, **2014**

(बी एन पुष्टी)

अधिशासी अभियंता,
माही मंडल

P R E F A C E

Central Water Commission (CWC) is playing a key role in flood forecasting alongwith planning, design and implementation of flood control projects in the country. CWC has developed a flood forecasting network to issue inflow/level forecast in most of the major interstate river basins in India.

Mahi Division, CWC, Gandhinagar is entrusted to issue flood forecasts to interstate rivers namely Mahi, Sabarmati and Banas. Inflow forecasts for Kadana (Mahi Basin), Dharoi (Sabarmati basin) and Dantiwada (Banas Basin) dams and flood level forecasts for Wanakbori Weir (Mahi river) and Subhash Bridge at Ahmedabad (Sabarmati river) are issued by Mahi Division whenever situation arises.

In this report an attempt has been made to give details of the Hydro-Meteorological situation that existed in Mahi, Sabarmati and Banas basins during the South-West (SW) monsoon 2013 and the flood forecasting activities of Mahi Division during the season.

From the hydrological perspective all the basins received rainfall above average rainfall. As per the cumulative of rainfall collected at CWC stations during current year, Mahi, Sabarmati and Banas basin received 1135 mm, 908 mm and 1001 mm respectively against their 10 year average rainfall (from 2003 to 2012) of 835 mm, 862 mm and 858 mm respectively.

The forecast criteria were crossed during this year 2013 for 3 forecasting stations out of 5. Number of forecast issued for Kadana dam, Dantiwada dam and Wanakbori weir were 21, 2 and 16 respectively. So all together 39 no.of forecasts were issued by this division and all of them were within limits of prescribed accuracy. The dissemination of forecast was done on time and the instructions given in Flood Memorandum 2013 were strictly followed.

The maximum Inflow at Kadana, Dharoi and Dantiwada dams during current year were 7194 cumecs (02.08.2013, 1300 hrs), 26666 cusecs (28.07.2013, 2400 hrs) and 29129 cusecs (28.09.2013, 2000 hrs) respectively. The maximum water level at Wanakbori Weir and Subhash bridge, Ahmedabad was 72.01 m (02.08.2013, 1900) and 41.97 m (06.09.2013, 2100hrs) respectively.

Telemetry installation at all the 38 of this division is complete. Currently reliability check of the telemetry data is under progress and lacunas noted with the telemetry systems installed at the sites are under rectification. Once the system gets implemented completely this division is hopeful to get a fast paced transmission of reliable data without much communication discontinuity and hence a much advanced flood forecasting setup.

All the officers and staffs assigned with flood season activities, worked sincerely round the clock with cooperation and coordination for carrying out the entrusted task successfully. The efforts of all the concerned officers and staff are greatly praiseworthy and gratefully acknowledged for bringing out this report in the present form.

Date: January, 2014

(B. N. Prusty)
Executive Engineer
Mahi Division

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CHAPTER 1

FLOOD FORECASTING SET UP

1.1 INTRODUCTION

In the long term of flood protection and prevention of flood damages the flood forecasting services assume considerable importance in proper operation of reservoirs in conjunction with flood control works, for planning optimum utilisation of water resources and minimising loss of life and property. The Flood Forecasting is one of the major activities undertaken by the Central Water Commission.

The Government of Gujarat requested the Central Water Commission, Government of India to establish Flood Forecasting Unit in Gujarat. The Central Flood Forecasting Division (CFFD) with its head quarter at Gandhinagar was established on June 7, 1978 for flood forecasting in the inter-state river basins namely Mahi, Sabarmati and Banas. The Division was shifted to Ahmedabad in 1980 and renamed as Mahi Division in 1986. In July 2004, the division was shifted to CWC office complex, Narmada Tapi Bhawan situated in sector-10A at Gandhinagar. This Division issues flood level forecasts for Ahmedabad City situated on the banks of river Sabarmati and Wanakbori Weir on river Mahi and inflow forecasts for major dams on the rivers viz., Kadana Dam on river Mahi, Dharoi Dam on river Sabarmati and Dantiwada dam on river Banas.

1.2 FLOOD FORECASTING SET UP

In the overall supervision of Member (River Management) CWC, at National Level, with its head quarters at New Delhi, the Chief Engineer, Narmada Tapi Basin Organisation, C.W.C. Gandhinagar has been entrusted with the work of providing assistance to the State Authorities of Government of Gujarat in Flood Management in the State. Accordingly, Executive Engineer, Mahi Division Gandhinagar under the supervision of Superintending Engineer, Hydrological Observations Circle, CWC, Gandhinagar has been entrusted with the work of issuing Inflow/Level Forecasts on river Mahi, Sabarmati and Banas. The Mahi Division has got four Sub Divisions located at Kadana, Himmatnagar, Palanpur and Ahmedabad to collect the hydro-meteorological data for the formulation of flood forecasting.

This Division has been issuing flood forecasts whenever necessary in Mahi, Sabarmati and Banas basins since 1978 for the stations such Kadana, Dharoi and Dantiwada dam respectively. The level forecasting for Subhash Bridge, Ahmedabad was started from 1979 and Wanakbori Weir from 1981.

1.3 FIELD SET UP

The Mahi Division, CWC, Gandhinagar issues flood forecasts for interstate rivers Mahi, Sabarmati and Banas. For this purpose 32 nos. regular wireless stations and 5 seasonal wireless stations have been set up for collection and transmission of hydro-met data in these river basins under four Sub Divisions viz.

(i) Mahi Sub Division, Kadana for inflow forecast for Kadana Dam and Flood level forecasts for Wanakbori Weir on River Mahi.

(ii) North Western Rivers Sub Division, Himmatnagar for inflow forecasts for Dharoi Dam on River Sabarmati.

(iii) Sabarmati Sub Division, Ahmedabad for level forecast for Subhash Bridge (Ahmedabad) on River Sabarmati

(iv) Banas Luni Sub Division, Palanpur for inflow forecast for Dantiwada Dam on River Banas.

Total No.of existing H.O and Flood forecasting stations of all types and categories under Mahi Division is detailed in the below given Table-1.1

1.	Total sites	:	41
2.	Total Number of HO/FF Sites(including 2-seasonal i.e. Anas PH-2, Swaroopganj)	:	38
3.	No.of sites under HO Scheme	:	13
4.	No.of Sites under FF Scheme	:	25
5.	No.of Gauge Sites	:	16
6.	No.of Gauge and Discharge Site	:	11
7.	No.of GDS site	:	--
8.	No.of GDQ Site	:	04
9.	No.of GDSQ Site	:	07
10.	No.of Seasonal Raingauge Sites (Mt Abu & Ambaji)	:	02
11.	No.of Station (link) with State Government (Nadiad)	:	01

There are 5 Flood Forecasting Stations under the jurisdiction of this Division. Out of which two are Flood Level Forecasting Stations and three are Inflow Forecasting stations.

Location of Division, Sub Divisions, Gauging Stations in Mahi, Sabarmati and Banas river basins are given in the Statement -1 and details of the River Gauging Net Work of Mahi Division of all the basins are given in Statement - 2a. Jurisdiction map of Mahi Division is shown in Plate -1 The Flood

Forecasting Network/ Basin Map of Mahi, Sabarmati and Banas river basins are shown in Plate - 2, 14 and 25 respectively.

Wireless stations at Watrak Dam, Ratanpur and Kheda on river Watrak and Raska Weir on its tributary Meshow were established in 1985 for flood warning for areas downstream of Ahmedabad city. Discharge observations were started at Ratanpur and Kheda in 1989. It is noticed that in Kheda, river banks are low and water of River Watrak spills over the banks during high flood when there is back water effect due to flood in its tributary Shedi which joins river Watrak about half km. downstream of Kheda bridge & vice versa. On account of back water effect no correlation could be established with available data. Government of Gujarat is maintaining Gauge sites namely Dakor on river Shedi, Bilodra and Kathlal on its tributary Mohar. Based on Gauge data of Shedi and Watrak, Government of Gujarat is giving warning to the affected areas.

1.4 FLOOD FORECASTING STATIONS UNDER MAHI DIVISION

Mahi Division, CWC, Gandhinagar is formulating and issuing flood level and inflow forecasts in three river basins viz., Mahi, Sabarmati and Banas. There are five forecasting stations in these basins, out of which, two are flood level forecasting stations and three are inflow forecasting stations. The relevant details/criteria for the flood forecasting of forecasting stations are as follows in table 1.2.

A. FLOOD LEVEL FORECASTING STATIONS

Table 1.2

Sl. No	Forecasting Station	River	Warning level(m)	Danger level(m)	Criteria for issuing forecast
1.	Wanakbori Weir	Mahi	69.8	72.54	When water level is likely to reach or exceed warning level at these Forecasting Site.
2.	Subhash Bridge Ahmedabad	Sabarmati	44.09	45.34	

B. INFLOW FORECASTING STATIONS

Sl. No	Forecasting Station	River	Warning level(m)	Danger level(m)	Criteria for issuing forecast
1.	Kadana Dam	Mahi	126.19	127.71	For inflows $\geq$ 2832 cumec
2.	Dharoi Dam	Sabarmati	187.45	192.25	For inflows $\geq$ 566 cumec
3.	Dantiwada Dam	Banas	182.88	185.06	For inflows 566 cumec when reservoir level attains R.L. 181.358 m & above (1.522m below warning level) then for inflows $\geq$ 283 cumec

The Salient features of all the inflow forecasting dams and that of level forecasting station Wanakbori weir is given below:

C. Kadana dam – Salient features

1) Location of Reservoir — Latitude: $23^0$18'30" N; Longitude: $73^0$49'45" E

2) Catchment of the Project — Gross : 25486 sq.km; Net: 19337 sq.km
(6149 sq.km intercepted @ Banswara in Rajasthan)

3) Cultivable Command Area in ha
   a) Mahi Right Bank Canal — 260405 ha (Original); 212694 ha (Reappraisal)
   b)Kadana Left Bank Canal — 11059 ha
   c)Kadana Right Bank Canal — 3344 ha

4) District Benefited
   a) Anand — 163280 ha (MRBC Shedhi)
   b) Kheda — 49414 + 48638 +98052 ha
   c) Panchamahal — 14403 ha

5) Irrigation Benefits - Both in Rabi and Kharif in ha

	MRBC	KLBC	KRBC	Total
a) Kharif	148887	6635	1873	157395
b) Rabi	40412	5115	1270	46797
c) Perennial	5105	-	-	5105
d) Two seasonal	17016	-	903	17919
e) Hot weather	48919	1659	-	50578
Total	260339	13409	4046	277794 ha

6) Power Generation in MW — 4 Nos x 60 MW each

7) a) Full Reservoir Level and Capacity — 127.71 m
   a) Gross : 1543 MCM Original,
   1473 MCM Revised
   1249.30 MCM Re-revised
   b) Live — 1203 MCM Original
   1147 MCM Revised
   954.68 MCM Revised

8) Dead Storage Level (DSL) — 99.00 m
   Dead Storage Level Capacity
   a) 70.79 mcm
   b) 60.00 mcm
   c) 57.60 mcm

9) Minimum Drawn Down Level (MDDL) — 114.00 m
   MDDL Capacity in case of Hydel Project — 340 mcm original; 326 mcm revised; 294.58 mcm re-revised

10) Average Annual Utilization of water for each of the various purposes like
   a) Irrigation
   MRBC — 2150 + 277.62 = 2427.62 mcm
   KLDC — 148.10 mcm
   KRBC — 29.82 mcm

b. Dharoi dam – Salient features

NAME OF PROJECT	:	DHAROI RESERVOIR		
LOCATION				
A. Across River	:	Sabarmati		
B. Nearest Village	:	Dharoi		
C. Taluka	:	Satlasana		
D.District	:	Mehsana		
E.State	:	Gujarat		
F.Location of dam	:	Lat. 24^0 - 00' N Long. 72^0 - 52' E		
G.Nearest Railway Station	:	Taranga Hill Station on the Mehsana Taranga Meter Gauge Rly.Line of the W.R. is 15 km from the Dam Site.		
H.Road Communication	:	8 km from Vav on Ahmedabad, Gandhinagar, Visanagar - Ambaji National Highway and State Highway		
HYDROLOGY				
CATCHMENTS AREA	:	sq.km	sq.miles	
i. Total Catchment Area	:	5540	2139	
ii.Catchments area in Rajasthan Territory	:	2901	1120	
iii.Catchments area in Gujarat Territory	:	2369	1019	
iv.Catchments area consider for availability of water of Dharoi dam site.	:	3416	1019	Gujarat
			300	Rjasthan
v. Catchments area harnessed by Harnav Reservoir and Harnav pickup	:	199	39	Reservoir
			38	Pickup Weir
vi.Net free Catchments area available at Dharoi for water planning	:	3217	1242	

CATCHMENTS DETAILS	:	Mm	Inch
i. Average W.M.R. in entire catchments	:	633	24.91
ii. Average W.M.R. in entire catchments of Rajasthan	:	550	21.65
iii. Average W.M.R. in entire catchments of Gujarat	:	725	28.55
iv. Maximum Rainfall in year 1926	:	1228	48.35
v. Minimum Rainfall in year 1989	:	310	12.05
vi. Average Rainfall in year 1869	:	767	30.21

YIELD FROM NET FREE CATCHMENTS	:	MM^3	LAFT
AREA OF 3217 SQ.KM	:		
i. Maximum yield in year 1926	:	1725.26	13.988
Ii. Average yield in year 1869	:	664.62	5.388
iii. Minimum yield in year 1933	:	9.99	0.08
iv.75% Reliable yield in year 1938	:	391.27	3.172

c. Dantiwada dam – Salient features

	LOCATION	
1	River:	Banas
2	Village, Taluka:	Dantiwada, Danera
3	Dist., State:	Banaskantha, Gujarat
4	Latitude, Longitude:	24^0 10' N, 72^0 20' E
	HYDROLOGY	
5	Total catchment area at dam site:	2861.84 Sq.Kms
6	Average annual rainfall:	97 Cms
	RESERVIOR	
7	Gross storage capacity (cap.)	408.12 Mcum
8	Live storage cap.:	398.52 Mcum
9	Dead storage cap:	9.91 Mcum
10	FRL:	R.L.184.15 Mt.
	DAM	
11	Type:	Composite rolled filled eartherm dam, masonary spillway in the river gorge portion
	FLOOD DISPOSAL THROUGH EXISTING SPILLWAY	
12	Type of gates:	Radial gates
13	No.of gates:	11 nos.
14	Operation of gates:	By electrical and mechanical
15	Clear water way:	137.5 Mt.
16	Flood Discharge:	7503.89 cumecs
17	Crest Level:	R.L. 175.91 Mt.
	CANALS	
18	Length of main canal its discharge cap. at head:	46 Kms, 35.375 cumecs
19	Length of branch canal its discharge cap. at head:	30.75, 12.03 cumecs
	COMMAND AREA	
20	Gross Commad area:	80939 Hectares
21	Culturable command area:	59895 Ha.
22	Irrigable command area:	45823 Ha.
	BENEFIT AND COST RATIO	
23	Benefits:	1. 26174 Ha. Of Banaskantha district & 19040 Ha. Of Patan district will be covered under irrigation. 2. Partial control of flood in river Banas
24	Cost Benefit Ratio:	1.15%

Summary of Salient features of all the forecasting stations are enclosed as Statement no. 2 b.

d. Wanakbori weir – Salient features

1)	Location	:	Village-Wanakbori Taluka-Balasinor District-Kheda
2)	Purpose	:	Irrigation
3)	River	:	Mahi
4)	Area of Catchment	:	30665 km^2
5)	Mean Annual runoff in the catchment	:	7950 Mm^2
6)	Mean annual rainfall (mm)	:	825.5
7)	Year of commencement of construction work	:	1948
8)	Year of Completion Dam	:	1980

DAM

1)	Type	:	Composite
2)	Bed Rock	:	Quartzite
3)	Maximum height above the lowest point of foundation	:	25 m
4)	Length of the top of dam	:	796 m
5)	Total volume of content:		
	Concrete	:	0.007 Mm^3
	Masonry	:	0.233 Mm^3

SPILLWAY

1)	Type	:	Ogee (weir)
2)	Length	:	735 m
3)	Energy dissipater	:	Stilling basin
4)	Maximum discharge	:	46978 $m^3 s^{-1}$
5)	Type nos.& size of gate	:	Ungated

RESERVOIR

1)	Area at full reservoir level	:	20.86 km^2
2)	Gross Storage capacity	:	41.91 Mm^3
3)	Effective Storage capacity	:	36.24 Mm^3
4)	Area under submergence (a)Forest (b)Waste Land (c) Cultivable	:	(a)+(b)+(c) =2086 ha
5)	No.of villages under submergence	:	24 nos

CANAL

1)	Length of canal(Main)	:	73.6 km
2)	Capacity	:	198/.10 $m^3 s^{-1}$
3)	Gross command area	:	315790 ha
4)	Cultivable command area	:	212694 ha
5)	Villages under command (a)District (b) Taluka ©No.of villages	:	(a)Kheda (b)Thasara (c) 29 Anand 78 Nadiad 49 Matar 64 Petlad 81 Borsad 87 Khambat 98

1.5 USER AGENCIES

The particulars of user agencies of flood forecasts of all the 5 flood forecasting stations located in Mahi, Sabarmati and Banas basin are given in Statement No.3.

Number of villages likely to be affected Tahasil wise in Mahi basin for which flood level forecast of Wanakbori Weir is used for taking precautionary measures, is given in Table –1.3. Statement showing villages affected by floods of Mahi river on the basis of discharge released from Kadana dam is given in Table 1.4. Similar tables for Sabarmati and Banas basin is given in table 1.5, 1.6 and 1.7 respectively.

Table –1.3

NUMBER OF VILLAGES LIKELY TO BE AFFECTED BY FLOODS IN MAHI RIVER ON THE BASIS OF GAUGE OF WANAKBORI WEIR

DISTRICT	TALUKA				
VADODARA	PADRA		SAVLI		VADODARA
	12		28		9
ANAND	BORSAD				ANAND
	20				6
KHEDA	THASRA				
	11				
PANCHMAHAL	LUNAWADA		SHEHRA	GODHRA	KADANA
	74	12	6	27	9

Table 1.4

Statement showing villages affected by floods of Mahi river on the basis of discharge released from Kadana Dam

Sr. No.	Releases from Kadana dam	Gauge level at Wanakbori	District	Taluka	Signals for villages		
					White	Blue	Red
1	5026.19	69.87	Vadodara	Padra	01 to 10	-	-
			Anand	Borsad	01 to 05	-	-
2	9995	71.32	Vadodara	Padra	11 to 12	01 to 10	-
				Savli	01 to 15	-	-
				Vadodara	01 to 05	-	-
			Anand	Borsad	06 to 14	01 to 05	-
				Anand	01 to 06	-	-
			Kheda	Thasara	01 to 04	-	-
			Panchmahal	Lunawada	01 to 05	-	-
				Shahera	01 to 10	-	-
3	10675.35	71.93	Panchmahal	Lunawada	06 to 74	01 to 05	-
				Shahera	11 to 12	01 to 06	-
				Kadana	01 to 27	-	-
				Khanpur	01 to 09	-	-
4	14158.29	72.54	Vadodara	Padra	-	11 to 12	01 to 05
				Savli	16 to 28	01 to 04	-
				Vadodara	06 to 09	01	-
5	15574.12	73.15	Panchmahal	Shahera	-	09	-
6	18688.94	73.76	Panchmahal	Shahera	-	10	01 to 09
				Godhra	06	01 to 05	-
7	20680	74.07	Vadodara	Padra	-	-	06 to 10
				Savli	-	05 to 08	-
				Vadodara	-	02	-
8	24996.46	74.89	Vadodara	Savli	-	09 to 12	-
				Vadodara	-	03 to 05	-
			Kheda	Thasra	-	03 & 04	-
			Anand	Borsad	-	-	03 to 05
				Anand	-	04	-
9	26192.83	74	Panchmahal	Lunawada	-	06 to 74	01 to 05
				Shahera	-	11 to 12	01 to 10
				Kadana	-	01 to 27	-
				Khanpur	01 to 09	-	-
10	29732.41	75.4	Vadodara	Savli	-	13 to 15	-
			Anand	Anand	-	05 to 06	-
11	33696.73	75.9	Panchmahal	Lunawada	-	-	06 to 83
				Shahera	-	-	11 to 12
				Kadana	-	-	01 to 27
				Khanpur	-	-	01 to 09

Table 1.4 contd/.

Sr. No.	Releases from Kadana dam	Gauge level at Wanakbori	District	Taluka	Signals for villages		
					White	Blue	Red
12	34999.9	76.2	Vadodara	Padra	-	-	11 to 12
				Savli	-	16 to 29	01 to 05
				Vadodara	-	06 to 09	01 to 05
			Kheda	Thasra	-	05 to 11	01 to 04
			Anand	Borsad	-	15 to 20	06 to 14
				Anand	-	-	01 to 06
13	37949.88	76.28	Panchmahal	Godhra	-	06	01 to 05
			Vadodara	Savli	-	-	16 to 28
				Vadodara	-	-	06 to 09
			Kheda	Thasra	-	-	05 to 11
			Anand	Borsad	-	-	15 to 20
14	40001	76.45	Panchmahal	Godhra	-	-	06

Numbers of villages in Sabarmati basin for which flood level forecasts for Subhash Bridge are used for taking precautionary measures are given in Table – 1.5.

Table – 1. 5

NUMBER OF VILLAGES LIKELY TO BE AFFECTED BY FLOODS IN RIVERS SABARMATI, WATRAK AND SHEDHI.

DISTRICT	TALUKA					
GANDHINAGAR	CITY	MANSA	KALOL			
	17	10	01			
AHMEDABAD	CITY	DASCROI	DHANDUKA	DHOLKA	SANAND	BAVLA
	19	18	18	74	14	9
KHEDA	MATAR	KHEDA	MATAR	KAPADVANJ	THASRA	KATHLAL
	13	16	13	02	20	03
	MEHMDAVAD	MAHUDHA				
	11	03				
ANAND	TARAPUR	KHAMABAT				
	11	02				
SABARKANTHA	BAYAD	MALPUR				
	14	03				

Table 1.6

Statement showing villages affected by floods of Sabarmati river on the basis of discharge/ gauge available at Subhash bridge gauge site

Sr. No.	Releases from Dharoi dam cusec	Gauge level at Subhash bridge	District	Taluka	Signals for villages		
					White	Blue	Red
1	125000	44.09	Ahmedabad	City	01 to 05	-	-
				Dholka	01 to 07	-	-
			Kheda	Matar	01 to 03	-	-
				Kheda	01 to 05	-	-
			Anand	Tarapur	-	-	-
				Khambat	01	-	-
2	140000	44.74	Ahmedabad	City	06 to 09	01 to 05	-
				Dholka	08 to 12	01 to 07	-
			Kheda	Matar	04 to 13	01 to 03	-
				Kheda	06 to 12	01 to 05	-
			Anand	Tarapur	01 to 11	-	-
				Khambat	02	01	-
3	168000	45.34	Ahmedabad	City	10 to 12	06 to 09	01 to 05
				Dascroi	01 to 18	-	-
				Dholka	13 to 43	08 to 12	01 to 07
				Bavla	01 to 07	-	-
			Kheda	Matar	-	04 to 13	01 to 03
				Kheda	-	06 to 12	01 to 05
			Anand	Tarapur	-	01 to 11	-
				Khambat	-	02	01
4	201123	45.95	Ahmedabad	City	13 to 19	10 to 12	06 to 09
				Dascroi	-	01 to 18	
				Dholka	-	13 to 43	08 to 12
				Dhandhuka	01 to 18	-	-
				Sanand	01 to 14	-	-
				Bhavla	-	01 to 07	-
			Kheda	Matar	-	04 to 13	01 to 03
				Kheda	-	06 to 12	01 to 05
			Anand	Tarapur	-	-	01 to 11
				Khambat	-	-	02
5	238584	46.56	Ahmedabad	City	-	13 to 19	10 to 12
				Dascroi	-	-	01 to 18
				Dholka	43 to 74	-	13 to 43
				Dhandhuka	-	01 to 18	-
				Sanand	-	01 to 14	-
				Bhavla	08 to 09	-	-
			Kheda	Matar	-	-	04 to 13
				Kheda	-	-	06 to 12
			Anand	Tarapur	-	-	01 to 11
				Khambat	-	-	02
6	289458	47.17	Ahmedabad	City	-	-	13 to 19
				Dholka	-	43 to 74	-
				Dhandhuka	-	-	01 to 18
				Sanand	-	-	01 to 14
				Bhavla	-	08 to 09	-
7	344953	47.78	Ahmedabad	Dholka	-	-	43 to 74
				Bhavla	-	-	08 to 09

Table – 1.7

NUMBER OF VILLAGES LIKELY TO BE AFFECTED BY FLOODS IN D/S OF DANTIWADA DAM OVER BANAS RIVER

DISTRICT	TALUKA			
PATAN	SANTALPUR 09	SAMI 19	RADHANPUR 26	PATAN 02
BANASKANTHA	KANKREJ 37	DEESA 18	DANTIWADA 03	

1.6 DISSEMINATION OF FORECAST

The level/inflow forecast is of no value if it is not disseminated in time to the users/beneficiaries though it may be very accurate. Hence dissemination should be quick without any loss of time. Therefore, it is done by wireless/telephone/fax or through special messenger to the concerned authorities so as to enable user agencies to take decisions on releases from reservoirs, warning the public likely to be affected by flood and arrange for rescue operations and evacuation of areas according to necessity.

The wireless communication is used, for receipt and transmission of data from different sites and forecasts message, are sent to concerned authorities through fax/telephone so as to prevent loss of time. Details of communication net work showing type of wireless, date of functioning etc. is given in Statement No. 4 and communication network showing availability of 100-W to 150-W high power and associated low power (15-W & 25-W) wireless sets at different stations is given in Plate-35.

The hourly water levels of the base stations and the forecasting station, flood warnings whenever necessary are communicated from time to time to the Flood Cell of Government of Gujarat and Focal Officers/sub focal officers through telephone, hot line and messenger. On the basis of flood warning issued by Mahi Division, the State Authority communicates messages to affected areas on radio and television.

The Flood Cell of Government of Gujarat, Gandhinagar is the main agency for monitoring the flood situation in rivers all over the State. It is responsible for collection of information on flood situation and dissemination of flood warning to the concerned local officers for taking precautionary measures in areas likely to be affected.

The State Government has fixed different colour code signals to indicate about the gravity of the flood situation. The white signal is used for making alert, blue signal for readiness for evacuation and red signal for immediate evacuation in the affected areas.

Criteria for flood warning signals for forecasting stations are given as under.

Table – 1.8

Sl.No.	Name of the Station	Rivers	Flood Likely to attain Level in mt	Type of Signal to be given
1	Wanakbori Weir	Mahi	69.8 71.93 72.54	White Blue Red
2	Subhash Bridge	Sabarmati	44.09 44.74 45.34	White Blue Red

CHAPTER 2

BASIN PHYSIOGRAPHY, RIVER SYSTEM AND BASIN RAINFALL

2.1 MAHI BASIN

2.1.1 BASIN PHYSIOGRAPHY AND RIVER SYSTEM

Mahi basin is bound on the North and the North-West by the Aravalli Hills, on the East by the ridge separating it from the Chambal basin, on the South by Vindhyas and on the West by the Gulf of Cambay. In Rajasthan, the basin consists of hills, forests and eroded terrain. In Gujarat up to the confluence of Mahi and Panam the terrain of the basin is undulating. Beyond Wanakbori Weir right up to the Gulf of Cambay, it is flat, fertile and well developed alluvial tract. Mahi basin extends over a catchment area of 34,842 sq km, which is nearly 1.1 % of total geographical area of the country. Its state - wise distribution is given below.

Table – 2.1

Sl. No.	Name of State	Drainage Area (sq. km)	Percentage of Drainage Area	River Length (km)
1	Madhya Pradesh	6695	19.22	167
2	Rajasthan	16453	47.22	174
3	Gujarat	11694	33.56	242
	Total	34842	100.00	583

The Mahi is the third major west flowing inter state river of India meeting the sea in Gulf of Cambay. The Mahi river originates from northern slope of Vindhyas at latitude 22^0 35' (N) and longitude 74^0 58' (E) near the village Sardarpur in Dhar district of Madhya Pradesh at an elevation of 500 m above MSL. It is flowing northwards through Dhar and Jhabua districts of Madhya Pradesh. In this reach a tributary Bageri meets from right. Then Mahi turns westwards through Ratlam district where a tributary Larki joins from south. Thereafter Mahi turns North-West and enters Rajasthan at Ambapara. In Rajasthan, Mahi flows in South-Westerly direction and two important tributaries Som from right and Anas from left join it upstream of Kadana Dam (latitude $23^0$18' and longitude 73^0 49'). In Gujarat, Mahi continues to flow in South-Westerly direction where an important tributary Panam joins from left. Wanakbori Weir is situated 31km down stream of confluence of river Panam with Mahi in Balasinor taluka of Kheda district and thereafter Mahi falls into Gulf of Cambay after a run of 583 km.

Brief outline of main tributaries of the river Mahi are as under.

Table – 2.2

Name of Tributary	Source of Origin	Elevation (m) above MSL	Length (km)	Catchment Area (sq. km)	Terrain
Som	Som on the eastern slopes of Aravallies in Udaipur District (Rajasthan)	600	155	8707	Mainly hilly covered with protected and reserved forest.
Anas	Kalmora on the northern slope of Vindhyas in Jhabua District of M.P.	450	156	5604	Hilly and partly covered with forests.
Panam	Near Bhadra on the northern slope of Vindhyas in Jhabua District of M.P.	300	127	2470	Mainly hilly covered with reserved forests.

2.1.2 RAINFALL

The Mahi basin receives 90% of the annual rainfall during South-West Monsoon which sets in the middle of June and ends by the first week of October. The average cumulative rainfall of the basin is 835 mm and in the year 2013; it received 1135 mm rainfall. Bar chart showing monthly average rainfall of past 10 years from 2003 to 2012 v/s 2013 is given in Plate –36.

The list of existing projects in Mahi basin is enclosed in Table

Table 2.3

List of existing projects in Mahi Basin

Sr. No.	Name of Project	River	Storage Capacity (Mm3)	
			Gross	Live
Rajasthan state				
1	Mahi Bajaj Sagar	Mahi	2180	1712
2	Jakham	Jakham	141.9	131.6
3	Jaisamand	Gomti	414.6	296.1
4	Nagalia weir	Jakham	-	-
5	Karmai weir	Karmai	-	-
6	Som Kamla Amba	Som	126.06	125.83
Gujarat state				
7	Kadana	Mahi	1542	1203
8	Panam	Panam	737.8	679.2
9	Machhan nalla	Machhan	37.91	29.16
10	Wanakbori weir	Mahi	41.884	36.224
11	Hadaf	Hadaf	32.26	25.02
12	Kabutary	Kabutary	9.58	8.07
13	Bhadar	Bhadar	46.72	40.06
14	Umaria	Hadaf	13.53	11.67
15	Edalwada	Naleshvar	11.33	10.5

2.2 SABARMATI BASIN

2.2.1 BASIN PHYSIOGRAPHY AND RIVER SYSTEM

The Sabarmati River is one of the major west flowing rivers meeting the Arabian Sea in Gulf of Cambay. The basin is bound on the North and North-East by Aravalli hills, on the East by the ridge separating it from the Mahi basin, on the South by Gulf of Cambay and on the West by ridge separating it from basins of the rivers draining into Rann of Kuchchh and the Gulf of Cambay. From origin up to Dharoi Dam in Gujarat the terrain is hilly covered with forests and there after it passes mainly through plains. Sabarmati basin extends over a catchment area of 21,674 sq. km. which is nearly 0.66% of the total geographical area of India. It's state-wise distribution is as follows:

Table – 2.4

Sl.No.	Name of State	Drainage Area (sq. km)	Percentage of Drainage Area	River Length (km)
1.	Rajasthan	4124	19.00	48
2.	Gujarat	17550	81.00	323
	Total	21674	100.00	371

It rises in the Aravalli hills at latitude 20^0 40' (N) and longitude 73^0 20' (E) in Rajasthan at elevation of 762 m above msl. The river passes through Rajasthan for about 48 km and then enters Gujarat. A tributary Wakal joins it from the left near village Ghanpilli then it flows in South-West direction and tributary Sei joins it on the right at about 16.5km from Wakal confluence. On the left side, tributary Harnav joins upstream of Dharoi dam. After passing over Dharoi Dam a major tributary Hathmati joins it at about 60km down stream of Dharoi Dam. It passes through Ahmedabad city & at about 49km further down stream another major tributary Watrak joins it from left. It continues to flow in the same direction and finally falls into Gulf of Cambay in the Arabian Sea.

Brief out line of main tributaries of the river Sabarmati are as under:

Table – 2.5

Name of Tributary	Source of Origin	Length (km)	Catchment Area (sq.km)	Terrain
Sei	Aravalli Hills Rajasthan)	95	946	Hilly covered with forests
Wakal	Aravalli Hills Rajasthan)	88	1625	Mainly hilly in upper reaches and undulating terrain in remaining portion
Harnav	Kulaliya Hills(Rajasthan)	75	972	Hilly area covered with forests
Hathmati	South-West foot hills of Rajasthan and Gujarat	122	1526	Moderate hilly
Watrak	Panchera Hills (Rajasthan)	248	8638	Mainly flows through plains

2.2.2 RAINFALL

The average cumulative rainfall of the basin is 862 mm, by the South-West Monsoon which sets in by middle of June and withdraws by the first week of October. In the year 2013; it received 908 mm rainfall. Bar chart showing monthly average rainfall of past 10 years from 2003 to 2012 v/s 2013 is given in Plate - 36.

The list of existing projects in Sabarmati basin is enclosed in Table 2.6

Table- 2.6

List of existing projects in Sabarmati Basin

Sr. No.	Name of Project	River	Storage Capacity (Mm3)	
			Gross	Live
Rajasthan state				
1	Sei dam	Sei	31.34	24.16
Gujarat state				
2	Dharoi dam	Sabarmati	907.88	737.99
3	Harnav I	Harnav	-	-
4	Harnav II	Harnav	21.67	19.97
5	Guhai	Guhai	62.34	57.04
6	Hathmati	Hathmati	161	153
7	Meshwo	Meshwo	82	77
8	Mazam	Mazam	43.86	36.58
9	Watrak	Watrak	176.9	154.3
10	Waidy	Suron	13.6	12.3
11	Raska weir	Meshwo	-	-
12	Moti Fatewadi	Sabarmati	-	-
13	Vasna barrage	Sabarmati	-	-

2.3 BANAS BASIN

2.3.1 BASIN PHYSIOGRAPHY AND RIVER SYSTEM

The river Banas originates from Aravalli hills and descends in a South-West direction through Rajasthan State and travels through Banaskantha and Mehsana district of Gujarat State before it merges with little Rann of Kuchchh. The basin is bound on North and South by Saraswati and Luni basins. The Aravalli hills and little Rann of Kuchch form its Eastern and Western extremity. In Rajasthan the basin consists of mainly hills covered with forests upto Mount Abu. Thereafter it passes through plains in Banaskantha District, Gujarat. In this reach the soil is sandy. Banas basin extends over a catchment area of 8674 sq.km. Its state-wise distribution is given below:

Table – 2.7

Sl.No	Name of State	Drainage Area (sq.km)	Percentage of Drainage Area	River Length (km)
1.	Rajasthan	3269	37.69	78
2.	Gujarat	5405	62.31	188
	Total	8674	100.00	266

The Sipu river is the important tributary of Banas which joins it on right bank. It has an approximate length of 75 km from origin up to confluence with Banas. The river Balaram, another tributary of Banas joins from left. The total length of the tributary from the origin to the confluence point is 40 km.

Brief outline of main tributaries of the river Banas are as under.

Table – 2.8

Name of Tributary	Source of Origin	Length (km)	Catchment Area (sq.km)	Terrain
Balaram	Ambaji Hills of Aravalli Ranges	40	345	Undulating terrain with forests
Sipu	Mount Abu Hills in Sirohi District	75	1420	Moderate Hilly

2.3.2 RAINFALL

The South-West monsoon sets in the fourth week of June and ends by the end of first week of October. The average cumulative rainfall of the basin is 858 mm and in the year 2013; it received 1001 mm rainfall. About 97% of total Rainfall is received during monsoon period. Bar chart showing monthly average rainfall of past 10 years from 2003 to 2012 v/s 2013 is given in Plate – 36.

CHAPTER 3

METEOROLOGICAL DATA.

In flood forecasting works, availability of Weather forecast and the Real time rainfall data in the river basin is very essential for the formulation of forecast. Weather forecasts help in assessing the magnitude and time of flood and useful in keeping watch on floods in various basins. Real time rainfall data in the basin helps in assessing the magnitude of the floods. Hence an adequate network of rain gauges with wireless facilities to transmit rainfall data on real time and the arrangements for obtaining weather forecasts like QPF/ Inference / etc from IMD are the basic need of flood forecasting network.

3.1 ARRANGEMENTS FOR RECEIVING WEATHER FORECAST

Flood Meteorological Office (FMO), Ahmedabad is issuing weather forecasts. Keeping in view the importance of rainfall activities in the region, the F.M.O., Ahmedabad passes the following information on daily basis on normal days and twice in a day in case of flood alert.

1. Daily rainfall of different stations of IMD
2. Heavy Rainfall Warnings (HRW).
3. Regional weather summary.
4. Weighted Average rainfall of Sub Basins.
5. Q.P.F for next 12/24 hrs.
6. Inference information about the movement of depression / storm formed in Bay of Bengal / Arabian Sea.

Sub-Division number wise areas for which H.R.W and QPF are supplied during monsoon season from FMO, Ahmedabad.

Table-3.1

Main River basin	Sub basin No.	Details of Area	Catchment area of the sub basin (Sq.Kms)
Mahi	A	Catchment Area (CA) of river Mahi from origin to Mahi dam	6149
	B	CA from downstream of Mahi dam and tributaries Som & Jakham to Paderdi	10098

	C	CA of river Anas from origin to Anas PH-2	4650
	D	CA downstream from Paderdi and Anas PH-2 to Kadana dam	4623
	E	CA of river Panam from Origin to Panam dam	2314
	F	CA downstream from Kadana and Panam dam to Wanakbori Weir	2831
Total	_	__	30665
Sabarmati	A	CA from origin of river Sabarmati to Kheroj	3650
	B	CA downstream from Kheroj to Dharoi dam	2226
	C	CA downstream from Dharoi dam to Subhash bridge (Ahmedabad)	5199
	D	CA downstream from Ahmedabad to end of the river	10599
Total	_	__	21674
Banas	A	CA from origin of river Banas to Abu Road	1600
	B	CA downstream of Abu road to Dantiwada dam	1582
	C	CA of river Sipu from origin to Bhakudar	1225
	D	CA of river Sipu & Banas downstream of Bhakudar & Dantiwada dam respectively to the end of the river.	4267
Total	_	__	8674

3.2 RAINGAUGE NETWORK IN MAHI, SABARMATI & BANAS BASIN.

Daily rainfall data recorded at sites equipped with wireless is transmitted to Sub Division on real time basis daily and if required, hourly during the floods. Considering judiciously heavy rainfall warnings, QPF, movement of depression and rainfall data, flood forecast / inflow forecast is formulated more accurately and well in advance for various forecasting Sites. The Data of following Rainfall Station is generally available through CWC wireless stations or from IMD and is used in Flood Forecasting in Mahi, Sabarmati & Banas Basin.

Table –3.2

MAHI BASIN	SABARMATI BASIN	BANAS BASIN
Rainfall Data of CWC stations through its wireless network		
Dhariawad	Sei Dam	Mt. Abu
Mataji	Jotasan	Ambaji
Somkamala Amba Dam	Kheroj	Swaroopganj Dam
Mahi Bajaj Sagar Dam	Harnav Weir	Abu Road
Paderdi Badi	Dharoi Dam	Sarotry
Chakalia	Derol Bridge	Chitrasani
Anas PH-2	Hathmati Weir	Dantiwada Dam
Kadana Dam	Nadiad	Bhakudar (Sipu Dam)
Panam Dam	Watrak Dam	
Wanakbori Weir	Ratanpur	
Khanpur	Raska Weir	
Udaipur	Kheda	
Rainfall Data of IMD stations through FMO Ahmedabad		
Udaipur	Idar	Deodhar
Shera	Vijapur	Deesa
Dahod	Prantij	Patan
Lunawada	V.V.Nagar	Palanpur
Baroda	Mansa	Radhanpur
Godhra	Modasa	
	Bayad	
	Vijayanagar	
	Bhiloda	
	Danta	
	Dansura	
	Gandhinagar	
	Dholka	
	Meghraj	
	Kapadwanj	
	Ahmedabad	

3.3 SOUTH WEST MONSOON 2013 – AN OVERVIEW

A brief summary of SW Monsoon 2013

For the country as a whole, the rainfall for the season (June-September) was 106 % of its long period average.

During the season Gujarat region received Area Weighted Rainfall of 1183.8 mm against normal 901 mm and hence +31% above normal and rainfall received over Saurashtra and Kutch was 777.3 mm against the average 473.5 mm (+64% above normal).

Onset of Monsoon

Formation of Cyclonic Storm Mahasen (10^{th}-16^{th} May, 2013) formed over South-East Bay of Bengal (BG) was the Ist triggering force of low level cross Equatorial Monsoon flow and subsequently monsoon onset took place over south Andaman sea and adjoining south BG on 17^{th} May, 2013. Monsoon cross equatorial flow remained strong and advanced in Kerala by 1^{st} June, and on the same day it covered entire Tamil Nadu and reached up to south Karnataka. Thereafter due to the presence of other favoring factors such convectively active phase of Madden-Julian Oscillation and its associated systematic northward propagation of the E-W shear zone at the mid-tropospheric levels, formation of Low Pressure Area (LPA) and W-NW-ward movement along the E-W trough all resulted in faster advancement of monsoon and remained as fastest during the period of last 70 years. SW Monsoon covered south peninsula and N-E India by 9^{th}, June and the entire country by 16^{th} June; one month earlier than its normal date (15^{th} July).

Monsoon onset over the North Gujarat region took place on 10^{th} June, 2013.

Performance of SW Monsoon from the perspective of Rainfall obtained over Gujarat

During the season, 2 monsoon depressions and 16 monsoon low pressure areas were formed. Out of the sixteen low pressure areas formed during this season, 12 formed over the Bay of Bengal, 3 formed over land and one formed over the Arabian Sea. The month wise break up is 3 in June, 4 in July, 5 in August and 4 in September

The major rain bearing systems that contributed to cumulative rainfall of Gujarat is described below.

Ist pressure system of the season (say L1) developed over Bay of Bengal on 26^{th} May had a northward movement towards Jharkhand and Bihar and does not help in contributing to Gujarat rains.

The monsoon onset over Gujarat happened when An upper air (u/A) cyclonic circulation (Cyc. Cir.) lay over northeast Arabian Sea on 9^{th} June moved over Gujarat coast & neighbourhood, the system further moved over Gujarat in the lower level and persisted 12^{th} June then moved towards Kutch and Pakistan, giving initial spells of rain to the state. During this period northward end of

off-shore trough was extended upto Gujarat coast and it was very active contributing to rainfall.

The first major LPA (Say L2) that had a path through Gujarat and neighborhood was that originated from an upper air cyclonic circulation developed over northwest Bay of Bengal 11th June. It intensified into a low pressure area on 12th and moved over Odisha on 13th June it again intensified into a well marked low pressure area over Chhattisgarh on 14th, over southeast Madhya Pradesh and neighbourhood on 15th and moved to West Madhya Pradesh and adjoining areas of East Rajasthan as a low pressure area on 16th June.The low pressure area weakened into cyclonic circulation over Haryana and became less marked on 19th June 2013. The above mentioned u/A Cyc. Cir. of 9th June and LPA of 11th June gave moderate rainfall over Mahi, Sabarmati and Banas basins till 19th June.

The 2nd major rainfall contributing LPA (say L3) was that formed over the northwest Bay of Bengal & neighbourhood on 22nd June. The system entered coastal Odisha & adjoining areas on 24th and intensified into a well marked low pressure on 25th over north Odisha. It moved over northeast Madhya Pradesh & adjoining southeast Uttar Pradesh on 26th June as a low pressure area. Then it has a track northeast Madhya Pradesh and adjoining area of Chhattisgarh and Uttar Pradesh on 2nd July. The low pressure area intensified into a well marked low pressure area on 3rd July then travelled across West Madhya Pradesh and neighbourhood on 4th July. It dissipated into cyclonic circulation over southwest Rajasthan and adjoining area of Kutch on 5th July and became less marked on 6th July 2013. Intense rainfall activity due to L2 was on 4th and 5th of July.

3rd LPA (L4) that raised rainfall averages of Gujarat was formed over Odisha & adjoining areas of northwest Bay of Bengal on 10th July. The system moved over Chhattisgarh and adjoining Jharkhand on 12th July, over West Madhya Pradesh & neighbourhood on 13th July and over West Rajasthan and adjoining Pakistan on 14th July where it merged with monsoon trough. Under its effect intense rainfall activity was observed over Gujarat on 12th and 13th July.

Low Pressure Area (L5) formed on 15th July over northwest Bay of Bengal had a northward movement and hence does not given rise to any rainfall to

Gujarat. But the region received moderate rainfall on 16th and 17th of July due to the presence of East-West Shear zone.

Next LPA (L6) was formed on 19th July over northwest Bay of Bengal & neighbourhood and persisted on 20th July. It lay over north Chhattisgarh and adjoining Jharkhand, Bihar, southeast Uttar Pradesh & northeast Madhya Pradesh on 21st July morning and merged with monsoon trough on the same day. Though it doesn't had a path through Gujarat and neighborhood, its formation activated Arabian sea cross equatorial monsoon flow and resulted in formation of Mid-Troposheric Cyclone (MTC) and gave rise to widespread rainfall over Gujarat on 23rd July.

Another low pressure area (L7) formed over northwest Bay of Bengal & neighbourhood on 21st July. The low pressure area became well marked on 22nd July and lay over the same region. The system weakned into a low pressure area on 23rd July over west-central Bay of Bengal & Odisha. It lay over interior Odisha and adjoining Chhattisgarh on 24th July morning and over West Madhya Pradesh & neighbourhood on 24th July afternoon. Remnants of the system caused intense rainfall on Gujarat region on 26th and 27th July.

The remnants of depression (say D1)that moved from north Chhattisgarh & neighbourhood weakened into a well marked low pressure area over southeast Madhya Pradesh and adjoining areas of Vidarbha & Chhattisgarh on 1 August. It further weakened into low pressure area and laid over west Madhya Pradesh & adjoining areas of east Rajasthan on 2 August. It merged with monsoon trough on 3 August. However, the associated upper air cyclonic circulation laid over southeast Rajasthan and adjoining Gujarat and west Madhya Pradesh extends upto lower tropospheric levels. It laid over southwest Rajasthan and neighbourhood extending up to 3.1 km above mean sea level on 4 August. Gujarat experienced heavy rainfall on 2nd to 4th August.

Next LPA (L8) formed over west central Bay of Bengal & adjoining northwest Bay of Bengal and north Andhra Pradesh south Odisha coasts on 5 August. It travelled to east Madhya Pradesh & adjoining area on 6th August and over Jharkhand & neighbourhood on 7th thus merged with monsoon trough on 8th August. The associated upper air cyclonic circulation laid over Bihar & neighbourhood extended upto mid-tropospheric levels. Under its influence, another low pressure area (L9) formed over northeast Madhya Pradesh &

neighbourhood on 9th August, it laid over central parts of Uttar Pradesh & adjoining northeast Madhya Pradesh on 10th August, over west Uttar Pradesh & adjoining east Rajasthan on 11th August and merged with monsoon trough on 12th August & its associated upper air circulation laid over northeast Rajasthan & neighbourhood extended upto 2.1 km. It persisted over same area on 13th August and over central parts of Rajasthan & neighbourhood on 14thAugust. Upper air circulation further moved to northwest Rajasthan on 15 August, and the moved towards Haryana and Punjab. River basins of Gujarat received fairly widespread rainfall on 10th August.

A low pressure area (L10) formed over west central & adjoining northwest Bay of Bengal off south coastal Odisha and north coastal Andhra Pradesh on 16 August and merged with monsoon trough on 17 August. Another low pressure area (L11) formed over east Uttar Pradesh & adjoining north Madhya Pradesh on 18 August and merged with monsoon trough on 19 August. Both do not contribute to Gujarat rainfall, but the region received widespread rainfall on 14th August due to formation of MTC.

Another fresh low pressure area formed over north Bay of Bengal & adjoining areas of Gangetic West Bengal with associated upper air cyclonic circulation extended upto mid-tropospheric levels on 18 August and became well marked on 19 August. It concentrated into depression (D2)over Gangetic West Bengal and adjoining area of northwest Bay of Bengal, north Odisha & Jharkhand on 20 August and laid over Gangetic West Bengal and adjoining areas of Jharkhand & north Odisha on 21 August. Depression over Gangetic West Bengal and adjoining areas of Jharkhand & north Odisha laid over east Madhya Pradesh, about 70 Km east-northeast of Jabalpur on 22 August. It weakened into well marked low pressure area over central parts of south Madhya Pradesh & adjoining Vidarbha on 23 August. It further weakened into low pressure area and laid over central parts of Madhya Pradesh & neighbourhood on 24 August; under its effect Gujarat region received fairly widespread rainfall on 24th August. The system became less marked on 25 August.

A low pressure area (L12) formed over northeast Bay of Bengal & neighbourhood on 27 August and it laid over Jharkhand & neighbourhood on

28 August; thereafter moved towards U.P and Bihar. On 9 September, southwest monsoon has withdrawn from some parts of west Rajasthan.

Another LPA (L13) formed and moved towards A.P. The system over coastal Andhra Pradesh & adjoining west central Bay of Bengal became less marked on 12 September. A east-west trough ran from north Bay of Bengal to east-central Arabian sea across Odisha, Chhattisgarh and Maharashtra on 16 & 17 September, from north Bay of Bengal to eastcentral Arabian sea across Odisha, south Chhattisgarh and Maharashtra with an embedded cyclonic circulation over Marathwada & neighbourhood extended upto 3.1 Km above mean sea level on 18 September. But a Lull phase of monsoon continued over Gujarat during this period.

On 19 September, Southwest monsoon has further withdrawn from entire Jammu & Kashmir, Himachal Pradesh and Punjab, some parts of Haryana, some more parts of Rajasthan and some parts of Kutch.

A low pressure area (L14) formed over northwest Bay of Bengal and adjoining coastal areas of West Bengal & Odisha with associated upper air cyclonic circulation extending upto mid-tropospheric level on 19 September. The low pressure area laid over Chhattisgarh and adjoining areas of east Madhya Pradesh & Vidarbha on 20 September, over south Madhya Pradesh & adjoining Vidarbha on 21 September and over South-central Madhya Pradesh & neighborhood on 21 September. It weakened and was seen as a upper air cyclonic circulation only over southwest Madhya Pradesh & adjoining Gujarat region extending upto 4.5 km above mean sea levels on 22 September and persisted over the same region on 23 September. It laid over southwest Madhya Pradesh and adjoining areas of Gujarat region & east Rajasthan extending upto mid-tropospheric levels on 24 September and over Gujarat region & neighbourhood on 25 September. The system gave intense rainfall from 22nd to 25th September over Gujarat region.

A low pressure area (L15) formed over Kutch & neighbourhood on 27 September. It laid over southwest Rajasthan & neighbourhood on 28 September and over south Rajasthan & neighbourhood with associated upper air cyclonic circulation extending upto 4.5 Km above mean sea level on 29 September. It became less marked on 30 September. However, the associated upper air cyclonic circulation extended upto 3.6 Km above mean

sea level over southeast Rajasthan & neighbourhood. The upper air cyclonic circulation reached north Gujarat & adjoining south Rajasthan on 1 October and over Saurashtra & neighbourhood on 2 October. Over Gujarat the heavy rainfall due to the system was observed on 29th and 30th September.

The last LPA (L16) of the season formed over northwest Bay of Bengal and adjoining coastal areas of West Bengal & Odisha on 29 September. Though it evaded more westward movement the associated U/A cy.cir came upto northeast Madhya Pradesh & neighbourhood and under its effect fairly widespread rainfall was observed over Gujarat region. Thereafter the monsoon flow weakened and it showed signs of withdrawal, its withdrawal from Gujarat was declared on 20th October.

Thus out of 16 LPA's formed during the season, 9 had more westward movement. It reached over the Gujarat region or till NE/NW M.P either as LPA or as U/A cy. cir. and contributed to rainfall over the region. Remnants of 2 depressions also had a path through Gujarat and neighborhood. 6 LPA had a more northward movement evading Gujarat, but in that 2 LPA activated Arabian sea cross equatorial flow and led to formation of MTC and hence rainfall over Gujarat. Besides this Gujarat region received heavy rainfall due to the formation of E-W shear zone during the season.

All the about said favorable conditions led to above average rainfall over Gujarat during the season.

Synoptic Condition that prevailed over Gujarat, West M.P and south Rajasthan, the 24 hr forecast and Details of QPF provided (in mm) by FMO Ahmedabad, when HRW was issued, for different sub basins of Mahi, Sabarmati and Banas during the period when there was considerable rain in the basins are given in Statement - 5 & 6 respectively.

Table 3.3

Month wise distributions of cumulative rainfall over different river basins for the current year and previous year are as under :

Name of Basin	Mahi Rainfall (mm)		Sabarmati Rainfall (mm)		Banas Rainfall (mm)	
Month	2012	2013	2012	2013	2012	2013
June	12	115	22	104	21	132
July	264	528	144	379	306	308
August	429	232	212	183	287	200
September	289	195	288	171	229	274
October	0	65	0	71	0	88
Cumulative of season	994	1135	667	908	844	1001

3.5 RAINFALL OBTAINED OVER DIFFERENT BASIN

3.5.1 Mahi Basin

The SW Monsoon sets in by the middle of June and withdraws by middle of October. The average rainfall in the Mahi basin for past 10 years from 2003 to 2012 is 835 mm and the rainfall received in 2013 is 1135 mm. The rainfall data when widespread to heavy rainfall occurred in Mahi basin is shown in Statement-7.

3.5.2 Sabarmati Basin

The SW Monsoon sets in by the middle of June and withdraws by middle of October. The average rainfall in the Sabarmati basin for past 10 years from 2003 to 2012 is 862 mm and the rainfall received in 2013 is 908 mm. The rainfall data when widespread to heavy rainfall occurred in Sabarmati basin is shown in Statement-8

3.5.3 Banas Basin

The South-West monsoon sets in the fourth week of June and ends by the end of first week of October. The average rainfall of the basin for last 10 years is 858 mm and the rainfall received in 2013 is 1001 mm. About 97% of total Rainfall is received during monsoon period. The rainfall data when widespread to heavy rainfall occurred in Banas basin is shown in Statement-9.

CHAPTER 4

TECHNIQUE FOR FLOOD FORECASTING IN MAHI, SABARMATI AND BANAS BASINS

The methodology adopted for flood forecast formulation for the inflow forecasting sites such as Kadana, Dharoi and Dantiwada dam are almost the same. The concise summary of the procedure for forecast formulation is given below:

The gauges observed at alerting stations gives an indication of incoming floods due to rain in upper catchment. Then the water level at base stations forms basis for formulation of flood forecast. Using the Stage-Discharge curve the discharge corresponding to the water level at base stations are got. The discharges of base stations are then added to get the total resultant discharge. The total resultant discharge is then summed up with due consideration of travel time from the base stations and thus the quantity of water that may arrive at forecasting station through river is obtained. The anticipated flow from intermediate catchment due to rainfall is assessed on the basis of hourly rainfall data at base stations and forecasting station. This is added to the contribution from river to get the net amount of water that may reach the forecasting station.

In case of Flood level forecast though the underlying concept of the procedure adopted is same as in inflow forecast. In flood level forecast the contribution due to rainfall is incorporated only is it is intense and the catchment area is large. If the flow is in receding trend it is assumed peak discharge at the base station will arrive at forecasting station with a reduction in quantity and the time taken by the peak to travel upto forecasting station will be more than the average travel time. And in rising trend the assumption is that the travel time taken by the peak will be less than the average travel time.

Prior to the onset of SW monsoon over this area, during off-season, the Hydromet staffs of this office revise the SD curve and travel time curve of all base stations with the inclusion of last monsoon river discharge data. After the approval of SD curve by Executive Engineer the stage-discharge values at equal intervals taken from the curve are then linearly interpolated to get a continuous stage-discharge digitized data or SD table. If the upper end magnitude of stage available is less than the bank height of the river, then by fitting a straight line equation to the upper end of the curve, stage-discharge

values is computed up to the bank height. The S-D table, Capacity table of reservoir (in case of inflow forecasting station), Travel time curves and other details such as un gauged catchment area etc that are prepared every year are put together in the form of a booklet for each basin separately. So this information's can be readily and easily available during forecast formulation.

Enquiries with state authorities regarding any development of minor/major project in the upstream of forecasting station are also done during pre monsoon season. If any project has developed in the above said area its specifications are got by this division to study about the effect of the same on the formulated volume of water.

In addition during the pre-monsoon season a chart containing all the contact numbers of officers and staffs engaged in flood management, of NTBO are prepared for ready use during flood season.

Brief details of the activities during Flood Forecast formulation for all forecasting stations are given below. Methodology, Technique & Type of data being used for formulation of forecast is given in Statement No. 10. Other than this a detailed description of methodology of forecast formulation along with simple mathematical computations adopted for each forecasting station is depicted under section 4.1, 4.2 and 4.3 respectively.

4.1 MAHI BASIN

Mahi Sub Division is functioning at Kadana for forecasting activities in Mahi Basin. Mahi Sub division, Kadana is engaged in the Flood forecasting activities at Kadana Dam (Inflow forecast) and Wanakbori weir (level forecast). In Mahi river basin floods are caused either due to heavy rainfall in the catchment area of Anas or the catchment area of main river Mahi or in both.

The details of Type of forecast issued, Base stations, Travel time, Warning Level and Danger Level are as follows:

Table 4.1

Forecasting Station/Type of Forecast	Base Station	River/ Tributary	Average Travel Time (hrs)	WL (m)*	DL(m)*	H.F.L (updated upto 2010)
1. Kadana Dam (Inflow forecast)	a. Paderdibadi b. Anas-PH-2	a. Mahi b. Anas	a. 5 to 6 b. 3 to 6	126.18	127.71	127.737 on 09/09/1989
2.Wanakbori Weir (Level Forecast)	a. Kadana Dam b. Panam Dam	a. Mahi b. Panam	a. 4 to 9 b. 3 to 9	69.8	72.54	76.10 on 12/08/2006 at 0400 hrs

* The above given Warning Level and Danger Level is as per Flood memorandum-2012. The magnitudes are subjected to change.

During monsoon season the data transmission is such that the Gauge, Discharge and Rainfall data of upstream stations like Mahi Bajaj Sagar Dam, Paderdibadi, Chakaliya, Anas PH-2, Panam Dam and Wanakbori Weir are received by the Sub Division at Kadana through wireless net work and that of Kadana Dam through telephone. The Superintending Engineer, Kadana Project Circle supplies the information regarding outflow through the spillway of Kadana Dam to this office. Line diagram of Mahi river basin is given in Plate - 3.

Schematic diagram showing forecast activities in Mahi basin is enclosed as Plate - 4.

4.1.1 KADANA DAM

The inflow forecasting at Kadana dam is done with the help of hydrological observations conducted at various CWC sites situated over Mahi basin. The lists of sites in Mahi basin with details are detailed in statement no.2a.

4.1.1.1 Criteria for issuing forecast:

The inflow forecast is issued if the inflow into the dam is about 1 lac cusecs (2832 cumecs) or more.

4.1.1.2 Data Used and its communication:

The type of data used for forecast formulation includes

1. Hourly Water level (in meters) and corresponding discharges of stations Paderdibadi and Anas PH-II. Discharges are obtained using SD curve prepared using historical data.
2. Rainfall (in millimetres) of Paderdibadi and Kadana Dam.
3. Inflow and outflow of dams like Mahi, and Kadana, collected from state authorities.

Apart from the hydrological data collected by CWC and State authorities that helps quantitatively in the formulation of forecast, data and information received from Flood Meteorological Office (FMO), Ahmedabad as given in chapter 3 helps qualitatively.

Communication of above said data is through wireless sets and via phone/Mobile. The Water level and Rainfall data that is collected at the above said 12 sites are passed to Mahi sub division, Kadana and from there to Mahi division as per wireless schedules.

4.1.1.3 Methodology

By Observing Satellite pictures provided in www.imd.gov.in the movement of pressure systems that is likely to cause precipitation over this area can be identified. Once the system reaches near to north Gujarat and neighbourhood, the weather forecast and QPF issued by IMD gives an idea about the area and time (in general not exact) and intensity of precipitation. Once the rainfall activity starts over this region hourly water level observed and the corresponding discharge got from SD table, of upstream stations gives an indication about the magnitude and time of peak discharge that would reach the base station. Thereafter for the computation of total quantum of water that would reach base station, the base station discharges, its hourly rainfall and the rainfall of forecasting stations is only used. In case of Kadana dam the base stations are Paderdibadi on main Mahi river and Anas PH-II on major contributing tributary Anas. The position of these stations can be better viewed on Mahi Basin map given on plate no. 2.

Revised Rating/SD curves of base stations Paderdibadi and Anas PH-II, and the Travel Time curve from base station to forecast station are enclosed in plate No. 5 a, b & 6 a, b.

Computational procedure:

During SW monsoon period all staffs in Hydromet section keeps a thorough watch on all the hourly data and meteorological situations. It is felt that the criteria for issuing forecast mentioned in section 4.1.1.1 is likely to attain in the succeeding one or two hours, Inflow Forecast is to be issued. Forecast is formulated using Stage and Rainfall data of base stations and rainfall of forecasting station for four to six consecutive hours prior to the current hour. In case of rainfall more preceding data is included in some occasions. The current hour data is also included in forecast formulation as it is, if it has been communicated to the divisional office or it is assumed that the current reading is same as that of preceding value. The inflow forecast gives

the amount of water that can be expected at the Forecasting station during the forecast period.

For every base station stage values corresponding discharge values are taken from the S-D table of the base station. With the help of Travel Time (TT) curve the TT corresponding to the discharge is got. For the same time, the discharges of base stations with similar TT are added together to get total discharge. The discharges with different TT are taken as it is. Then cumulative is taken to get the total discharge for the entire period. Total discharge for the entire period, which is in cumec is then converted into MCM by dividing by the factor 277.77.

The quantity of rainfall that contributes to the surface runoff (effective rainfall) is a function of soil infiltration properties and amount of rainfall. For Kadana dam inflow forecast the rainfall contribution to surface flow is estimated by using Antecedent Precipitation Index or API (See literature for more details). API computation procedure and estimation of effective rainfall adopted is same as explained in Chapter – 4, section. 4.3.2.1& 4.3.2.2 of Manual on Flood Forecasting.

To include the contribution from rainfall, same period hourly rainfall data of the base and forecasting stations are used. Every hour rainfall at each base station and forecasting stations are multiplied by its corresponding Thiessen's weightage and total rainfall for that particular hour is taken by adding all. Cumulative rainfall for the entire period is then taken by adding the total rainfall of each hour.

Using API of that day the effective rainfall is taken from the API table. Plot of 'Rainfall – Runoff correlation with API as parameter' used by Mahi Division for Kadana dam inflow forecast is enclosed in plate No. 7. Rainfall contribution to runoff is got by multiplying effective rainfall with free catchment area (the area in between base and forecasting stations). The rainfall-contributed runoff is then converted to MCM by dividing it with 10^6. The Total discharge for the entire basin and rainfall-contributed runoff added together to get total inflow that is going to come in Kadana dam during the period of forecast.

The forecast validation can be done using 2 procedures

1. Simply by adding the inflow during the forecast period and converting it into MCM and then finding the percentage of departure from actual as follows:
   % of departure = (Forecasted Volume/Cumulative volume attained during FF period)*100

2. In the 2nd method inflow given by dam authorities is not used directly for forecast validation, instead of that, the inflow into the dam is computed using water level and outflow information provided by project authorities using the below given simple procedure.

   First Capacity corresponding to dam water level is got from capacity table. Change in capacity in two consecutive hours is equal to inflow into the dam. If there is any outflow from the dam between these hours, its volume must be added to change in capacity to get net inflow into the dam. Thus the inflow into the dam is calculated for entire forecast period and there after the procedure adopted to calculate percentage of departure is similar to that of given above as (1).

The forecast validation procedure adopted in case of other inflow forecasting stations are exactly the same.

The forecasted inflow is considered to be within limits if the computed percentage of variation from the actual inflow is within ± 20%.

The dissemination of forecast is done in the prescribed performa and it is sent to Flood cell Gandhinagar and FFM Directorate, New Delhi by Fax. Hard copy of the same is send to SE, HOC Gandhinagar. The sample Performa used for disseminating inflow forecast of Kadana dam in case of low flood is attached as plate No. 8, Performa given in CWC Flood Forecasting Manual has been used. The colour code proposed by NDMA for disseminating forecast has been included in the format by typing the same on the top of the performa. As the forecast message is send through fax to user agencies only in this way colour code can be included. The colour code will change as per the intensity of flood.

<u>Steps for formulation of inflow forecast for Kadana dam in a Nut-shell</u>:

(1) Preparation of S-D and travel time V/s stage curves using past data.

(2) Prepare S-D table.

(3) Keep watch on flood situation, if it is felt that inflow is likely to exceed criteria fixed for issuing forecast in succeeding one or two hours, forecast should be issued.

(4) Corresponding discharges are taken from the S-D table, from the Stage data of base stations for four to six consecutive hours prior to the current hour.

(5) The discharges over the base stations Paderdibedi and Anas PH-2 are added together and then cumulative value is considered to get total discharge for the entire period.

(6) The total discharge in cumec is converted into MCM by dividing with the factor 277.77.

(i.e. 1MCM = 10^6 cumec
= $10^6/3600$ m^3/hr
= 277.77 m^3/hr)

(7) To estimate the rainfall contribution to surface runoff the hourly rainfall data of the base stations and the forecasting station for the same period (lower limit of data period can be extended) are multiplied by its corresponding Thiessen's weightage and total rainfall for that particular hour is taken by adding all the station values. Cumulative rainfall for the entire period is then taken by adding the total rainfall of each hour.

(8) Using API of that day from the API table effective rainfall is got, rainfall contribution to runoff is got by multiplying effective rainfall with free catchment area.

(9) The rainfall-contributed runoff is then converted to MCM by dividing it with 10^6.

(i.e. If effective rainfall got from API table = 1.8mm = 1.8/1000 m
Free Catchment area = 4623 Sq.Km = $4623*10^6$m
Rainfall Contribution in mcm = $[(1.8/1000)*(4623*10^6)]/ 10^6$ mcm)

(10) The Total discharge for the entire basin and rainfall-contributed runoff added together give the total inflow likely to reach in forecasting station during the forecast period.

A worked out example depicting the computation of inflow forecast of Kadana dam along with forecast validation procedure adopted is given in plate No.9.

4.1.2 WANAKBORI WEIR

The main contribution to Wanakbori Weir comes from Kadana and Panam Dams situated on its upstream. The water level corresponding to the net resultant discharge is worked out at Wanakbori Weir taking into consideration the releases from two base stations i.e. Kadana Dam and Panam Dam and runoff from the intermediate catchment taking into account different travel time of floods in each river.

4.1.2.1 Criteria for issuing forecast:

Whenever water level at Wanakbori weir is likely to reach or exceed Warning level 69.8 m or, discharge from any one of the base stations or both the stations is between 1 – 1.5 lakh cusec for continuously 3 hrs.

Concerned Executive Engineer, of Kadana and Panam Project Division, communicates the outflows to the Mahi Sub Division, Kadana through the wireless at Dam Site.

4.1.2.2 Data Used and its communication:

The data that helps in forecast formulation of Wanakbori weir are

1. Discharges at Kadana and Panam dam
2. Hourly rainfall at Kadana, Panam dam and Wanakbori weir

4.1.2.3 Methodology

Satellite pictures given in IMD website and weather forecast and QPF issued by FMO serves the similar purpose given in section 4.1.1.3 for Wanakbori level forecast. For forecast computation the data given in section 4.1.2.2 is only used.

Computational Procedure:

During intense rainfall events the Hydromet and wireless staffs of this division keeps watch on Hydrometeorological situation, if there is huge release from Kadana and Panam dam or from any of them, then necessity for forecast formulation arises. Forecast is formulated using discharge and Rainfall data of Kadana and Panam dam for four - six consecutive hours prior to the current hour and the forecast is issued for the succeeding sixth hour. Average discharge of Kadana and Panam dam for the entire period are added together to get the total discharge. The rainfall contribution is computed by adding the average rainfall of the base and forecasting station to get the total rainfall. Effective rainfall is computed as 30% of total rainfall (if it is August). Total runoff over the basin is got by multiplying effective rainfall and Ungauged catchment area (In case of Wanakbori weir the ungauged Catchment area is 2831 Km^2). Total runoff is then converted into cumec by dividing it by 3600. The total discharge and total runoff will give expected discharge at the forecasting station. Stage corresponding to the expected discharge taken from S-D table will give the maximum stage that can be attained in succeeding

sixth hour. Level forecast can also be issued for a short period of 3 hrs. The S-D curve of Sabarmati river at Wanakbori weir and the combined TT curve of Kadana and Panam dam releases, to Wanakbori weir are given in Plate No. 10 & 11.

The forecasted level is considered to be within limits, if the difference from the actual level attained is only ± 15cm. The Performa used for disseminating flood level forecast of Wanakbori weir is attached as Plate No.12.

Steps for formulation of level forecast for Wanakbori weir in a Nut-shell:

(1) Preparation of S-D and travel time V/s stage curves using past data.

(2) Prepare S-D table.

(3) Keep watch on flood situation, if it is felt that inflow is likely to exceed criteria fixed for issuing forecast in succeeding one or two hours, forecast should be issued.

(4) The average discharges over the base stations Kadana dam and Panam computed using four to six consecutive hours of data prior to the current hour are added together to get total discharge for the entire period.

(5) The hourly rainfall data of the base stations and the forecasting station averaged over the entire period are added together to get the total average rainfall.

(6) To find the rainfall contribution from the ungauged catchment effective rainfall is taken as 30% (for August and September, for July it is 20%) of the average rainfall likely to covert into runoff. Effective rainfall is then multiplied by ungauged catchment area to get total runoff over the area.

(7) The rainfall-contributing runoff (in meters) is converted to cumec by dividing it by 3600.

(8) The Total discharge for the entire basin and rainfall-contributed runoff added together give the total discharge likely to reach in forecasting station during the forecast period.

(9) Stage corresponding to the expected discharge taken from S-D table will give the maximum stage that can be attained.

Computational steps are similar to shown for Kadana dam inflow forecast.

An API table has not been prepared for any forecasting station other than Kadana dam since the un-gauged catchment area is less for rest of the FF stations.

A worked out example depicting the computation of Wanakbori weir forecast is shown in Plate No.13.

4.2 Sabarmati Basin

For Managing flood forecasting activities in Sabarmati Basin, two Sub Divisions has been set up i.e. North Western Rivers Sub Division, CWC, Himmatnagar to look after Flood forecast of Dharoi dam, and Sabarmati Sub Division, CWC, Ahmedabad to deal with the flood level forecasting at Subhash bridge and advisory level forecast for Kheda Road Bridge. The details of Type of forecast issued, Base stations, Travel time, Warning Level and Danger Level are as follows:

Table 4.2

Forecasting Station/Type of Forecast	Base Station	River/ Tributary	Travel Time (hrs)	WL* (m)	DL* (m)	H.F.L (m)
1.Dharoi Dam (Inflow Forecast)	a. Kheroj b.Harnav Weir	Sabarmati Harnav	3 to 5 2 to 4	187.45	192.25	189.625 on 03.09.1990
2.Subhash Bridge (Level Forecast)	a.Derol Bridge b.Hathmati Weir	Sabarmati Hathmati	5 to 11 7 to 11	44.09	45.34	47.45 m on 20.08.06 at 0600 hrs
3. Kheda Road Bridge (Advisory Level Forecast)	a.Raska weir b.Ratanpur	Meshow Watrak	4 to 5 10 to 12	24.25	26.25	-
Note: Whenever the water level at Dakor on Shedi river and Katlal on Mohar are 7.05 m and 6.49 m above zero guage (45.01 m & 36.44 m) respectively then it will cause significant flood in Kheda.						

4.2.1 Dharoi Dam

Huge inflow into Dharoi dam occurs then there is intense rainfall over upper catchment of Sabarmati basin.

4.2.1.1 Criteria for issuing forecast:

The inflow forecastfor Dharoi Dam is to be issued when discharges of the order of 20,000 cusec/567 cumec or above is expected to come in reservoir at any time.

4.2.1.2 Data Used and its communication:

For the purpose of flood forecasting the type of data used are given below:

1. Water Level and Discharge collected at all stations upstream of Dharoi dam i.e Jotasan, Sei dam Kheroj and Harnav weir. In this Kheroj and Harnav weir are taken as the base stations for Dharoi dam inflow forecast.
2. Hourly Rainfall collected over above mentioned stations.

The data pertaining to dams and weir are collected from concerned project authorities.

Basin Map or Flood forecasting network of Sabarmati basin is included as Plate No.14 to get an overview about the positions of various stations located over the Basin. Line diagram of Sabarmati basin is enclosed as Plate no.15 and the Schematic diagram showing the flood forecast activities in Sabarmati basin is given in Plate no.16.

4.2.1.3 Methodology

In case of Dharoi Dam inflow forecast too, the expected volume of water that would reach the forecasting stations can be contributed from

1. The water that reaches the forecasting station through main river/tributary and that is assessed at base station from W.L & discharge measurements.
2. The water that is contributed from rainfall in the intermediate catchment that enter the river/ directly that reaches the dam.

Expected volume of water due to later is computed in the same way as that adopted for Kadana dam inflow forecast. In the latter case volume contribution due to rainfall in ungauged catchment is assessed by assuming that the average of rainfall that occurred over base stations and forecasting stations is approximately equal or representative of that received over entire free catchment. So the average computed is converted to areal rainfall over the catchment. The method is similar to what is adopted for Wanakbori weir level forecast.

The SD curve of Kheroj and Harnav weir to Dharoi dam and the Travel Time (TT) curve for the same is enclosed as Plate No. 17 a&b and 18 a&b respectively.

Steps for formulation of inflow forecast for Dharoi dam in a Nut-shell:

(1) Preparation of S-D and travel time V/s stage curves using past data.

(2) Keep watch on flood situation, if it is felt that inflow is likely to exceed criteria fixed for issuing forecast in succeeding one or two hours, forecast should be issued.

(3) Corresponding discharges are taken from the S-D table, from the Stage data of base stations for four to six consecutive hours prior to the current hour.

(4) The discharges over the base stations Kheroj and Harnav weir are added together and then cumulative value is considered to get total discharge for the entire period.

(5) The total discharge in cusec is converted into MCM by multiplying with the factor $0.02832/10^6$.

(6) The hourly rainfall data of the base stations and the forecasting station for the same period (lower limit of data period can be extended) are averaged for every hour.

(7) To find the rainfall contribution from the un -gauged catchment effective rainfall is taken as of the average rainfall likely to convert into runoff. Effective rainfall is then multiplied by un- gauged catchment area to get total runoff over the area.

(8) The rainfall-contributing runoff is converted to MCM by dividing it by 10^6.

(10) The Total discharge for the entire basin and rainfall-contributed runoff added together give the total inflow likely to reach in forecasting station during the forecast period.

The Performa used for disseminating inflow forecast of Dharoi dam is attached as Plate No.19.

4.2.2 SUBHASH BRIDGE

Since the flood in the downstream of Dharoi dam is to be very seriously viewed since it will affect Ahmedabad city, hence flood forecasting at Subhash bridge is very crucial. The flood in the downstream of Sabarmati river can occur due to

1. Large releases from Dharoi dam
2. Intense rainfall activity in the downstream of Dharoi dam.

4.2.2.1 Criteria for issuing forecast:

Whenever the inflow at Subhash bridge is likely to cross Warning Level (44.09 m). Forecast is to be issued regularly till the water level comes down below warning level.

4.2.2.2 Data Used and its communication:

The data used for forecast formulation at Subhash bridge are

1. G observed at base stations namely Derol bridge on main Sabarmati and Hathmati weir on major tributary Hathmati, corresponding discharge is assumed from SD table.
2. Hourly rainfall at Base stations as given below and that at recorded at Subhash Bridge.

All the base station data observed at CWC stations and that obtained from state authorities are collected at sub-Divisional office and then transmitted to divisional office. The stations over Sabarmati basin used by CWC for flood forecasting purpose are given in Statement no.2.

4.2.2.3 Methodology

From satellite pictures and QPF gives an indication about the advent of intense rainfall activity. A need for forecast at Subhash bridge normally occurs when Dharoi dam is almost full and there is huge releases from it. Outflow from Dharoi dam is intimated by project authorities. Contribution of intermediate catchment of the Sabarmati downstream of Dharoi Dam is assessed on the basis of gauge at Derol Bridge site and the total resultant discharge is computed from the stage discharge curve. The flow over the Hathmati Weir is taken into consideration for computing net peak discharge on the basis of rating tables of Hathmati Weir supplied by state authorities. Apart from this for assessing rainfall contribution from the un-gauged catchment rainfall observation is made hourly for all the base stations when there is intense rainfall activity in the basin. Superimposing the flood hydrograph of Derol Bridge and Hathmati Weir on the basis of time of travel of in each river, the resultant peak discharge expected to pass through Subhash Bridge, Ahmedabad is computed. The water level at Subhash Bridge corresponding to the resultant peak discharge is worked out from the stage discharge curve.

Steps for formulation of level forecast for Subhash bridge in a Nut-shell:

(1) Preparation of S-D and travel time V/s stage curves using past data for base station namely Derol Bridge and TT curves for Hathmati weir discharge.

(2) Keep watch on flood situation, if it is felt that inflow is likely to exceed criteria fixed for issuing forecast in succeeding one or two hours, forecast should be issued.

(3) The average discharges over the base stations Derol bridge and Hathmati weir are computed using four to six consecutive hours of data prior to the current hour are added together to get total discharge for the entire period.

(4) The hourly rainfall data of the base stations and the forecasting station averaged over the entire period are added together to get the total average rainfall.

(5) To find the rainfall contribution from the un-gauged catchment effective rainfall is taken(it also depends on existing meteorological conditions) of the average rainfall likely to convert into runoff. Effective rainfall is then multiplied by un-gauged catchment area (2593 Km^2).

(6) The rainfall-contributing runoff (in meters) is converted to cumec by dividing it by 3600.

(8) The Total discharge for the entire basin and rainfall-contributed runoff added together give the total discharge likely to reach in forecasting station during the forecast period.

(9) Stage corresponding to the expected discharge taken from S-D table will give the maximum stage that can be attained.

The SD curve of Derol bridge and similar curve provided for Hathmati weir by state authorities, and that of Subhash bridge is given in Plate no.20,21 and 22 respectively. The combined TT curve of both Derol bridge and Hathmati weir discharge to Subhash bridge is enclosed as plate no. 23 respectively.

The Performa used for disseminating flood level forecast of Subhash bridge is attached as Plate no. 24.

4.3 Banas Basin

Over Banas basin, Mahi division is having only one flood forecasting station Dantiwada dam. Banas Luni Sub Division, CWC, Palanpur has been entrusted with the work of issuing inflow forecast for Dantiwada Dam in Banas Basin.

The Basin Map /Flood forecasting network of and Line diagram of Banas basin are included as Plate No. 25 & 26. Schematic diagram showing forecast activities in Banas basin is enclosed as Plate – 27.

4.3.1 Dantiwada Dam

Flood in Dantiwada normally occurs due to intense rainfall activity under the effect of rain bearing systems over north Gujarat or adjoining Rajasthan. The details of base stations and average travel time is given in the below table:

Table – 4.3

Forecasting Station	Base Station	River	Time Lag (hrs)	WL (m)	DL (m)	H.F.L (m)
Dantiwada Dam (Inflow Forecast)	a) Sarotry b) Chitrasani	Banas Balaram	3 to 5 2 to 4	182.88	185.06	186.04 in 1973

4.3.1.1 Criteria for issuing forecast:

For water level < 181.34 m the inflow forecast is to be issued whenever the inflow at Dantiwada dam is likely to be ≥ 20,000 cusec. And if water level at dam is > 181.34 m inflow forecast is to be issued whenever the flow is ≥ 10,000 cusec.

4.3.1.2 Data Used and its communication:

The data mainly used in forecast formulation are base stations data namely

1. Gauge observed at Sarotry on Main river and Chitrasani on major tributary Balaram. The discharge corresponding to gauge at the time of forecast is got from SD table. Data and forecast of IMD and of all other upstream sites are used for alertness.
2. Hourly rainfall observed at Base stations as given below and at forecasting station Dantiwada dam

Gauge, Discharge and Rainfall data of stations namely, Swaroopganj, Abu Road, Sarotry, Chitrasani and Dantiwada Dam are received by the sub division through wireless network and then transmitted to divisional office. The stations over Banas basin used by CWC for flood forecasting purpose are given in Statement no.2.

4.3.1.3 Methodology

The forecast formulation procedure adopted in case of Dantiwada dam is similar to that of Dharoi dam. Only difference is that Banas is more flashy

compared to Mahi and Sabarmati hence the sudden rise and fall in inflow makes the inflow forecast a difficult task. For formulating of inflow forecast for Dantiwada Dam, the sites at Sarotry and Chitrasani are treated as base stations. The discharge of river Banas at Sarotry is computed from stage discharge curve of site Sarotry and contribution of the major tributary of the river Banas, Balaram is computed from gauge/ discharge observed at Chitrasani site. The resultant inflow into Dantiwada Dam on river Banas is computed taking into consideration discharges at Sarotry and Chitrasani with due weightage to meteorological situations prevailing in intermediate catchment considering hourly rainfall data at these sites. The water level of Swaroopganj is considered when the weir overflows.

Steps for formulation of inflow forecast for Dantiwada dam in a Nut-shell:

(1) Preparation of S-D and travel time V/s stage curves using past data.
(2) Prepare S-D table.
(3) Keep watch on flood situation, if it is felt that inflow is likely to exceed criteria fixed for issuing forecast in succeeding one or two hours, forecast should be issued.
(4) Corresponding discharges are taken from the S-D table, from the Stage data of base stations for four to six consecutive hours prior to the current hour.
(5) The discharges over the base stations Sarotry and Chitrasani are added together and then cumulative value is considered to get total discharge for the entire period.
(6) The total discharge in cusec is converted into MCM by multiplying with the factor $0.02832/10^6$.
(7) The hourly rainfall data of the base stations and the forecasting station for the same period (lower limit of data period can be extended) are averaged for every hour.
(8) To find the rainfall contribution from the ungauged catchment (342 Km^2)effective rainfall is taken as 30% (for August, it also depends on current meteorological conditions) of the average rainfall likely to covert into runoff. Effective rainfall is then multiplied by ungauged catchment area to get total runoff over the area.
(9) The rainfall-contributing runoff is converted to MCM by dividing it by 10^6.

(10) The Total discharge for the entire basin and rainfall-contributed runoff added together is the total inflow likely to reach in forecasting station during the forecast period.

SD and TT curves of base stations respectively Sarotry and Chitrasani are enclosed as Plate No. 28,29,30, and 31. The Performa used for disseminating inflow forecast of Dantiwada dam is attached as Plate No. 32.

This division is currently to install telemetry system for data acquisition for FF purposes. With the advent of telemetry system the data quality will improve so this office is hopeful to get some encouraging results from the model with the input of new data sets produced by telemetry system.

Second method is a very simple conventional adopted by this division for the FF purposes. The main assumption involved is regarding the rainfall contribution of surface runoff from un gauged catchment. Field experience and board knowledge about the catchment is demanded for successful estimation of rainfall contribution. This involves personal judgment which cannot be coded.

CHAPTER 5

HYDROLOGICAL SITUATION IN DIFFERENT BASINS DURING SW MONSOON 2013

This year the entire three basins received above normal rainfall on an average. All altogether 39 forecasts were issued.

A brief review of hydrological situation that existed in different basins during SW monsoon 2013 is detailed below:

5.0 FLOOD SITUATION DURING MONSOON 2013

In 2013, SW Monsoon started on 10.06.2013, before the start of flood season by CWC. Onset spells does not gave rise to much surface flow as the underlying terrain was very dry and Pre-Monsoon thunderstorm activity were also limited to 1 or 2 days over limited locations.

5.1 MAHI BASIN

1st LPA that contributed countable surface flow in the basin is L3 (Pl. See chapter 3 for details). In Upper Mahi basin rainfall started on 02.07.2013 evening and continued till 04.07.2013 evening. Past 24 hr Rainfall (RF) recorded was found to be heavy over many stations. The above 50 mm RF was recorded on 3th July over Chakaliya (129.2), Anas (77), Kadana dam (135.8), Mataji (97) and Panam dam (118) and on 4th July over Paderdibadi (104.4), Kadana dam (73.3), Panam dam (164), Wanakbori weir (235), Dhariawad (84), Mataji (56.2) and Khanpur (73.8). Maximum Inflow (IF) recorded was on 4th July, Mahi dam recorded 13749.06 cumec and corresponding Water Level (WL) was 271.5 m on 1400 hrs. Anas PH-II maximum WL was 141.5 m on 2100 hrs, Kadana dam recorded 2738.97 cumec from 2000 to 2100 hr of 04.07.2013. Since Kadana dam was capacity was 80% there were heavy releases from the dam and under its effect Wanakbori WL raised till 69.27 m between 1000 to 1800 hrs of 05.07.2013. No flood forecast was issued during the period.

After 4th July there were cases of small spells due to activation of off-shore trough but all were of mild intensity and doesn't give rise sufficient surface flow.

2nd heavy spell started on 23.07.2013 due to formation of MTC. Widespread rainfall activity continued till next two days and on 26th the remnants of system

L7 reached over Gujarat and neighbourhood. High IF > 1700 cumec occurred into the Kadana dam and hence Outflow (OF) was raised to 2824 cumec by dam authorities at 0800 hrs and this resulted in rise of Wanakbori weir WL over Warning level of 69.8 m by 1900 hrs of 26.07.2013. During the period Mahi dam received huge IF > 5000 cumec and WL reached its FRL of 281.35 m on 0800 hrs of 27.07.2013 and thereafter there were heavy releases from the dam of the order of 5179 cumec between 1100 – 1200 hrs and 3000 cumec between 1300 to 1500 hrs and then it reduced to 1387 cumec. Releases from Mahi dam raised Paderdibadi WL to 139 m at 2400 hrs of 27.07.2013. Anas river also swelled due to rains, Chakaliya recorded 223.4 m (0500 hrs of 27.07.2013) and Anas PH-II 145 m (0800 hrs). Kadana dam crossed its IF forecast criteria on 2300 hrs of 26.07.2013. Maximum IF into Kadana dam was 5162 cumec (2300 hrs of 27.07.2013). Prior to rise of IF above forecast criteria Kadana dam started its heavy releases of the magnitude 5600 cumec on 2200 hrs of 26.07.2013 and it continued till 0600 hrs of 27.07.2013. During this time releases from Panam dam were also around 1000 cumec (from 1000 to 1800 hrs of 27.07.2013). Both the releases peaked the WL at Wanakbori weir to 71.17 m on 2000 to 2100 hrs of 27.07.013. After the RF ceased Kadana dam IF gradually fell below 2832 cumec by 0500 hrs of 28.07.2013 and Wanakbori WL drop below warning level by 1400 hrs of 28.07.2013. 6 IF forecast was issued for Kadana dam and 6 no.of level forecast was issued for Wanakbori weir.

To maintain rule levels the Kadana dam authorities released water at the rate of 2892.25 cumec at 1600 hrs of 31.07.2013 and it was raised to 5661 cumec at 1900 hrs. For similar reasons Panam dam also released water at the rate of 1983 cumec by 2000 hrs and under the combined effect Wanakbori weir WL crossed warning level by 2300 hrs and 2 forecast was issued. The WL dropped below warning level on 1300 hrs of 01.08.2013.

On 02.08.2013 due to heavy RF caused by remnants of D1, IF into Mahi dam increased, as the dam is already filled, the same quantity of water was released. This raised WL at Paderdibadi to 140.62 at 1100 hrs of 02.08.2013. On the same day Chakaliya WL raised to 22.5 m at 0700 hrs due to rain in Anas river. RF between Chakaliya and Anas PH-II raised Anas PH-II WL to 145 m (0500 – 0600 hrs). Discharges from main river Mahi and its tributary, Kadana dam IF raised to 7194 cumec at 1300 to 1400 hrs of 02.08.2013. From 0700 to 1800 hrs Kadana dam OF was around 7000 cumec. Panam dam

releases were 2018 cumec between 1000 to 1800 hrs. Wanakbori weir raised to 72.01 m between 1900 to 2200 hrs of 02.08.2013 and it remained as maximum WL attained at Wanakbori weir during SW monsoon 2013. During the spell the RF recorded at all CWC stations in Mahi basin was less than 50 mm. The huge surface flow was the result of heavy RF over ungauged catchments. IF at Kadana dam reached below forecast criteria on 1500 hrs of 03.08.2013 and Wanakbori weir WL fell below 69.8 m after 2300 hrs of 03.08.2013. 6 IF forecast was issued for Kadana dam and 2 no.of level forecast was issued for Wanakbori weir.

From 13.08.13 heavy RF was reported from Mahi Basin. Releases from Mahi dam peaked and under its effect Kadana IF was reported 3662 cumecs netween 1000 to 1500 hrs of 14.08.2013. There were no much RF activity over Anas basin. Releases from Kadana dam raised the WL at Wanakbori weir to a maximum of 70.18 m by 2100 hrs of 14.08.2013 and the WL remained constant till 0500 hrs of 15.08.2013. During the spell the heavy RF was recorded over Dhariawad (58), Khanpur (93.2) and Kadana dam (59.4) on 14.08.2013. 2 forecast each were issued for Kadana dam and Wanakbori weir.
Next spell occurred on 23.08.2013. Initial rains of this spell do not invoke much surface flow but by afternoon hours of 24.08.2013 the RF intensified. Mahi dam IF became 3317 at 1400 to 1500 hrs of 24.08.2013. Due to heavy RF in Anas catchment, WL at Chakaliya rise up to 222.4 by 1700 hrs of 24.08.2013 and Anas Ph-II became 143.7 between 1700 to 1800 hrs. Maximum IF observed at Kadana dam was 3539 cumecs (300, 24.08.2013). OF from Kadana dam was raised to ~ 4200 cumec (1200, 24.08.2013), Panam OF was 1200 cumecs from 1100 hrs and this raised Wanakbori weir WL above Warning Level. During the period, RF (on 24.08.2013) recorded at Chakaliya was 83.6, Anas PH-II, 53, Kadana, 74.8, Mahi dam 54.5, Wanakbori weir, 63, Mataji, 74.8 and on 25.08.2013 Mahi dam recorded 86.6. After the cessation of RF Kadana dam If and Wanakbori weir WL gradually reduced below the forecast criteria. During the period 4 IF forecast was issued for Kadana dam and 2 flood level forecast was issued for Wanakbori weir.
Last major spell of the season started on 23.09.2013. Under the influence of high OF from Kadana dam and Panam dam (2294 cumecs and 556 cumec), the Wanakbori weir WL was raised above warning level by 0900 hrs of 24.09.2013. There after the spell continued and got intensified on 30.09.2013. Initially due to ungauged catchment and localised RF IF into Kadana dam crossed forecast

criteria by 1300 hrs. Thereafter heavy releases from Mahi dam also added to the flow. OF from Kadana dam (around 4300 cumecs) and that of Panam dam (~ 100 cumecs) raised Wanakbori weir WL above forecast criteria and it raised till 70.87 by 2200 and remained constant till 1100 hrs of 01.10.2013. Intense RF recorded stations were Anas H-II (104, 30.09.2013), Kadana dam (56.2 (30.09.2013 and 71.2 (01.10.2013), Chakaliya (91.4, 01.10.2013) and Wanakbori Weir (80, 01.10.2013). For the remaining days of monsoon, the basin remained comparatively silent. By end of the season all the major dams in the basin such as Mahi dam, Som Kamla Amba, Kadana and Panam were all filled upto FRL.

5.2 SABARMATI BASIN

Inflow into Dharoi dam started on 16.06.2013 when there was short period intense RF between 1600 and 1800 hrs in Sabarmati basin. During 18.06.2013 there were another spell of moderate rains but existed for only 5 to 6 hrs and induced maximum IF of 5880 cusec between 0900-1000.

Sabarmati basin remained comparatively dry during remaining days of June and odd events of localied rainfall happened in the basin and those events do not evoke any significant surface flow. RF event of 04.07.2013 due to L2 do not led to much surface flow. Maximum water levels observed at various stations on 05.07.2013 were Harnav weir 54.4 m, Derol bridge 61, Hathmati weir 79, Watrak dam 76, Ratanpur 156.8, Raska weir 152.8, Nadiad 66, Kheda 54.6 and Subhash bridge 141.6.

Spell of 12.07.2013 (L3) increased surface flow and led to maximum IF of 6881 cusec between 2400 to 0100 hrs at Dharoi dam, well below the forecast criteria. Similarly WL at Subhash bridge also remained well below forecast criteria. During the spell more than 50 mm RF was recorded at Watrak dam (91, 12.07.2013), Jotasan (68.4), Kheroj (82.2), Harnav weir (50.2), Dharoi dam (93.6), Derol bridge (84.8) and Hatmati weir (59) on 13.07.2013.

Another spell that invoked surface flow into Dharoi dam started from 2200 hrs of 22.07.2013. Under the effect f moderate RF activity in the basin Dharoi recorded maximum IF of 17,777 cusecs on 0400 hrs of 23.07.2013. Heavy RF was recorded at Dharoi dam (87.2), Hathmati (53.6) and Harnav weir (52) on 23.07.2013.

Next major spell in the basin started from 24.07.2013. RF from 24.07.2013 to 26.07.2013 des not invoke sufficient surface flow. But on 27.07.2013 the rains

still strengthened and on 28.07.2013 IF increased above 10,000 cusec in Dharoi dam. Maximum IF observed was 26,666 cusecs at 2400 hrs. Since only for 2 hrs IF was above the forecast criteria, forecast was not issued. Intense RF was recorded over stations Dharoi (95.2 on 28.07.2013 and 75.2 on 29.07.2013), Kheroj (62.2, 28.07.2013) and Harnav (58.2, 29.07.2013).

RF event of 02.08.2013 (D1) does not affect Sabarmati basin though widespread RF activity was recorded over Derol bridge (90.4), Hathmati weir (106.6), Voutha (52) and Subhash bridge (77.4) on 03.08.2013. Maximum Observed IF at Dharoi dam was 18,055 cusec (1900 hrs of 02.08.2013).

There was short spells of rain from 10.08.2013 to 17.08.2013 in Sabarmati basin.

In September break like situation was observed for 2 weeks period. Monsoon flow strengthened after 20th September. Lower Sabarmati basin received heavy RF on 25.09.2013. Raska weir, Nadiad, Kheda, Voutha and Subhash bridge recorded 54.8, 100, 195.9, 119.3 and 108.6 respectively. On 26.08.2013 also Subhash bridge recorded 83. On 29.09.2013 widespread RF activity was recorded. Dharoi dam IF was 7500 cusec at 0500 to 2400 of 29.09.2013. Sei dam (56), Jotasan (53.4), Kheroj (61.8) and Hathmati (50) recorded intense RF during the period.

Last spell of the season was on 08.102013. Maximum Induced RF was 15833 cusec during 2100 and 2200 hrs of 08.10.2013.

Thereafter there was no wide spread RF activity in the basin. On 20.10.2013, the WL at Dharoi dam was 186.996 m which was 0.455 m below warning level. During the season there were no releases from Dharoi dam. Subhash bridge remained well below warning level throughout the season and no forecast was issued for Dharoi dam and Subhash bridge.

5.3 BANAS BASIN

Moderate rains were received in the basin during monsoon onset period on 18.06.2013. Sarotry recorded 92, Chitrasani 180.8, Dantiwada 74.2 and Bhakudar 104.2.

On 0407.2013 fairly widespread RF was recorded in the basin. Abu road recorded 55 on 04.07.2013. But the rains does not evoke any flow in the streams.

Surface flow was induced by spells of 13.08.2013. RF started on 12.07.2013 night by 2300 hrs and continued till 13.07.2013, 1000hrs. Sarotry recorded

110, Chitrasani 69.8, Dantiwada 73.8, Bhakudar 101 and Ambaji recorded 65.6 on 13.07.2013. IF recorded at Dantiwada was 1459 cusec on 1100 hrs of 13.07.2013.

Next widespread RF was observed on 23.07.2013. spell strengthened on 27.07.2013, Mt.Abu recorded 72.2. IF into Dantiwada dam was 1500 cusec on 2300 hrs of 27.07.2013. Heavy Rf was recorded on 28.07.2013 over stations Abu Road (55.2), Chitrasani (53.8), Dantiwada (55), Bhakudar (122), Mt.Abu (66) and Ambaji (59.8). Though RF continued on 29.07.2013 and 30.07.2013 but fail to induce any commendable surface flow.

Sell of 13.08.2013 started by morning 0800 hrs in the basin. Abu road (81.8), Sarotry (52.4), Dantiwada dam (75), Bhakudar (64.4) and Mt.Abu (115) recorded heavy rainfall on 14.08.2013. During this period the maximum IF observed at Dantiwada dam was 4304 cusec by 1000 to 1100 hrs of 14.08.2013. Mt.Abu received heavy Rf (54.2) on 15.08.2013.

Strongest spell of the monsoon happened on 27.09.2013. Heavy RF of 28.09.2013 raised Abu Road WL to 256.45 (2200 hrs), Sarotry to 188.8 (2000 – 2400) and Chitrasani to 186.26 (1900-2200), under its effect IF at Dantiwada dam raised above forecast criteria. Maximum IF observed was 29,129 on 2000 hrs f 28.09.2013. After 2200 hrs (28.09.2013) IF dropped below forecast criteria. Intense RF was recorded over Chitrasani (63.8), Dantiwada (99), Bhakudar (130.2), Mt.Abu (134.2). Two no.of IF forecast for Dantiwada during this period. Heavy RF continued till 29.09.2013; Abu Road (93.2), Sarotry (79.2), Chitrasani (108.8), Dantiwada (196.6), Bhakudar (72.6), Mt. Abu (271.2), Ambaji (66.6)

Last spell was received on 09.10.2013. Swaroopganj recorded 504, Abu Road 59.6, Mt.Abu 101 and Ambaji 68. Dantiwada IF maximum was 4000 cusec from 0900, 09.10.2013 to 0800, 10.10.2013.

By the end f the season, Dantiwada WL was 175.91 (20.10.2013) where warning level at Dantiwada dam is 182.88 m.

Maximum Water Level/Inflow attained at all Sites in Mahi, Sabarmati and Banas Basins during Monsoon 2013 is given in Statement no.11a.

Details of Unprecedented flood events, High flood events, Low to Moderate flood events are included in statements 11 b to d.

CHAPTER 6

MODERNISATION OF FLOOD FORECASTING TECHNIQUES

Implementation of general purpose flood forecasting package developed by Shri. A. B. Pandya, former Director, Monitoring Directorate, CWC, Gandhinagar to Kadana dam inflow forecast.

6.1 Introduction

Currently this office relies on Statistical approach for flood forecasting for all the stations under this office. The performance is satisfactory from the perspective of attaining the forecasted value within the prescribed ranges. But there is a constant demand from the user agencies for advanced warning time. The current forecasting setup is a constraint to it. Moreover the statistical methodology adopted involves development of statistical correlation between u/s (upstream) parameter like gauge, discharge etc and correlate the same with the d/s (downstream) gauge at a later time. The time of travel is also correlated with the base station gauge. Additional parameters are usually considered to correct the direct correlation output. Efficient usage of this approach demands expertise and experienced staffs, since more judgement is involved in arriving at the final forecast value. For this, continuity of the field level personnel is necessary. With inevitable turnover of manpower the recourse has to be towards a rigid data base oriented approach so that standard algorithms are not affected due to different interpretations arising out of extraneous consideration like manual computations or faulty implementation on EXCEL like packages. Hence the Hydromet staffs of this office office are tried to implement general purpose software package for flood forecasting developed by Shri. A.B. Pandya, then Superintending Engineer (C), NTBO, CWC, for flood forecasting over this region under his guidance. The software package has the potential to incorporate any current model in use as well as provides a simple hydrological model for forecasting.

6.2 About the Flood Forecasting (FF) Package

The package has been developed around a Relational Data base currently using Microsoft Jet Database Engine 4.0 colloquially recognized as ACCESS database. Software code has been developed in Visual Basic.NET (2003). The package extensively uses the EXCEL as output medium and almost all the output is produced in the form of worksheets. And the package implementation is done using a series of dialog forms in a Windows application written using Visual Basic.NET. The authorized person can login and prepare forecast based on the latest date available for the basin of interest.

6.2.1 Principle used

The model is developed in such a way that the forecast formulation can be done using 2 different methods.

1. First method solely using hourly rainfall data and it works on the concept of Unit hydrograph and Muskingam Routing.
2. Second method is a conventional method. In this method the past discharges at base stations are integrated to get resultant discharge at forecast station with due consideration of travel time from the base stations. And the anticipated flow from intermediate catchment due to rainfall is assessed on the basis of hourly rainfall data at base stations and forecasting station.

6.2.3 FF Package implementation

First Method:

The Prime aim was to implement the package for Kadana dam Inflow forecast. The implementation started with Anas Catchment (one of the base station for Kadana dam IF forecast), since it is an unobstructed catchment. After introducing hydrological conditions of Anas basin into the model, it was assumed that Rainfall of Anas and Chakaliya can represent the rainfall over entire Anas catchment as there were no other rainfall stations with hourly rainfall observations. With this assumption the rainfall data of station Chakaliya and Anas was inputted in the model to stimulate the discharge at Anas PH II. Model

validation was done using the historical data of 6 wet years from 1996-98, 2003-05.

6.2.4 Summary of Model validation

- For most of the single rainfall events the model was successful in catching the entire volume of water generated by the event. On comparison with that of total volume observed for the same event shows 80 to 90% accuracy.
- In case of multiple events the model fail to quantify the volume of water generated by the event in most of the cases.
- In all the cases time and magnitude of peak discharge was not matching with that of observed. Peak discharge was found to be much sharper than that of stimulated. Some of the results got are given in Fig.6.1 & 2.

6.2.5 Conclusion

The first method which is developed on a concrete theory appears to be potential in giving satisfactory results as it could stimulate the total volume of water in case of single rainfall events. The deviations occurred from the actual may also be due to the crude assumption that were forced to take due to insufficient rainfall stations in the basin. Another factor that contributed negatively can be the k and x values in Muskingum Routing. Successful implementation of the model can be done only through meticulous analysis and guidance from Shri. A. B Pandya and other experts in this field.

The telemetry data collected at various sites of this division is currently under reliability check. Once the data observation, transmission and reception through telemetry system becomes fully operational this division is hopeful that the quality of data will improve, so this office is hopeful to get some encouraging results from the model with the input of new data sets produced by telemetry system.

Second method is a very simple conventional adopted by this division for the FF purposes. The main assumption involved is regarding

the rainfall contribution of surface runoff from ungauged catchment. Field experience and board knowledge about the catchment is demanded for successful estimation of rainfall contribution. This involves personal judgment which cannot be coded.

For the time being the package is still in research mode and with the current setup it appears to be inadequate for issuing flood forecast to the public.

Fig. 6.1

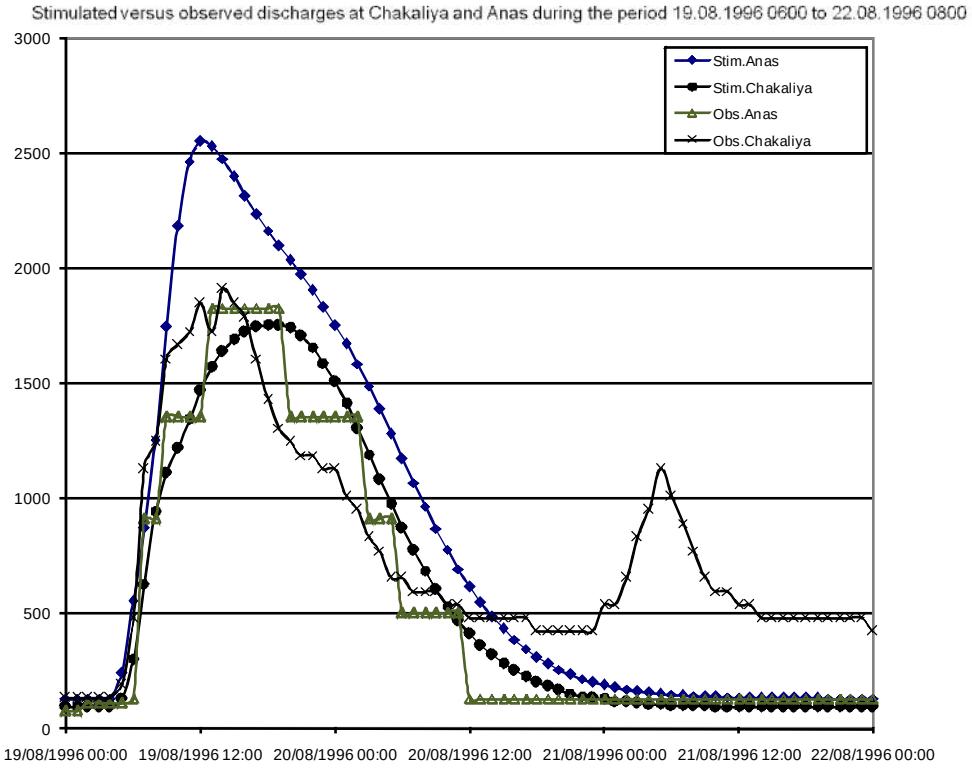
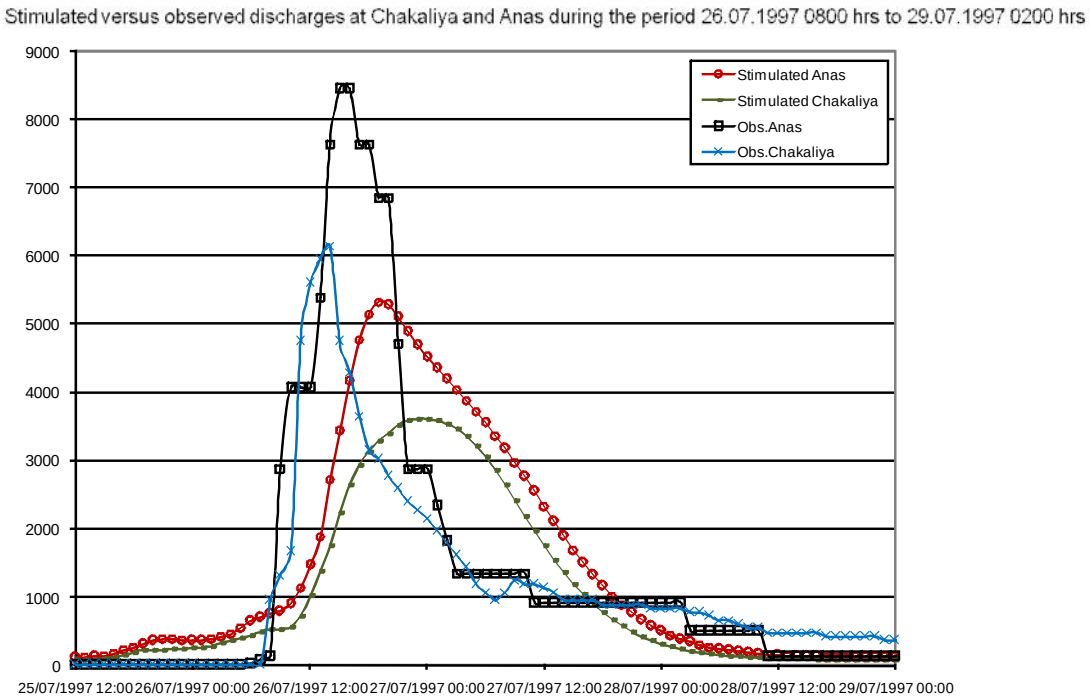

Stimulated versus observed discharges at Chakaliya and Anas during the period 19.08.1996 0600 to 22.08.1996 0800
3000
2500
2000
1500
1000
500
0
Stim.Anas
Stim.Chakaliya
Obs.Anas
Obs.Chakaliya
19/08/1996 00:00
19/08/1996 12:00
20/08/1996 00:00
20/08/1996 12:00
21/08/1996 00:00
21/08/1996 12:00
22/08/1996 00:00

Fig.6.2


Stimulated versus observed discharges at Chakaliya and Anas during the period 26.07.1997 0800 hrs to 29.07.1997 0200 hrs
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Stimulated Anas
Stimulated Chakaliya
Obs.Anas
Obs.Chakaliya
25/07/1997 12:00
26/07/1997 00:00
26/07/1997 12:00
27/07/1997 00:00
27/07/1997 12:00
28/07/1997 00:00
28/07/1997 12:00
29/07/1997 00:00

CHAPTER 7

Telemetry system - Mahi Division

As per to the decision of XIth five year plan Mahi Division of Central Water Commission got sanction for supply, installation, testing, Commissioning and maintenance of Real Time Data acquisition net work at 38 sites under its jurisdiction and 1 modelling centre at division office itself. The details of the telemetry installed sites are given in statement no.15 a and current status of telemetry functioning at sites is included as 15 b..

7.1 Current status

Telemetry installation at all the 38 sites is complete and data has been recieiving at modelling centre. Currently reliability checks are progressing and problems regarding telemetry data mismatching w.r.to manually observed and improper attendence to complaints by the company has been comunicated to higher offices in time. The graphical comparison details of manually observed verses telemetry data for Monsoon and Post monsoon 2013 is included under Plate no.37.

Few bottlenecks noticed are given below:

1. The proposed system has not capacity for instantaneous data transmission that is required for flood forecasting system. There is time lag of 1 hour approximately.
2. It has been noticed that it is possible to set default values at ERS for the data received from the instruments installed at remote sites and thus default values may be communicated to concerned modelling centre through satellite link. This may cause condition of manipulating the data.
3. The system is useful for hydro-meteorological data collection during monsoon season but during non monsoon season when water level is below the level of termination block, it is not

possible to collect the data. However, if orifice tube is extended upto water level; then water level data may be collected

4. For Dams and large rivers, if orifice tube malfunctions due to any reason then it is not possible to correct it unless water level goes down below the level of termination block.
5. Lack of manpower:- The division is facing the crunch of manpower specially for Junior Engineers who are the key persons who has to work for telemetry system.
6. Slow response from Company :- Complaints registered regarding malfunctioning of telemetry system at sites are not attending in time by the company in that case data for that period of time is lost without recovery
7. Theft cases:- There are many cases of telemetry thefts at various sites within Mahi Division but company is not replacing the theft items with new ones in time and this causes interruptions in data communication from the remote sites where theft occurs. Theft is ocurring mainly due to unavailability of watch and ward service at sites.
8. Silting of termination block:- There are many sites in Mahi Division where silting on termination blocks occured and this causes malfunctioning of system.

Note: In the Year 2013, Telemetred data was not used in flood forecast formulation due to lack of sufficient accuracy.

CHAPTER 8

FLOOD DAMAGE

The details that are given below regarding flood damage over entire Gujarat region have been taken from the website of National Disaster Management, www.ndmindia.nic.in. As per the report the below given figures are updated upto 16.09.2013 and the report belongs to 06.10.2013.

Extents of Damage (Cumulative figures) are given below:

Type of Damage	Extent of Damage (cumulative figures) (Provisional)
Population affected	177435
No. of human lives lost	186
No. of districts affected	4
No. of villages affected	448
No. of cattle/Live stock lost	274
Cropped area affected (in ha)	0.05
No. of houses damaged: Fully	21
No. of houses damaged: partially	386
Estimated value of damage (Rs. In Lakh)	Damaged houses: 14.41 Damaged crops: 775
Estimated value of total damage (Rs. In lakh)	789.41

Rescue and Relief (provisional) carried out

No.of persons evacuated	:	-
No.of relief camps opened	:	-
No.of persons accommodated in the relief camps.	:	-
GR paid, if any, specify the item and amount	:	154.24
No.of medical teams deployed	:	-
No.of cattle in the cattle camps	:	-

CHAPTER 9

FORECAST PERFORMANCE

During SW monsoon 2013, Mahi Division, CWC, issued 23 number of inflow forecast for Kadana and Dantiwada Dams and 16 number level forecast for Wanakbori Weir. The issued forecast was disseminated on time to user agencies as directed in Flood Memorandum 2013 of State Government of Gujarat. No forecast was issued for forecasting station for Subhash Bridge and Dharoi dam.

The forecast performance is as given below.

Table 9.1

Sl. No.	Forecasting Station	Number of forecast issued in 2011	Number of Forecast within + or – 20% accuracy	Percentage of accuracy (%)
A.	LEVEL FORECAST			
1	Wanakbori Weir	16	16	100
B.	INFLOW FORECAST			
1	Kadana Dam	21	21	100
2	Dantiwada Dam	2	2	100

Details of Forecast issued for Wankbori Weir, Kadana Dam and Dantiwada Dam is given in statement no.12,13 and 14. Plate No. 33 & 34a shows the forecast performance since 1981 to 2013 for the years in which forecast was issued for both inflow and level forecasting sites respectively. Plate no.34b shows forecast performance of Mahi Division.

Basin-wise, River-wise- Flood Forecasting information of stations of CWC, Performance of Flood Forecasting Stations (Division-wise) in India during Flood Season 2013 (in Tabular and Figure form), etc are included in statement no.16.

CHAPTER 10

PROBLEMS FACED AND DEFICIENCIES NOTICED

10.1 TECHNICAL

1. The desired limit of accuracy needed for the flood level forecast is ±15cm. This level of accuracy is feasible in rivers where the catchments are large and the river slopes are gentle as in case of Ganga etc. However the rivers under jurisdiction of this division are having steeper slopes and are fed by torrential storms under cyclonic conditions generating flash floods. The rainfall in the catchments of rivers like Mahi, Sabarmati and Banas which rise on the peripheries of desert and arid hills areas of central India, is non-uniform and is often concentrated over the small areas of the catchments. This leads to variations in flood wave formation and propagation. These factors hamper achievement of desired accuracy of ±15cm.

2. The details of 0800 hr water level, its trend, details of forecast issued and 24-hr rainfall information for all flood forecasting stations was entered in the website www.india-water.com on daily basis and this was done very easily. But few lacunas noted with website data entries are given below.
   - In the start of last year's (2011) monsoon season this division staffs use to enter/upload hourly values of all base and forecasting stations. But this division received complaint from FFM directorate for not entering 0800 hr data and they directed to enter 0800 hr water level under the heading 'Add PWL/FF/RF' given on left side of the page http://www.india-water.com/ffs/index.htm. So from this it is understood that website could recognise only those data entered under the heading mentioned above as 'daily WL data'. This office would suggest that data once uploaded under any heading should not be retyped under another heading because it is not visible from there, these are duplication of works.
   - Even there is provision to upload FF site data from the icon provided for base stations. And if FF site data is loaded from there it is not visible at customised report provided under FF station.

10.2 ADMINISTRATIVE

1. Hydromet perform their duties during monsoon season round the clock including on Sundays and Holidays. They deserve to be granted incentives. Such practice is followed by India Meteorological Department (IMD) for their staff working at Flood Meteorological Offices. Currently Hydromet staffs are eligible for Compensatory Leave (CL) against extra duty hours, it is suggested that they may be granted incentives besides CL.
2. As on now the sanctioned strength of Hydromet section of Mahi division office is comprised of one EAD(HM) and three S.A. (Hydromet). As on now only EAD(HM)'s post is filled and other 3 posts of S.A(HM) are vacant. This shortage of staff causes difficulty when 24x7 duty has to be given during monsoon. The situation became very harsh for this division whenever leave was required by Hydromet staff /officer due to unavoidable reasons. During this season, the outsourcing seasonal staffs in respect to work of seasonal Khalasis were used to run the works smoothly.

   This year the shortages of staffs at Division and sub-divisional offices were crucial. Filling up of above said technical post is very much necessary as it creates several constraints on flood management and telemetry management works.

   However in spite of shortage of staff, the Mahi Division has managed the routine works somehow during flood season with the help of other staffs of Mahi division.

CHAPTER 11

CONCLUSION

This year SW monsoon set in over Kerala on 1st June and it reached Gujarat by 10th June and it covered entire country by 16th June, 2013. Sixteen low pressure areas formed during the season. However, two of the low pressure areas intensified into depression. 12 systems formed in Bay of Bengal and 3 over Land and one over Arabian sea. Rainfall received in June, July & August were below normal, and it was excess in September. Average rainfall received by Mahi, Sabaramati & Banas basins were 1135, 908, 1001 mm against the 10 yr average of 835, 862, 858 mm respectively. The southwest monsoon withdrew from extreme parts of west Rajasthan on 9th September, there after it revived and further withdraw started after 15th October. Withdrawal from entire Gujarat occurred by 17th October, 2013. Over Gujarat region Monsoon rainfall was +31% and Saurashtra and Kutch it was +64% deficits.

23 inflow forecasts (21 forecast for Kadana dam and 2 forecast for Dantiwada dam) issued by this division were within the prescribed limits of accuracy. And 16 Flood level forecast issued for Wanakbori weir were also within prescribed limits of accuracy. The percentage of accuracy of total flood forecasts issued by this office was 100%. The dissemination of forecast was done on time and the instructions given in Flood Memorandum 2013 of State Government of Gujarat were strictly followed.

Maximum inflow observed for Kadana Dam, Dharoi Dam and Dantiwada Dam were 7194.25 cumec (1300 to 1400 hrs, 02.08.2013), 755.09 cumec (2400, 28.07.2013) and 824.83 cumec (2000, 28.09.2013) respectively.

Maximum water level observed at Wanakbori Weir was 73.96 m (1800, 06.09.2012) and for Subhash Bridge was 41.97 m (2100, 06.09.2013). During monsoon 2013, Kadana dam was filled upto 127.69 m, just few centimetres below FRL.

During Monsoon 2013, the Water Level at all the forecasting stations remained below Danger level and no new HFL were observed.

The monsoon season activities were carried out with skeleton staff available. Engineering, Hydromet and wireless staffs who were assigned with monsoon duty worked round the clock to keep proper watch over the situation and performed monsoon season routine works without fail. The activities at control room on 24x7 basis continued throughout the season. Dissemination of forecast and other information to user agencies were done in time.

Telemetry installation at all the 38 sites under this division is complete and the data has been received at modelling centre during this monsoon. Some lacunas has been noted from the contractor's side in maintenance of telemetry sites and mismatching of telemetry data with manually observed data has also been noted. Necessary steps have been taken to rectify the problems. Once the data reliability has been proved beyond doubt, this division is hopeful in building up a much sophisticated flood forecasting setup without much communication discontinuity.

* * * * *

Location of Division / Sub Division Offices

Sr.No.	Particulars	District	State
1	2	3	4
(i)	**HEADQUARTER OF DIVISION OFFICE**		
	MAHI DIVISION, GANDHINAGAR	Gandhinagar	Gujarat
(ii)	**HEAD QUARTERS OF SUB DIVISIONS**		
1	Sabarmati Sub Division, Ahmedabad	Ahmedabad	Gujarat
2	Mahi Sub Division, Kadana	Panchamahal	Gujarat
3	North Western Rivers Sub Division,Himatnagar	Sabarkantha	Gujarat
4	Banas Luni Sub Division, Palanpur	Banaskantha	Gujarat

Location of Field Stations In Mahi,Sabarmati,Banas and other Independent Basins

Sr.No.	Code No.	Name of Station	Zero of Gauge in m	Location						River / Tributory	District	State
				Latitude			Longitude					
				D	M	S	D	M	S			
1	2	3	4	5a			5b			6	7	8
Mahi Basin												
1	01 02 13 001	Mataji	284.00 (GTS)	23	20	56	74	43	4	Mahi	Ratlam	M.P.
2	01 02 13 002	Mahi Bajaj Sagar Dam	268.50 (CL)	23	37	39	74	32	43	Mahi	Banswara	Rajasthan
3	01 02 13 003	Somkamla Amba Dam	201.25 (CL)	23	58	37	74	1	58	Som	Dungarpur	Rajasthan
4	01 02 13 004	Dhariawad	203.00 (AR)	24	5	13	74	28	30	Jakham	Udaipur	Rajasthan
5	01 02 13 005	Rangeli	150.00 (GTS)	23	52	14	74	13	25	Som	Dungarpur	Rajasthan
6	01 02 13 006	Paderdi Badi	131.00 (GTS)	23	45	34	74	7	56	Mahi	Dungarpur	Rajasthan
7	01 02 13 007	Chakaliya	215.00 (GTS)	23	3	15	74	19	6	Anas	Dahod	Gujarat
8	01 02 13 008	Anas Ph-2	133.72 (AR)	23	21	12	74	14	4	Anas	Banswara	Rajasthan
9	01 02 13 009	Kadana Dam	113.69 (CL)	23	18	23	73	49	33	Mahi	Panchamahal	Gujarat
10	01 02 13 010	Panam Dam	116.70 (CL)	23	3	12	73	42	57	Panam	Panchamahal	Gujarat
11	01 02 13 011	Wanakbori Weir	69.30 (CL)	22	57	0	73	25	31	Mahi	Kheda	Gujarat
12	01 02 13 012	Khanpur	8.22 (GTS)	22	32	5	73	8	15	Mahi	Anand	Gujarat

Location of Field Stations In Mahi,Sabarmati,Banas Basin and other Independent Basins

Sr.No.	Code No.	Name of Station	Zero of Gauge in m	Location						River / Tributory	District	State
				Latitude			Longitude					
				D	M	S	D	M	S			
1	2	3	4	5a			5b			6	7	8
Sabarmati Basin												
13	01 02 12 001	Jotasan	285.00 (GTS)	24	21	17	73	9	51	Wakal	Sabarkantha	Gujarat
14	01 02 12 002	Sei Dam	515.25 (CL)	24	42	56	73	12	0	Sei	Udaipur	Rajasthan
15	01 02 12 003	Kheroj	208.00 (GTS)	24	13	49	73	0	32	Sabarmati	Sabarkantha	Gujarat
16	01 02 12 004	Harnav Weir	234.756 (CL)	24	1	49	73	10	21	Harnav	Sabarkantha	Gujarat
17	01 02 12 005	Dharoi Dam	178.92 (CL)	24	0	17	72	51	8	Sabarmati	Mehasana	Gujarat
18	01 02 12 006	Derol Bridge	87.00 (GTS)	23	34	35	72	48	30	Sabarmati	Sabarkantha	Gujarat
19	01 02 12 007	Hathmati Weir	134.05 (CL)	23	36	22	72	58	5	Hathmati	Sabarkantha	Gujarat
20	01 02 12 008	Subhash Bridge	41.00 (GTS)	23	3	34	72	35	12	Sabarmati	Ahmedabad	Gujarat
21	01 02 12 009	Watrak Dam	128.00 (CL)	23	19	5	73	24	23	Watrak	Sabarkantha	Gujarat
22	01 02 12 010	Ratanpur	37.00 (GTS)	22	58	36	72	53	7	Watrak	Kheda	Gujarat
23	01 02 12 011	Raska Weir	35.51 (CL)	22	54	18	72	44	26	Meshwo	Kheda	Gujarat
24	01 02 12 012	Kheda	19.00 (GTS)	22	44	48	72	40	57	Watrak	Kheda	Gujarat
25	01 02 12 013	Vautha	12.00 (GTS)	22	39	1	72	31	59	Sabarmati	Kheda	Gujarat
Banas Basin												
26	01 02 02 001	Swaroopganj	334.45 (CL)	24	39	33	72	55	45	Banas	Sirohi	Rajasthan
27	01 02 02 002	Abu Road	254.850 (GTS)	24	29	35	72	47	30	Banas	Sirohi	Rajasthan
28	01 02 02 003	Sarotry	186.00 (GTS)	24	22	3	72	32	45	Banas	Banaskantha	Gujarat
29	01 02 02 004	Chitrasani	184.OO (GTS)	24	17	8	72	30	1	Balaram	Banaskantha	Gujarat
30	01 02 02 005	Dantiwada Dam	175.91 (CL)	24	20	12	72	20	19	Banas	Banaskantha	Gujarat
31	01 02 02 006	Bhakudar(Sipu Dam)	178.20 (CL)	24	24	1	72	18	33	Sipu	Banaskantha	Gujarat
32	01 02 02 007	Kamalpur	34.00 (GTS)	23	47	59	71	45	0	Banas	Patan	Gujarat
33	NB000A1	Mt.Abu	1387.00	24	35	13	72	42	13	-	Sirohi	Rajasthan
34	NB000B1	Ambaji	465.00	24	19	48	72	51	4	-	Banaskantha	Gujarat
Luni Basin												
35	01 02 01 001	Balotra	102.00 (GTS)	25	49	18	72	13	23	Luni	Barmer	Rajasthan
36	01 02 01 002	Gandhav	31.00 (GTS)	24	59	22	71	40	47	Luni	Barmer	Rajasthan
Shetrunji Basin												
37	01 02 09 001	Lowara	56.00 (GTS)	21	26	40	71	33	37	Shetrunji	Bhavanagar	Gujarat
Bhadar Basin												
38	01 02 07 001	Ganod	26.00 (GTS)	21	39	53	70	10	52	Bhadar	Rajkot	Gujarat
Machu Basin												
39	01 02 03 001	Gungan	8.00 (GTS)	22	57	42	70	45	52	Machhu	Rajkot	Gujarat
Rupen Basin												
40	01 02 04 001	Sapawada	36.00 (GTS)	23	32	54	72	00	52	Rupen	Mehsana	Gujarat

A.R. - Arbitrary : C.L.- Crest Level ; GTS- Great Trigonometric Survey

River Gauge Net Work of Mahi Division

S. No.	River	Site	Name of Scheme	Length of River Upto Site in kms	Catchment area Upto Site in sq. kms.	Bank of Station Gauge	Type of Site FS-Forecast Station BS-Base Station
1	2	3	4	5	6	7	8
I	**Mahi Basin**						
1	Mahi	Mataji	HOS	125	3880	Left	BS
2	Jakham	Dhariawad	FF	70	1510	Left	BS
3	Mahi	Mahi Bajaj Sagar Dam	FF	185	6149	Left	BS
4	Som	Somkamla Amba Dam	FF	100	5376	Right	BS
5	Som	Rangeli	HOS	140	8329	Right	---
6	Mahi	Paderdibadi	HOS	266	16247	Right	BS
7	Anas	Chakaliya	HOS	125	3121	Left	BS
8	Anas	Anas Ph-2	FF	147	4650	Right	BS
9	Mahi	Kadana Dam	FF	337	25520	Left	FS (Inflow)
10	Panam	Panam Dam	FF	95	2314	Left	BS
11	Mahi	Wanakbori Weir	FF	411	30665	Right	FS(Level)
12	Mahi	Khanpur	HOS	426	32510	Right	---
II	**Sabarmati Basin**						
13	Sei	Sei Dam	FF	36	332	Left	BS
14	Wakal	Jotasan	FF	88	1421	Left	BS
15	Sabarmati	Kheroj	FF	130	3650	Left	BS
16	Harnav	Harnav Weir	FF	38	401	Left	BS
17	Sabarmati	Dharoi Dam	FF	163	5475	Right	FS (Inflow)
18	Sabarmati	Derol Bridge	FF	221	6724	Left	BS
19	Hathmati	Hathmati Weir	FF	98	1357	Left	BS
20	Sabarmati	Subhash Bridge	FF	311	10674	Left	BS
21	Watrak	Watrak Dam	FF	73	1114	Left	BS
22	Watrak	Ratanpur	FF	152	2916	Left	BS
23	Watrak	Kheda	FF	210	7550	Right	FS(Level)
24	Meshow	Raska Weir	FF	-	1683	Right	BS
25	Sabarmati	Vautha	HOS	292	19636	Left	--
III	**Banas Basin**						
26	Banas	Swaroopganj	FF	24	507	-	BS
27	Banas	Abu Road	FF	45	1600	Right	BS
28	Banas	Sarotry	FF	75	2200	Left	BS
29	Balaram	Chitrasani	FF	30	320	Left	BS
30	Banas	Dantiwada Dam	FF	114	2862	Left	FS (Inflow)
31	Sipu	Bakudar(Sipu Dam)	FF	61	1225	Left	--
32	Banas	Kamalpur	HOS	190	6960	Right	--
IV	**Luni Basin**						
33	Luni	Balotra	HOS	297	19000	Left	--
34	Luni	Gandhav	HOS	447	32010	Left	--
V	**Shetrunji Basin**						
35	Shetrunji	Lowara	HOS	110	3953	Left	--
VI	**Bhadar Basin**						
36	Bhadar	Ganod	HOS	137	6266	Right	--
VII	**Machu Basin**						
37	Machu	Gungan	HOS	114	2137	Right	--
VIII	**Rupen Basin**						
38	Rupen	Sapawada	HOS	156	2125	Right	--

continued

River Gauge Net Work of Mahi Division

S. No.	River	Site	Type of Observation G/GD GDS/GDSQ	Commencement Year of Observation				Remarks
				Gauge	Discharge	Sediment	Water Quality	
1	2	3	9	10	11	12	13	14
I	**Mahi Basin**							
1	Mahi	Mataji	GDSQ	21.07.82	21.07.82	21.07.82	21.07.82	(1)Gauges are recorded hourly during monsoon at all sites.
2	Jakham	Dhariawad	GD	17.07.84	01.06.88			
3	Mahi	MahiBajaj Sagar Dam	G	13.06.82				
4	Som	Somkamla Amba Dam	G	06.01.95				
5	Som	Rangeli	GDQ	15.07.78	15.07.78		01.07.88	
6	Mahi	Paderdibadi	GDSQ	17.09.77	24.06.78	21.07.80	01.07.78	(2) Gauges are recorded at 08/13/18 hours during non monsoon.
7	Anas	Chakaliya	GD	13.02.91	13.02.91			
8	Anas	Anas Ph-2	G	12.06.82				
9	Mahi	Kadana Dam	G	10.06.78				
10	Panam	Panam Dam	G	20.06.80				
11	Mahi	Wanakbori Weir	G	25.06.79				
12	Mahi	Khanpur	GDSQ	21.12.78	21.12.78	01.06.87	01.01.79	(3)Discharges are measured daily at GD/GDS.
II	**Sabarmati Basin**							
13	Sei	Sei Dam	G	23.03.79				
14	Wakal	Jotasan	GD	03.07.79	28.07.95			
15	Sabarmati	Kheroj	GD	01.06.81	01.06.90			(4)Sediment Sampling are done daily, water quality done fortnightly.
16	Harnav	Harnav Weir	G	22.07.79				
17	Sabarmati	Dharoi Dam	G	28.12.78				
18	Sabarmati	Derol Bridge	GDSQ	19.08.80	01.06.91	25.09.92	15.07.92	
19	Hathmati	Hathmati Weir	G	19.06.80				
20	Sabarmati	Subhash Brdg	G	01.04.80				(5)All data available from the commencement year.
21	Watrak	Watrak Dam	G	04.07.85				
22	Watrak	Ratanpur	GD	30.03.85	11.07.89			
23	Watrak	Kheda	GD	29.03.85	10.07.89			
24	Meshow	Raska Weir	G	05.11.85				
25	Sabarmati	Vautha	GDQ	05.08.99	24.06.00	--	01.01.00	
III	**Banas Basin**							
--								
26	Banas	Swaroopganj	G	08.07.89				
27	Banas	Abu Road	GDQ	10.05.78	10.05.78	01.07.88		
28	Banas	Sarotry	GD	12.06.80	12.06.80			
29	Balaram	Chitrasani	GDQ	08.05.78	15.06.88		15.07.88	
30	Banas	Dantiwada Dam	G	07.05.78				
31	Sipu	Bakudar(Sipu Dam)	G	1993				
32	Banas	Kamalpur	GDSQ	21.07.71	25.07.71	25.08.73	01.07.77	
IV	**Luni Basin**							
33	Luni	Balotra	GD	05.07.90	11.07.90			
34	Luni	Gandhav	GD	24.06.74	24.06.74			
V	**Shetrunji Basin**							
35	Shetrunji	Lowara	GDSQ	29.11.70	29.11.70	25.07.73	01.07.77	
VI	**Bhadar Basin**							
36	Bhadar	Ganod	GDSQ	14.11.70	14.11.70	07.07.73	01.07.77	
VII	**Machu Basin**							
37	Machu	Gungan	GD	13.09.70	09.12.70			
VIII	**Rupen Basin**							
38	Rupen	Sapawada	GD	20.08.89	31.08.89			

Statement - 2b

Salient Features of Flood Forecasting Stations maintained by Central Water Commission

S.No	Name of FF Station/Type	River/Basin	Nearest Town/Vill/District/State	Lat (N)	Long (E)	Base Station (TT in hrs)	Div/Circle/ Orgn	Met Sub Division as per IMD	WL (m)	DL (m)	HFL		Mode of Data Collection	Methodology/ Model used for FF Formulation	Remarks
											(m)	Year			
1	Subash Bridge (Ahmedabad)	Sabarmati/ West Flowing Rivers	Ahmedabad/Ahmedabad/ Gujarat	23.06	72.59	125.1 Derol Bridge (04-06) 125.2 Hatmati Weir (04-06)	MD/HOCG/ NTBO	Gujarat	44.09	45.34	47.45	2006	Wireless/ Telemetry	Conventional	-
2	Wanakbori Weir	Mahi/ West Flowing River	Wanakbori/Kheda	22.74	72.69	126.1 Kadana Dam (06) 126.2 Panam Dam (06)	MD/HOCG/ NTBO	Gujarat	71.00	72.54	76.10	2006	Wireless/ Telemetry	Conventional	-
3	Dantiwada Dam	Banas/ West Flowing Rivers	Dantiwada dam/Palanpur/ Banaskanta/ Gujarat	24.34	72.34	160.1 Sarotry (2-5) 160.2 Chitrasani (2-5)	MD/HOCG/ NTBO	Gujarat	182.88	185.06	186.04	1973	Wireless/ Telemetry	Conventional	-
4	Dharoi Dam	Sabarmati/ West Flowing Rivers	Dharoi Dam/ Mehsana/ Gujarat	24.00	72.86	161.1 Kheroj (2-5) 161.2 Harnav Weir (2-5)	MD/HOCG/ NTBO	Gujarat	187.45	192.25	189.63	1990	Wireless/ Telemetry	Conventional	-
5	Kadana Dam	Mahi/ West Flowing Rivers	Kadana Dam/ Panchmahal/ Gujarat	23.31	73.83	162.1 Paderdibadi (2-7) 162.2 Anas PH -II (2-7)	MD/HOCG/ NTBO	Gujarat	126.19	127.71	127.74	1989	Wireless/ Telemetry	Conventional	-

The particulars of user agencies of flood forecasts - 2013

Sl.No	Name	Designation	Telephone No.			Station
			Office	Residence	Mobile	
1	Sh. D. G. Pandian	Pri.Secy.(Revenue)	23251503	26301728	9978406109	GNR
			23251507(F)			
			23251501(F)			
2	Shri Punamchand Parmar	Commissioner Relief	23251916	23254917	9978406123	
			23251509(D)			
Officers to be contacted for Kadana dam inflow forecast - Mahi Sub Division, Kadana, CWC						
1	Sh. K.B. Rabadia	SE (Kadana P.C)	02675 237525	-	9978405563	Kadana
2	Sh. K.B. Rabadia	SE (Mahi Irr. C)	0268 2555481	0268-2555478(D)	9978405558	Nadiad
			0268 2556412			-do-
			0268 2556270	(Fax)		-do-
3*	Flood control cell, GNR	-	23248735/36	-	-	GNR
			23240553	(Fax)		-do-
Officers to be contacted for Wanakbori weir level forecast - Mahi Sub Division, Kadana, CWC						
7	Sh. K.B. Rabadia	SE (Kadana P.C)	02675 237525	-	9978405563	Kadana
8	Sh. K.B. Rabadia	SE (Mahi Irr. C)	0268 2555481	-	9978405558	Nadiad
			0268 2556412			-do-
			0268 2556270	(Fax)		-do-
9	Dr. R. C. Tank	SE (Panam P. C)	02672 241931	02672 241801 (D)	9978405562	Godhra
			02672 242850	(Fax)		
10	Sh. G.N. Damor	EE(Kadana Div.1)	02675 237674	-	9099954289	Kadana
11	Sh. D. R.Shah	EE(Nadiad Ir.Div.)	0268 2566653	-	9427316005	Nadiad
			0268 2560543	0268 2549007(FAX)		-do-
Officers to be contacted for Dharoi dam inflow forecast - NWRSD, Himatnagar, CWC						
15	Sh. P.C.Vyas	SE (A.I.P.C)	079 26301823		9978405135	Ahmedabad
			079 26307298	(Fax)		-do-
16	Sh. N.B.Patel	SE, (S.S.C II)	02762 286448	(Te/Fax)	9426048021	Mehsana
					9978405559	-do-
17	N.V.Kotwal	EE (D. HW Div.1)	02761 262001		9427060873	Dharoi
			2762 262004			-do-
			02761 262208	(Fax)		-do-

The particulars of user agencies of flood forecasts - 2013

Sl.No	Name	Designation	Telephone No.			Station
			Office	Residence	Mobile	
Officers to be contacted for Subhash bridge level forecast - Sabarmati Sub Division, Ahmedabad, CWC						
21	Sh. P.C.Vyas	SE (A.I.P.C)	079 26301823		9978405135	Ahmedabad
			079 26307298	(Fax)	9426534845	-do-
22	Shri G.N.Shah	EE (Ahm. Ir. Div.)	079 26303497	(Fax)	9825056782	-do-
Other Emergency telephone numbers						
23	Flood cell		079 26302351	-	-	Ahmedabad
24	Guhai dam		02772 291596	-	-	
25	Harnav dam		02775 254047	-	-	
26	Hathmati dam		02771 277434	-	-	
27	Himatnagar weir		02772 241820	-	-	
Officers to be contacted for Kheda Road bridge advisory level forecast - Sabarmati Sub Division, Ahmedabad, CWC						
28	Collector		0268 2550856	0268 2556700	9978406212	Kheda(Nadiad)
			0268 2552210	(Fax)		
G&D data of Kheda may be conveyed to						
29	Sh. P.C.Vyas	SE (A.I.P.C)	079 26301823	-	9978405135	Ahmedabad
			079 26307298	(Fax)	9426534845	-do-
30	Shri J.K. Trivedi	EE (Ahm. Ir. Div.)	079 26303497	-	9825056782	Ahmedabad
					9909028737	
Other Emergency telephone numbers						
31	Watrak dam		02774 222079	-	-	-
32	Mazam dam		02774 246530	-	-	-
33	Meshwo dam		02771 240144	-	-	-
Officers to be contacted for Dantiwada dam inflow forecast - BLSD, Palanpur, CWC						
34	Shri. N.B.Patel	SE, (S.S.C II)	02762 286448	(Tel/Fax)	9978405559	Palanpur
35	Sh. R.N.Ninama	EE(Deesa Ir. Div)	02744 220071	-	9909989702	-do-

* All the forecast message should be send to Flood cell, GNR

Abbreviations used:

Kadana P.C	Kadana Project Circle	P.I.P.C	Palanpur Irrigation Project Circle
Mahi Irr. C	Mahi Irrigation Circle	Deesa Ir. Div	Deesa Irrigation Division
A.I.P.C	Ahmedabad Irrigation Project Circle	Ahm. Ir. Div.	Ahmedabad Irrigation Division
S.S.C II	Sujlam Suflam Circle II	Panam P. C	Panam Project Circle
D. HW Div.1	Dharoi Head works Division No.1	Nadiad Ir.Div.	Nadiad Irrigation Division

Statement No.4

COMMUNICATION NET WORK

Sr.No.	Name of Wireless Station	River	Type of Wireless Set	No.& Type of Stand by Set	State/District/Taluka	Date of Functioning
I	**MAHI DIVISION, CWC GANDHINAGAR**		**GE-524 JSB-161**	--	**Guj/Gandhinagar**	**20.02.1980**
II	**MAHI SUB DIVISION KADANA**		**HNL-501**	**ALINCO**	**Guj/Panchamahal/Kadana**	**10.06.1978**
1	Mataji	Mahi	GE-524	-	MP/Ratlam/Bajna	13.05.1999
2	Dhariawad	Jakham	GE-524	-	Raj/Dhaiawad/Dhariawad	31.07.1984
3	Mahi Bajaj Sagar Dam	Mahi	GE-524	-	Raj/Banswara/Banswara	13.06.1982
4	Somkamla Amba Dam	Som	GE-524	-	Raj/Dungarpur/Dungrpur	06.01.1995
5	Paderdibadi	Mahi	GE-524	ALINCO & VHF	Raj/Dungarpur/Dungrpur	27.05.1981
6	Chakaliya	Anas	GE-524	-	Guj/Dahod/Zalod	08.06.1995
7	Anas Ph-2(Seasonal)	Anas	GE-524	VHF	Raj/Banswara/Banaswara	26.05.1981
8	Panam Dam	Panam	GE-524	-	Guj/Panchamahal/Kalol	20.06.1980
9	Wanakbori Weir	Mahi	GE-524	ALINCO	Guj/Kheda/Balasinore	26.12.1978
10	Khanpur	Mahi	GE-524	-	Guj/Anand/Anand	13.05.1999
III	**NORTH WESTERN RIVERS SUB DIVISION HIMMATNAGAR.**		**VHF**		**Guj/Sabarkantha/Himatnagar**	**01.07.2003**
1	Sei Dam	Sei	GE-524	-	Raj/Udaipur/Bagidore	25.03.1979
2	Jotasan	Wakal	GE-524	VHF	Guj/Sabarkantha/Khedbrahma	14.06.1995
3	Kheroj	Sabarmati	GE-524	VHF	Guj/Sabarkantha/Khedbrahma	01.06.1981
4	Harnav Weir	Harnav	GE-524	VHF	Guj/Sabarkantha/Khedbrahma	22.07.1979
5	Dharoi Dam	Sabarmati	GE-524	ALINCO & VHF	Guj/Mehasana/Mehasana	28.12.1978
6	Derol Bridge	Sabarmati	GE-524	-	Guj/Sabarkantha/Himatnagar	19.08.1980
7	Hathamati Weir	Hathamati	GE-524	JSB-161R & VHF	Guj/Sabarkantha/Himatnagar	19.06.1980
IV	**SABARMATI SUB DIVISION AHMEDABAD**				**Guj/Ahmedabad/City**	
1	Subhash Bridge(Ahmedabad)	Sabarmati	LHP-228	-	Guj/Ahmedabad/City	27.06.1995
2	Watrak Dam	Watrak	GE-524	-	Guj/Sabarkantha/Malapur	04.07.1985
3	Ratanpur	Watrak	GE-524	-	Guj/Kheda/Kapadvanj	28.05.1985
4	Kheda	Watrak	GE-524	-	Guj/Kheda/Kheda	29.03.1985
5	Rerska Weir	Meshow	GE-524	-	Guj/Kheda/Memdabad	05.11.1984
6	Vautha	Sabarmati	GE-524	-	Guj/Kheda/Dholka	06.10.2000
7	Nadiad		GE-524	-	Guj/Kheda/Nadiad	27.04.1979
8	Ganod	Bhadar	LHP-228	-	Guj/Rajkot/Upleta	26.03.1999
9	Lowara	Shetrunji	LHP-228	-	Guj/Bavanagar/Gariadhar	27.03.1999
V	**BANAS LUNI SUB DIVISION PALANPUR**		**Punwire JSB-161R**	**Alinco, LHP 228 (2) & VHF (2)**	**Guj/Banaskantha/Palanpur**	**05.05.1980**
1	Mount Abu (Seasonal)		C-5210	-	Raj/Sirohi/Abu Road	29.06.1996
2	Ambaji (Seasonal)		GE-524	-	Guj/Banaskantha/Palanpur	21.06.1997
3	Swaroopganj (Seasonal)	Banas	C-5210	-	Raj/Sirohi/Abu Road	07.07.1989
4	Abu Road	Banas	LHP-228	VHF	Raj/Sirohi/Abu Road	09.06.1978
5	Sarotry	Banas	C-5210	VHF	Guj/Banaskantha/Palanpur	12.06.1980
6	Chitrasani	Balaram	C-5210	-	Guj/Banaskantha/Palanpur	08.06.1978
7	Dantiwada Dam	Banas	LHP-228	VHF	Guj/Banaskantha/Dhanera	10.05.1978
8	Bakudar (Sipu Dam)	Sipu	C-5210	-	Guj/Banaskantha/Dhanera	06.07.1982

Synoptic Situation, HRW provided by FMO, Ahmedabad during SW Monsoon 2013

14.06.2013	Yesterday's off shore trough on SLC from south Gujarat coast to Kerala coast persists) Yesterday's upper air cyclonic circulation over northeast Arabian sea & adjoining Gujarat state now lies over northwest Rajasthan & adjoining Pakistan. HRW: Mahi: Isolated Heavy rainfall would occur in A,B,C,D,E sector
15.06.2013	Yesterdays's off shore trough on SLC extending from Gujarat coast to Kerala coast persists. A low pressure area lies over Madhyapradesh and adjoining area with associated upper air cyclonic circulation extending up to 5.8 km.above sea level. HRW: Mahi: Heavy rainfall would occur in All sector Sabarmati: Heavy rainfall would occur in A,C,D sector
16.06.2013	Yesterday's off shore trough on mean sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's low pressure area over M.P & adjoining area now lies over west Madhya Pradesh and adjoining Gujarat region with associated upper air cyclonic circulation extending up to 5.8 km above sea level.
17.06.2013	The off shore trough on SLC extending from Gujarat coast to Kerala coast persists with an embedded vortex off Konkan coast. Yesterday's Low Pressure Area over west Madhya Pradesh and adjioning Gujarat now lies over east Rajasthan and neighbourhood with associated cyclonic circulation extending upto mid-tropospheric level.
18.06.2013	The off shore trough on mean sea leval chart extending from Gujarat coast to Kerala coast persists with an embedded vortex off Konkan coast.
03.07.2013	LPA lies over west Madhyapradesh & adjoining Gujarat region with associated upper air cyclonic circulation extending up to mid tropospheric level The off shore trough on mean sea leval chart extending from Gujarat coast to Kerala coast persists . HRW: Mahi - Heavy rainfall would occur in sector A rest No Large change
04.07.2013	Yesterday's well marked LPA now lies over west Madhya Pradesh & adjoining Gujarat region with associated upper air cyclonic circulation extending up to mid tropospheric level. Yesterday's off shore trough on mean sea level chart extending from Gujarat coast to Kerala coast persists HRW: Mahi - Heavy rainfall would occur in All sector Sabarmati - Heavy rainfall would occur in All sector Banas - Heavy rainfall would occur in All sector
22.07.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. An upper air cyclonic circulation lies over Gujarat region and adjoining area extending from 2.1 km above sea level to mid-tropospheric level.
23.07.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. An upper air cyclonic circulation lies over Gujarat region and adjoining area extending from 1.5 km above sea level to mid-tropospheric level. HRW: Mahi - Heavy rain would occur in All sector Sabarmati -Heavy rain would occur in All sector Banas - Heavy rain would occur in All sector
24.07.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's upper air cyclonic circulation over Gujarat region now lies over Saurashtra- Kutch and adjoining north east Arabian sea area extending up to mid tropo-spheric level.

Synoptic Situation, HRW provided by FMO, Ahmedabad during SW Monsoon 2013

25.07.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's upper air cyclonic circulation over Saurashtra-Kutch and adjoining north-east Arabian sea now lies over north-east Arabian sea and adjoining Saurastra-Kutch from 3.1 km above sea level to mid-tropospheric level.
26.07.2013	Yesterday's offshore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's upper air cyclonic circulation over north east Arabian sea & adjoining Saurashtra-Kutch area extending from 3.1km asl to mid tropospheric level persists.
27.07.2013	Yesterday's offshore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Morning's upper air cyclonic circulation over north east Arabian sea & adjoining Saurashtra-Kutch extending from 3.1km above sea level to mid tropospheric level persists.
28.07.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's upper air cyclonic circulation over north-east Arabian sea & adjoining Saurashtra-Kutch has become less marked. The upper air cyclonic circulation over east Rajasthan and adjoining areas Haryana persists exten ding upto mid-tropospheric levels.
29.07.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. An upper air cyclonic circulation over south west Rajasthan and adjoining Gujarat state extending from 3.1 km above mean sea level to mid tropo-spheric level.
01.08.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's two cyclonic circulation one over south-west Rajasthan and adjoining area and the other over Saurashtra-Kutch and adjoining north-east Arabian sea, have become less marked. A well-marked low pressure area lies over south-east Madhya Pradesh and adjoining area with associated upper air cyclonic circulation extending up to mid-tropospheric level HRW: Mahi - Heavy rain would occur in sector A,C,D,E,F Sabarmati - Heavy rain would occur in sector C,D
02.08.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's well-marked low pressure area lies over south-east Madhya Pradesh and neighbourhood with associated cyclonic circulation extending upto mid-tropospheric level
03.08.2013	Yesterday's off shore trough on sea level chart extending from Gujarat coast to Kerala coast persists. Yesterday's low pressure area over west Madhya Pradesh and neighbourhood now lies over south-east Rajasthan & adjoining area with associated upper air cyclonic circulation extending upto mid-tropospheric level
21.09.2013	The low pressure area over southeast Madhya Pradesh and adjoining Vidarbha & Chhattisgarh with associated upper air cyclonic circulation extending up to midtroposheric levels tilting southwestwards with height persists. The feeble off-shore trough from Karnataka coast to Kerala coast persists.

Synoptic Situation, HRW provided by FMO, Ahmedabad during SW Monsoon 2013

22.09.2013	The low pressure area over south Madhya Pradesh and adjoining Vidarbha now lies over South-central Madhya Pradesh and neighborhood with associated upper air cyclonic circulation extending upto 3.1km above mean sea levels.
23.09.2013	Yesterday's low pressure area over central parts of south Madhya Pradesh and adjoining areas has become less marked, however an upper air cyclonic circulation lies over south Madhya Pradesh & neighbourhood extending up to 4.5 km. above mean sea level.
24.09.2013	The upper air cyclonic circulation now lies over west Madhya Pradesh and adjoining Gujarat region extending up to mid-tropospheric level.
27.09.2013	A low pressure area lies over Saurashtra-Kutch & adjoing Gujarat region with associated upper air cyclonic circulation extending upto mid - tropospheric level. HRW: Banas - Heavy rainfall would occur in sector D
28.09.2013	Yesterday's low pressure area over Kutch region & neighbourhood now lies over south-west Rajasthan and neighbourhood with associated upper air cyclonic circulation extending upto mid - tropospheric level.
29.09.2013	Yesterday's low pressure area over south-west Rajasthan and neighbourhood with associated upper air cyclonic circulation extending up to mid - tropospheric levelpersists.

Details of QPF issued by IMD for different spells occurred for the north Gujarat region

Date	QPF / Basin	01-10	11-25	26-38	39-50	51-75
14.06.2013	Mahi	-	F	A to E	-	-
	Sabarmati	D	A to C	-	-	-
	Banas	C,D	A,B	-	-	-
15.06.2013	Mahi	-		C	A,B	D to F
	Sabarmati	-	B	A	C,D	-
	Banas	-	A to D	-	-	-
16.06.2013	Mahi	-	A to F		-	-
	Sabarmati	-	A to D	-	-	-
	Banas	-	A to D	-	-	-
17.06.2013	Mahi	-	B	A,D		C,E,F
	Sabarmati	-	A	B	C	D
	Banas	-	C,D	B	A	-
18.06.2013	Mahi	A to F	-	-	-	-
	Sabarmati		A to D	-	-	-
	Banas	A to D	-	-	-	-
03.07.2013	Mahi		B to F	A	-	-
	Sabarmati	A to D	-	-	-	-
	Banas	A to D	-	-	-	-
22.07.2013	Mahi		A to F	-	-	-
	Sabarmati		A to D	-	-	-
	Banas	D	A to C	-	-	-
23.07.2013	Mahi	-	-	A to F	-	-
	Sabarmati	-	-	A to D	-	-
	Banas	-	-	A to D	-	-
24.07.2013	Mahi	-	B to D, F	A,E	-	-
	Sabarmati	-	A,B	C,D	-	-
	Banas	-	A to D	-	-	-
25.07.2013	Mahi	-	A to D	E,F	-	-
	Sabarmati	-	A,B	C,D	-	-
	Banas	-	A to D	-	-	-
26.07.2013	Mahi	-	B, D to F	A,C	-	-
	Sabarmati	-	A to D	-	-	-
	Banas	A to D	-	-	-	-
27.07.2013	Mahi	-	E,F	C,D	A,B	-
	Sabarmati	-	A to D	-	-	-
	Banas	-	A to D	-	-	-
28.07.2013	Mahi	-	-	A, C to F	B	-
	Sabarmati	-	C, D	A, B	-	-
	Banas	-	D	A to C	-	-

Details of QPF issued by IMD for different spells occurred for the north Gujarat region

Date	QPF / Basin	01-10	11-25	26-38	39-50	51-75
29.07.2013	Mahi	-	A to F	-	-	-
	Sabarmati	-	A to D	-	-	-
	Banas	-	A to D	-	-	-
01.08.2013	Mahi	-	B	A, C to F	-	-
	Sabarmati	-	A, B	C, D	-	-
	Banas	-	A to D	-	-	-
02.08.2013	Mahi	-	A to C	D, E, F	-	-
	Sabarmati	-	A	B	-	C,D
	Banas	-	A to D	-	-	-
03.08.2013	Mahi	A, C to F	B	-	-	-
	Sabarmati		A to D	-	-	-
	Banas		A to D	-		
21.09.2013	Mahi	F	B,D,E	A,C	-	-
	Sabarmati	B to D	A	-	-	-
	Banas	A to D	-	-	-	-
22.09.2013	Mahi	-	A to F	-	-	-
	Sabarmati	-	A to D	-	-	-
	Banas	-	A to D	-	-	-
23.09.2013	Mahi	-	A to D	E, F	-	-
	Sabarmati	-	A,B	C,D	-	-
	Banas	-	A to D	-	-	-
24.09.2013	Mahi	C	A,E,F	B,D	-	-
	Sabarmati	-	A,B	C,D	-	-
	Banas	A to D	-	-	-	-
27.09.2013	Mahi	A to F	-	-	-	-
	Sabarmati	D	A to C	-	-	-
	Banas	-	A	B	C	D
28.09.2013	Mahi	A,C to F	B	-	-	-
	Sabarmati	-	D	A to C	-	-
	Banas	-	-	A	B,C	D
29.09.2013	Mahi	A,C	B, D to F	-	-	-
	Sabarmati	-	A, B	C, D	-	-
	Banas	-	A	B to D	-	-

Statement No.7

DATE	RAINFALL DATA DURING INTENSE RAINFALL EVENTS FOR THE YEAR 2013										
	MAHI BASIN										
	Dha'wad	SK Dam	Mataji	Mahi Dam	Paderdi	Chakalia	A PH-2	Kadana D	Panam D	Wanakbori	Khanpur
	1 Flood Wave										
12.06.2013	5.8	15	6.4	11.8	0	0	0	0	25	2.2	11
13.06.2013	11	8	0	0	6	0	0	0	3	1.2	27
14.06.2013	0.8	10	38.8	5	0	2.2	0	0	1	0	0
15.06.2013	24	0	6.4	8	16.2	11.4	2	5.4	11.5	52.4	58
16.06.2013	19	10.2	3	2	4	4	0	9.6	3	1	0
17.06.2013	63.4	7	0	16.4	2	3.4	16.4	0	0	2	62
18.06.2013	3.2	18.2	10	9.2	1	9	15.6	11	4	40	55.2
19.06.2013	9.6	45.6	19.8	52	28	4.6	4	5.6	5.5	1.5	0
	2 Flood Wave										
04.07.2013	11	24	97	64	28.6	129.2	77	135.8	118	24	32
05.07.2013	84	16	56.2	19.8	104.4	41.4	42	73.3	164	235	73.8
06.07.2013	0	0	4.2	0	0	2.4	4	7	4	0	2.8
	3 Flood Wave										
09.07.2013	17.6	0	8	16	0	17.6	0	51.4	76.4	34.8	0
10.07.2013	1	0	39.4	40	6.8	31	28	56	43.6	21.4	63.4
11.07.2013	0	0	3	0	0	5.2	0	10.8	10	1.8	5.2
12.07.2013	11.2	11.6	4	24	1	14.6	10	0.6	15	8.8	39.6
13.07.2013	18.4	47.2	14	23	41.6	33.6	25	23.4	72.4	41	16.6
14.07.2013	10	0	1.4	0	0	0	1.4	3.4	3.6	21	4
15.07.2013	0	0	0	0	0	0	0	0.4	0.5	2.6	59.6
16.07.2013	10	8.4	7.2	1.1	6.2	7.4	10	1.8	2.5	1.2	0
17.07.2013	15.4	43	23.2	14	15.8	4	9	1.6	1	0	11.6
18.07.2013	21	4.2	2	2	81.6	9	4	19.6	13	5	2.4
	4 Flood Wave										
23.07.2013	51	60.6	34.4	51	60.6	34.4	34	94.4	9	14.2	34
24.07.2013	0	0	7	7	0	38.8	11	29.8	4	17.4	241.4
25.07.2013	7	27.4	8.6	9	11.4	20.8	0	18	20	126.6	14.8
26.07.2013	34.6	13.6	47.4	57	46	51	18	27.2	18.5	15	42
27.07.2013	87.6	36.6	106	120	30.4	15.8	54.2	34.2	10.5	18.2	73.1
28.07.2013	11.6	5.6	6	12	2.2	2.6	0	0	0	0	5.2
29.07.2013	15	13	10	51	15	27.8	9	7.6	22.4	12.2	3.6
	5 Flood Wave										
02.08.2013	3.6	16.6	43.2	14	18.6	62.4	20	26.6	39	38.2	33
03.08.2013	2	21.2	15.6	30	27.6	13.2	21	26	45	47.6	33.4
04.08.2013	2.6	2	2.6	1	2.6	1.6	0	8.6	47	5.4	0
	6 Flood Wave										
09.08.2013	1	0	6	0.1	0	17	22	20.2	64.6	4.4	0
10.08.2013	12.4	27.6	12	36	13	18.6	12	10.4	5	4	23.2
11.08.2013	1.4	3	1	14	0	7.6	0	0.4	3	4.2	7.8
12.08.2013	3.4	0	5.6	0	0	0	15	1	6	16.2	1.8
13.08.2013	6.2	0	4	0	0	2.8	0	0	2	1	0
14.08.2013	58	5	6.2	25	41	25.4	31	59.4	26.5	7.4	93.2
15.08.2013	17.2	3	1.4	0	9	0	0	2.2	27.5	8.6	7.4
	7 Flood Wave										
23.08.2013	55.6	0	11.4	13	0	0	0	0	0	0	0
24.08.2013	23	17.5	74.8	37	38.8	83.6	53	57	54.5	63	0
	8 Flood Wave										
22.09.2013	11.4	7	46.6	31.4	31.6	45.4	12	64.6	57	50.2	0
23.09.2013	19.4	5.8	21	15.04	16.4	33.8	53	55.8	36	100	0
24.09.2013	18.4	49.8	2	20	18.2	23.8	15	30.4	44	45	0
25.09.2013	1.2	11.4	3	0	16.6	10	5	24.2	13.5	34	0
	9 Flood Wave										
29.09.2013	56.4	112	0	7.6	41.8	0	7	31.8	26.5	31.4	0
30.09.2013	25.8	42	221	27.4	16	34	104	56.2	27	0	0
01.10.2013	0	8	7	3.8	0	91.4	17	71.2	28	80	0

Date	RAINFALL DATA DURING INTENSE RAINFALL EVENTS FOR THE YEAR 2013													
	SABARMATI BASIN													
	Sei Dam	Jotasan	Kheroj	Harnav W	Dharoi	Derol	Hathmati	Subhash B	Watrak D	Ratanpur	Raska W	Kheda	Voutha	Nadiad
	1st Flood Wave													
13.06.2013	5.6	9.2	36.6	0	0	7.2	51.6	12.6	0	0	0	36.6	0	0
14.06.2013	0	1	17.8	2.2	9	0	0	0	0	0	0	17.8	0	0
15.06.2013	1	10.4	25	10.6	25.2	14.8	7.2	58	0	27.4	29.4	13	5.8	0
16.06.2013	2.8	2.2	1.8	10.6	5.4	2	6	3.4	10	10	0	0	0	0
17.06.2013	4.8	23	38.8	9.8	32.2	3	0.4	40.6	10	58.6	62.8	58.9	12.2	16.5
18.06.2013	9	13.8	15.8	14.8	32.4	78	64	0	59	37	2.4	4.5	0	8.5
	2nd Flood Wave													
04.07.2013	22	2.6	20.4	0	18	29	6.4	0	31.4	20	15	18	15.6	14.5
05.07.2013	6.4	23	18.4	54.4	32.8	61	79	141.6	76	156.8	152.8	54.6	37	66
06.07.2013	0.6	1.4	0	2.2	1.6	0	0	0	0	0	0	4	5	12
07.07.2013	1	4.2	3.2	6.2	0	0	0	0	2	0	6	43.8	12	18
	3rd Flood Wave													
09.07.2013	0	2.8	0	0	0	1.2	1.8	10.4	46.3	8.8	2.2	0	16.4	0
10.07.2013	0	2.4	0.4	0	2.8	14.2	5	2.4	25	23.2	17.4	14.6	4	6
11.07.2013	0	0	23.2	14.6	34	16.8	7.8	24.6	8.2	0	1.2	15	3.2	6
12.07.2013	11	4.2	3.6	21.2	4	9.4	19.2	4.2	N.A	2	47.6	18.2	4	25
13.07.2013	4	68.4	82.2	50.2	93.6	84.8	59	53	45.4	27.9	16	26.8	10.4	38
14.07.2013	7.4	0	2.2	0	1.6	13	40.4	102	3	50.6	101.4	4	2	32
15.07.2013	3.4	1.2	4.8	11.6	3.6	0	0	2.8	0	0	0	3.6	2	43
	4th Flood Wave													
22.07.2013	14	1.2	0	54	0.8	1.4	0	0	0	0	0	22.4	21.8	0
23.07.2013	29	21.4	33.6	52	87.2	30.4	53.6	39.8	30.8	19.4	40	33.4	16.9	35
24.07.2013	28.4	4.8	3	5.2	3.4	18	0	0	4	4.2	2.8	8.2	3	7
25.07.2013	10	2	36	40.2	22	36.4	17	42.4	34	99.8	59.6	20.6	8.2	65.5
26.07.2013	4	25.8	33	14.6	4	83	28	12.2	70	1	4	18.4	55	75
27.07.2013	8	33	20.8	0	4.8	32.6	7	37.4	266.1	18.4	11.8	22.7	44.6	17.5
28.07.2013	7	25.2	62.2	35.2	95.2	0	1.4	0	0	0	0	43	7	0
29.07.2013	46	22.4	13.6	58.2	75.2	17	12	44	19.4	42	40	3.6	7.8	3
	5th Flood Wave													
02.08.2013	5	11.4	6.6	13	17.6	39.6	48.4	19.2	0	22.7	12.4	20.6	13.4	32
03.08.2013	8.4	15.6	3.8	43.4	38.2	90.4	106.6	77.4	11.2	43	41.2	27.2	52	36
04.08.2013	2.2	13	11	6.7	11.2	12.4	14	10.8	8	7.8	5.6	7.2	4	3

Date	RAINFALL DATA DURING INTENSE RAINFALL EVENTS FOR THE YEAR 2013													
	SABARMATI BASIN													
	Sei Dam	Jotasan	Kheroj	Harnav W	Dharoi	Derol	Hathmati	Subhash B	Watrak D	Ratanpur	Raska W	Kheda	Voutha	Nadiad
	6th Flood Wave													
10.08.2013	34	54.6	17.2	25.3	22.8	28	19.2	1	NA	1.8	0	2.2	1.6	19
11.08.2013	6.6	7.6	20.4	5	19.2	18.6	7	18.2	0	20	11.2	5.8	5	15
12.08.2013	3.8	1.2	10.8	0	4.4	3	10.8	1.2	4.2	12.8	1.2	0	3	0
13.08.2013	10.4	8.4	5.6	15.2	5.2	0	0	4.6	40	7.6	2.4	9.6	17	6
14.08.2013	55	7.8	10.6	10.4	4.4	7.4	15	7.8	46.7	14.6	24.2	41	28.6	22
15.08.2013	42	19.2	5.2	20.6	7.2	1.8	12	35.2	0	4	18.6	4.6	6.4	6
16.08.2013	13	10	11.8	16.4	11	4.8	4.6	2.6	0	7	12.4	15.4	21.8	7
17.08.2013	7.4	33.4	14.8	24.2	14.4	5	3.2	1.2	NA	0	0	15	0	3
	7th Flood Wave													
22.09.2013	29.4	1.2	0	10	2	6.2	13.8	2.2	15.5	9.8	6.4	6.4	0	0
23.09.2013	2.6	3.6	24.8	16.2	4.2	6.8	27.8	13	0	47.8	43.2	43	40	0
24.09.2013	2	20.6	9	24.4	6.6	25.4	20.8	30.2	0	38.8	40	17.8	26.4	0
25.09.2013	0	14.8	36	10	13.4	20	23.4	108.6	N.A	20.6	54.8	195.9	119.3	0
26.09.2013	0	0	1	0	2	4.4	5.4	83	14.8	23.6	23.8	36	26.9	0
27.09.2013	2.2	1.6	1	12.2	6.4	3	1	11.2	0	5.6	0	1	0	0
28.09.2013	7	14.2	17	23.8	34.4	37.8	18	3.4	0	3.2	0	0.6	0	0
29.09.2013	56	53.4	61.8	33	42.2	20.6	50	6.4	49.6	26.8	21.4	6.2	4.2	0
30.09.2013	12.2	3.4	2.4	12.4	1.2	1.4	5.4	0	0	0	0	1.4	1.8	0
01.10.2013	0	1.6	0	4.2	3.4	26.4	13.8	9.4	27.9	6	0	1.8	0	0

Statement No.9

Date	RAINFALL DATA DURING INTENSE RAINFALL EVENTS FOR THE YEAR 2013 BANAS BASIN							
	Sw.ganj	Abu Road	Sarotry	Chitrasani	Dantiwada	Bhakudar	Mt.Abu	Ambaji
	1 Flood Wave							
16.06.2013	4.6	0	34	32.4	36.4	37	7.6	38.4
17.06.2013	1	16.8	33	8.8	3	5.4	11.2	3.4
18.06.2013	3.2	14	92	180.8	74.2	104.2	13.8	21.4
19.06.2013	2.4	34.6	14	15.4	0	0	31	11.4
	2 Flood Wave							
04.07.2013	30.4	55	1.4	4	2	11.4	18.8	10
05.07.2013	4.6	6.8	8	6.4	5.2	1	35.4	14
	3 Flood Wave							
11.07.2013	0	0	10	33.4	2	0	40.8	0
12.07.2013	1	1	4	3.4	20.2	26	6.6	27.4
13.07.2013	34	34	110	69.8	73.8	101	47.6	65.6
14.07.2013	4	4.2	3.4	9.6	5.4	6	13.6	5.8
15.07.2013	0	0	20	1.4	6.8	4	2.8	2.8
	4 Flood Wave							
22.07.2013	0	0	5	0	0	0	98.6	0
23.07.2013	17	54.8	26	47.4	21.6	25.4	33.2	8
24.07.2013	16.8	1.2	0	0.2	0	6	20.2	3
25.07.2013	6.2	13.4	5	3.8	12	0	24.4	15.8
26.07.2013	0	0.6	0	0.4	0	4.6	13.4	8
27.07.2013	2.8	0.4	0	1.6	0.8	0	72.2	16
28.07.2013	29.6	55.2	17	53.8	55	122.2	66	59.8
29.07.2013	10.6	26.8	5.4	15.8	60.6	21	31.4	22.6
30.07.2013	2	8.8	3	4.2	1.2	2	21.8	3.6
31.07.2013	0	0.4	0	0	8.2	0	10.4	0
	5 Flood Wave							
04.08.2013	22.6	45.2	7	18.8	18	8	34	25.2
05.08.2013	0	1.8	0	0.4	0	0	26.8	1.6
	6 Flood Wave							
08.08.2013	69.4	4.6	0	0.4	0	0	8.2	16
09.08.2013	1.8	2	0	0	2.2	0	10	2.6
10.08.2013	12.8	8.4	3	10.6	1.8	0	16.6	10.4
11.08.2013	2.2	3.8	4	7.8	2.4	4.6	5.4	7.2
12.08.2013	0	4.4	10.2	1.8	0	0	6.6	2.4
13.08.2013	2	8.4	0	1	0	0	5.6	2.2
14.08.2013	34	81.8	52.4	27.8	75	64.4	115	5.4
15.08.2013	2.4	11.4	30	31.6	25.8	17.8	54.2	12.8
16.08.2013	6	10	6.2	3.8	9.8	23	19.8	14.2
17.08.2013	0	8	7.2	12.6	8.8	11	7.6	17.6
18.08.2013	1.8	7.8	0	7.4	16	8.6	30.4	4.8
	7 Flood Wave							
23.09.2013	0	13	2	4	1.4	3	63.6	22
24.09.2013	15	4.4	5	2.6	19.4	33.6	16.2	30
25.09.2013	10.6	4	7	14.6	14.6	38	6.8	22.4
26.09.2013	2	3	0	0.6	0	0	13.8	10.2
27.09.2013	1.2	5.8	36	13	14.6	20	31.2	19.2
28.09.2013	31.6	44.8	27	63.8	99	130.2	134.2	42.4
29.09.2013	39.6	93.2	79.2	108.8	196.6	72.6	271.2	66.6
30.09.2013	6.8	5.6	0	0	0	0	10.6	3.4
	8 Flood Wave							
07.10.2013	27.2	1.6	3.6	40.2	0.6	0	0	0
08.10.2013	29.4	6	0	0	0	0	0	0
09.10.2013	50.4	59.6	41	30.2	34.4	43	101.8	68
10.10.2013	0	0	0	0	0	0	0	0
11.10.2013	9.4	43.8	7.2	11	2	0	13.4	35

Statement No.10

Methodology Technique and Type of Data used for Formulation of Forecast for Various River Basins

S.NO.	RIVER	FORECAST STATION	BASE STATION	WARNING LEVEL (M)	DANGER LEVEL HFL RECORDED IN (m) & YEAR	TRAVEL TIME (HRS)	METHODOLOGY/ TECHNIQUE BEING USED FOR FORMULATION OF FORECAST	TYPE OF DATA BEING USED LEVEL, DISCHARGE(Q), RAINFALL(RF)
1	MAHI	WANAKBORI WEIR (Flood Level)	1.KADANA DAM (OUT FLOW) 2.PANAM DAM (OUT FLOW)	69.80	D.L.72.54 HFL 76.10 in 2006	4 - 9 3 - 9	The hydromteorological data of base stations is obtained round the clock during flood season.	Q- Kadana & Panam Dam RF- Kadana dam Panam Dam and Wanakbori Weir
		KADANA DAM (Inflow)	1. PADERDI BADI 2. ANAS PH-2	126.18	D.L.127.71 HFL-127.737 in 1989	5 - 6 3 - 6	From the past Stage and discharge data of the base station travel time V/s Stage and S-D curves were	Q-Paderdi & Anas Ph-2 RF Paderdi,Anas Ph-2 & Kadana Dam
2	SABARMATI	SUBHASH BRIDGE AHMEDABAD (Flood Level)	1. DEROL BRIDGE 2. HATHMATI WEIR	44.09	D.L.45.34 HFL 47.45 in 2006	5 - 11 7 - 11	developed. With the help of these curves of base stations, the magnitude and time of occurance of flood	Q-Derol Bridge & overflow of Hathmati weir RF-Derol Bridge, Hathmati Weir & A'bad
		DHAROI DAM (Inflow)	1. KHEROJ 2. HARNAV WEIR	187.45	D.L.192.25 HFL-189.625 in 1990	3 - 5 2 - 4	are estimated from the stage data of base station.Rainfall data of ungauged catchment is also being used to assess the contributon	Q-Kheroj &Harnav Weir RF Kheroj, Harnav Weir and Dharoi Dam
3	BANAS	DANTIWADA DAM (Inflow)	1. SAROTRY 2. CHITRASANI	182.88	D.L.185.06 HFL 186.04 in 1973	3 - 5 2 - 4	of ungauged catchment.	Q-Sarotry & Chitrasani RF Sarotry, Chitrasani and Dantiwada dam

Statement No. 11a

Maximum Water Level, Inflow & Outflow attained at all Sites in Mahi, Sabarmati and Banas Basins during Monsoon 2013(15.06.13 to 15.10.13)

River Basin	Site	June			July			August			September			October			Max.during -2013		
		Date	Time	WL (m) / I.F/O.F	Date	Time	WL (m) / I.F/O.F	Date	Time	WL (m) / I.F/O.F	Date	Time	WL (m) / I.F/O.F	Date	Time	WL (m) / I.F/O.F	Date	Time	WL (m) / I.F/O.F
Mahi	Dhariawad	16.06.13	2200	204.46	26.07.13	1800	206.550	13.08.13	2400	206.65	30.09.13	1300	205.22	01.10.13	0100	205.180	13.08.13	2400	206.65
	Som Kamla	19.06.13	2100	209.95	01.08.13	0100	211.35	25.08.13	1800	213.50	24.09.13	0900	213.70	03.10.13	1100	213.65	24.09.13	0900	213.70
	Mataji	29.06.13	1500	286.250	26.07.13	2100	291.55	02.08.13	0100	292.35	30.09.13	1200	289.27	09.10.13	1000	289.90	02.08.13	0100	292.35
	Mahi Dam	30.06.13	1800	271	27.07.13	1100	281.50	28.08.13	0800	281.45	04.09.13	0200	281.5	01.10.13	0100	281.50	04.09.13	0200	281.5
	Inflow (cumec)	26.06.13	0800	52.760	26.07.13	1900	10170	24.08.13	2100	7193.00	30.09.13	0900	7523	09.10.13	1300	1387.000	26.07.13	1900	10170
	Outflow (cumec)	-	-	0.000	27.07.13	1000	5779.000	02.08.13	0200	6345	30.09.13	0900	7523	09.10.13	1300	1387.000	30.09.13	0900	7523
	Paderdi	27.06.13	0100	133.7	27.07.13	2200	139.63	25.08.13	0800	140.7	30.09.13	1700	139.8	01.10.13	0100	137.40	25.08.13	0800	140.7
	Chakaliya	18.06.13	0100	218.40	27.07.13	0500	223.4	02.08.13	0700	222.50	23.09.13	0300	221.50	01.10.13	0400	220.00	27.07.13	0500	223.4
	Anas PH-2	19.06.13	0900	135.050	26.07.13	0700	145.0	02.08.13	0500	145.0	23.09.13	0900	142.00	01.10.13	1000	140.85	26.07.13	0700	145.0
	Kadana Dam	22.06.13	1800	125.730	31.07.13	0800	125.86	31.08.13	0700	126.44	23.09.13	0900	127.46	05.10.13	1300	127.69	05.10.13	1300	127.69
	Inflow (cumec)	20.06.13	1900	65.700	27.07.13	2300	5162.25	02.08.13	1300	7194.25	30.09.13	2000	6529.15	01.10.13	0100	3617.01	02.08.13	1300	7194.25
	Outflow (cumec)	26.06.13	1000	144.410	26.07.13	2200	5690.49	02.08.13	0700	7395.7	30.09.13	1000	4422.59	01.10.13	0100	4319	02.08.13	0700	7395.7
	Panam Dam	15.06.13	0100	123.8	27.07.13	0800	126	01.08.13	2300	127.25	13.09.13	1000	127.41	07.10.13	2100	127.35	13.09.13	1000	127.41
	Inflow (cumec)	18.06.13	0900	33.000	04.07.13	1200	2405.00	02.08.13	1100	2833.7	22.09.13	1800	524	01.10.13	1600	404.92	02.08.13	1100	2833.7
	Outflow (cumec)	-	-	0.000	31.07.13	2000	1983.23	02.08.13	1000	2018.17	23.09.13	1000	608	01.10.13	1500	556.98	02.08.13	1000	2018.17
	Wanakbori Weir	29.06.13	0700	67.670	27.07.13	2000	71.17	02.08.13	1900	72.01	30.09.13	2200	70.87	01.10.13	0100	70.87	02.08.13	1900	72.01
	Discharge(cusec)	29.06.13	0700	4237	27.07.13	2000	200311	02.08.13	1900	336101	30.09.13	2200	166402	01.10.13	0100	166402	02.08.13	1900	336101
	Khanpur	30.06.13	2400	9.380	28.07.13	0200	16.170	03.08.13	0300	18.22	30.09.13	2400	13.92	01.10.13	1200	15.710	03.08.13	0300	18.22
Sabarmati	Sei Dam	18.06.13	2100	509.80	30.07.13	1500	511.4	13.08.13	1600	512.05	01.09.13	0100	509.95	13.10.13	0600	510.2	13.08.13	1600	512.05
	Jotasan	20.06.13	1500	286.650	03.07.13	0900	288.80	11.08.13	0800	287.26	29.08.13	0800	287.65	10.10.13	1000	287.54	03.07.13	0900	288.80
	Kheroj	20.06.13	1300	209.800	26.07.13	2000	210.9	11.08.13	0600	210.40	29.09.13	1200	210.5	10.10.13	1500	210.40	26.07.13	2000	210.9
	Harnav Weir	-	-	0.000	29.07.13	2300	234.8	16.08.13	2400	234.97	29.09.13	0800	234.970	04.10.13	0100	234.88	16.08.13	2400	234.97
	Dharoi Dam	18.06.13	1600	181.520	31.07.13	2300	183.63	31.08.13	2100	185.47	30.09.13	2400	185.970	15.10.13	1800	186.925	15.10.13	1800	186.925
	Inflow (cusec)	18.06.13	0900	5880.000	28.07.13	2400	26666	02.08.13	1900	18055	29.09.13	0500	7500	08.10.13	2100	15833	28.07.13	2400	26666
	Outflow (cusec)	-	-	0.000	-	-	0.000	-	-	0.000	-	-	0.000	-	-	0.000	-	-	0.000
	Derol	20.06.13	1100	87.110	13.07.13	1100	88.5	02.08.13	1000	89.80	29.09.13	1500	87.7	12.10.13	0800	87.67	13.07.13	1100	88.5
	Hathmati	-	-	0.000	-	-	0.000	03.08.13	1400	134.70	-	-	0.000	-	-	0.000	03.08.13	1400	134.70
	Subhash Bridge	16.06.13	1800	41.28	21.07.13	1300	41.65	03.08.13	0800	41.33	06.09.13	2100	41.97	14.10.13	1400	40.98	06.09.13	2100	41.97
	Watrak Dam	20.06.13	1000	132.45	31.07.13	1900	134.14	10.08.13	0100	136.61	30.09.13	1000	136.23	09.10.13	0900	136.26	10.08.13	0100	136.61
	Outflow (cusec)	-	-	0.000	-	-	0.000	13.08.13	1400	5000	29.09.13	1300	12000	09.10.13	1000	7500	29.09.13	1300	12000
	Ratanpur	18.06.13	2400	39.5	27.07.13	2000	39.7	14.08.13	1300	41	29.09.13	2100	39.9	10.10.13	2300	39.95	14.08.13	1300	41
	Raskwa Weir	18.06.13	2100	35.99	26.07.13	1700	36.21	03.08.13	2200	36.480	30.09.13	1800	35.94	01.10.13	0100	35.87	03.08.13	2200	36.480
	Kheda	20.06.13	1000	19.78	26.07.13	2400	21.4	14.08.13	2400	21.54	30.09.13	0600	21.64	01.10.13	1500	21.5	30.09.13	0600	21.64
	Voutha	18.06.13	1000	14.64	27.07.13	1200	16.5	04.08.13	1500	17.45	30.09.13	1100	16.07	11.10.13	0300	16.51	04.08.13	1500	17.45
Banas	Swaroopganj	-	-	BG	-	-	BG	-	-	BG	-	-	BG	-	-	BG	-	-	BG
	Abu Road	-	-	0.0	28.07.13	0800	254	14.08.13	0600	255	28.09.13	2200	256.45	09.10.13	2300	255.25	28.09.13	2200	256.45
	Sartory	-	-	0.0	30.07.13	0800	186.84	14.08.13	0700	187.2	28.09.13	2000	188.8	09.10.13	1200	187.36	28.09.13	2000	188.8
	Chitrasani	18.06.13	0600	186.5	13.07.13	0600	185.96	03.08.13	1000	186.07	29.09.13	0700	186.38	09.10.13	2100	186.63	09.10.13	2100	186.63
	Dantiwada	19.06.13	1100	164.3	31.07.13	2000	165.89	31.08.13	0700	170.35	30.09.13	2300	174.1	14.10.13	1700	175.73	14.10.13	1700	175.73
	Inflow (cusec)	-	-	0.0	27.07.13	0100	1500	14.08.13	1000	4304	28.09.13	2000	29129	09.10.13	0900	4000	28.09.13	2000	29129
	Outflow (cusec)	-	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0
	Bakudar	18.06.13	1300	175.37	13.07.13	1300	175.19	15.08.13	1800	175.21	30.09.13	1700	177.49	10.10.13	1500	177.6	10.10.13	1500	177.6

Statement 11 b

Unprecedented flood events in India under CWC FF & W Network - 2013 flood season													
Sl .No	River	Station	State	Danger level in metres	Highest Flood Level (HFL) in 2013		Existing HFL		Duration		New HFL		
					Level in metres	Date of occurrence	Level in metres	Date of occurrence	From	To	Level	From	To
1	Mahi	Kadana dam	Gujarat	**127.737**	127.69	05.10.13, 1300	127.74	09/09/1989	NA	NA	NA	NA	NA
2	Sabarmati	Dharoi dam	Gujarat	**192.24**	186.925	15.10.13, 1800	189.63	03/09/1990	NA	NA	NA	NA	NA
3	Banas	Dantiwada	Gujarat	**185.06**	175.73	14.10.13, 1700	186.04	01/09/1973	NA	NA	NA	NA	NA
4	Mahi	Wanakbori weir	Gujarat	**72.54**	72.01	02.08.13, 1900	76.10	12/08/2006	NA	NA	NA	NA	NA
5	Sabarmati	Subhash bridge	Gujarat	**45.34**	41.97	06.09.13, 2100	47.45	19/08/2006	NA	NA	NA	NA	NA

Statement - 11c

High Flood Events during Flood Season - 2013

Sl.No	River	Station	State	District	Danger level in metres	Existing HFL		Duration of High Flood	
						Level in metres	Date of occurrence	From	To
1	Mahi	Kadana dam	Gujarat	**Panchamahal**	**127.737**	127.74	09/09/1989	Nil	Nil
2	Sabarmati	Dharoi dam	Gujarat	**Mehasana**	**192.24**	189.63	03/09/1990	Nil	Nil
3	Banas	Dantiwada	Gujarat	**Banaskantha**	**185.06**	186.04	01/09/1973	Nil	Nil
4	Mahi	Wanakbori weir	Gujarat	**Kheda**	**72.54**	76.10	12/08/2006	Nil	Nil
5	Sabarmati	Subhash bridge	Gujarat	**Ahmedabad**	**45.34**	47.45	19/08/2006	Nil	Nil

High Flood Level= HFL-0.50 M

Statement - 11d

Low and Moderate flood events on various river systems (excluding Ganga and Brahmaputra basins)- 2013 flood season

Sl. No.	River	Station	State	Warning level in metres	Danger level in metres	Peak level in 2012		Flood period => warning level			Flood period => danger level		
						Level in metres	Time	From	To	No. of days	From	To	No. of days
1	Mahi	Kadana dam	Gujarat	**127.71**	**127.737**	127.69	05.10.13, 1300	26.08.2013, 1200	15.10.2013, 2400	50 days 12 hrs	Nil	Nil	Nil
2	Sabarmati	Dharoi dam	Gujarat	**187.06**	**192.24**	186.925	15.10.13, 1800	Nil	Nil	Nil	Nil	Nil	Nil
3	Banas	Dantiwada	Gujarat	**182.88**	**185.06**	175.73	14.10.13, 1700	Nil	Nil	Nil	Nil	Nil	Nil
4	Mahi	Wanakbori weir	Gujarat	**69.80**	**72.54**	72.01	02.08.13, 1900	26.07.2013, 1900	28.07.2013, 1400	1 day, 19 hrs	Nil	Nil	Nil
								31.07.2013, 2300	01.08.2013, 1300	14 hrs			
								02.08.2013, 0700	03.08.2013, 2300	1 day, 16 hrs			
								14.08.2013, 0900	15.08.2013, 0900	1 day			
								24.08.2013, 1700	25.08.2013, 2400	1 day 7 hrs			
								23.09.2013, 2400	24.09.2013, 0800	8 hrs			
								30.09.2013, 1500	01.10.2013, 1900	1 day 4 hrs			
									Tot.	**5 days 68 hrs**			
5	Sabarmati	Subhash bridge	Gujarat	**44.09**	**45.34**	41.97	06.09.13, 2100	Nil	Nil	Nil	Nil	Nil	Nil

Statement No. 12

DETAILS OF FORECAST ISSUED DURING FLOOD SEASON - 2013 (WANAKBORI WEIR)- LEVELFORECASTING SITE

Name of Forecasting Station **Wanakbori Weir** On Mahi River

Name of Base Stations 1. Kadana Dam on Mahi River 2. Panam Dam on Panam River

Danger level - 72.54 m
Warning level- 69.80 m
HFL:76.10m 12.8.06 at 0400hrs

River basin/ Station	FF No.	Issue Time Date/Time	Period of Forecast (date time) From	To	Value of Forecast MCM/ level(m)	Actual Achieved MCM/ level(m)	Time of actual achieved (hrs)	% of accuracy/ diff. in level (in cm)	cumulative forecast during the season	No.of correct forecast	Over all accuracy (in %)
Mahi basin, Wanakbori Weir	MW-1	26.07.13 (1600)	1900 (26/07)	2000 (26/07)	69.95	69.87	2000	8			
	MW-2	26.07.13 (2345)	0600 (27/07)	0700 (27/07)	70.86	70.94	0600	8			
	MW-3	27.07.13 (0545)	0700 (27/07)	0800 (27/07)	71.02	71.1	0700	8			
	MW-4	27.07.13 (1130)	1800 (27/07)	1900 (27/07)	70.25	-	-	-			
	MW-4R	27.07.13 (1530)	1800 (27/07)	1900 (27/07)	70.75	70.86	1700 (-1 hr.)	12			
	MW-5	27.07.13 (2030)	0300 (28/07)	0400 (28/07)	70.48	70 .41	0400	7			
	MW-6	28.07.13 (0430)	0900 (28/07)	0900 (28/07)	69.95	-	-	-			
	MW-6R	28.07.13 (1100)	1200 (28.07)	1200 (28.07)	69.95	70.03	1200	8			
	MW-7	31.07.13 (2030)	0100 (01/08)	0200 (01/08)	71.35	71.24	0300 (+1hr)	11			
	MW-8	01.08.13 (0330)	1100 (01/08)	1100 (01/08)	71.24	71.18	1100	11			
	MW-9	02.08.13 (0730)	1600 (02/08)	1600 (02/08)	71.24	-	-	-			
	MW-9R	02.08.13 (1140)	1600 (02/08)	1600 (02/08)	72.01	71.86	1700(+1hr)	15			
	MW-10	14.08.13 (0415)	0900 (14/08)	1000 (14/08)	70.1	69.95	1100 (+1hr)	15			
	MW-11	15.08.13 (0030)	0800 (15/08)	0900 (15/08)	69.8	69.8	0800	0			
	MW-12	24.08.13 (1345)	2000 (24/08)	2100 (24/08)	70.49	70.64	2000	15			
	MW-13	25.08.13 (1215)	1800 (25/08)	1900 (25/08)	71.2	71.17	1800	3			
	MW-14	23.09.13	0400 (24/09)	0500 (24/09)	69.95	70.03	0400	8			
	MK-15	31.09.13 (1245)	1900 (31/09)	2000 (31/09)	70.48	70.56	1800 (-1 hr)	8			
	MW-16	01.10.13 (1130)	1800 (01/10)	1900 (01/10)	69.87	69.95	1900	8	16	16	100

Statement No.13

DETAILS OF FORECAST ISSUED DURING FLOOD SEASON - 2013 (KADANA DAM)INFLOW FORECASTING SITE

Name of Division: Mahi division CWC Gandhinagar

Name of Inflow : Kadana Dam Name of Base Stations **Paderdi on Mahi River** Danger level **127.71 m**

Forecasting Station : **Anas PH-2 on Anas River** Warning level **126.18 m**

River basin/ Station	FF No.	Issue Time Date/Time	Period of Forecast (date time) From	To	Value of Forecast MCM/ level(m)	Actual Achieved MCM/ level(m)	Time of actual achieved (hrs)	% of accuracy/	cumulative forecast during the season	No.of correct forecast	Over all accuracy (in %)
Mahi basin, Kadana dam	MK-1	26.07.13 (0930)	0900 (26/07)	1500 (26/07)	40	42.04	1500	4.05			
	MK-2	27.07.13 (0530)	0500 (27/07)	1100 (27/07)	45	-	-	-			
	MK-2R	27.07.13 (0845)	0500 (27/07)	1100 (27/07)	75	76.45	1100	1.89			
	MK-3	27.07.13 (1130)	1100 (27/07)	1700 (27/07)	65	-	-	-			
	MK-3 R	27.07.13 (1430)	1100 (27/07)	1700 (27/07)	50	59.175	1600 (-1 hr.)	15.5			
	MK-4	27.07.13 (1730)	1700 (27/07)	2300 (27/07)	55	-	-	-			
	MK-4 R	27.07.13 (2145)	1700 (27/07)	2300 (27/07)	75	80.65	2300	13			
	MK-5	27.07.13 (2330)	2400 (27/07)	0500 (28/07)	90	-	-	-			
	MK-5 R	27.07.13 (0330)	2400 (27/07)	0500 (28/07)	72	70.17	500	2.6			
	MK-6	28.07.13 (0530)	0600 (28/07)	1100 (28/07)	50	42.75	1100	16.9			
	MK-7	02.08.13 (0630)	0700 (02/08)	1200 (02/08)	65	-	-	-			
	MK-7R	02.08.13 (0945)	0700 (02/08)	1200 (02/08)	105	113.43	1200	7.4			
	MK-8	02.08.13 (1215)	1300 (02/08)	1800 (02/08)	125	128.46	1800	2.69			
	MK-9	02.08.13 (1830)	1900 (02/08)	2400 (02/08)	65	73.66	2300(-1hr)	11.7			
	MK-10	02.08.13 (0030)	0100 (03/08)	0600 (03/08)	60	67.68	0600	12.8			
	MK-11	03.08.13 (0615)	0700 (03/08)	1200 (03/08)	58	62.83	1200	7.68			
	MK-12	03.08.13 (1430)	1500 (03/08)	2000 (03/08)	57	60.54	2000	-			
	MK-13	14.08.13 (0915)	1000 (14/08)	1500 (14/08)	70	79.19	1500	11.6			
	MK-14	14.08.13 (1530)	1600 (14/08)	2100 (14/08)	60	61.7	2100	2.83			
	MK-15	24.08.13 (1330)	1300 (24/08)	1900 (24/08)	65	71.45	1800 (-1 hr)	9.03			
	MK-16	24.08.13 (1945)	1900 (24/08)	0100 (25/08)	85	97.85	0100	13			
	MK-17	25.08.13 (0130)	0200 (25/08)	0700 (25/08)	90	110.06	0700	18.2			
	MK-18	25.08.13 (0715)	0800 (25/08)	1300 (25/08)	110	106	1300	3.77			
	MK-19	31.09.13 (1845)	1900 (31/09)	2400 (31/09)	57	-	-	-			
	MK-19R	31.09.13 (2130)	1900 (31/09)	2400 (31/09)	90	93.88	2400	4.13			
	MK-20	01.10.13 (0030)	0100 (01/10)	0600 (01/10)	75	75.31	0600	0.41			
	MK-21	01.10.13 (0645)	0700 (01/10)	1200 (01/10)	50	57.89	1200	8.63	21	21	100

Statement No. 14

DETAILS OF FORECAST ISSUED DURING FLOOD SEASON - 2013 (DANTIWADA DAM)-INFOLW FORECASTING SITE

Name of Division: Mahi Division CWC Gandhinagar

Name of Forecasting Station **Dantiwada Dam on Banas River**

Name of Base Stations **Sarotry on Banas River** **Chitrasani on Balaram River**

Danger level **185.06 m**

Warning level **182.88 m**

River basin/ Station	FF No.	Issue Time Date/Time	Period of Forecast (date time) From	To	Value of Forecast MCM/ level(m)	Actual Achieved MCM/ level(m)	Time of actual achieved (hrs)	% of accuracy/ |diff. in level| (in cm)|	cumulative forecast during the season	No.of correct forecast	Over all accuracy (in %)
Dantiwada Dam	BD-1	28.09.13 (1645)	1600 (28/09)	2000 (28/09)	10.5	8.779	2000	19.6			
	BD-2	28.09.13 (2145)	2100 (28/09)	0100 (29/09)	10	9.02	0100	10.86	2	2	100

THE LIST OF TELEMETRY STATIONS UNDER THE JURISDICTION OF MAHI DIVISION CWC

Name of Organisation: NTBO, Gandhinagar **Name of Division: Mahi Division CWC, Gandhinagar**

Sl. No.	Name of Station	Type A/B/C/ D*	District / State		River / Tributary	Latitude			Longitude			Altitude in Metre	Satellite ID
						D	M	S	D	M	S		
	MSD KADANA												
1	Mataji	B	Ratlam	Madhya Pradesh	Mahi	23	20	56	74	43	4	284.000	73800E66
2	Mahi Dam	C	Banswara	Rajsthan	Mahi	23	37	39	74	32	43	268.500	738013C2
3	Dhariawad	B	Udaipur	Rajsthan	Mahi/Jakham	24	5	13	74	28	30	203.000	73801D10
4	Somkamla Amba Dam	C	Dungarpur	Rajsthan	Mahi/Som	23	58	37	74	1	58	201.250	73802658
5	Rangeli	B	Dungarpur	Rajsthan	Mahi/Som	23	52	14	74	13	25	150.000	7380288A
6	Paderdibadi	B	Dungarpur	Rajsthan	Mahi	23	45	34	74	7	56	131.000	7380352E
7	Anas Ph- II (Seasonal)	B	Banswara	Rajsthan	Mahi/Anas	23	21	12	74	14	4	133.720	73803BFC
8	Chakaliya	D	Dahod	Gujarat	Mahi/Anas	23	3	15	74	19	6	215.000	738043BE
9	Kadana- Dam	C	Panchmahal	Gujarat	Mahi	23	18	23	73	49	33	113.690	73804D6C
10	Panam Dam	C	Panchmahal	Gujarat	Mahi/Panam	23	3	12	73	42	57	116.700	738050C8
11	Wanakbori	C	Kheda	Gujarat	Mahi	22	57	0	73	25	31	69.300	73805E1A
12	Khanpur	B	Anand	Gujarat	Mahi	22	32	5	73	8	15	8.220	73806552
13	***Jhabua***	A	Jhabua	Madhya Pradesh	Mahi/Anas	22	46	15	74	35	45	300.000	73806B80
	NWRSD HIMMATNAGAR												
14	***Jharol***	A	Udaipur	Rajasthan	Sabarmati	24	24	52	73	28	21	290.000	7380E346
15	Sei Dam	C	Udaipur	Rajasthan	Sabarmati	24	42	56	73	12	0	515.250	73807624
16	Jotasan	B	Sabarkantha	Gujarat	Sabarmati/Wakal	24	21	17	73	9	51	285.000	738078F6
17	Kheroj	B	Sabarkantha	Gujarat	Sabarmati	24	13	49	73	0	32	208.000	738086A0
18	Harnav Weir	C	Sabarkantha	Gujarat	Sabarmati	24	1	49	73	10	21	234.756	73808872
19	Dharoi Dam	C	Mehsana	Gujarat	Sabarmati	24	0	17	72	51	8	178.920	738095D6
20	Derol Bridge	B	Sabarkantha	Gujarat	Sabarmati	23	34	35	72	48	30	87.000	73809B04
21	Hathmati Weir	C	Sabarkantha	Gujarat	Sabarmati / Hathmati	23	36	22	72	58	5	134.050	7380A04C
	SSD AHMEDABAD												
22	Subhash Bridge	D	Ahmedabad	Gujarat	Sabarmati	23	3	34	72	35	12	41.000	7380AE9E
23	Watrak Dam	C	Sabarkantha	Gujarat	Sabarmati/Watrak	23	19	5	73	24	23	128.000	7380B33A
24	Ratanpur	B	Kheda	Gujarat	Sabarmati/Watrak	22	58	36	72	53	7	37.000	7380BDE8
25	Raska Weir	C	Kheda	Gujarat	Sabarmati/Meshwo	22	54	18	72	44	26	35.510	7380C5AA
26	Kheda	B	Kheda	Gujarat	Sabarmati/Watrak	22	44	48	72	40	57	19.000	7380CB78
27	Vautha	B	Kheda	Gujarat	Sabarmati	22	39	1	72	31	59	12.000	7380D6DC
28	Lowara	B	Bhavnagar	Gujarat	Shetrunji	21	26	40	71	33	37	56.000	738137D4
29	Lachchai	A	Sabarkanta	Gujarat	Sabarmati	23	19	54	73	1	47	125.000	7380D80E
30	Borij	A	Gandhinagar	Gujarat	Sabarmati	23	16	6	72	41	22	70.000	7380ED94
	BLSD PALANPUR												
31	Swaroopganj (Seasonal)	B	Sirohi	Rajsthan	Banas	24	39	33	72	55	45	334.450	7380F030
32	Mount Abu (Seasonal)	A	Sirohi	Rajsthan	Banas	24	35	13	72	42	13	1387.000	7380FEE2
33	Ambaji (Seasonal)	A	Banaskantha	Gujarat	Banas	24	19	48	72	51	4	465.000	7381024E
34	Abu Road	B	Sirohi	Rajsthan	Banas	24	29	35	72	47	30	254.850	73810C9C
35	Sarotry	B	Banaskantha	Gujarat	Banas	24	22	3	72	32	45	186.000	73811138
36	Chitrasani	B	Banaskantha	Gujarat	Banas/Balaram	24	17	8	72	30	1	184.000	73811FEA
37	Dantiwada Dam	C	Banaskantha	Gujarat	Banas	24	20	12	72	20	19	175.910	738124A2
38	Bhakudar (Sipu Dam)	C	Banaskantha	Gujarat	Banas/Sipu	24	24	1	72	18	33	178.200	73812A70

* A - Rainfall Station; B - Rainfall and River Water Level stations; C - Rainfall & raservoir water level stations; D - Water level and Automatic weather stati

STATUS OF TELEMETRY SYSTEM

Name of Organisation; NTBO, CWC, Gandhinagar

Name of Division: Mahi Division, CWC, Gandhinagar

SN.	Name of station	River/ Tributary	Type of sensor(s) A/B/C/D	Status			Status of data * accuracy at modeling center		Remarks	Post monsoon calibration completion date
				Reduction if any	Working/ not working/ Satisfactory	Period from which data was transmitted	Rainfall	Water level		
1	2	3	4	5	6	7	8	9	10	11
1	Mataji	Mahi	B	Bubbler chamber to be extended	Not Working Satisfactory	26.03.2012	Not matching		-	26.12.13
2	Mahi Dam	Mahi	C	Nil	-do-	26.03.2012	Not matching		-	18.11.13
3	Dhariawad	Mahi/Jakham	B	Bubbler chamber to be extended	-do-	26.03.2012	Not matching		-	11.11.13
4	Somkamla Amba Dam	Mahi/Som	C	Nil	-do-	29.01.2012	Not matching		-	13.11.13
5	Rangeli	Mahi/Som	B	Bubbler chamber to be extended	-do-	26.03.2012	Not matching		-	12.11.13
6	Paderdibadi	Mahi	B	WL is below the level of termination block and needs extension.	-do-	26.03.2012	Not matching		-	22.11.13
7	Anas Ph- II (Seasonal)	Mahi/Anas	B	WL is below the level of termination block and needs extension.	-do-	03.11.2012	Not matching		-	26.11.13
8	Chakaliya	Mahi/Anas	D	Bubbler chamber to be extended	-do-	26.03.2012	Not matching		-	18.12.13
9	Kadana- Dam	Mahi	C	Nil	-do-	26.03.2012	Not matching		-	12.11.13
10	Panam Dam	Mahi/Panam	C	Nil	-do-	29.01.2012	Not matching		-	15.11.13
11	Wanakbori	Mahi	C	Bubbler chamber to be extended	-do-	26.03.2012	Not matching		-	16.11.13
12	Khanpur	Mahi	B	Bubbler chamber to be extended	-do-	26.03.2012	Not matching		-	14.11.13
13	*Jhabua*	Mahi/Anas	A	Nil	-do-	29.0.2012	Not compared		ORG of CWC not available for comparison	27.12.13
14	Sei Dam	Sabarmati	C	Nil	-do-	21.06.2011	Not matching		-	15.11.13
15	Jotasan	Sabarmati/Wakal	B	Bubbler and battery has be thefted	-do-	10.06.2011	Not matching		-	not done, since site was not functioning due to theft

STATUS OF TELEMETRY SYSTEM

Name of Organisation; NTBO, CWC, Gandhinagar Name of Division: Mahi Division, CWC, Gandhinagar

SN.	Name of station	River/ Tributary	Type of sensor(s) A/B/C/D	Status			Status of data * accuracy at modeling center		Remarks	Post monsoon calibration completion date
				Reduction if any	Working/ not working/ Satisfactory	Period from which data was transmitted	Rainfall	Water level		
1	2	3	4	5	6	7	8	9	10	11
16	Kheroj	Sabarmati	B	Nil	-do-	26.03.2011	Not matching		-	17.12.13
17	Harnav Weir	Sabarmati	C	Nil	-do-	27.03.2011	Not matching		-	18.11.2013
18	Dharoi Dam	Sabarmati	C	Nil	-do-	04.06.2011	Not matching		-	16.11.13
19	Derol Bridge	Sabarmati	B	Reinstallation of block chamber yet to be done by contractor	-do-	18.03.2011	Not matching		Theft of soloar panel and battery ocurred on 11.02.2014.	18.11.13
20	Hathmati Weir	Sabarmati / Hathmati	C	with nozzle point. HDPE p	-do-	05.08.2011	Not matching		-	18.11.13
21	Subhash Bridge	Sabarmati	D	Nil	-do-	25.05.2012	Not matching		-	26.11.13
22	Watrak Dam	Sabarmati/W atrak	C	Nil	-do-	29.01.2012	Not matching		-	10.01.14
23	Ratanpur	Sabarmati/W atrak	B	Soil has deposited about 1.5 mt. over termination block.	-do-	26.03.2012	Not matching		Bubbler chamber to be extended	11.01.14
24	Raska Weir	Sabarmati/Me shwo	C	Nil	-do-	26.03.2012	Not matching		-	14.11.13
25	Kheda	Sabarmati/W atrak	B	Nil	-do-	15.6.11	Not matching		-	13.11.13
26	Vautha	Sabarmati	B	Soil has deposited about 1.5 mt. over termination block.	-do-	16.6.11	Not matching		Bubbler chamber to be extended	10.01.14
27	*Jharol*	Sabarmati	A	Nil	-do-	03.07.2011	Not matching			14.11.13
28	Swaroopganj (Seasonal)	Banas	B	Bubbler chamber and DCP disconnected. RF sensor is working	-do-	23.6.11	Not matching		WL was below the level of bubbler chamber during whole monsoon period.	30.01.14
29	Mount Abu (Seasonal)	Banas	A	Nil	-do-	29.01.2012	Not matching	-	-	20.11.13

STATUS OF TELEMETRY SYSTEM

Name of Organisation; NTBO, CWC, Gandhinagar — Name of Division: Mahi Division, CWC, Gandhinagar

SN.	Name of station	River/ Tributary	Type of sensor(s) A/B/C/D	Status			Status of data * accuracy at modeling center		Remarks	Post monsoon calibration completion date
				Reduction if any	Working/ not working/ Satisfactory	Period from which data was transmitted	Rainfall	Water level		
1	2	3	4	5	6	7	8	9	10	11
30	Ambaji (Seasonal)	Banas	A	Nil	-do-	03.05.2012	Instrument dismantled	-	Telemetry system is currently dismantled due to construction work at site	16.11.13
31	Abu Road	Banas	B	Bubbler chamber stolen in Oct-13. Extension of bubbler chamber also required	-do-	1.6.11	Not matching		-	19.11.13
32	Sarotry	Banas	B	Bubbler chamber to be extended	-do-	1.6.11	Not matching		-	13.11.13
33	Chitrasani	Banas /Balaram	B	Bubbler chamber to be extended	-do-		Not matching		-	13.11.13
34	Dantiwada Dam	Banas	C	Nil	-do-	26.03.2012	Not matching		-	12.11.13
35	Bhakudar (Sipu Dam)	Banas/Sipu	C	Nil	-do-	26.03.2012	Not matching		-	12.11.13
36	Lowara	Shetrunji	B	Nil	-do-	19.1.12	Not matching		-	09.01.14
37	Lachchai	Sabarmati	A	Nil	-do-	03.08.2011	Not compared	-	-	22.11.13
38	Borij	Sabarmati	A	Nil	-do-	29.01.2012	Not matching	-	-	18.11.13
39	MC at MD, GNR	-	-	Anti-Virus not ipdated	Working	Mar-11	Not matching		-	visits as per request

* Data not matching means the telemetered data is considered as matching if the variation of
i. Telemetered rainfall is within +2% of reading of manually observed (using ORG) data.
ii. Telemetered water level is within 1.5 cm of manually observed data.
The criteria adopted is as per the accuracy given in Contract Agreement no.UYD/AB/2010/04 Part – II, under Heading 'Technical specifications', Sub-heading no.4.2.1 and 4.3.1, page 165 & 167 respectively.

Data comparison was performed during monsoon and in post monsoon and winter many of the sites water level was below the level of termination block and some sites were dry. RF recorded is almost nil after monsoon so no data for comparison.

Statement - 17 a

Basinwise -Riverwise- Flood Forecasting Information in India during Flood Season 2013												
Sl.No.	Name of the river	Name of FF site	Name of State	Warning Level (m)	Danger level (m)	Highest Flood Level		Maximum Level -2013		No.of Forecasts issued	No.of Forecasts within limits	Percent-age of accuracy
						Level (m)	Date/ Month/ Year	Level (m)	Date and Time DD/MM/YY)			
1	2	3	4	5	6	7	8	9	10	11	12	13.00
	Western River Systems:											
1	Banas	Dantiwada Dam	Gujarat	182.88	185.06	186.04	01/09/1973	175.73	14.10.13, 1700	2	2	100.00
2	Sabarmati	Dharoi Dam	Gujarat	187.45	192.25	189.63	03/09/1990	186.925	15.10.13, 1800	0	0	-
3	Sabarmati	Ahmedabad	Gujarat	44.09	45.34	47.45	19/08/2006	41.97	06.09.13, 2100	0	0	-
4	Mahi	Kadana Dam	Gujarat	126.19	127.71	127.74	09/09/1989	127.69	05.10.13, 1300	21	21	100.00
5	Mahi	Wanakbori	Gujarat	71.00	72.54	76.10	12/08/2006	72.01	02.08.13, 1900	16	16	100.00
									Total Forecasts	***39***	***39***	**100.00**
									Level Forecasts	**16**	**16**	**100.00**
									Inflow Forecast	**23**	**23**	**100.00**

Statement - 17b

Statewise Flood Forecasting Information In India during Flood Season 2013

Sl.No.	Name of the river	Name of FF site	Warning Level (m)	Danger level (m)	Highest Flood Level		Maximum Level -2013				
					Level (m)	Date/ Month/ Year	Level (m)	Date and Time DD/MM/YY)	No.of Forecasts issued	No.of Forecasts within limits	Percent-age of accuracy
1	2										
	Gujarat										
1	Banas	Dantiwada Dam	182.88	185.06	186.04	01/09/1973	175.73	14.10.13, 1700	2	2	100.00
2	Sabarmati	Dharoi Dam	187.45	192.25	189.63	03/09/1990	186.925	15.10.13, 1800	0	0	-
3	Sabarmati	Ahmedabad	44.09	45.34	47.45	19/08/2006	41.97	06.09.13, 2100	0	0	-
4	Mahi	Kadana Dam	126.19	127.71	127.74	09/09/1989	127.69	05.10.13, 1300	21	21	100.00
5	Mahi	Wanakbori	71.00	72.54	76.10	12/08/2006	72.01	02.08.13, 1900	16	16	100.00
							Total Forecasts		***39***	***39***	**100.00**
							Level Forecasts		**16**	**16**	**100.00**
							Inflow Forecast		**23**	**23**	**100.00**

Statement- 17c

Performance of Flood Forecasting Stations (Divisionwise) in India during Flood Season 2013

Sl. No	Division	Level Forecasts only					Inflow Forecasts only					Total Forecast Stations				
		Stns.	F/c issued for	Total	Within Limit	Accuracy	Stns.	F/c issued for	Total	Within Limit	Accuracy	Stns.	F/c issued for	Total	Within Limit	Accuracy
1	Himalayan Ganga Divn, Dehradun															
2	Middle Ganga Division 1, Lucknow															
3	Middle Ganga Division 2, Lucknow															
4	Middle Ganga Division 3, Varanasi															
5	Middle Ganga Division 4, Patna															
6	Middle Ganga Division 5, Patna															
7	Upper Yamuna Divn, Delhi															
8	Chambal Division, Jaipur															
9	Lower Yamuna Divn, Agra															
10	Damodar Divn, Asansol															
11	Upper Brahmaputra Divn, Dibrugarh															
12	Middle Brahmaputra Divn, Guwahati															
13	Lower Brahmaputra Divn, Jalpaiguri															
14	Eastern Rivers Divn, Bhubaneswar															
15	Mahanadi Divn, Burla															
16	Lower Godavari Divn, Hyderabad															
17	Lower Krishna Divn, Hyderabad															
18	Mahi Divn, Ahmedabad	2	1	16	16	100.00	3	2	23	23	100.00	5	3	39	39	100.00
19	Tapi Divn,Surat															
20	Narmada Divn, Bhopal															
Total		**2**	**1**	**16**	**16**	**100.00**	**3**	**2**	**23**	**23**	**100.00**	**5**	**3**	**39**	**39**	**100.00**

FLOOD FORECASTING PERFORMANCE FROM 2000 TO 2013

Year	No.of Level Forecasts issued			No.of Inflow Forecasts issued			Total No.of Forecasts issued		
	Total	Within +/-15 cm of deviation from actual	Accuracy (%)	Total	Within +/- 20% cumec of deviation from actual	Accuracy (%)	Total	Within +/- 15 cm or +/- 20% cumec of deviation from actual	Accuracy (%)
2000	0	0	-	0	0	0.00	0	0	-
2001	0	0	-	2	2	100.00	2	2	100.00
2002	0	0	-	1	1	100.00	1	1	100.00
2003	0	0	-	6	6	100.00	6	6	100.00
2004	27	24	88.89	21	20	95.24	48	44	91.67
2005	1	0	0.00	15	13	86.67	16	13	81.25
2006	56	49	87.50	113	108	95.58	169	157	92.90
2007	17	13	76.47	31	30	96.77	48	43	89.58
2008	0	0	-	0	0	0.00	0	0	-
2009	0	0	-	5	5	100.00	5	5	100.00
2010	0	0	-	1	1	100.00	1	1	100.00
2011	5	4	80.00	33	32	96.97	38	36	94.74
2012	21	19	90.48	24	24	100.00	45	43	95.56
2013	16	16	100.00	23	23	100.00	39	39	100.00
Average	10	8	80.00	19	19	100.00	29	27	93.10

Plate No.1

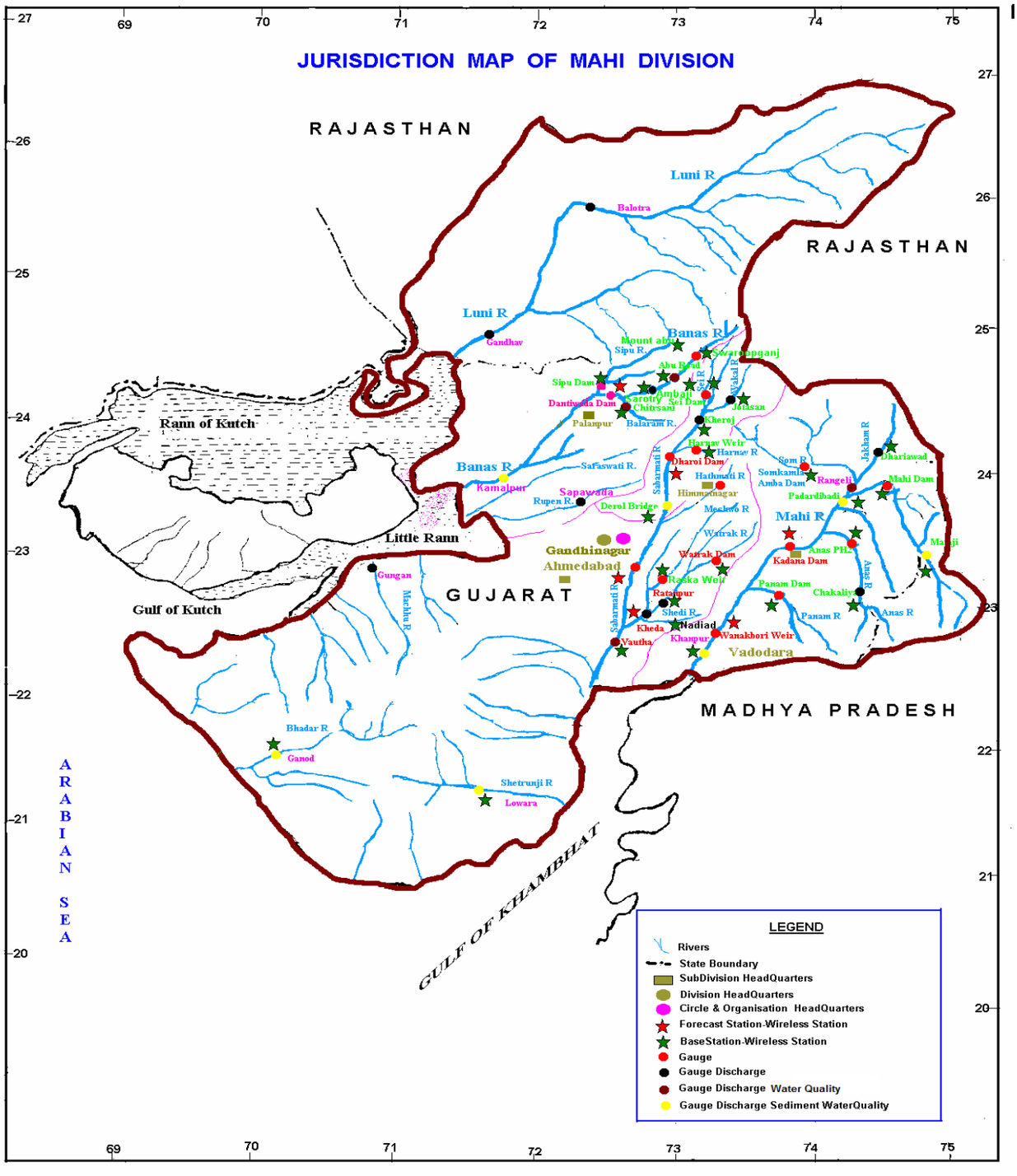
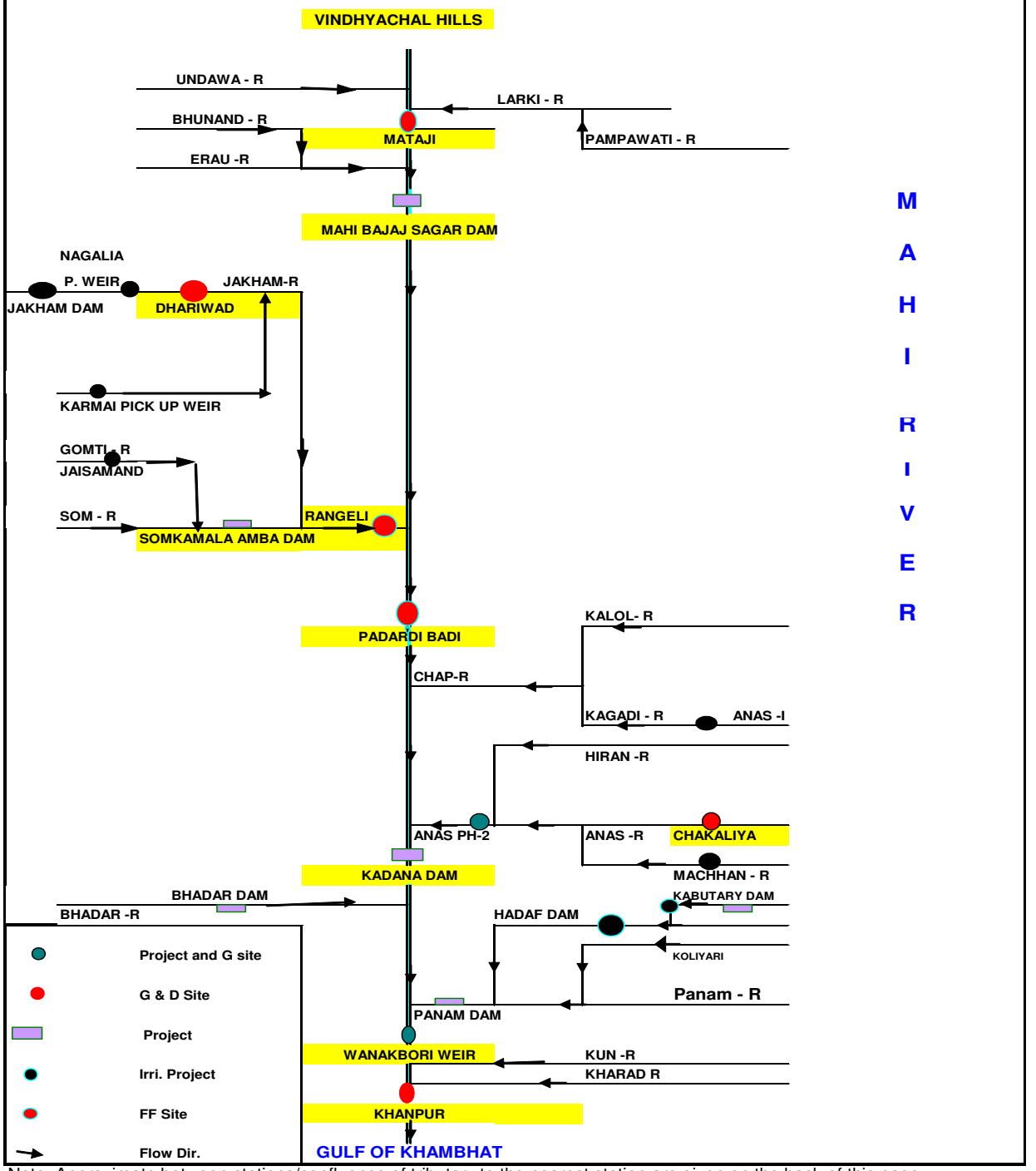

JURISDICTION MAP OF MAHI DIVISION
RAJASTHAN
RAJASTHAN
MADHYA PRADESH
GUJARAT
Rann of Kutch
Little Rann
Gulf of Kutch
GULF OF KHAMBHAT
ARABIAN SEA
Luni R
Balotra
Gandhav
Banas R
Mount abu
Sipu R.
Swaroopganj
Abu Road
Sipu Dam
Ambaji
Sarotra
Chitrasni
Danthiwada Dam
Palanpur
Balaram R.
Jhilvan
Kheroj
Harnav Weir
Harnav R
Dharoi Dam
Hathmati R
Himmatnagar
Saraswati R.
Kamalpur
Sapawadia
Rupen R.
Derol Bridge
Meshwo R
Watrak R
Watrak Dam
Raska Weir
Ratanpur
Shedi R.
Kheda
Nadiad
Vautha
Khampur
Wanakbori Weir
Vadodara
Gandhinagar
Ahmedabad
Sabarmati R
Som R
Somkamla
Amba Dam
Rangpur
Padardibadi
Mahi R
Kadana Dam
Anas PH2
Panam Dam
Panam R
Chakaliya
Anas R
Jakham R
Dhariawad
Mahi Dam
Gungan
Machhu R
Bhadar R
Ganod
Shetrunji R
Lowara
LEGEND
Rivers
State Boundary
SubDivision HeadQuarters
Division HeadQuarters
Circle & Organisation HeadQuarters
Forecast Station-Wireless Station
BaseStation-Wireless Station
Gauge
Gauge Discharge
Gauge Discharge Water Quality
Gauge Discharge Sediment WaterQuality

Plate No.2


FLOOD FORECASTING NETWORK IN MAHI BASIN
73
74
75
25
24
23
22
TO UDAIPUR
RAJASTHAN
JAISMAND
DHARIAWAD
JAKHAM R.
SOM KAMALA AMBA DAM
SOM R.
DUNGARPUR
RANGELI
MAHI BAJAJ SAGAR DAM
MAHI R.
PADARDIBADI
TO HIMAT NAGAR
MODASA
BANSWARA
RATLAM
ANAS PH2
MATAJI
KADANA DAM
GUJARAT
CHAKALIA
MAHI R.
PANAM DAM
TO AHMEDABAD
WANAKBORI WEIR
ANAS R.
MAHI R.
GODHRA
JHABUA
NADIAD
KHANPUR
TO DHAR
GULF OF KHAMBHAT
VADODARA
MADHYA PRADESH
TO MUMBAI
Flood Level Forecast Station
Inflow Forecast Station
Base Station
Wireless Station
Gauge
Alerting Station
Gauge Discharge
Gauge Discharge Water Quality
Gauge Discharge Sediment Water Quality

Plate No.3

LINE DIAGRAM - MAHI BASIN



Note: Approximate between stations/confluence of tributary to the nearest station are given on the back of this page.

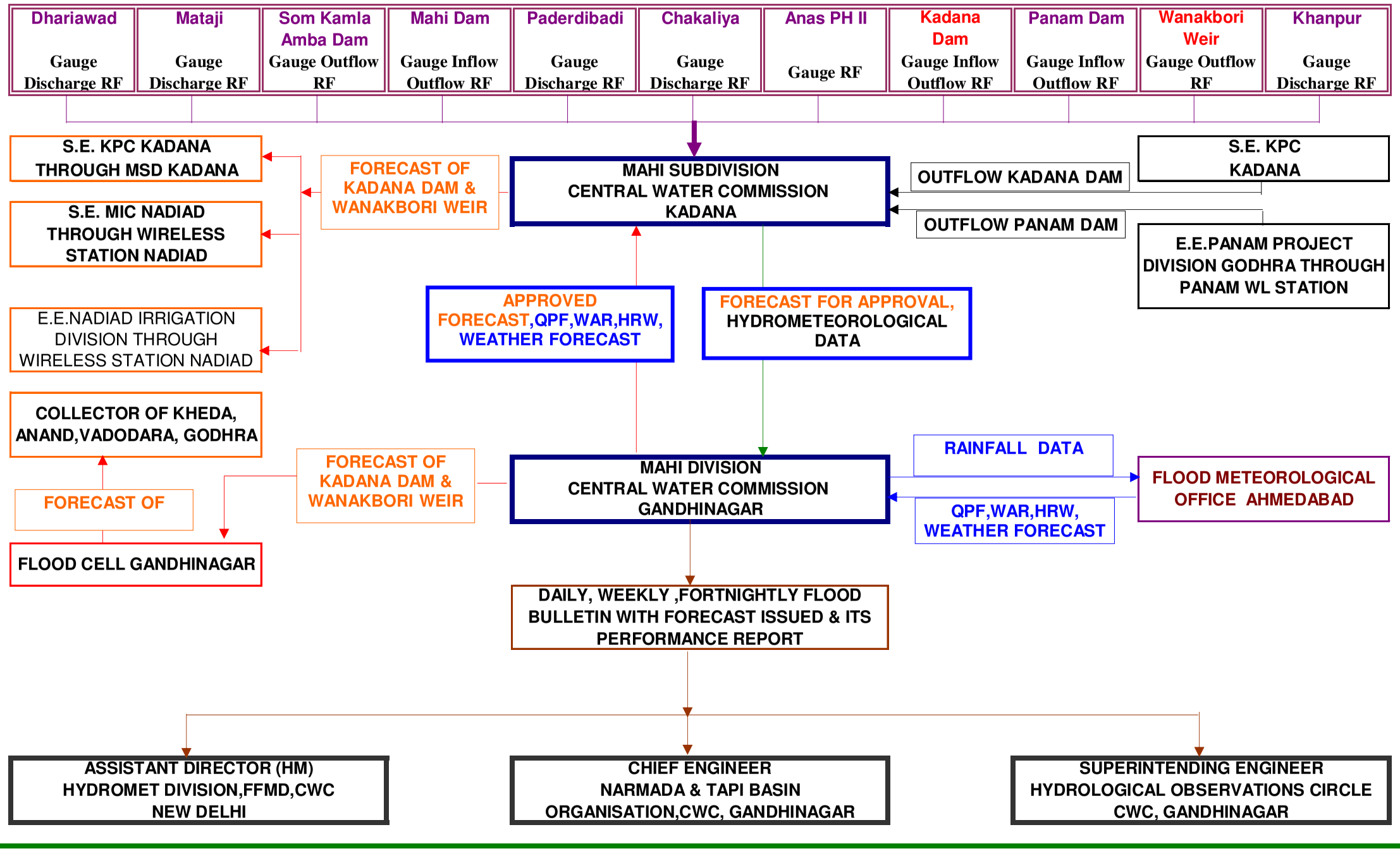
Distance from origin of river/ between various stations on Mahi river system

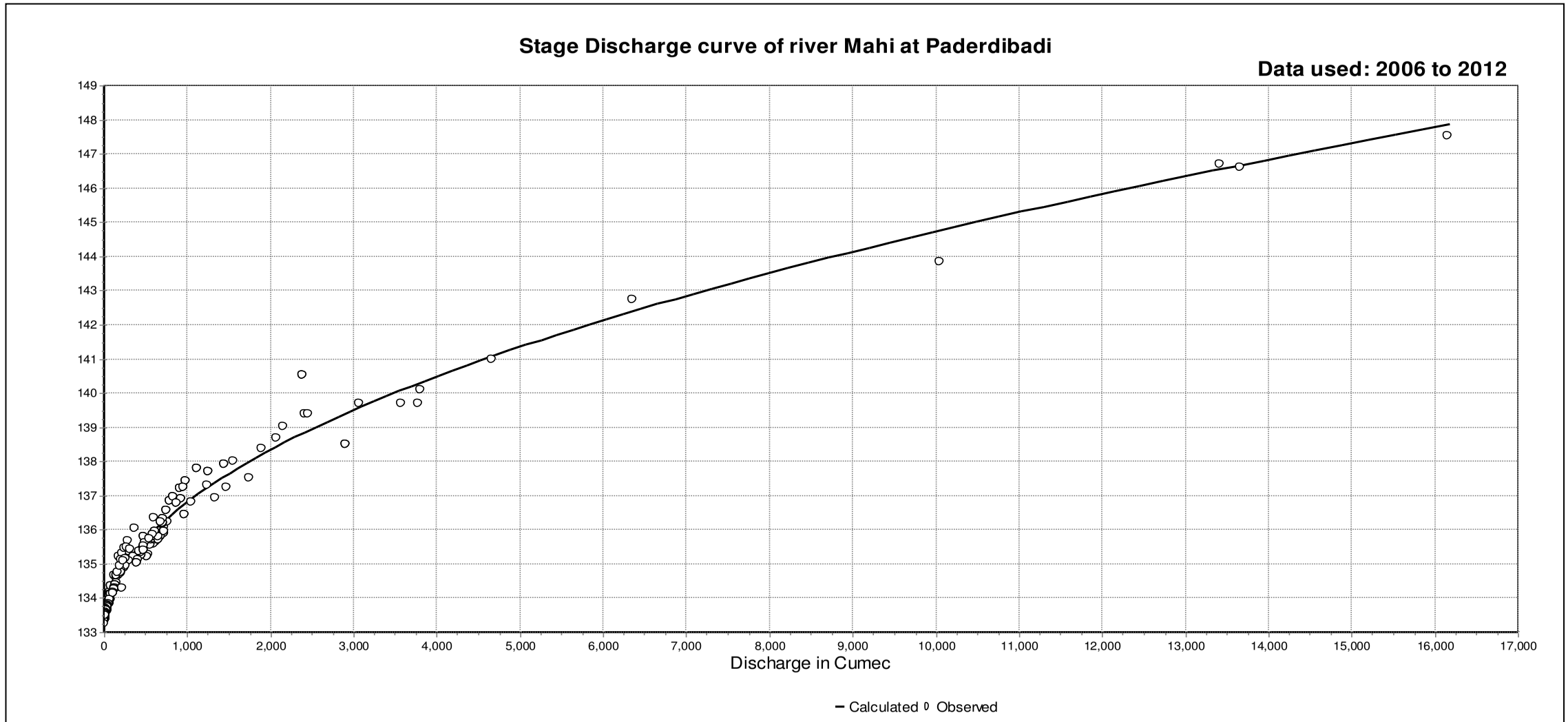
Station		Distance
From	To	(Km)
Mahi river Origin	Mataji	125
Mataji	Mahi dam	60
Mahi dam	Paderdibadi	81
Origin of Som river	Som Kamla Amba (SK) dam	100
SK dam	Rangeli	40
Rangeli	Som river confluence	10
Origin of Jakham river	Dhariawad	70
Dhariwad	Jakham river confluence	47
Origin of Anas river	Chakaliya	125
Chakaliya	Anas PH-II	22
Anas PH-II	Anas river confluence	36
Paderdi badi	Kadana dam	71
Anas river confluence	Kadana dam	21
Origin of Panam river	Panam dam	95
Panam dam	Panam dam confluence	18.75
Kadana dam	Wanakbori weir	74
Panam dam confluence	Wanakbori weir	22.5
Wanakbori weir	Khanpur	15

Note: Details of Catchment area of the site is given on **Statement No.2**

SCHEMATIC DIAGRAM SHOWING FORECAST ACTIVITIES IN MAHI BASIN DURING FLOOD SEASON

Plate No. 4





Procedure : Standard

Equation type: Power Q = c(a+h)^b

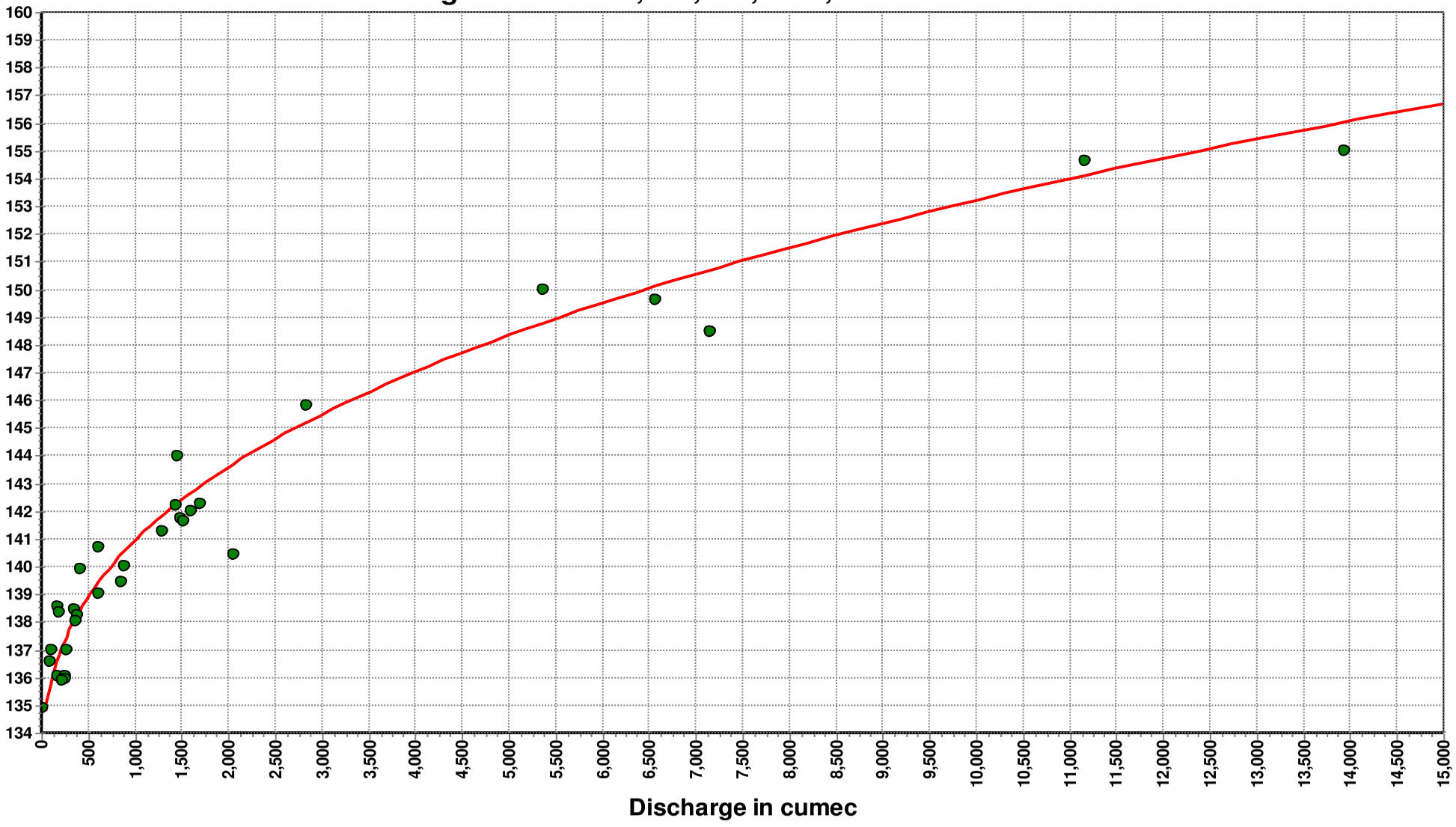
Parameters:

LB	UB	a	b	c
133	148	-133.1	2.024	69.427

Interval	. error of est.	Number of data	Degrees of freedom	% T-value Re	Actual T-value	Result
1	25.991	292	582	1.964	1.517	Accept

Plate No.5b

Rating Curve of Anas at Anas PH-2 for flood forecasting purpose(Base station for Kadana Dam) using data of 1987,188,989,1990,1992 and 1994



Equation Q=C*(h+a)^b Procedure : Standard

Eq.No.	LB	UB	a	b	c
1	134.8	157	-132.024	2.658	2.993

Plate No.6a

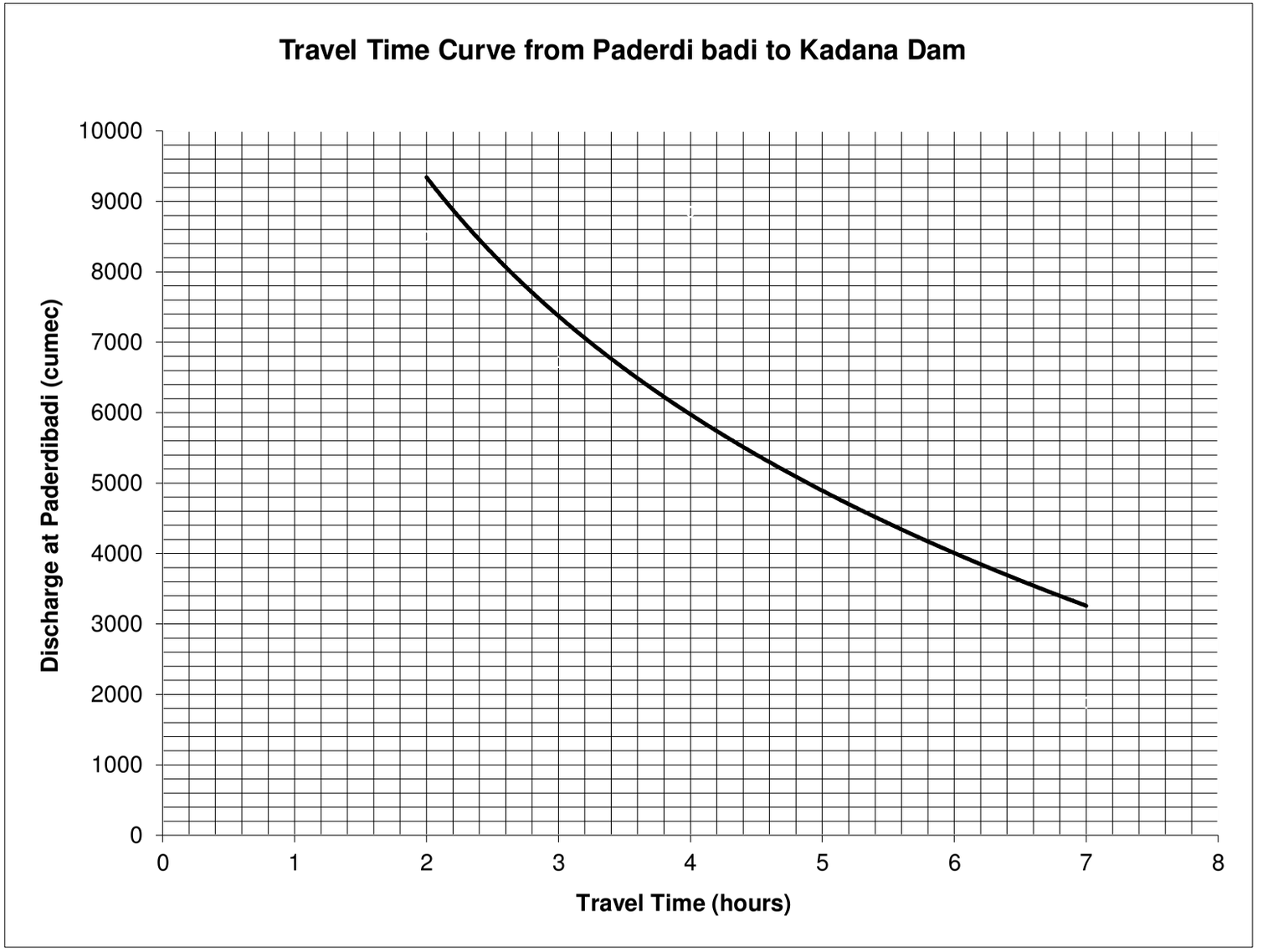

Travel Time Curve from Paderdi badi to Kadana Dam
Discharge at Paderdibadi (cumec)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
Travel Time (hours)

Plate No.6b

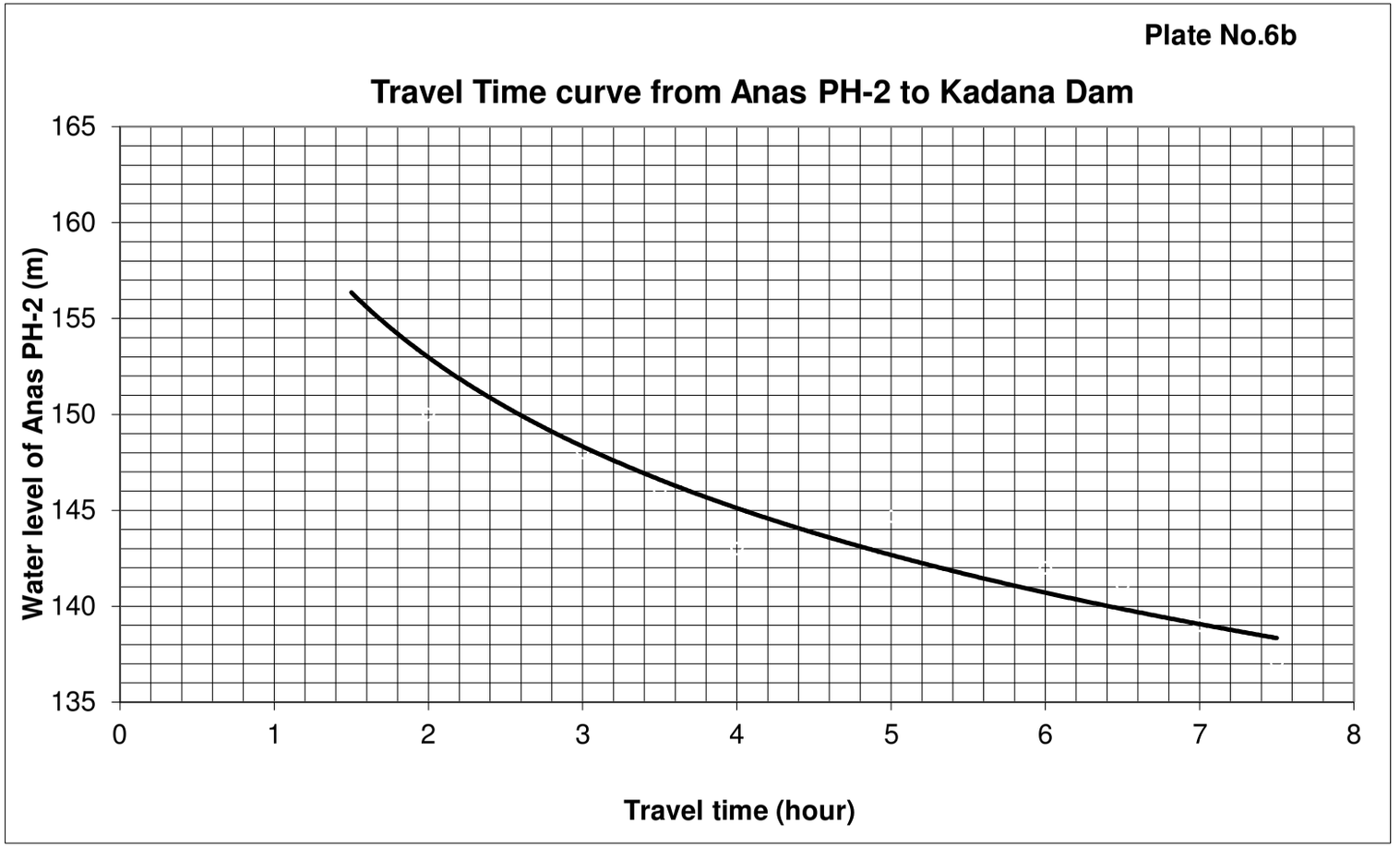

Travel Time curve from Anas PH-2 to Kadana Dam
Water level of Anas PH-2 (m)
165
160
155
150
145
140
135
0
1
2
3
4
5
6
7
8
Travel time (hour)

Plate No.7

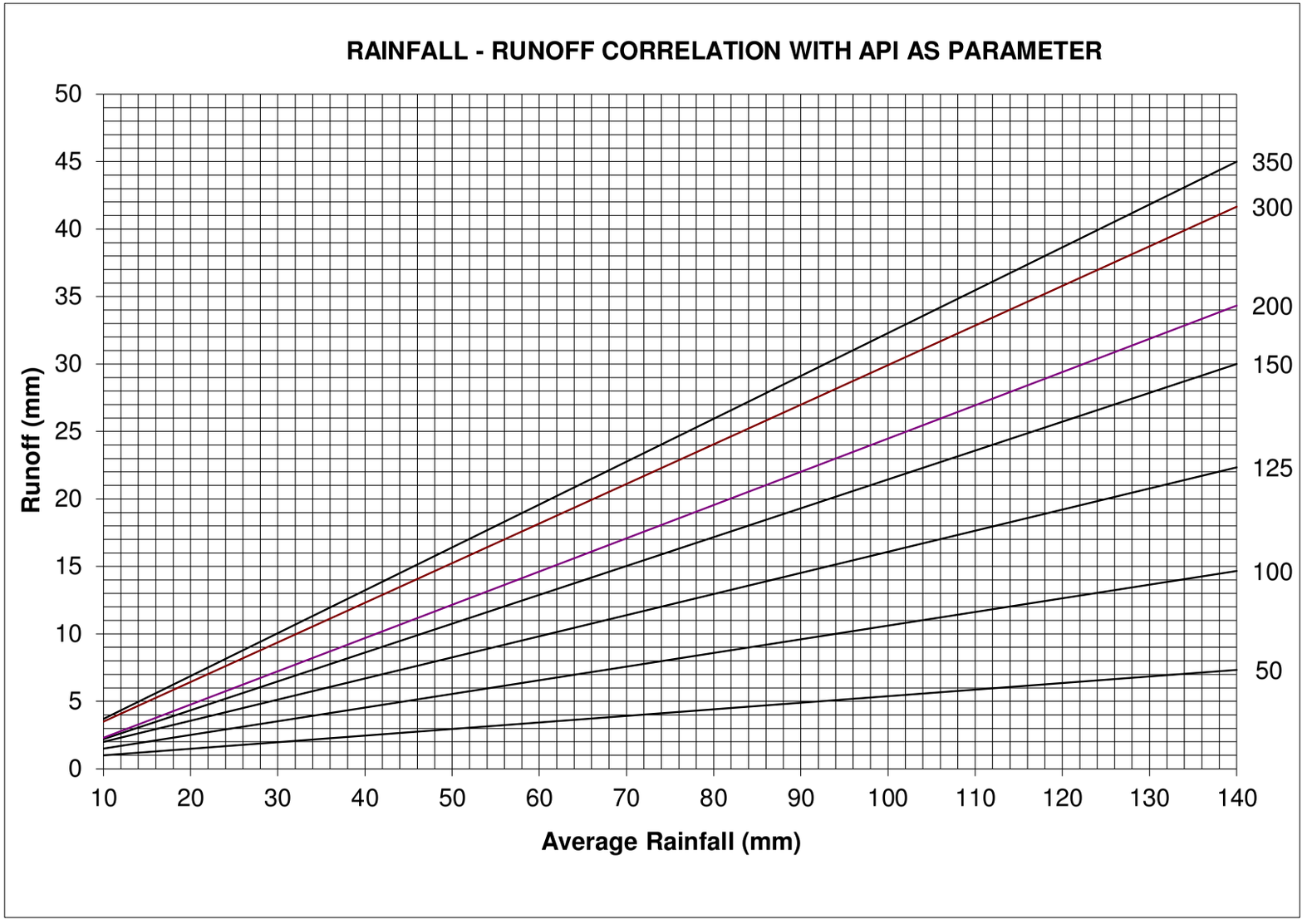

RAINFALL - RUNOFF CORRELATION WITH API AS PARAMETER
Runoff (mm)
0
5
10
15
20
25
30
35
40
45
50
Average Rainfall (mm)
10
20
30
40
50
60
70
80
90
100
110
120
130
140
350
300
200
150
125
100
50

Plate No. 8

Forecast Dissemination format used for Kadana dam Inflow forecast.

Flood Immediate

Telefax - 079-23239509/Control room:23243075
GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHI DIVISION
GANDHINAGAR – 382010.

CWC – INFLOW FORECAST

Forecast Number: MK -

Name of River: Mahi **Date of Issue:**

Site: Kadana Dam **Time of Issue:_____IST**

Danger Level: 127.71 m **Warning Level: 126.18 m**

FRL: 127.71 m **HFL:127.737 m / 1989**

As per Central Water Commission, the Reservoir level of Kadana Dam on River Mahi at _____hrs. on _____ (date) was _____ metres.

As per present indications/ data available with CWC _____ Million Cubic Metres (MCM) of water is likely to flow into the reservoir between _____ hrs. of _____ to _____ hrs. of _____.

Inflow is likely to increase/decrease/remain steady thereafter.

EXECUTIVE ENGINEER

Note:

1. *The Forecast given above is based on present indications available at base stations Paderdibadi and Anas PH-II with the assumption that there is no appreciable rain in the intermediate catchment during the period of forecast.*
2. *The forecast period given above supersedes the forecast issued previously for the overlapping period, if any.*

Copy for confirmation in regard of message transmitted on W/L, Phone / Fax.
No.MD/HM/Forecast/2013/ Date:

Copy for necessary action

1. The Superintending Engineer, Kadana Project Circle,Diwada Colony, Kadana (through AE, MSD Kadana). Tel./Fax no. 02675237525/ 237627.
2. The Superintending Engineer, Mahi Irrigation Circle, Sarakari Vasahat, Mission Road, Nadiad (through CWC Nadiad wireless station). Tel.no. 0268 2555481/2556412, Fax No. 2556270
3. Flood Control Cell, Sardar Training Centre, Walmi Campus, Sector-8,Gandhinagar. Tel.no. (direct) 23248735/36, Fax No.23240553.

Copy for information:

4. The Chief Engineer, NTBO, CWC., Gandhinagar
5. The Superintending Engineer, HOC, CWC., Gandhinagar
6. The Assistant Director (HM) Flood Forecasting Monitoring Directorate, Room No.828(N) Sewa Bhawan, R.K.Puram, New Delhi-110 066 (through Fax No.011-26105274/26106523.

Copy to:

7. The Sub-Divisional Engineer, Mahi Sub Division, CWC Kadana(through Phone or Fax 02675-237667) or through wireless
8. The Site-in-charge, CWC Nadiad (through wireless)

Off: 3rd Floor, Narmada Tapi Bhavan, Sector 10 'A', Gandhinagar, Pin code-382010
E-mail: mahi_cwc@yahoo.co.in

Plate No.9

A WORKEDOUT EXAMPLE OF KADANA DAM INFLOW FORECAST

FORECSTING STATION : KADANA DAM BASE STATION: 1.Paderdi badi on Mahi
2. Anas PH-2 on Anas

Travel Time considered for 8 hours from both station.

A. Total Discharge from Base flow

Date	Time	Paderdibadi		Anas PH-2	
		Water Level(m)	Discharge Q1(cumec)	Water Level(m)	Dicharge Q2(cumec)
30th	0700	138.13	1838.22	140.3	823.5
August	0800	137.99	1734.71	140.28	818.2
2011	0900	137.98	1727.44	140.25	810.4
	1000	137.97	1720.18	140.23	805.1
	1100	137.96	1712.94	140.2	797.3
	1200	137.95	1705.71	140.15	784.4
	1300	137.94	1698.5	140.08	766.6
	1400*	137.94	1698.5	140.08	766.6
Total Discharge			13836.2		6371.1

*Assumed the Water level

Total Discharge = 13836.2 + 6371.1 = 20208.3 cumec

Total volume of water coming into Dam for next 8 hours from base station = 72.55 mcm

Intermittent rainfall contribution is = Nil

From Dungarpur area the incoming water (known from state

authority that there is heavy rainfall in down stream of Paderdibadi) is 8 mcm

since we do not have any station

At the time of forecast formulation the rate of inflow is 10.5 mcm. Hence it was assumed same inflow is going to continue for next 8 hours it comes to - 84 mcm.

Since base station water level is falling the forecast issued for 80mcm from 1300 hrs to 2100hrs of 30.8.2011.

Actual inflow into kadana dam is 82.79 mcm from 1300 to 2100 hrs of 30.08.2011

Plate No.10

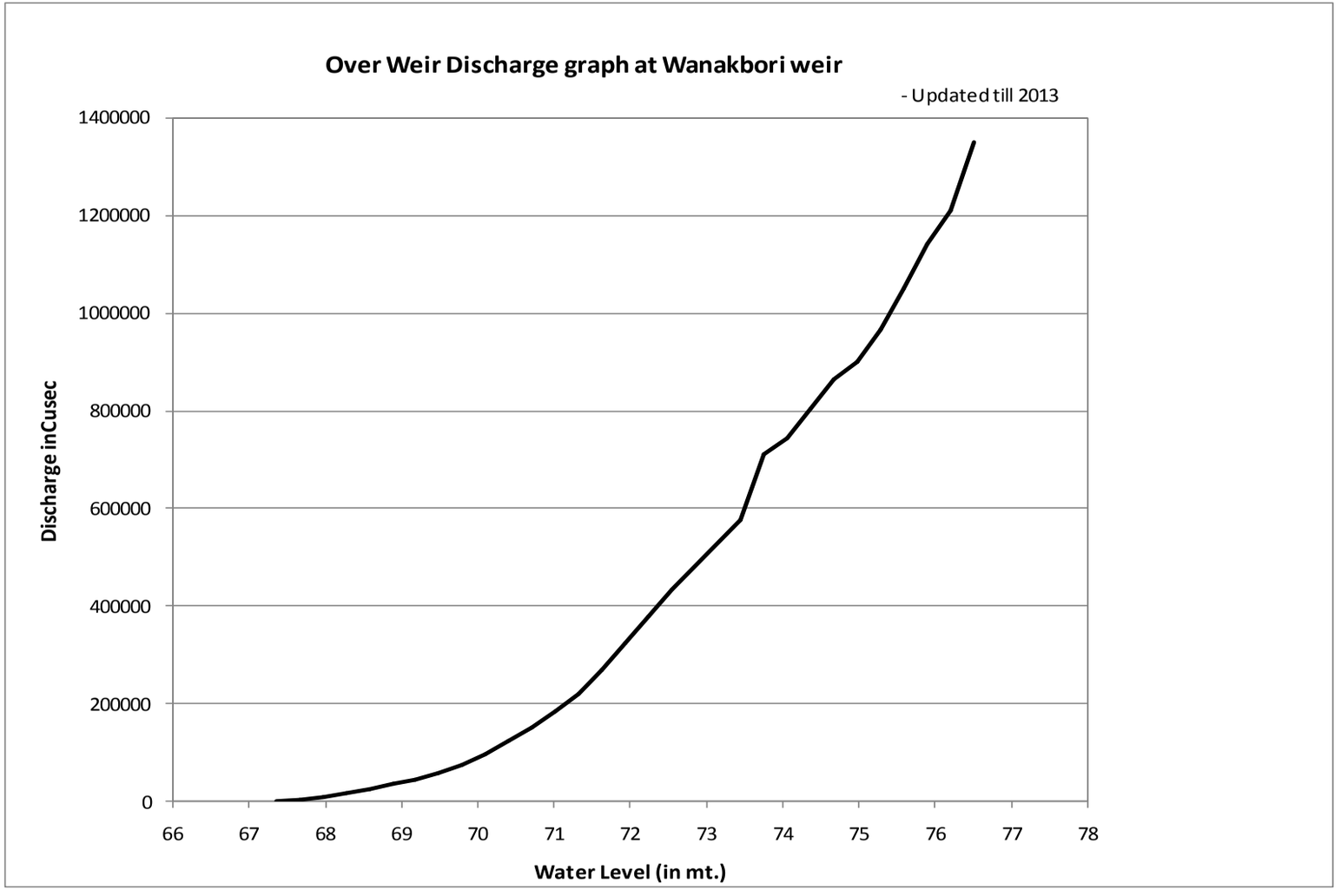
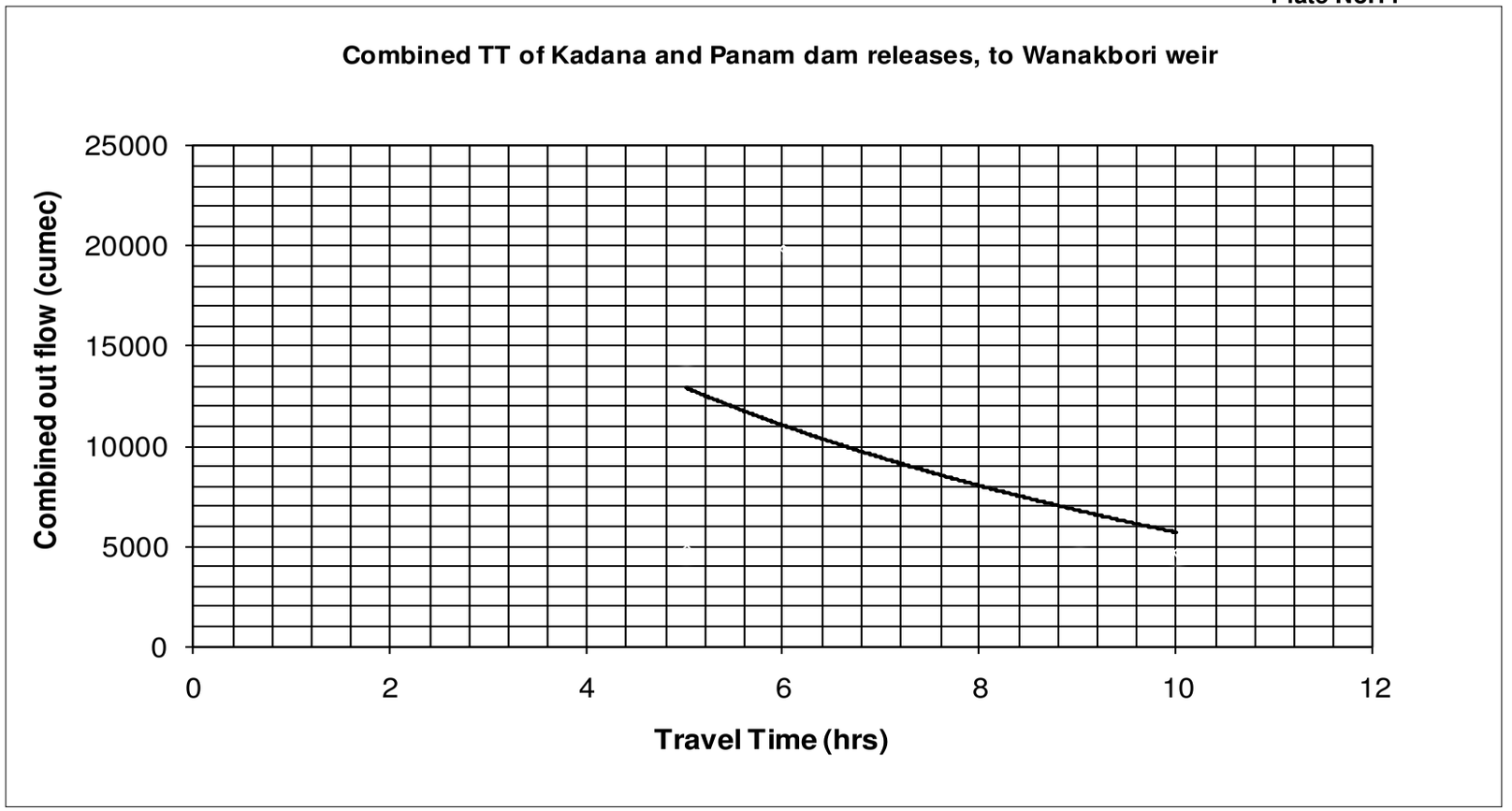

Over Weir Discharge graph at Wanakbori weir
- Updated till 2013
Discharge inCusec
1400000
1200000
1000000
800000
600000
400000
200000
0
66
67
68
69
70
71
72
73
74
75
76
77
78
Water Level (in mt.)

Plate No.11


Combined TT of Kadana and Panam dam releases, to Wanakbori weir
Combined out flow (cumec)
25000
20000
15000
10000
5000
0
0
2
4
6
8
10
12
Travel Time (hrs)

Forecast Dissemination format used for Wanakbori weir level forecast in case of Moderate Flood.

Flood Immediate

Telefax - 079-23239509/Control Room-23243075
GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHI DIVISION
GANDHINAGAR - 382010

CWC – FLOOD FORECAST

Forecast Number: MW -

Name of River: Mahi **Date of Issue:**

Site: Wanakbori Weir **Time of Issue:**

Danger Level: 72.54 m **Warning Level : 69.8 m**

H.F.L: 76.10 m / 12.08.2006

As per Central Water Commission, the water level of Wanakbori weir on River Mahi at _____hrs. on _____ (date) was _____ metres.

As per present indications/ data available with CWC, it is expected that water level will rise/ fall/ remain stationary and be near about _____ metres in the morning/ forenoon/ afternoon / evening/ night/ by _____ hrs. of _____.

Provided there is no/Appreciable rain in the intermediate catchment.

Thereafter, the level is likely to rise/ fall/ remain stationary.

Further forecast will follow, if found necessary.

EXECUTIVE ENGINEER

Copy for confirmation in regard of message transmitted on W/L, Phone / Fax.
No.MD/HM/Forecast/2013/ Date:

Copy for necessary action

1. The Superintending Engineer, Mahi IrrigationCircle, Sarkar Vasahat, Mission Road, Nadiad Tel.no. 0268 2555481/2556412, Fax No. 2556270.
2. The Superintending Engineer, Kadana Project Circle,Diwada Colony, Kadana.(through AE, MSD Kadana) Tel./Fax no.02675 237525/237627.
3. The Superintending Engineer, Panam Project Circle,Godhra. Tel No.02672 241931, Fax. No. 02672 242850.
4. The Executive Engineer, Kadana Division No.1,Diwada Colony, Kadana.(through AE MSD, CWC Kadana). Tel No. 02675 237674/237627.
5. The Executive Engineer, Nadiad Irrigation Division, Nadiad. Tel No. 0268 2566653/0543, Fax no. 0268 2549007.
6. The Flood Control Cell, Walmi Campus, Sardar Training Centre, Sector-8, Gandhinagar. Tel.no. (direct) 23248735/36, Fax No.23240553.

Copy for kind information:

7. The Chief Engineer, NTBO, CWC., Gandhinagar
8. The Superintending Engineer, HOC, CWC., Gandhinagar
9. The Assistant Director (HM) Flood Forecasting Monitoring Directorate, Room No.828(N) Sewa Bhawan, R.K.Puram, New Delhi-110 066 (through Fax No.011-26105274/26106523).

Copy to:

10. The Sub-Divisional Engineer, MSD, CWC Kadana(phone: 02675-237667)
11. The Site in-charge Wanakbori Weir and Nadiad

Off: 3rd Floor, Narmada Tapi Bhavan, Sector 10 'A', Gandhinagar, Pin code-382010
E-mail: mahi_cwc@yahoo.co.in

Plate No.13

WOKEDOUTEXAMPLE OF WANAKBORI WEIR LEVEL FORECASTING FORMULATION

FORECATING STATION; WANAKBORI WEIR

1. Kadana Dam on Mahi R
2.Panam Dam on Panam R

Date	Time	Kadana Dam outflow in cumec	Panam Dam Outflowin cumec	Total cumec
02.09.11	1300	4097.51	0	4097.51
	1400	4089.81	0	4089.81
	1500	3777.2	0	3777.2
	1600	4018.68	0	4018.68

averag outflow from Kadana Dam continously = 3995.58 cumec

1. 90% of 3995.58 cume = 3596 cumec
2. Travel time considered = 9 hours
3.Free catchment contribution (at 0300 hrs outflow from Kadana Dam is 1965.62 cumec and at 1500 is 2330 cumec Hence contribution from free catchment is 364 cumec considering 12 hour travel time of low flood
4. Probable inflow into Wanakbori Weir will be 3596 + 364 = 3960 cumec
5.The corresponding level at Wanakbori Weir will be = 70.33m fom S.d.Table
6.Forecast issued for 70.33 m between 2200 to 2300 hrs of 02.09.2011 at 1630 hrs
7.Actual level attained -70.33m at 2200 hrs
8.Variation= Nil

Plate No.14

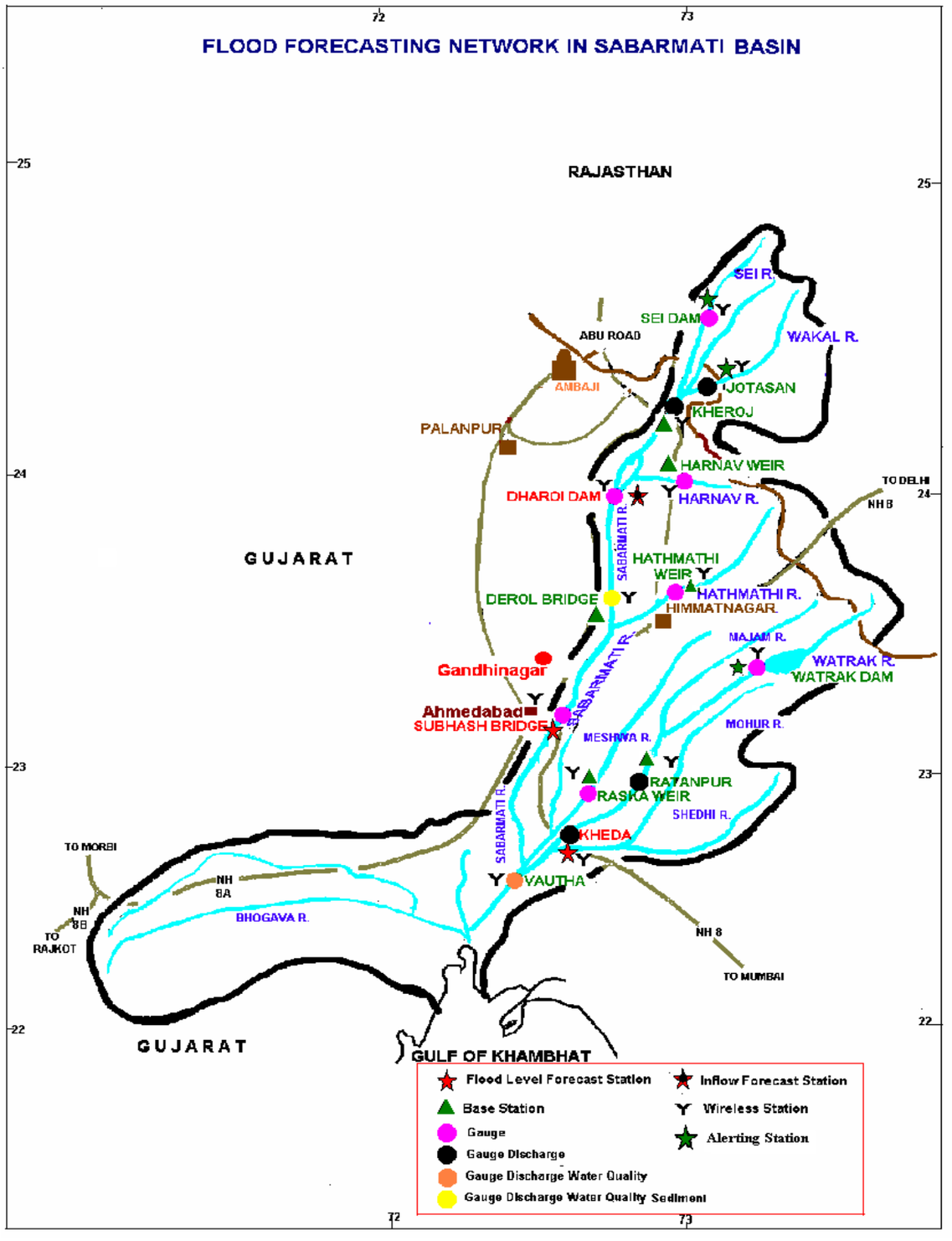
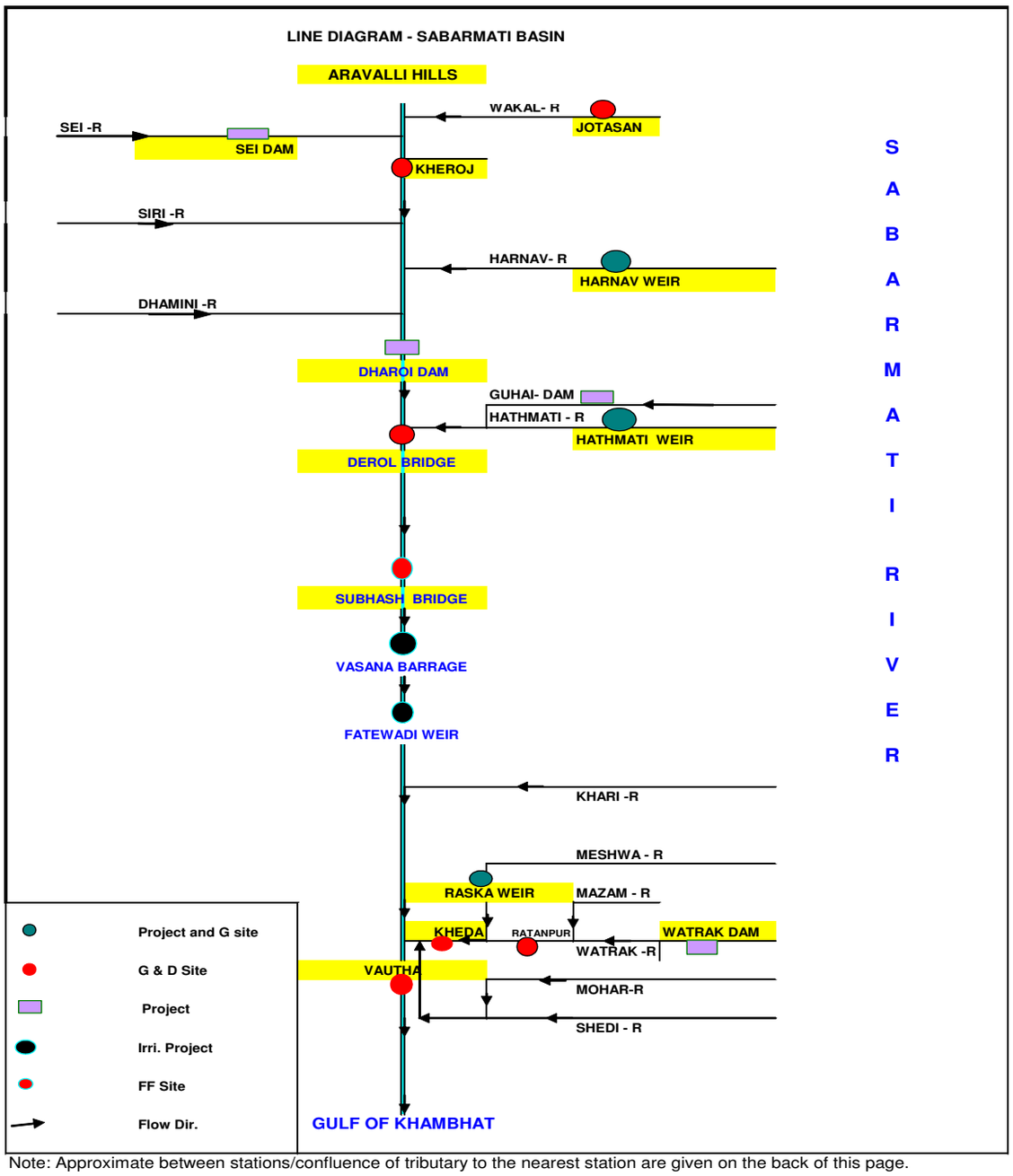

FLOOD FORECASTING NETWORK IN SABARMATI BASIN
RAJASTHAN
GUJARAT
GUJARAT
GULF OF KHAMBHAT
SEI R.
SEI DAM
ABU ROAD
WAKAL R.
AMBAJI
JOTASAN
KHEROJ
PALANPUR
HARNAV WEIR
DHAROI DAM
HARNAV R.
TO DELHI
NH 8
SABARMATI R.
HATHMATHI WEIR
HATHMATHI R.
DEROL BRIDGE
HIMMATNAGAR
MAZAM R.
WATRAK R.
WATRAK DAM
Gandhinagar
Ahmedabad
SUBHASH BRIDGE
MESHWA R.
MOHUR R.
RATANPUR
RASKA WEIR
SHEDHI R.
KHEDA
VAUTHA
TO MOREI
NH 8A
NH 8B
TO RAJKOT
BHOGAVA R.
NH 8
TO MUMBAI
Flood Level Forecast Station
Inflow Forecast Station
Base Station
Wireless Station
Gauge
Alerting Station
Gauge Discharge
Gauge Discharge Water Quality
Gauge Discharge Water Quality Sediment
72
73
25
24
23
22

Plate No.15



Note: Approximate between stations/confluence of tributary to the nearest station are given on the back of this page.

Distance from origin of river/ between various stations on Sabarmati river system

Station		Distance
From	To	(Km)
Origin of Watkal river	Jotasan	88
Jotasan	Watkal river confluence	6.75
Watkal river confluence	Kheroj	20.5
Origin of Sei river	Sei dam	36
Sei dam	Sei river confluence	79
Sei river confluence	Kheroj	4.5
Origin of Sabarmati river	Kheroj	130
Kheroj	Dharoi dam	33
Harnav weir	Dharoi dam	17.5
Dharoi dam	Derol bridge	58
Derol bridge	Hathmati weir confluence	10
Hathmati weir	Hathmati weir confluence	22.8
Hathmati weir confluence	Subhash bridge	79.6
Origin of Meshwo river	Raska weir	-
Raska weir	Meshwo river confluence	19
Meshwo river confluence	Kheda	7.5
Origin of Watrak river	Watrak dam	73
Watrak dam	Ratanpur	79
Ratanpur	Kheda	55.5
Kheda	Watrak river confluence	36
Subhash bridge	Voutha	64.5

Note: Details of Catchment area of the site is given on **Statement No.2**

Plate No.16

SCHEMATIC DIAGRAM SHOWING FORECAST ACTIVITIES IN SABARMATI BASIN DURING FLOOD SEASON

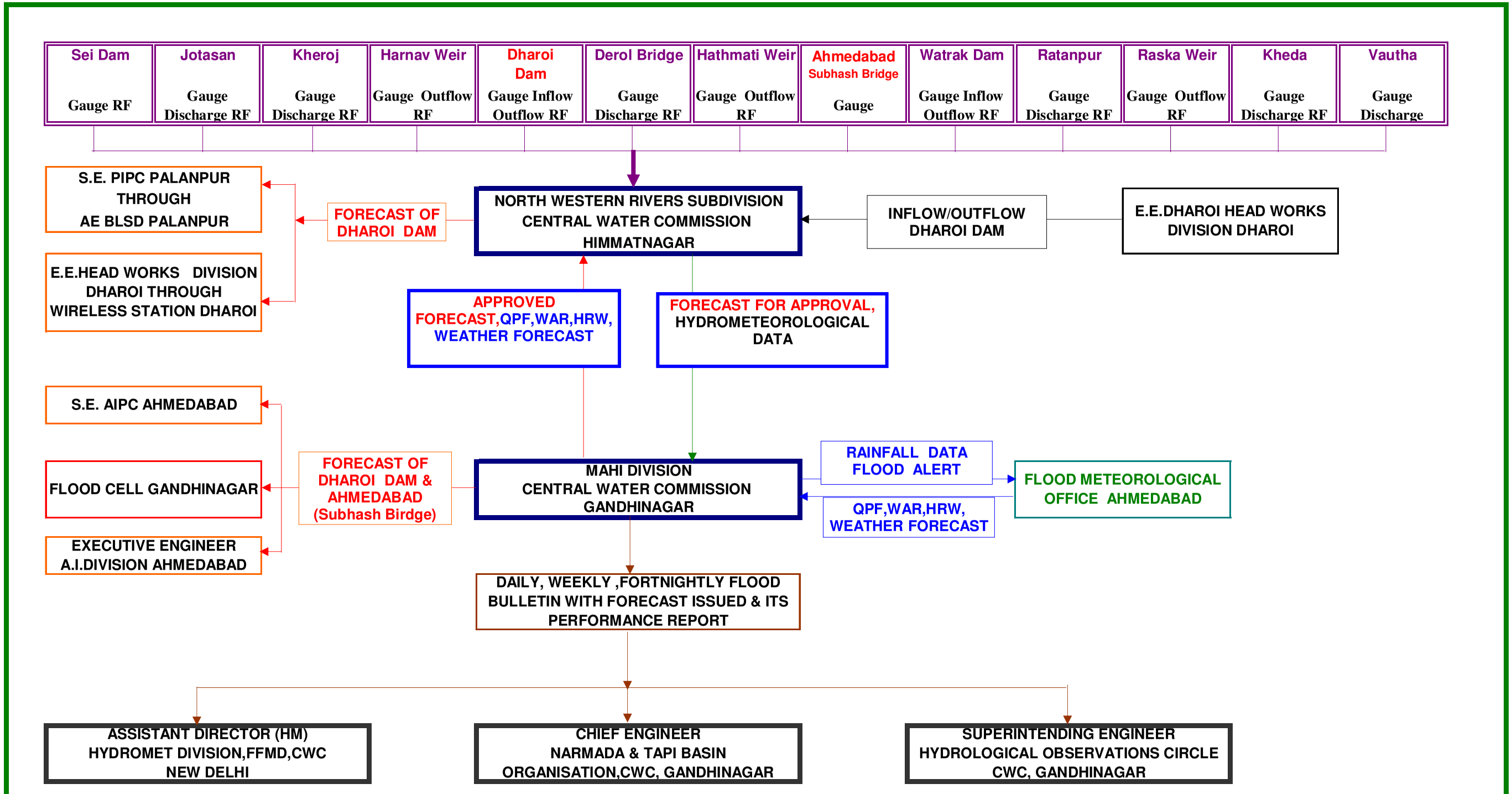
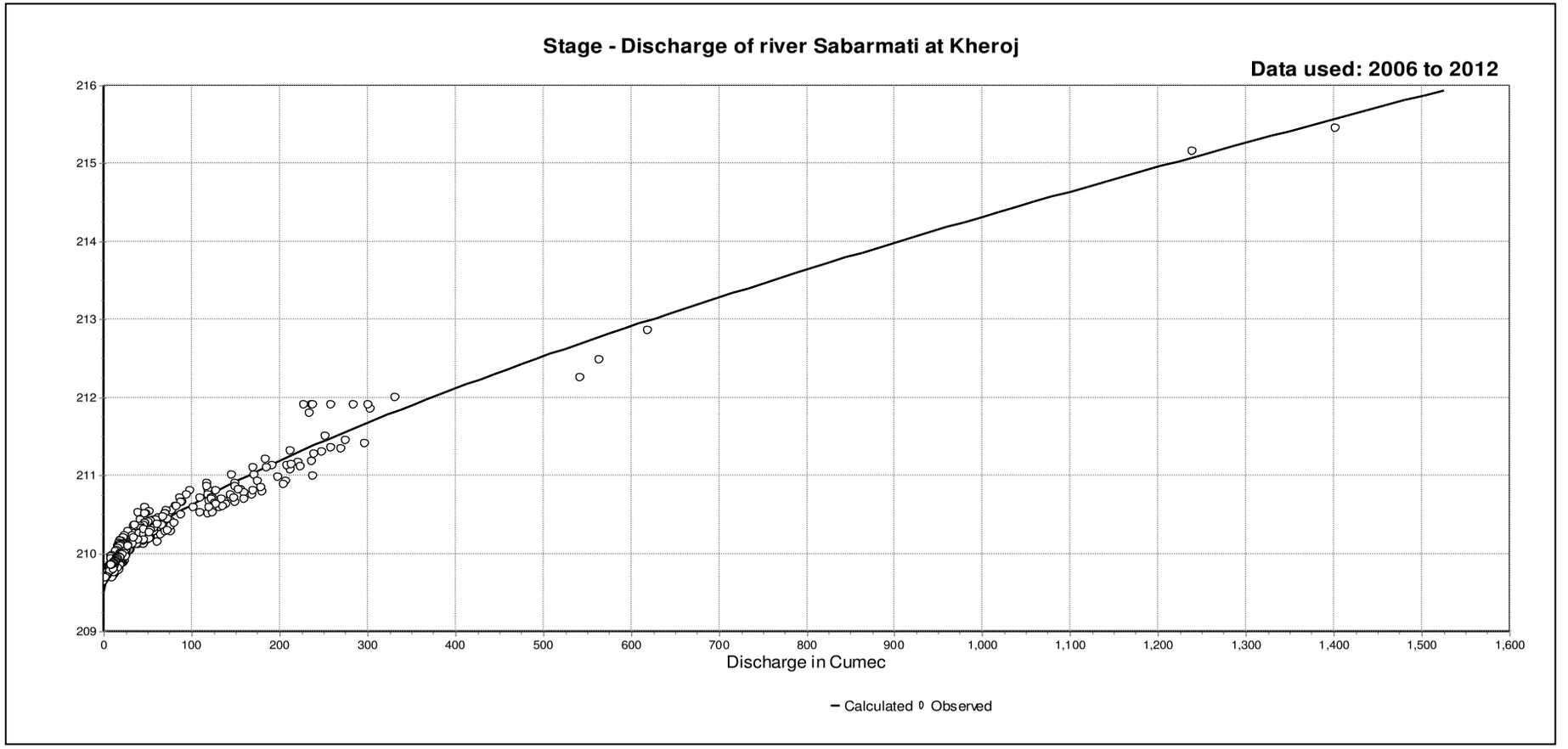


Plate no.17a



Procedure : Standard

Equation type: Power Q = c(a+h)^b

Parameters:

Curve no.	LB	UB	a	b	c	Curve no.	LB	UB	a	b	c
1	209.5	210.16	-209.4	2.15	62.037	2	210.16	216	-209.8	1.385	122.503

Interval	St. error of est.	Number of data	Degrees of freedom	95% T-value	Actual T-value	Result
1	40.67	222	442	1.965	1.903	Accept
2	25.312	195	388	1.966	0.998	Accept

Plate No.17b

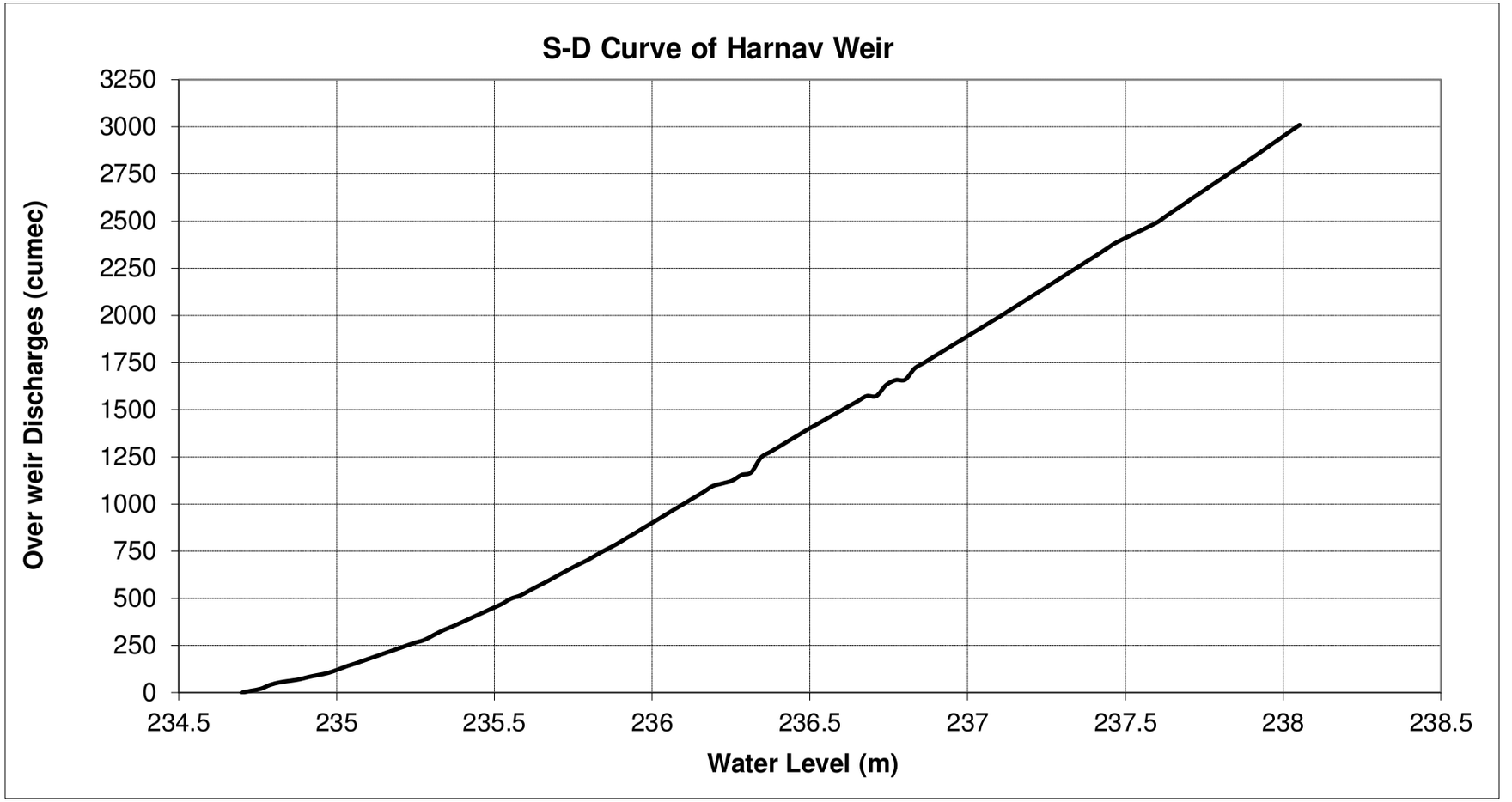
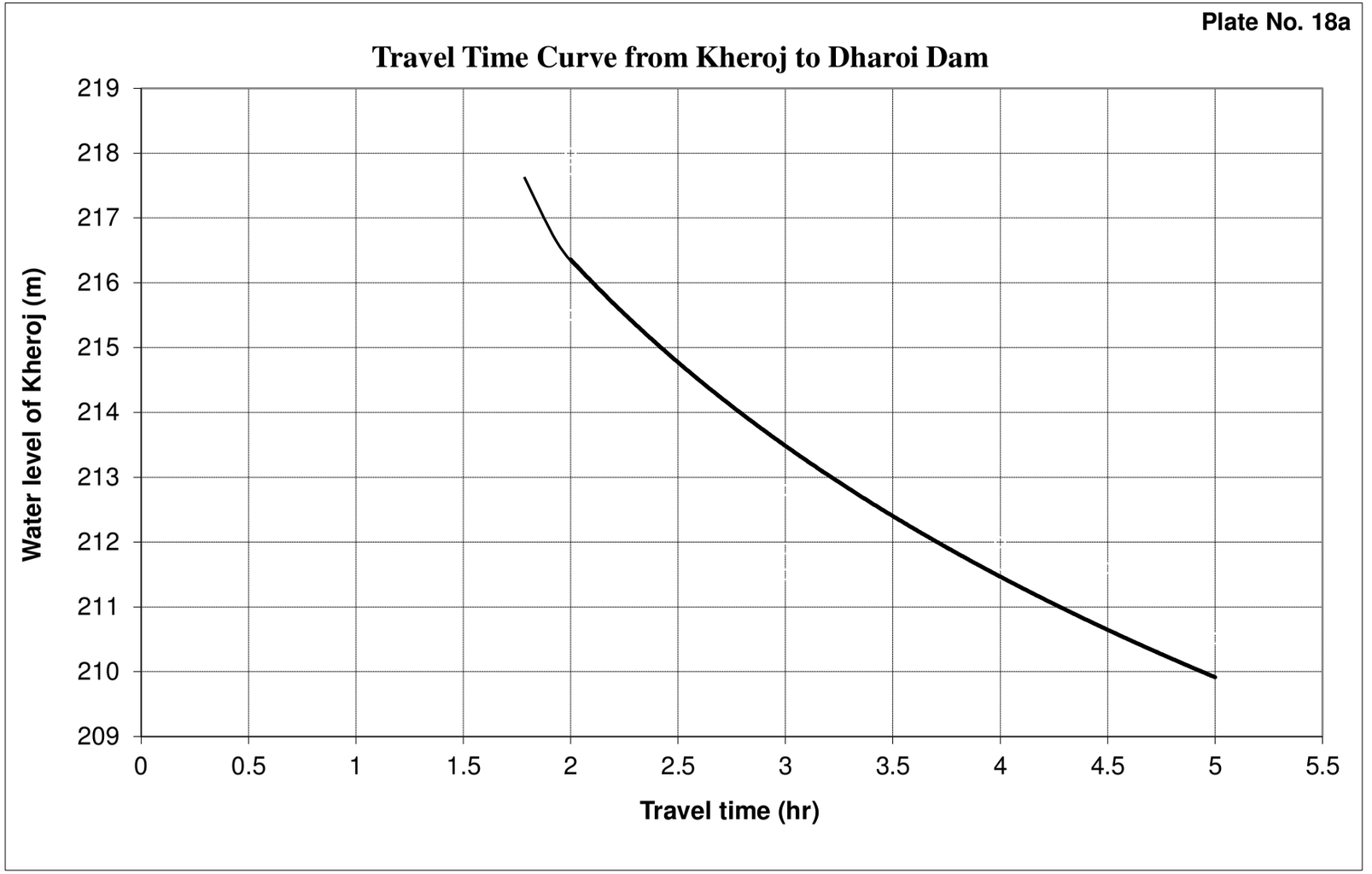

S-D Curve of Harnav Weir
Over weir Discharges (cumec)
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
234.5
235
235.5
236
236.5
237
237.5
238
238.5
Water Level (m)

Plate No. 18a


Travel Time Curve from Kheroj to Dharoi Dam
Water level of Kheroj (m)
219
218
217
216
215
214
213
212
211
210
209
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
Travel time (hr)

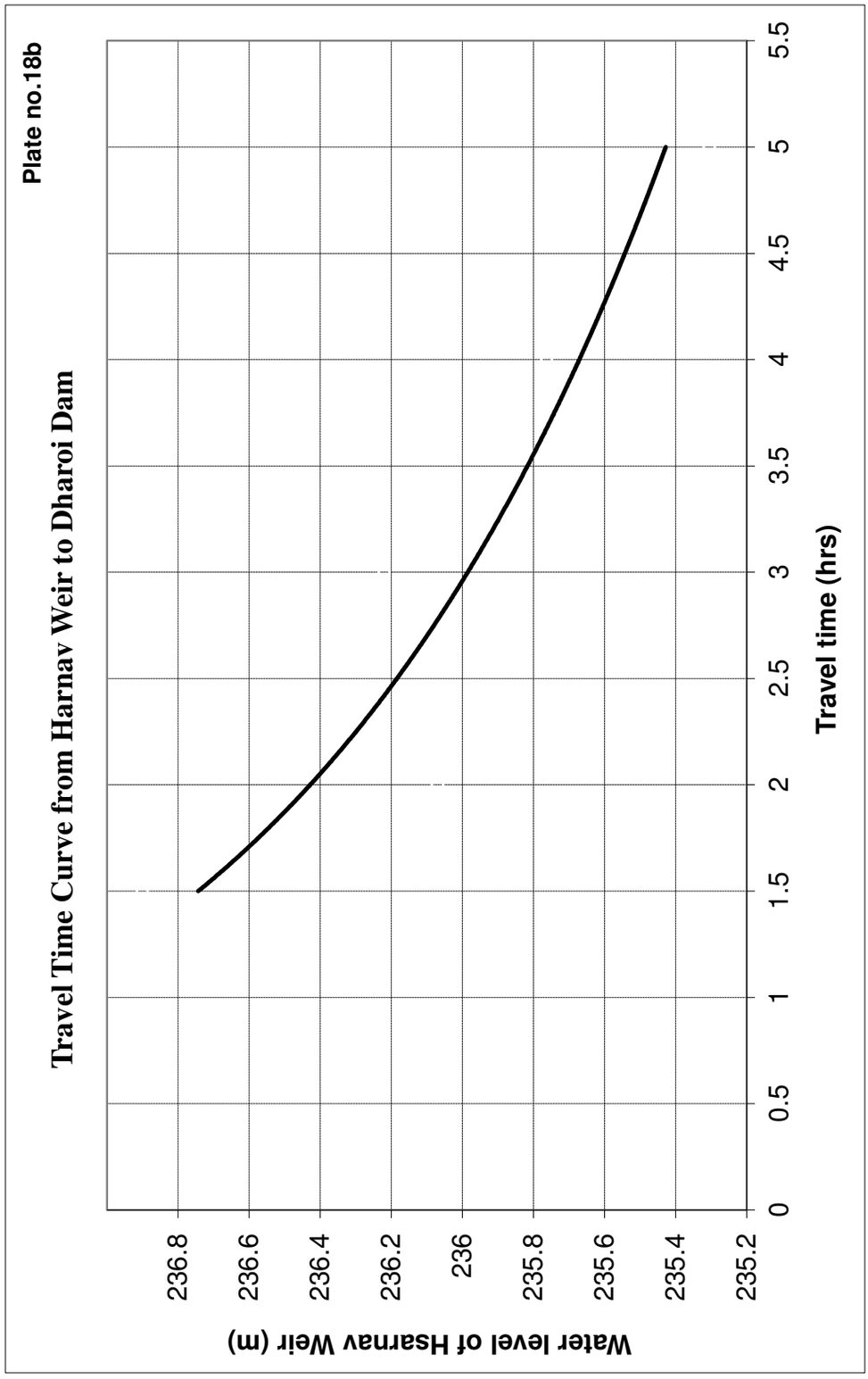


Plate no.18b
Travel Time Curve from Harnav Weir to Dharoi Dam
Water level of Hsarnav Weir (m)
236.8
236.6
236.4
236.2
236
235.8
235.6
235.4
235.2
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
Travel time (hrs)

Plate No. 19

Forecast Dissemination format used for Dharoi dam Inflow forecast in case of High Flood.

Flood Immediate

Telefax - 079-23239509/Control room:23243075

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHI DIVISION

CWC – INFLOW FORECAST

Forecast Number: SD -

Name of River: Sabarmati **Date of Issue:**

Site: Dharoi Dam **Time of Issue:**

Danger Level: 192.24 m **Warning Level: 187.06 m**

FRL: 189.59 m **HFL:189.625 m / 3.9.1990**

As per Central Water Commission, the Reservoir level of Dharoi Dam on River Sabarmati at _____hrs. on _____ (date) was _____ metres.

As per present indications/ data available with CWC _____ Million Cubic metres (MCM) of water is likely to flow into the reservoir between _____ hrs. of _____ to _____ hrs. of _____.

Inflow is likely to increase/decrease/remain steady thereafter.

EXECUTIVE ENGINEER

Note:

1. *The Forecast given above is based on present indications available at base stations Kheroj and Harnav Weir with the assumption that there is no appreciable rain in the intermediate catchment during the period of forecast.*
2. *The forecast period given above supersedes the forecast issued previously for the overlapping period, if any.*

Copy for confirmation in regard of message transmitted on W/L, Phone / Fax.

No.MD/HM/Forecast/2013/ Date:

Copy for necessary action

1. The Superintending Engineer, Ahmedabad Irrigation Project Circle, L.D.Engineering College Compound, Ahmedabad. Tel No. 26301823, Fax No. 26307298.
2. The Superintending Engineer, Sujlam Suflam Circle No.2, Mehsana(Kherva). Tel./Fax No. 02762 286448.
3. The Executive Engineer, Dharoi Head Works Division, Dharoi. Tel no. 02761 262001, Fax no. 02761 262208.
4. The Flood Control Cell, Walmi Campus, Sardar Training Centre, Sector-8, Gandhinagar. Tel.no. (direct) 23248735/36, Fax No.23240553.

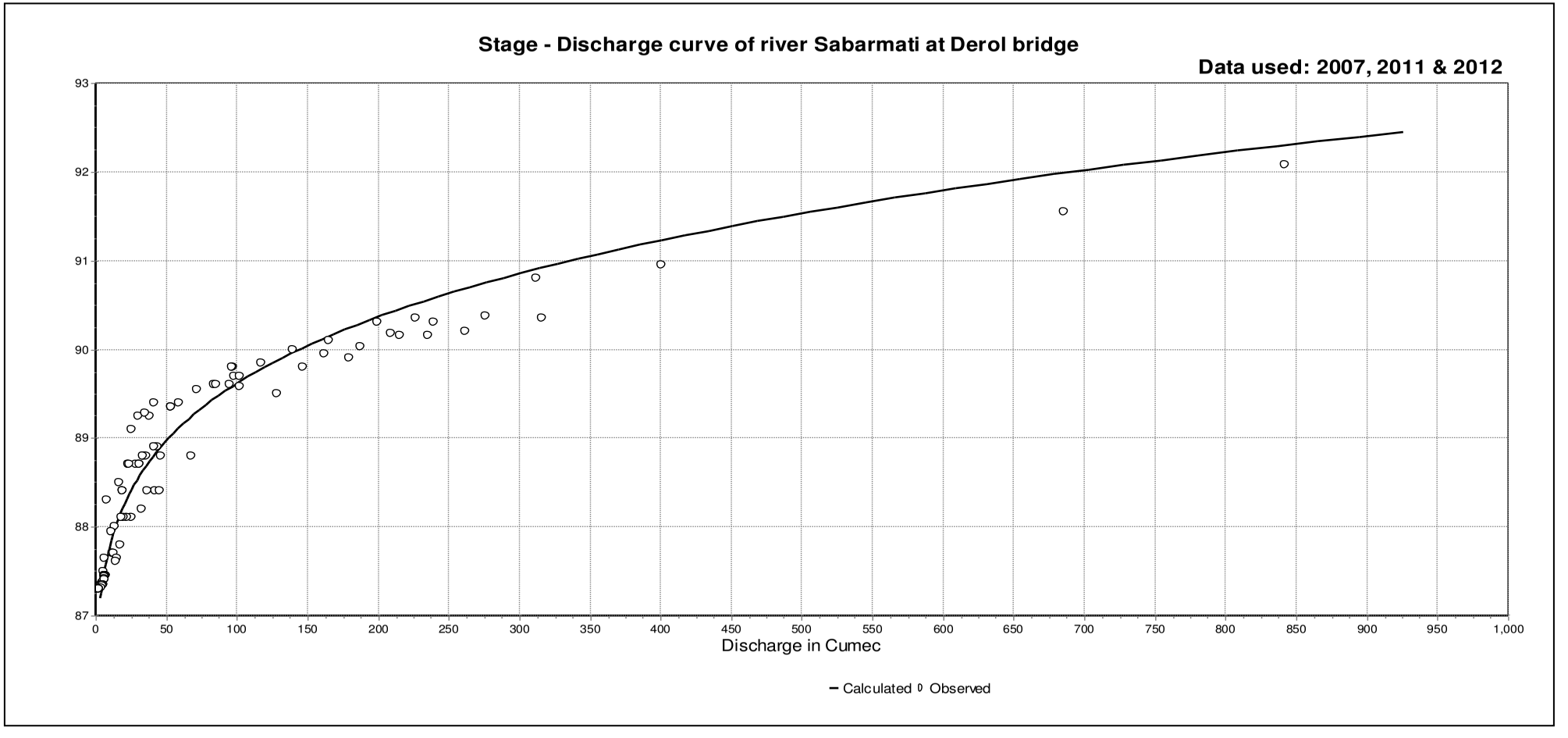
Copy for kind information:

5. The Chief Engineer, NTBO, CWC., Gandhinagar
6. The Superintending Engineer, HOC, CWC., Gandhinagar
7. The Assistant Director (HM) Flood Forecasting Monitoring Directorate, Room No.828(N) Sewa Bhawan, R.K.Puram, New Delhi-110 066 (through Fax No.011-26105274/26106523.

Copy to:

8. The Sub-Divisional Engineer, NWRSD, Himatnagar Tel/Fax no. 02772-222314.

Off: 3rd Floor, Narmada Tapi Bhavan, Sector 10 'A', Gandhinagar, Pin code-382010
E-mail: mahi_cwc@yahoo.co.in



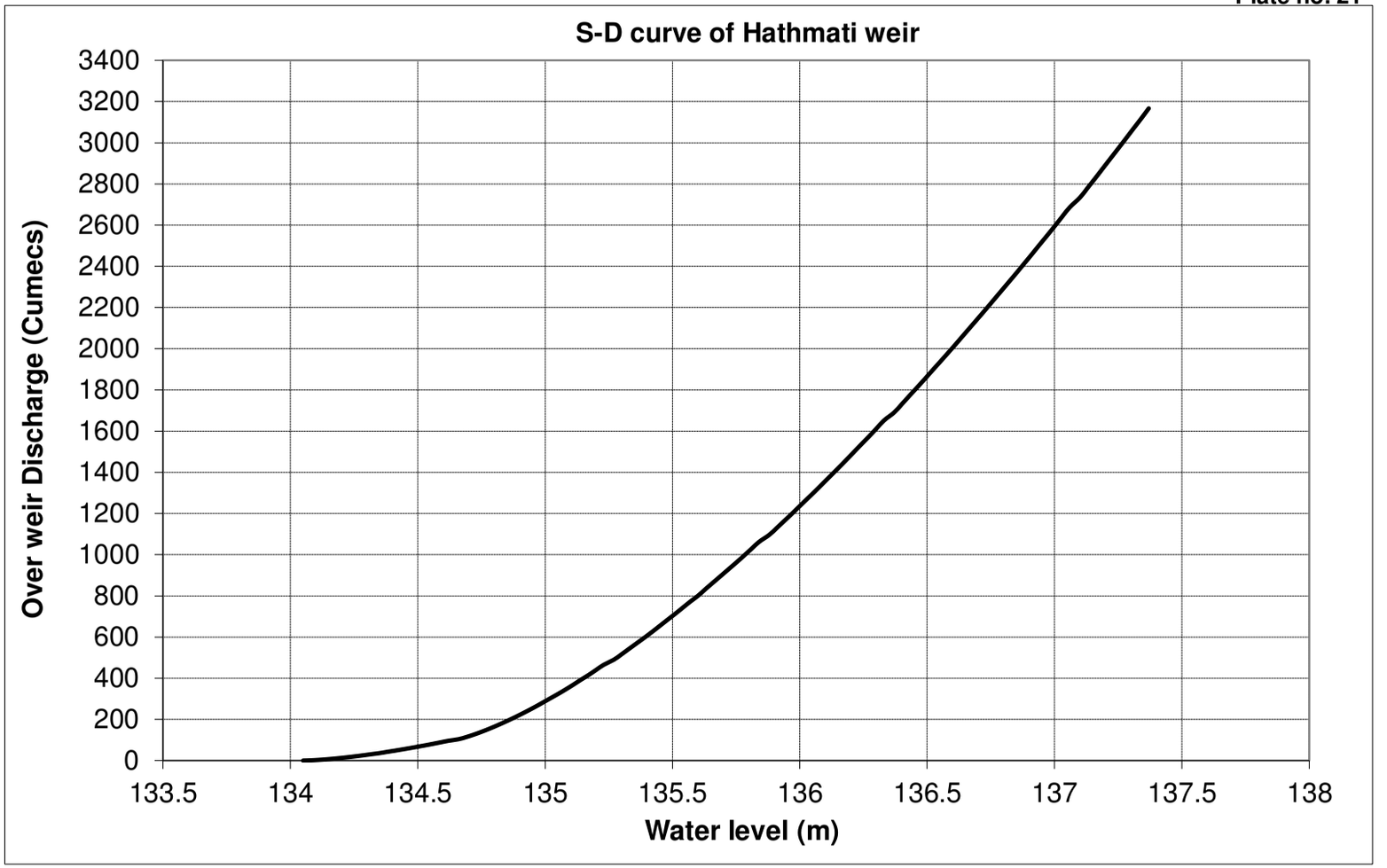
Procedure : Standard

Equation type: Power Q = c(a+h)^b

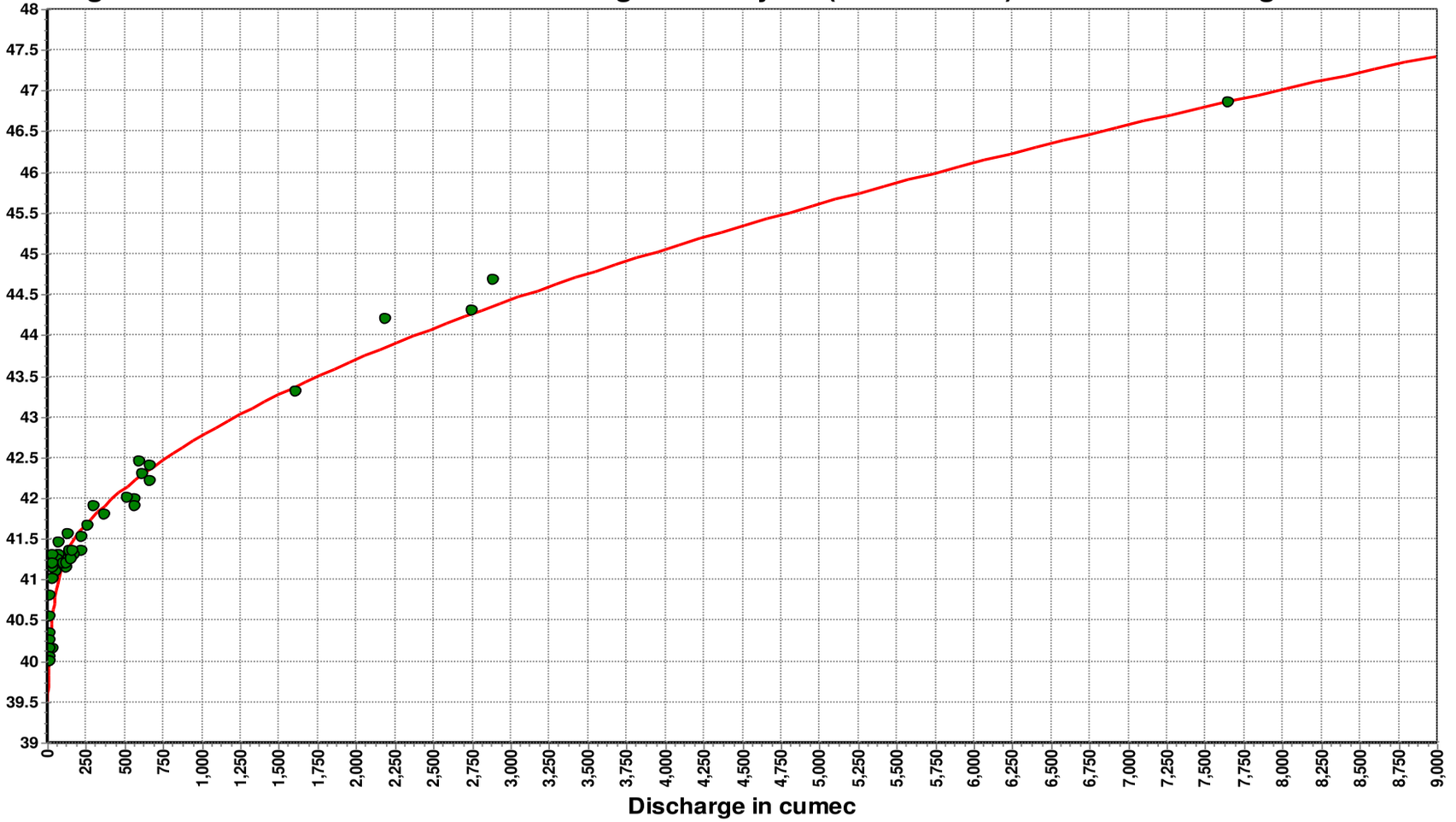
Parameters:

Interval	LB	UB	a	b	c
1	87.2	92.5	-84.75	4.851	0.046

Plate no. 21


S-D curve of Hathmati weir
Over weir Discharge (Cumecs)
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
133.5
134
134.5
135
135.5
136
136.5
137
137.5
138
Water level (m)

Rating Curve of Sabarmati at Subhash Bridge for the year (1993 & 1994) - flood forecasting Station



Procedure : Standard	Eq.No.	LB	UB	a	b	c	Eq
Equation type: Power	1	39.5	41.403	-37.45	5.741	0.053	Q=c(h+a)^b
	2	41.403	47.5	-40.67	1.873	251.777	

Plate No.23

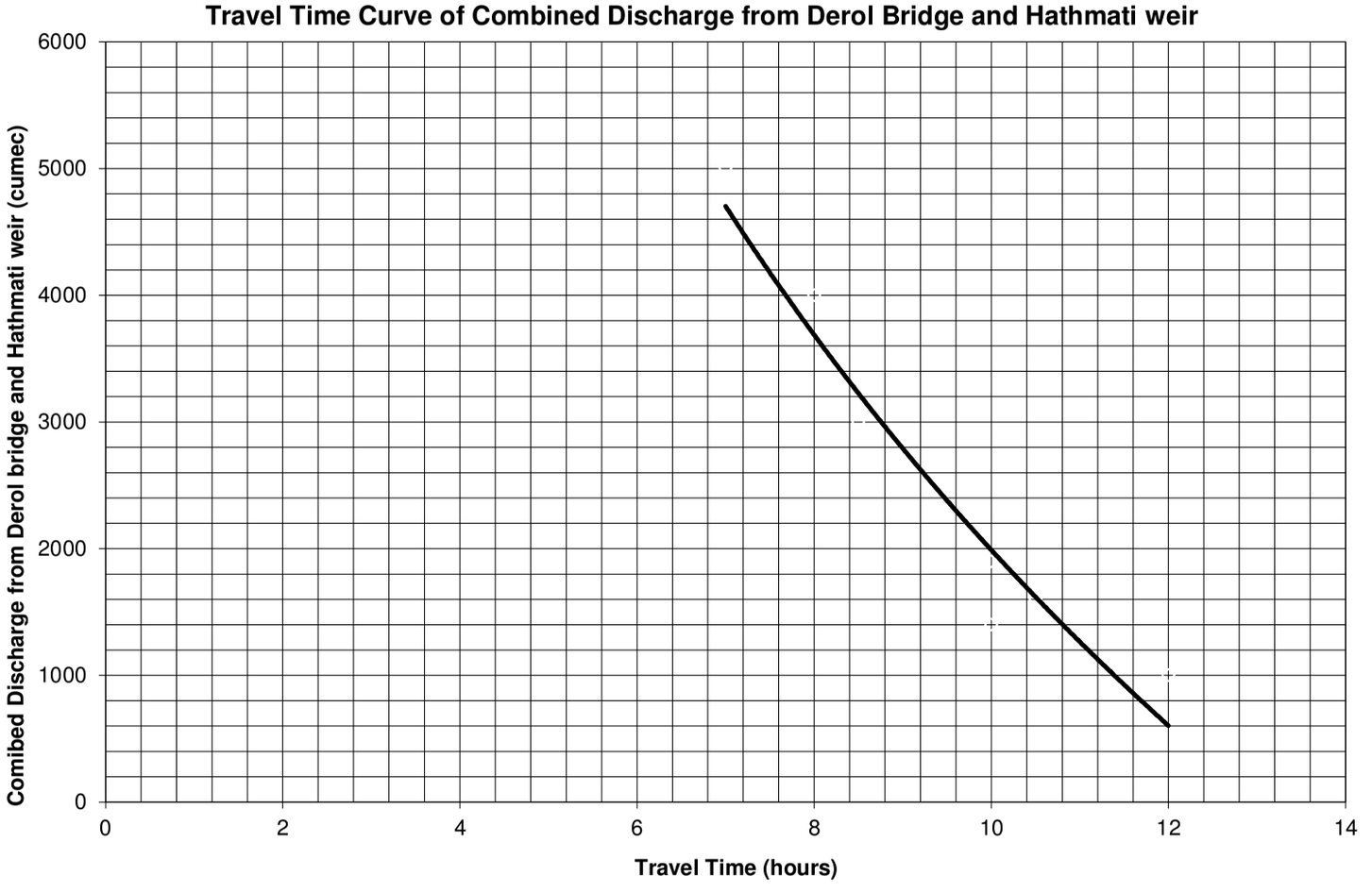

Travel Time Curve of Combined Discharge from Derol Bridge and Hathmati weir
Comibed Discharge from Derol bridge and Hathmati weir (cumec)
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
Travel Time (hours)

Plate No.24

Forecast Dissemination format used for Subhash bridge level forecast in case of Normal Flood.

Flood Immediate

Telefax - 079-23239509/Control room: 23243075
GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHI DIVISION

CWC – FLOOD FORECAST

Forecast Number: SA -

Name of River: Sabarmati **Date of Issue:**

Site: Subhash Bridge **Time of Issue:**

Danger Level: 45.34 m **Warning Level : 44.09 m**

H.F.L: 47.45m /20.8.06

As per Central Water Commission, the water level of Subhash bridge on River Sabarmati at _____hrs. on _____ (date) was _____ metres.

As per present indications/ data available with CWC, it is expected that water level will rise/ fall/ remain stationary and be near about _____ metres in the morning/ forenoon/ afternoon / evening/ night/ by _____ hrs. of _____. Provided there is no/Appreciable rain in the intermediate catchment.

Thereafter, the level is likely to rise/ fall/ remain stationary.

Further forecast will follow, if found necessary.

EXECUTIVE ENGINEER

Copy for confirmation in regard of message transmitted on W/L, Phone / Fax.

No.MD/HM/Forecast/2013/ Date:

Copy for kind information:

1. The Chief Engineer, NTBO, CWC., Gandhinagar
2. The Superintending Engineer, HOC, CWC., Gandhinagar
3. The Assistant Director (HM) Flood Forecasting Monitoring Directorate, Room No.828(N) Sewa Bhawan, R.K.Puram, New Delhi-110 066 (through Fax No.011-26105274/26106523.

Copy for necessary action:

4. The Superintending Engineer, A.I.P.Circle, L.D.College compound, Block no.2, G Floor, Navaranpura, Ahmedabad -380015. Tel: 26301823, Fax: 079 26307298.
5. The Executive Engineer, Ahmedabad Irrigation Division, L.D.Engineering College Compound, Block no.2, G Floor, Navaranpura, Ahmedabad -380015. Tel: 079 26303497 Fax: 079 26303497.
6. The Flood Control Cell, Walmi Campus, Sardar Training Centre, Sector-8, Gandhinagar (Tel: 23248735-36, Fax No.23240553).

Copy to:

7. The Sub-Divisional Engineer, SSD. Subhash Bridge, Ahmedabad.

Off: 3rd Floor, Narmada Tapi Bhavan, Sector 10 'A', Gandhinagar, Pin code-382043
E-mail: mahi_cwc@yahoo.co.in

Plate No.25

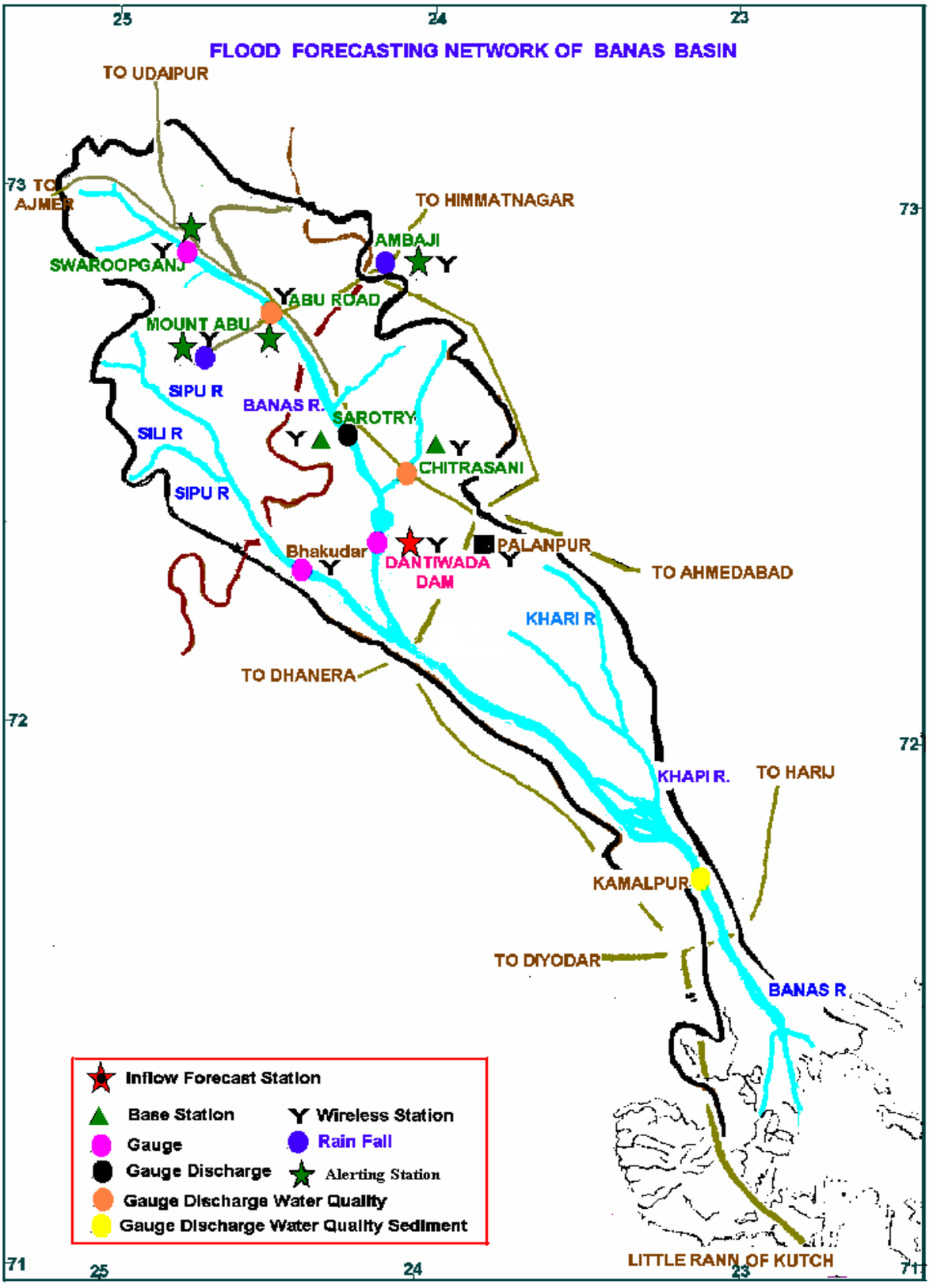
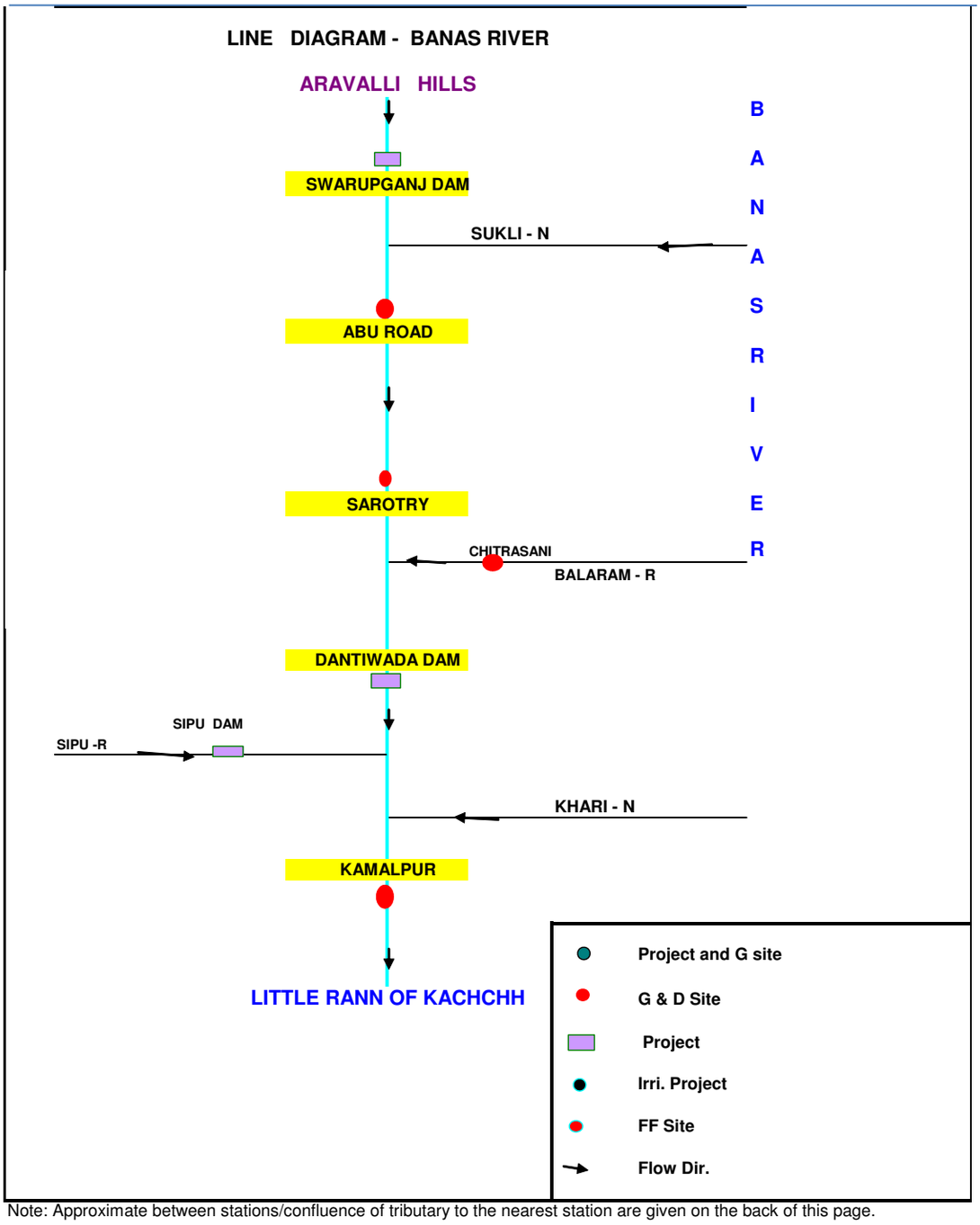

FLOOD FORECASTING NETWORK OF BANAS BASIN
25
24
23
73
72
71
TO UDAIPUR
73 TO AJMER
TO HIMMATNAGAR
AMBAJI
SWAROOPGANJ
ABU ROAD
MOUNT ABU
SIPU R
BANAS R.
SAROTRY
SILI R
CHITRASANI
SIPU R
Bhakudar
DANTIWADA DAM
PALANPUR
TO AHMEDABAD
KHARI R
TO DHANERA
KHAPI R.
TO HARIJ
KAMALPUR
TO DIYODAR
BANAS R
LITTLE RANN OF KUTCH
Inflow Forecast Station
Base Station
Wireless Station
Gauge
Rain Fall
Gauge Discharge
Alerting Station
Gauge Discharge Water Quality
Gauge Discharge Water Quality Sediment

Plate No.26



Note: Approximate between stations/confluence of tributary to the nearest station are given on the back of this page.

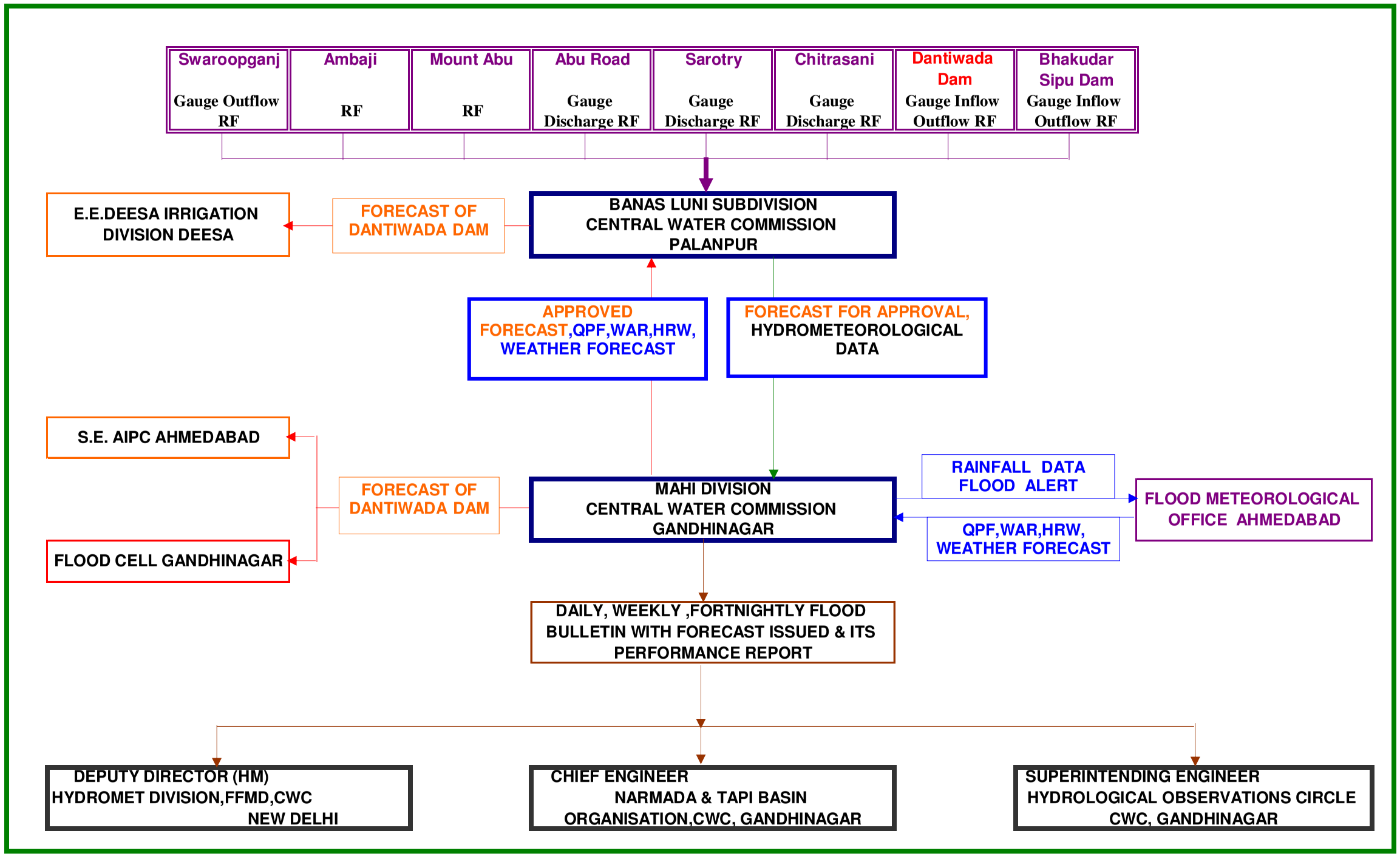
Distance from origin of river/ between various stations on Banas river system

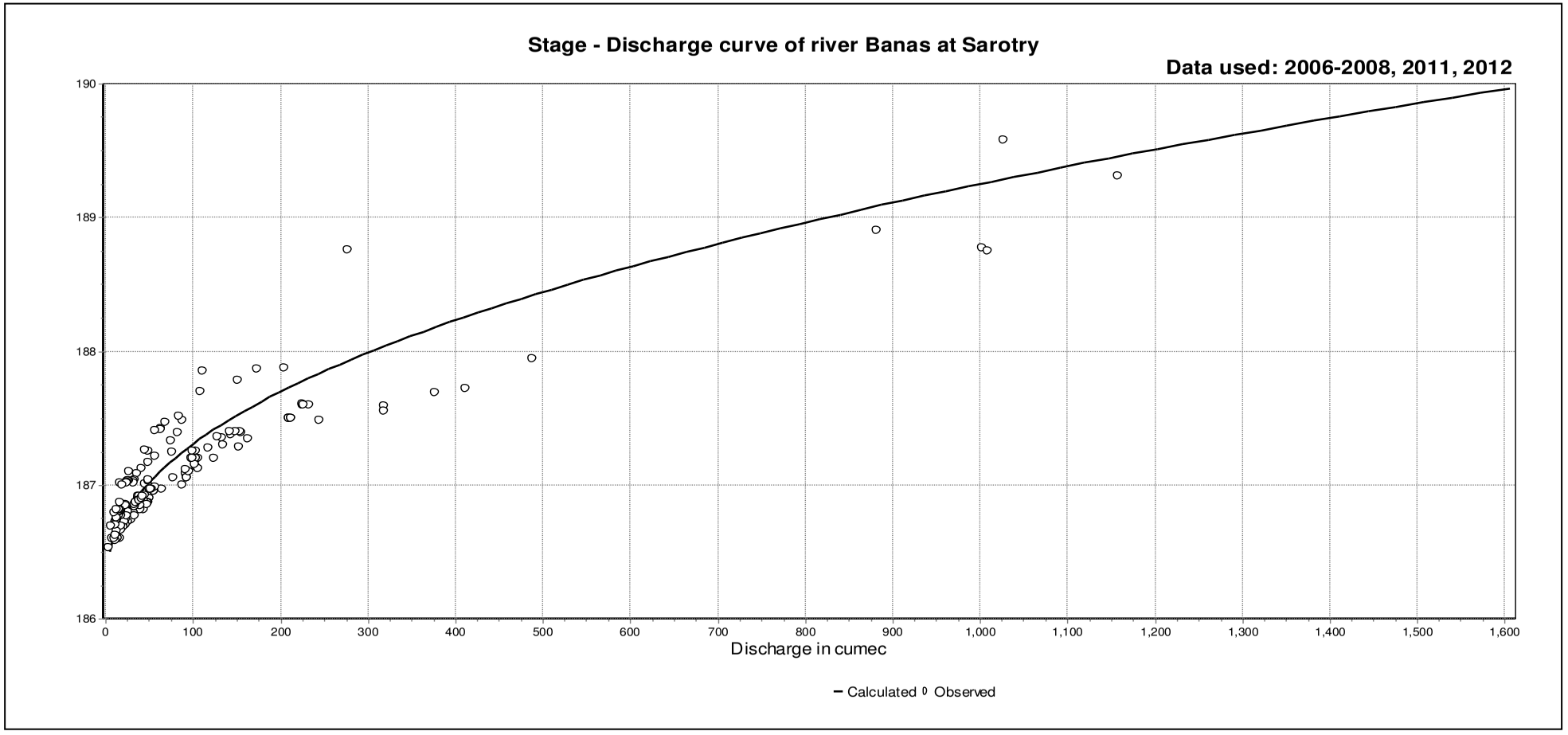
Station		Distance
From	To	(Km)
Origin of river Banas	Swaroopaganj	24
Swaroopaganj	Abu Road	21
Abu Road	Sarotry	30
Sarotry	Dantiwada dam	39
Origin of river Balaram	Chitrasani	30
Chitrasani	Balaram river confluence	5
Balaram river confluence	Dantiwada dam	28.5
Origin of Sipu river	Bhakudar	61
Bhakudar	Sipu river confluence	12.5
Dantiwada dam	Kamalpur	76
Sipu river confluence	Kamalpur	63.5

Note: Details of Catchment area of the site is given on **Statement No.2**

Plate No.27

SCHEMATIC DIAGRAM SHOWING FORECAST ACTIVITIES IN BANAS BASIN DURING FLOOD SEASON





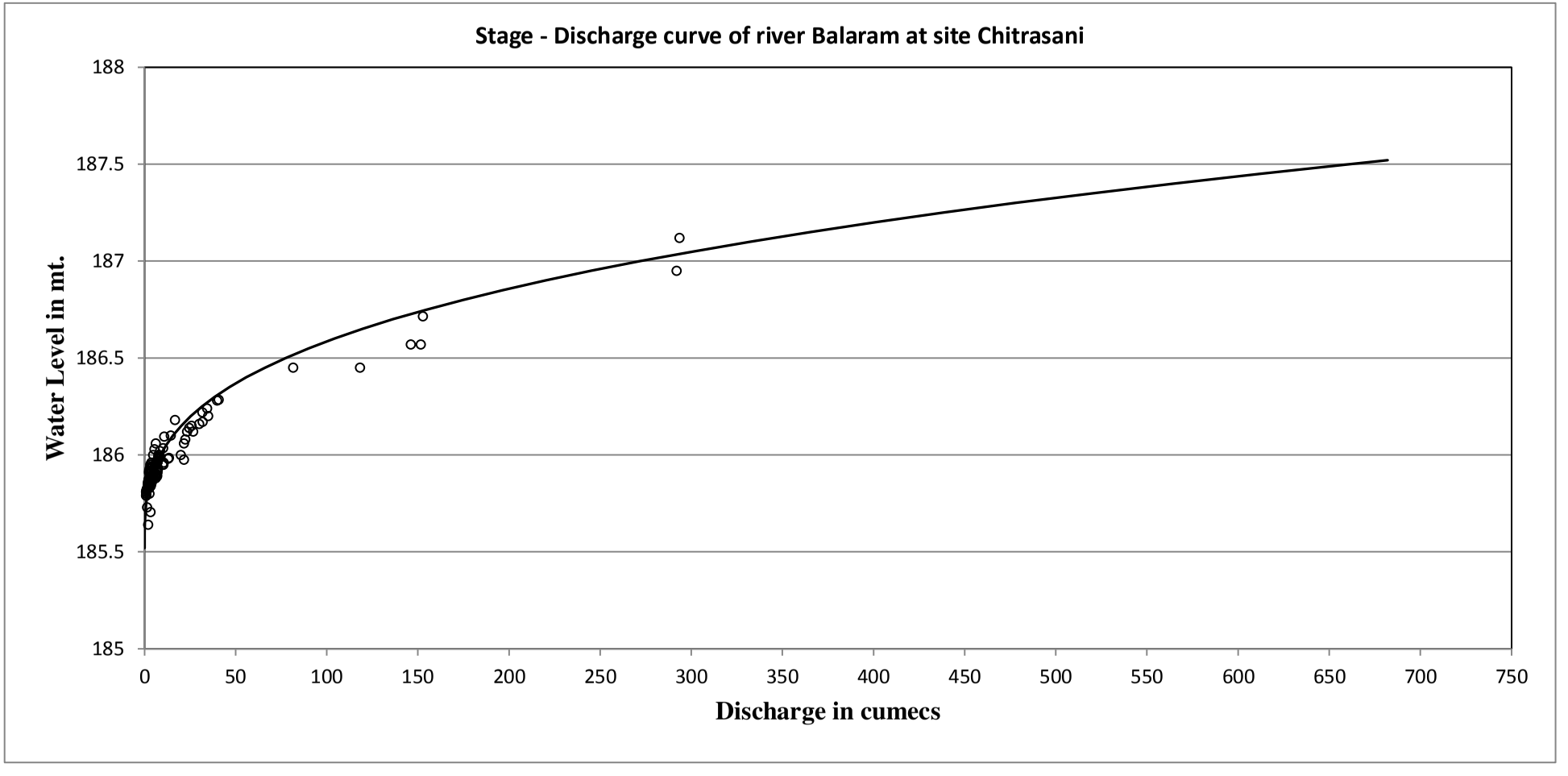
Procedure : Standard

Equation type: Power Q = c(a+h)^b

Parameters:

LB	UB	a	b	c
186.5	190	-186.2	2.216	87.162

Interval	St. error of est.	Number of data	Degrees of freedom	95% T-value	Actual T-value	Result
1	41.031	181	360	1.967	1.937	Accept



Procedure : Standard

Equation type: Power Q = c(a+h)^b

Parameters:

LB	UB	a	b	c
185.5	187.52	-185.5	3.05	82.356

Interval	Number of data	Degrees of freedom	95% T-value	Actual T-value	Result
1	119	236	1.97	1.095	Accept

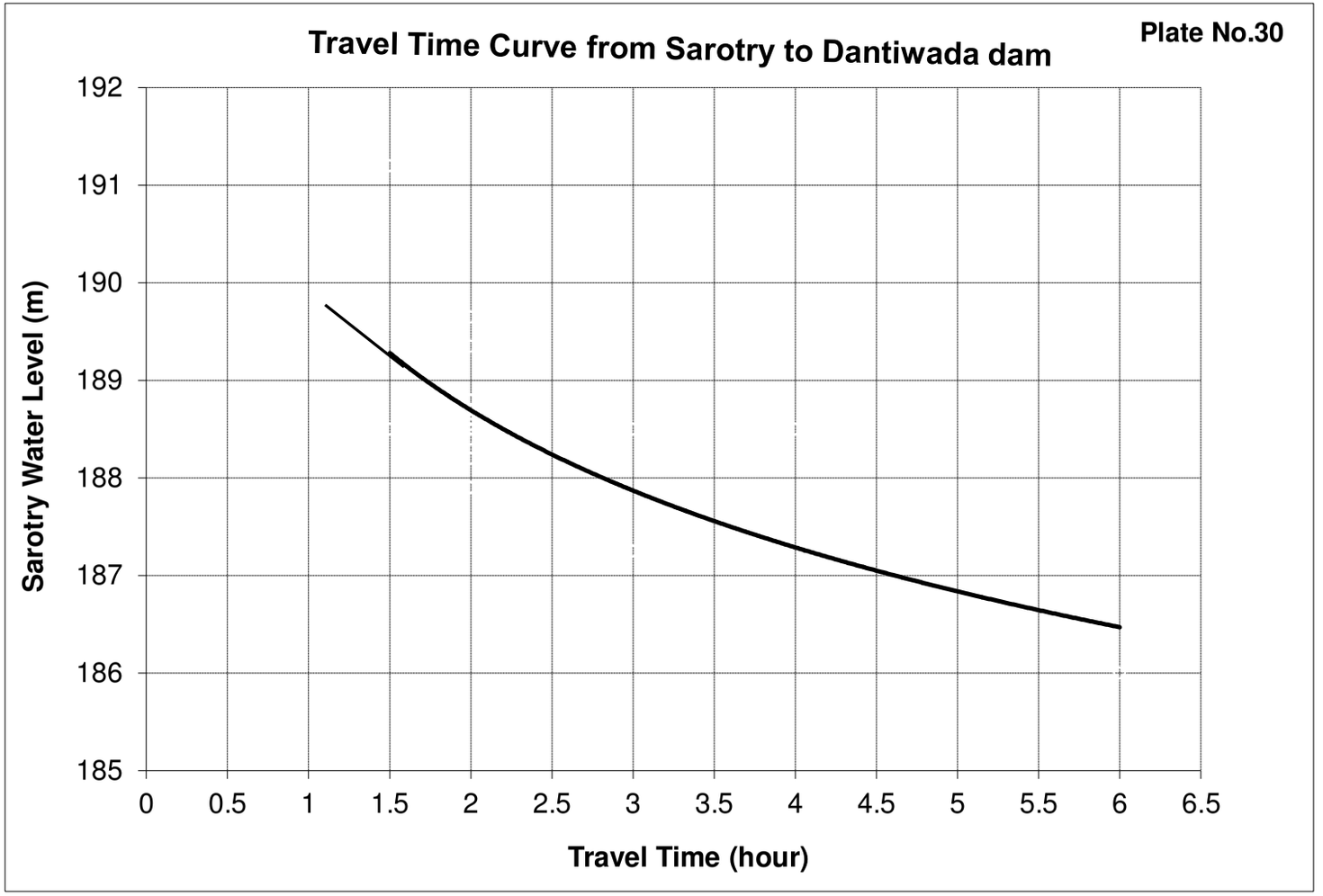


Plate No.30
Travel Time Curve from Sarotry to Dantiwada dam
Sarotry Water Level (m)
192
191
190
189
188
187
186
185
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
Travel Time (hour)

Plate No.31

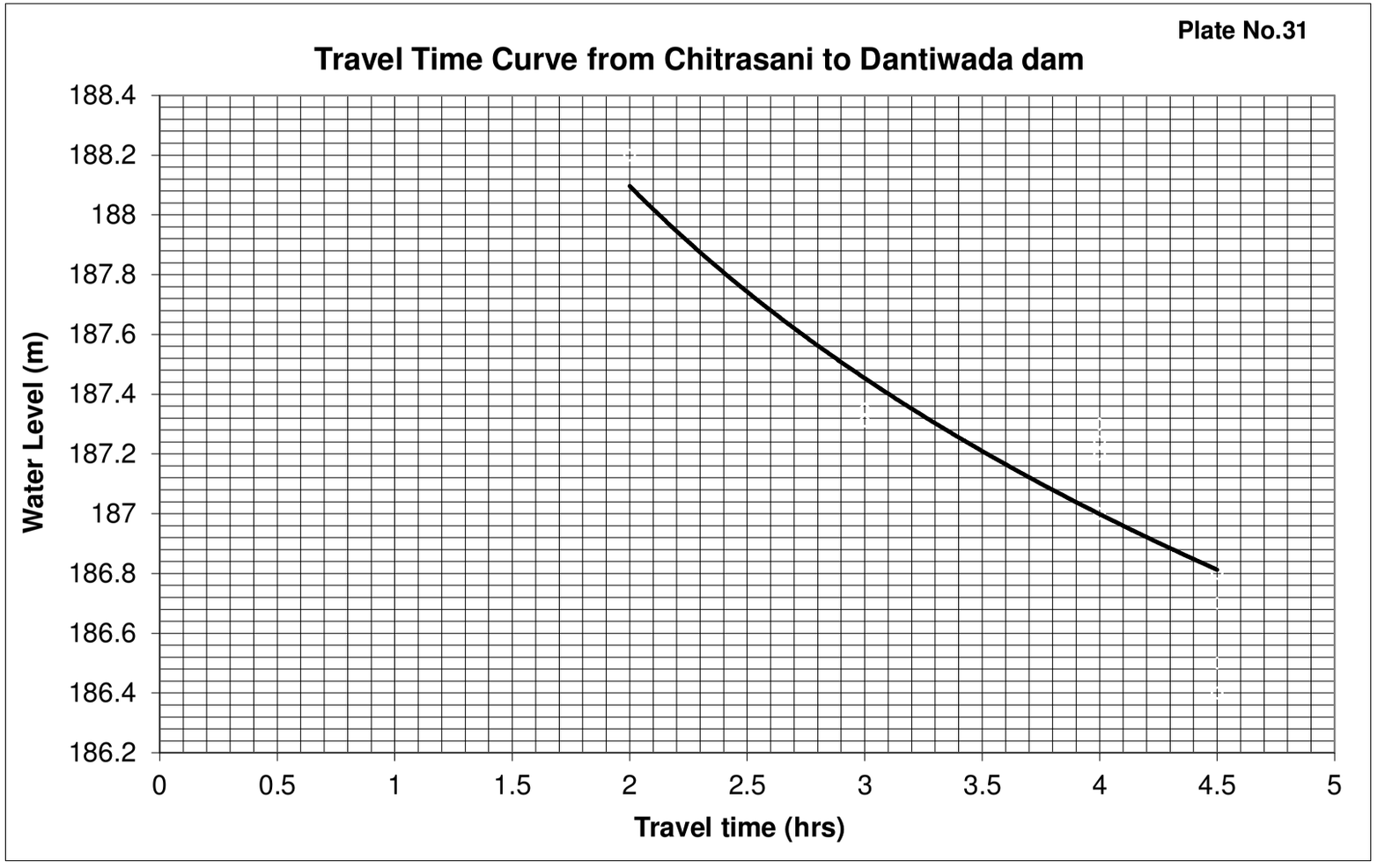

Travel Time Curve from Chitrasani to Dantiwada dam
Water Level (m)
188.4
188.2
188
187.8
187.6
187.4
187.2
187
186.8
186.6
186.4
186.2
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Travel time (hrs)

Plate No.32

Forecast Dissemination format used for Dantiwada dam inflow forecast

Flood Immediate

Telefax - 079-23239509/Control room: 23243075

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHI DIVISION

CWC – INFLOW FORECAST

Forecast Number: BD -

Name of River: Banas **Date of Issue:**

Site: Dantiwada Dam **Time of Issue:**

Danger Level: 185.06 m **Warning Level: 182.88 m**

FRL: 184.10 m **HFL:186.04 m / 1973**

As per Central Water Commission, the Reservoir level of Dantiwada Dam on River Banas at _____hrs. on _____ (date) was _____ metres.

As per present indications/ data available with CWC _____ Million Cubic Metres (MCM) of water is likely to flow into the reservoir between _____ hrs. of _____ to _____ hrs. of _____.

Inflow is likely to increase/decrease/remain steady thereafter.

EXECUTIVE ENGINEER

Note:

1. *The Forecast given above is based on present indications available at base stations Sarotry and Chitrasani with the assumption that there is no appreciable rain in the intermediate catchment during the period of forecast.*
2. *The forecast period given above supersedes the forecast issued previously for the overlapping period, if any.*

Copy for confirmation in regard of message transmitted on W/L, Phone / Fax.
No.MD/HM/Forecast/2013/ Date:

Copy for necessary action:

1. The Superintending Engineer, Sujlam Suflam Circle No.2, Kherva, Mehsana. Fax no.02762 286448
2. The Executive Engineer, Deesa Irrigation Division, Deesa. Tel no. 02744 220071.
3. The Flood Control Cell, Walmi Campus, Sardar Training Centre, Sector-8, Gandhinagar. Tel.no. (direct) 23248735/36, Fax No.23240553.

Copy for kind information:

4. The Chief Engineer, NTBO, CWC., Gandhinagar
5. The Superintending Engineer, HOC, CWC., Gandhinagar
6. The Assistant Director (HM) Flood Forecasting Monitoring Directorate, Room No.828(N) Sewa Bhawan, R.K.Puram, New Delhi-110 066 (through Fax No.011-26105274/26106523.

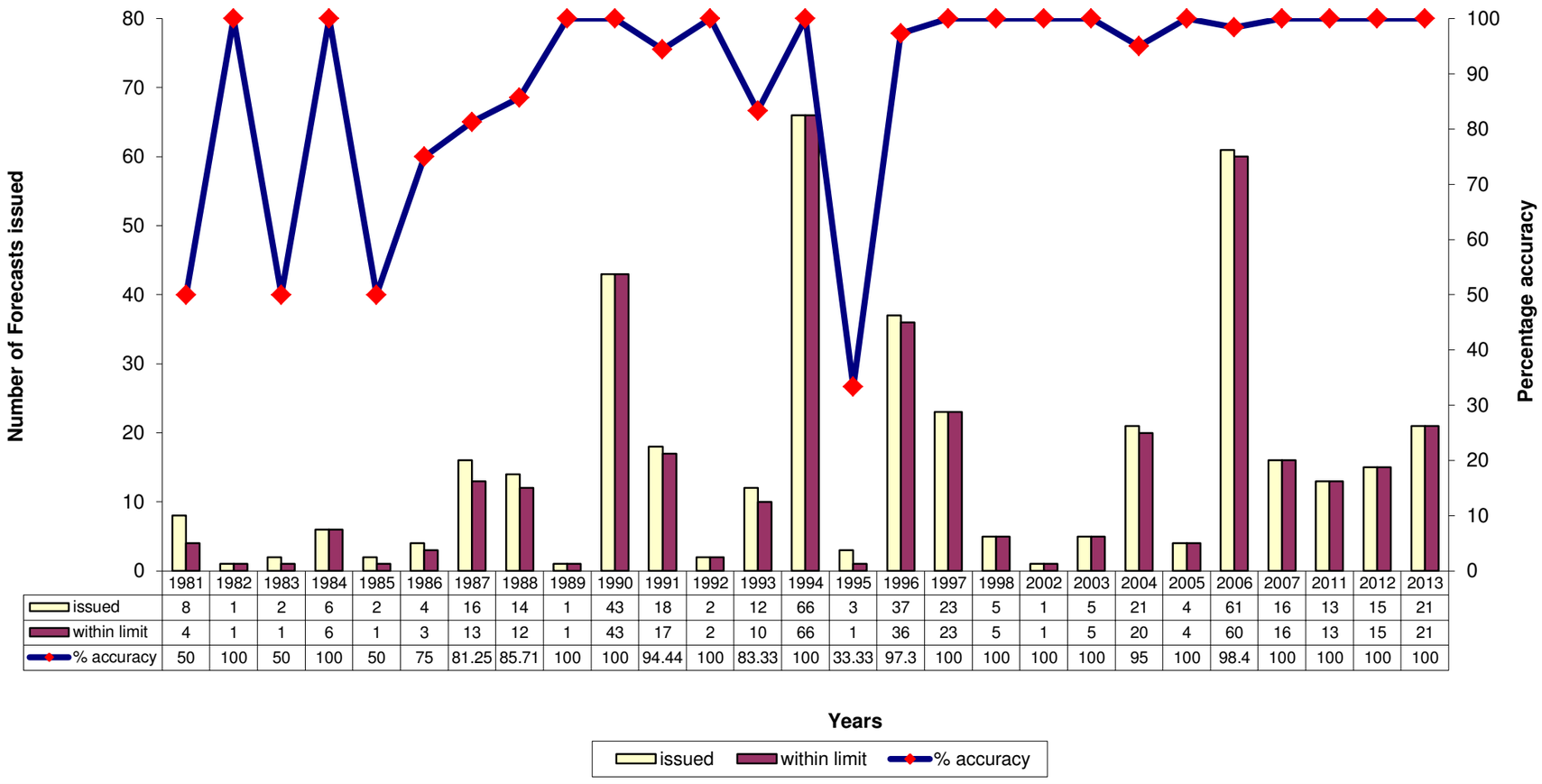
Copy to:

7. The Sub-Divisional Engineer, BLSD, Palanpur. Tel/Fax no. 02742-245662
8. The Site-in-charge, Dantiwada Site.

Off: 3rd Floor, Narmada Tapi Bhavan, Sector 10 'A', Gandhinagar, Pin code-382010
E-mail: mahi_cwc@yahoo.co.in

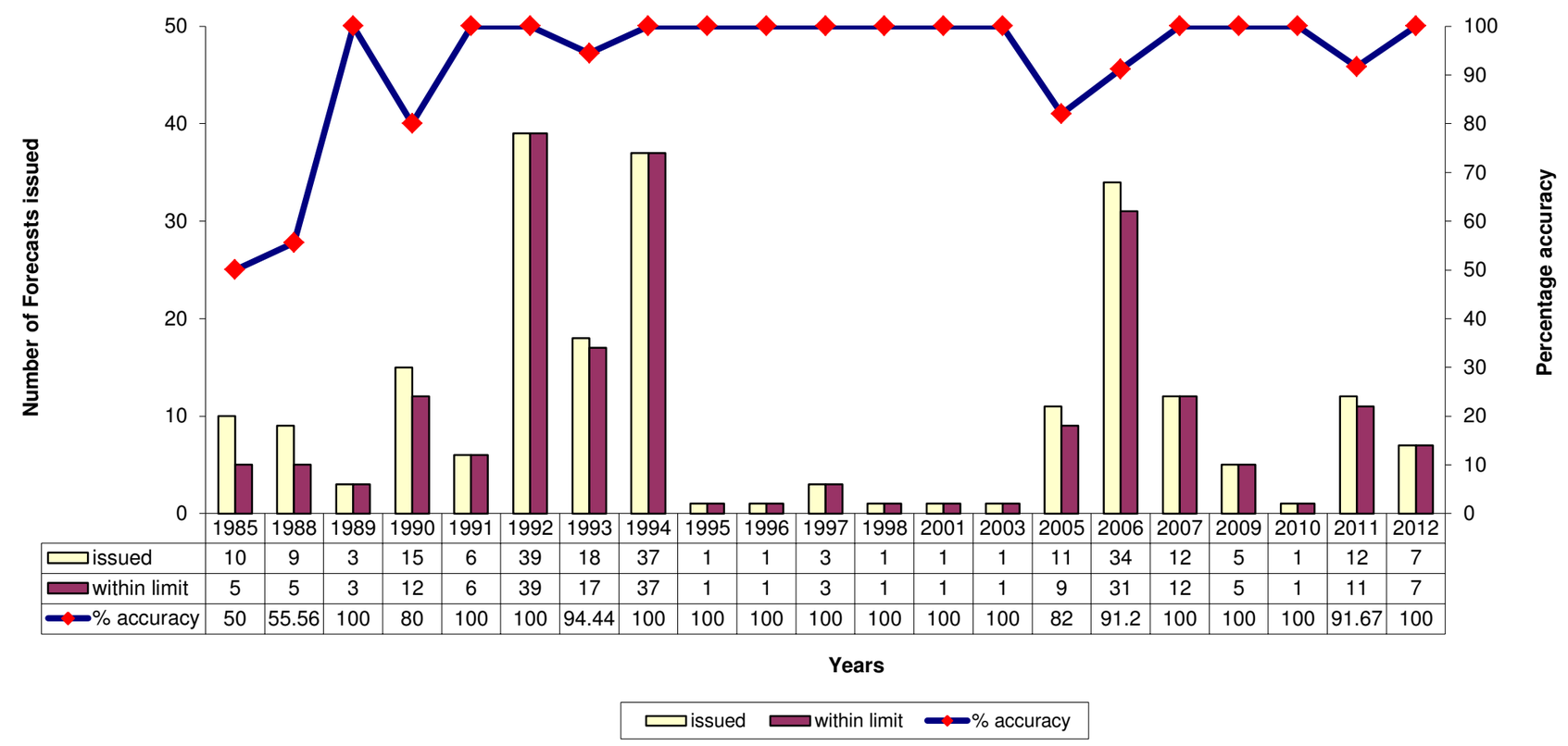
Plate No.33

Forecast Performance Since 1981 to 2007 for the Years in which Forecast were issued
Kadana Dam on Mahi River



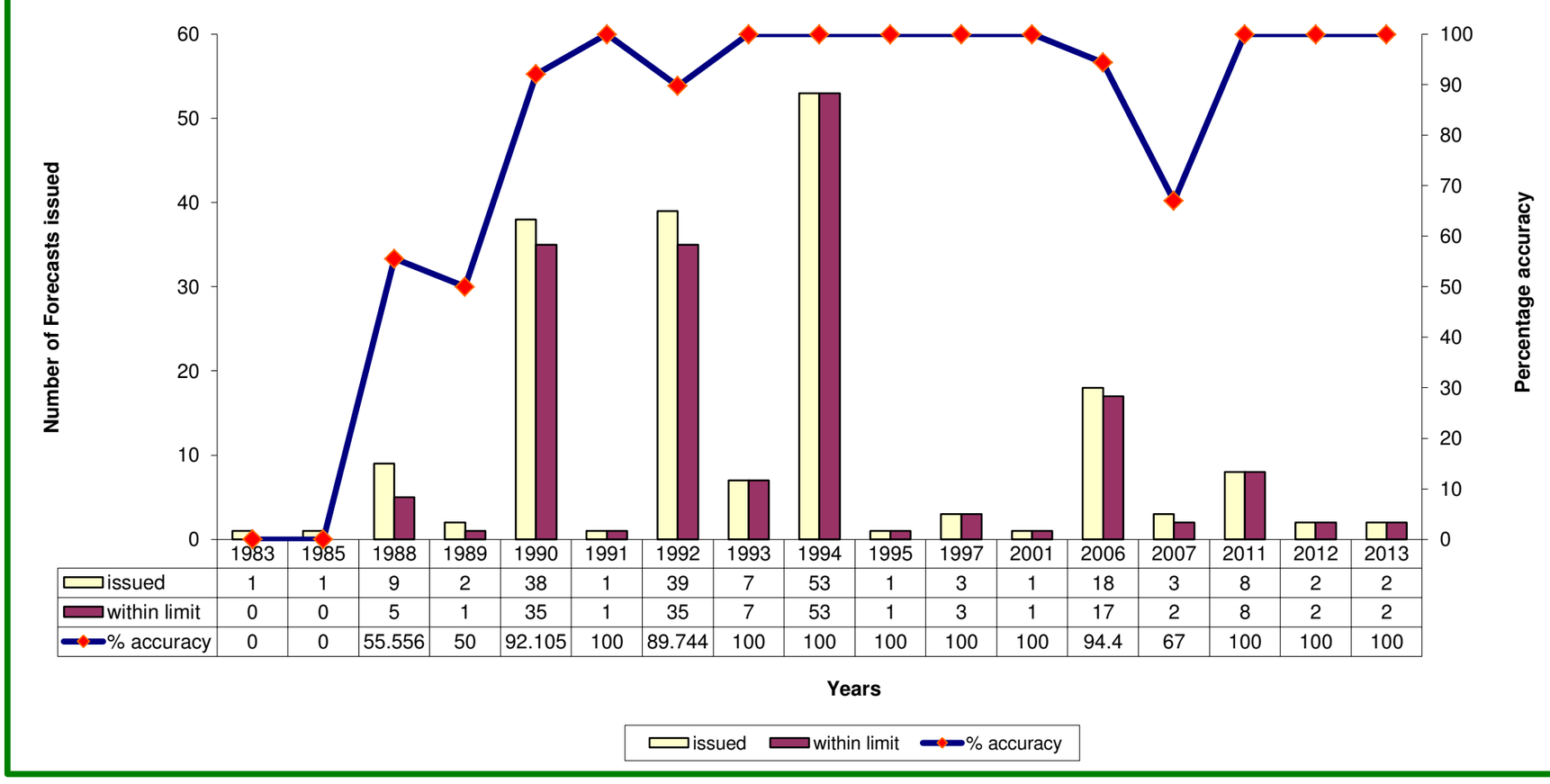
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2002	2003	2004	2005	2006	2007	2011	2012	2013
issued	8	1	2	6	2	4	16	14	1	43	18	2	12	66	3	37	23	5	1	5	21	4	61	16	13	15	21
within limit	4	1	1	6	1	3	13	12	1	43	17	2	10	66	1	36	23	5	1	5	20	4	60	16	13	15	21
% accuracy	50	100	50	100	50	75	81.25	85.71	100	100	94.44	100	83.33	100	33.33	97.3	100	100	100	100	95	100	98.4	100	100	100	100

Forecast Performance Since 1981 to 2007 for the Years in which Forecast were issued
Dharoi Dam on Sabarmati River



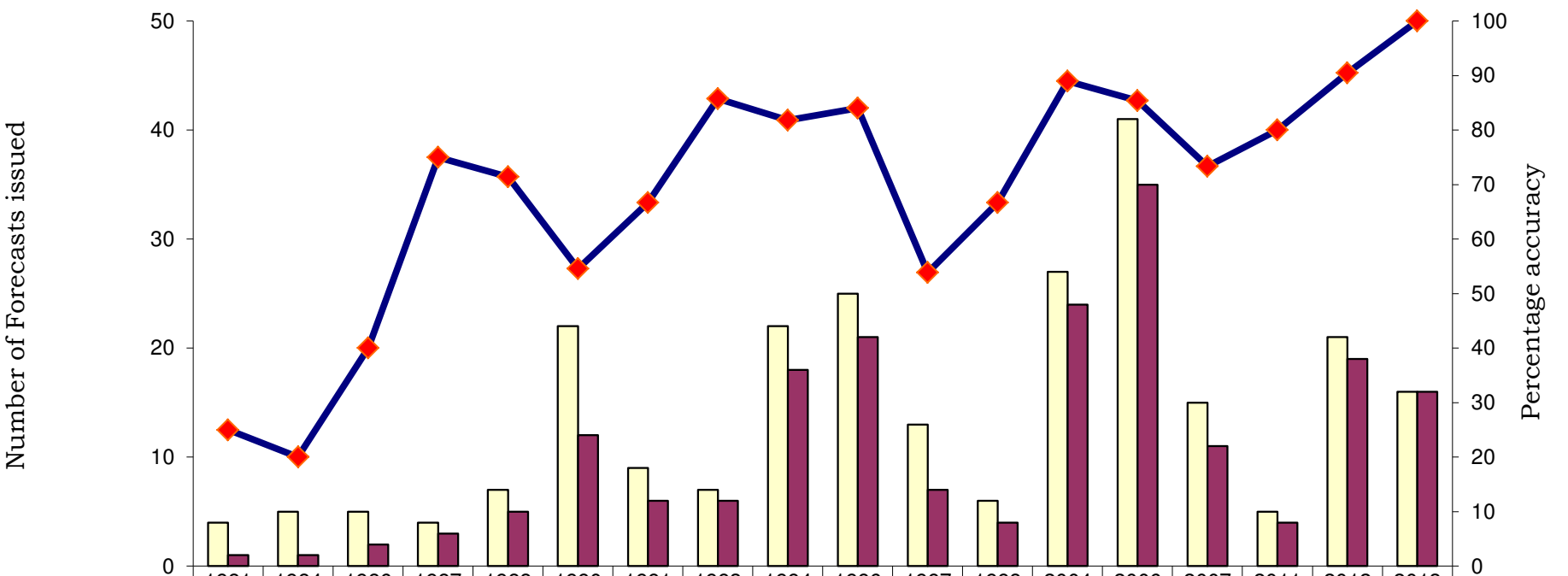
	1985	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2001	2003	2005	2006	2007	2009	2010	2011	2012
issued	10	9	3	15	6	39	18	37	1	1	3	1	1	1	11	34	12	5	1	12	7
within limit	5	5	3	12	6	39	17	37	1	1	3	1	1	1	9	31	12	5	1	11	7
% accuracy	50	55.56	100	80	100	100	94.44	100	100	100	100	100	100	100	82	91.2	100	100	100	91.67	100

Forecast Performance Since 1981 to 2007 for the Years in which Forecast were issued
Dantiwada Dam on Banas River



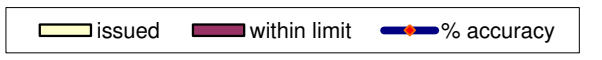
	1983	1985	1988	1989	1990	1991	1992	1993	1994	1995	1997	2001	2006	2007	2011	2012	2013
issued	1	1	9	2	38	1	39	7	53	1	3	1	18	3	8	2	2
within limit	0	0	5	1	35	1	35	7	53	1	3	1	17	2	8	2	2
% accuracy	0	0	55.556	50	92.105	100	89.744	100	100	100	100	100	94.4	67	100	100	100

Forecast Performance Since 1981 to 2007 for the Years in which Forecast were issued
Wanakbori Weir on Mahi River

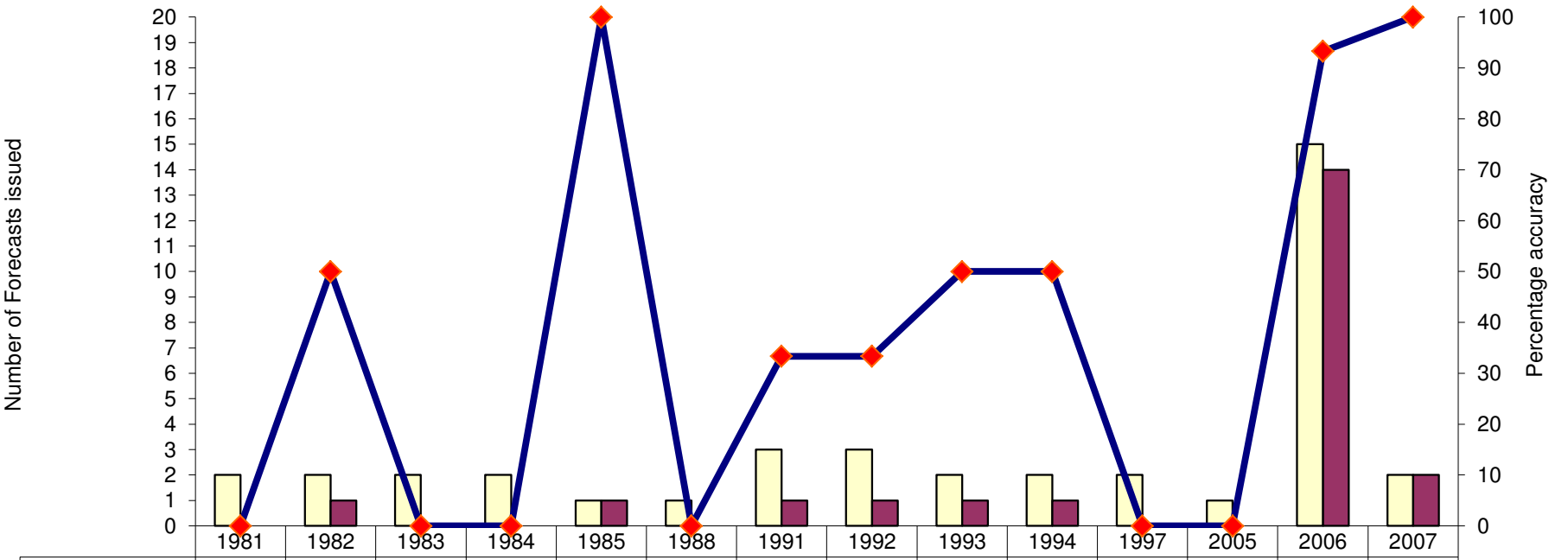


	1981	1984	1986	1987	1988	1990	1991	1993	1994	1996	1997	1998	2004	2006	2007	2011	2012	2013
issued	4	5	5	4	7	22	9	7	22	25	13	6	27	41	15	5	21	16
within limit	1	1	2	3	5	12	6	6	18	21	7	4	24	35	11	4	19	16
% accuracy	25	20	40	75	71.43	54.55	66.67	85.71	81.82	84	53.85	66.67	89	85.4	73.33	80	90.48	100

Years



Forecast Performance Since 1981 to 2007 for the Years in which Forecast were issued
Subhash Bridge,Ahmedabad on Sabarmati River



	1981	1982	1983	1984	1985	1988	1991	1992	1993	1994	1997	2005	2006	2007
issued	2	2	2	2	1	1	3	3	2	2	2	1	15	2
within limit	0	1	0	0	1	0	1	1	1	1	0	0	14	2
% accuracy	0	50	0	0	100	0	33.3333	33.3333	50	50	0	0	93.3	100

Years

Plate No. 34b

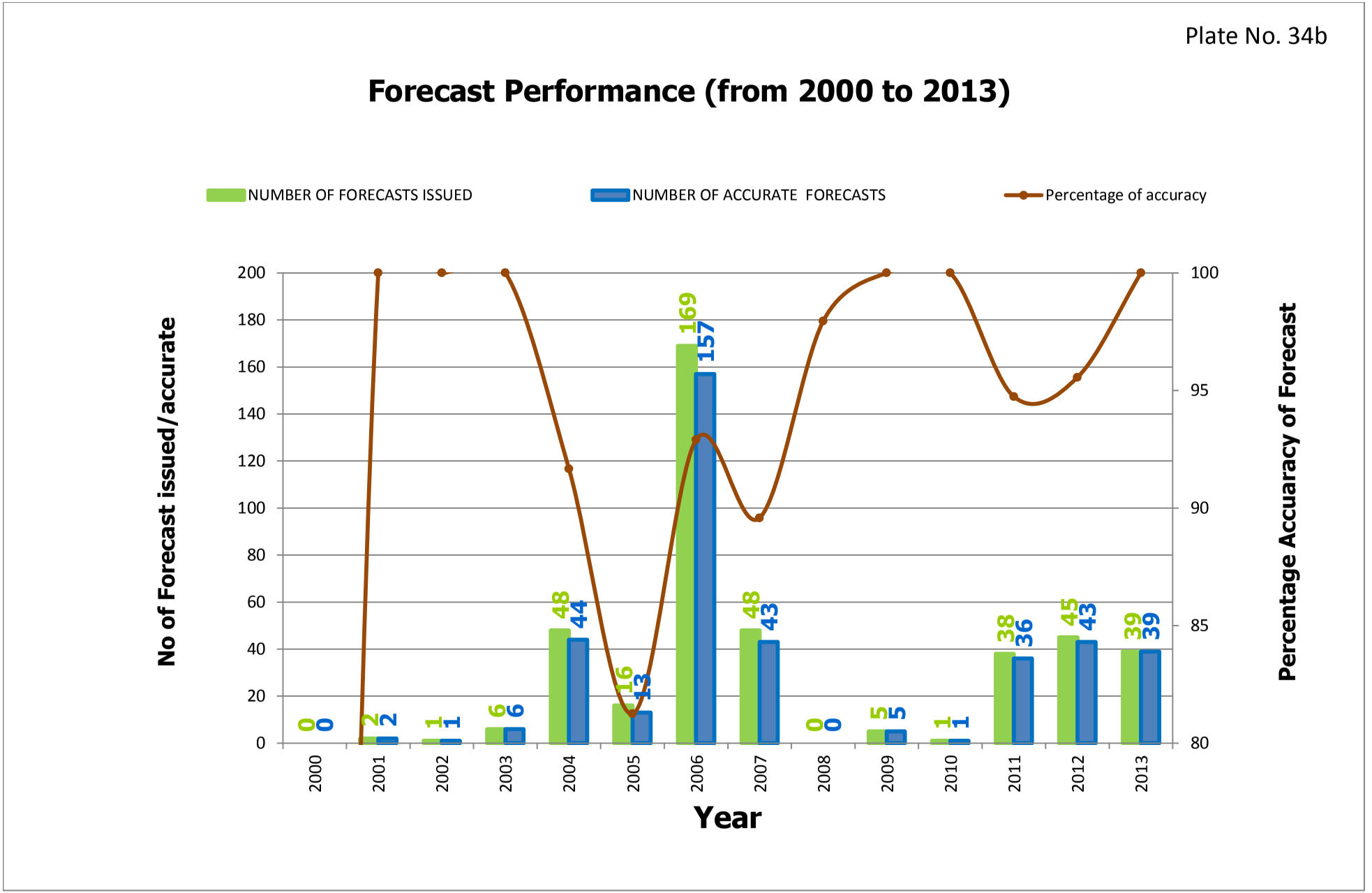
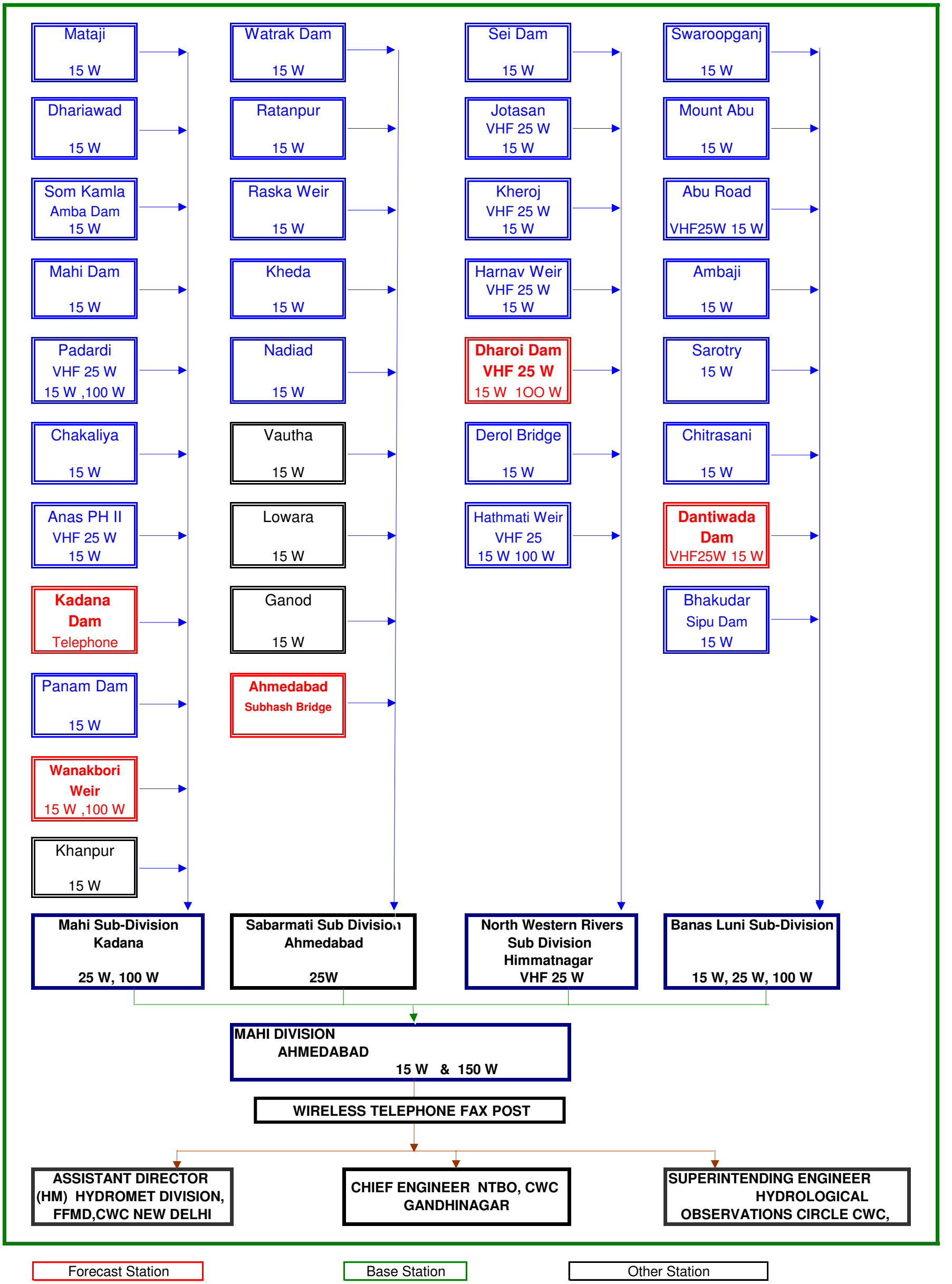
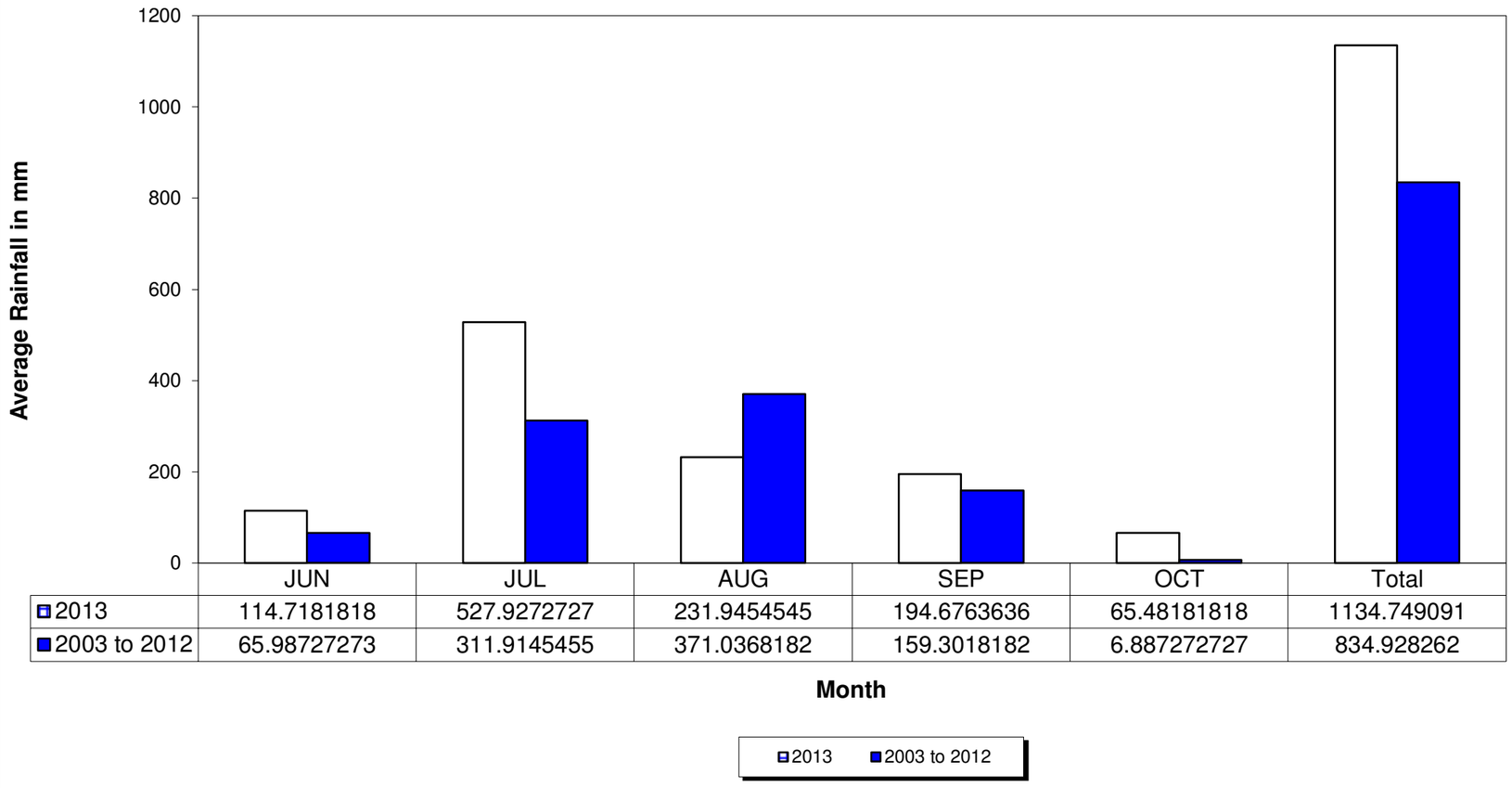

Forecast Performance (from 2000 to 2013)
NUMBER OF FORECASTS ISSUED
NUMBER OF ACCURATE FORECASTS
Percentage of accuracy
No of Forecast issued/accurate
Percentage Accuaracy of Forecast
Year
200
180
160
140
120
100
80
60
40
20
0
100
95
90
85
80
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
0 0
2 2
1 1
6 6
48 44
16 13
169 157
48 43
0 0
5 5
1 1
38 36
45 43
39 39

Plate No. 35

COMMUNICATION NETWORK OF MAHI DIVISION

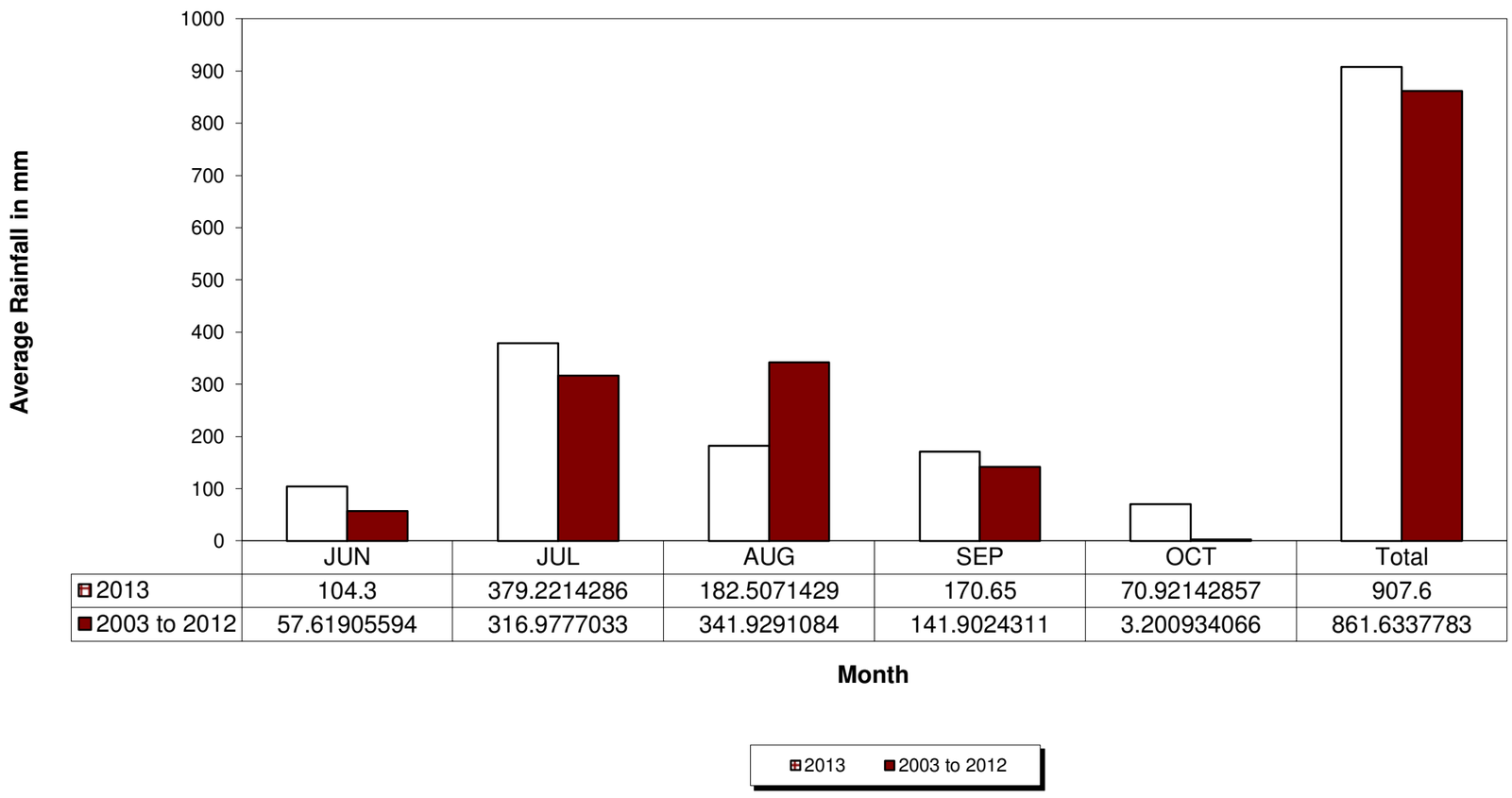


Bar Chart Showing Monthly Average Rainfall of Past 10 Years up to 2012 α 2013 in Mahi Basin



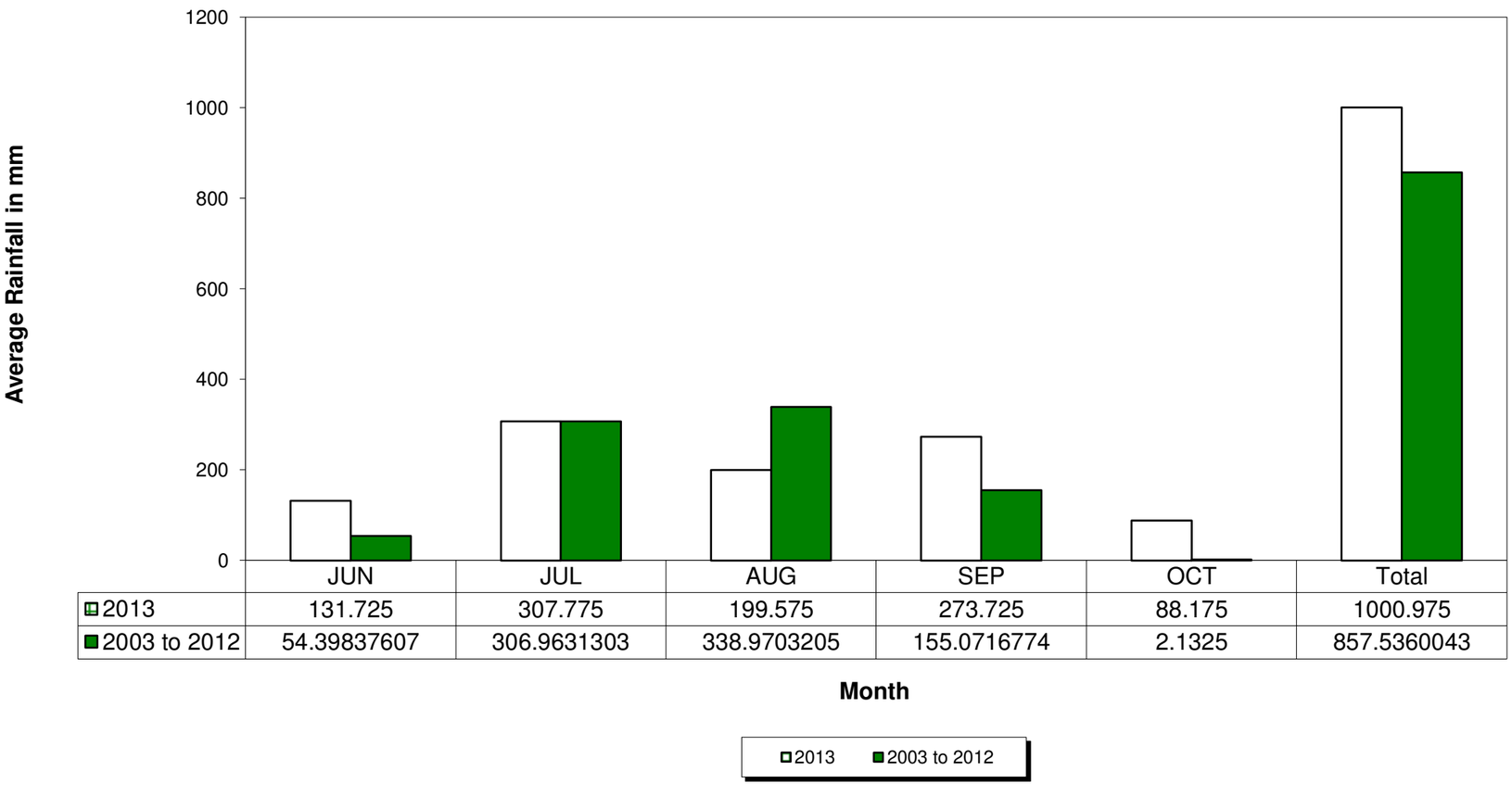
	JUN	JUL	AUG	SEP	OCT	Total
2013	114.7181818	527.9272727	231.9454545	194.6763636	65.48181818	1134.749091
2003 to 2012	65.98727273	311.9145455	371.0368182	159.3018182	6.887272727	834.928262

Bar Chart Showing Monthly Average Rainfall of Past 10 Years up to 2012 α 2013 in Sabarmati Basin



	JUN	JUL	AUG	SEP	OCT	Total
2013	104.3	379.2214286	182.5071429	170.65	70.92142857	907.6
2003 to 2012	57.61905594	316.9777033	341.9291084	141.9024311	3.200934066	861.6337783

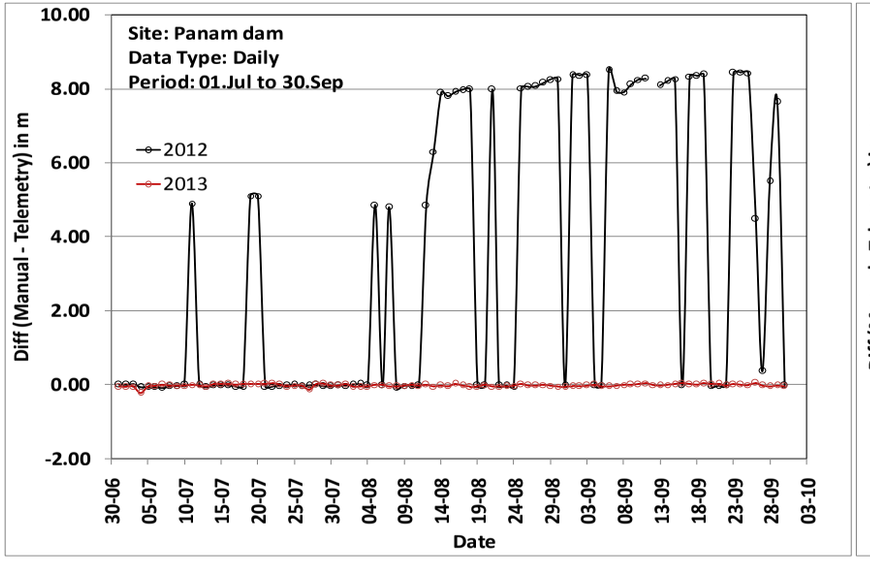
Bar Chart Showing Monthly Average Rainfall of Past 10 Years up to 2012 α 2013 in Banas Basin



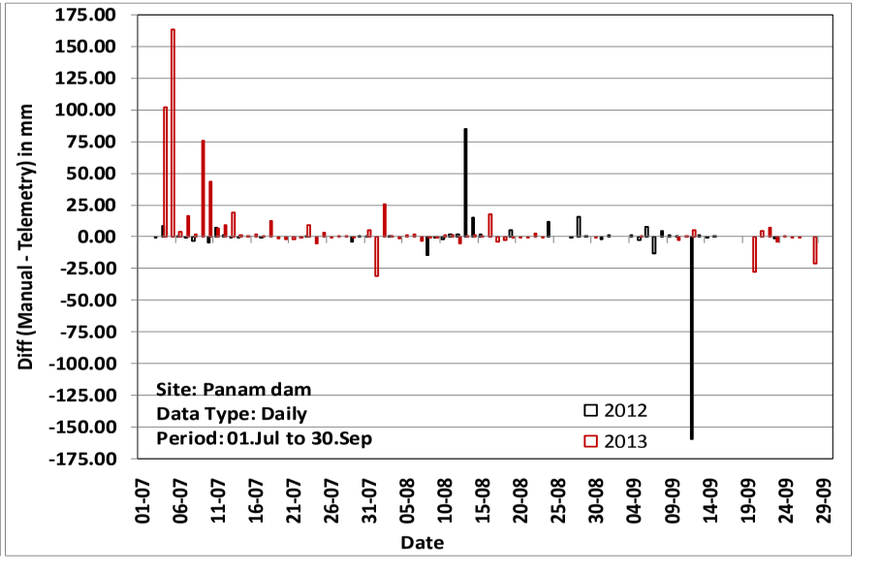
	JUN	JUL	AUG	SEP	OCT	Total
2013	131.725	307.775	199.575	273.725	88.175	1000.975
2003 to 2012	54.39837607	306.9631303	338.9703205	155.0716774	2.1325	857.5360043

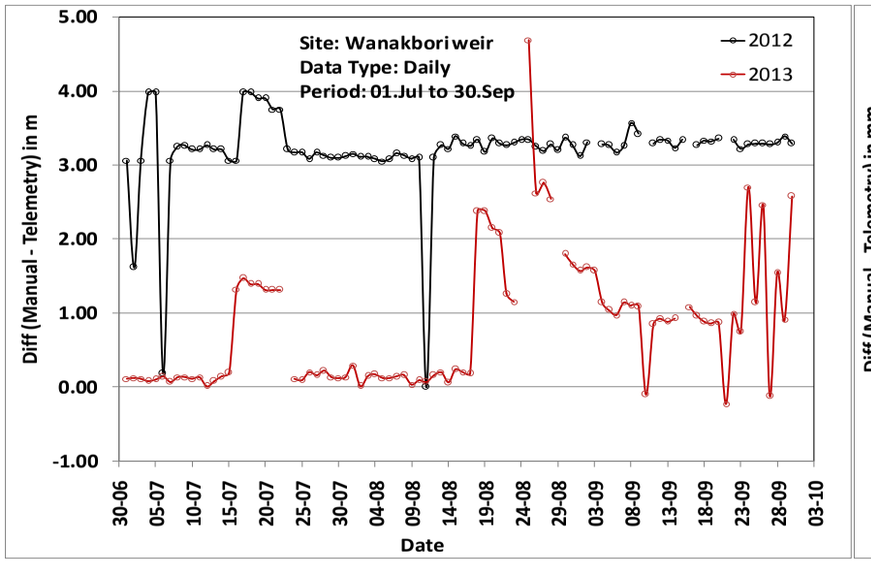
Comparison between Manually observed and Telemetred Water Level and Rainfall

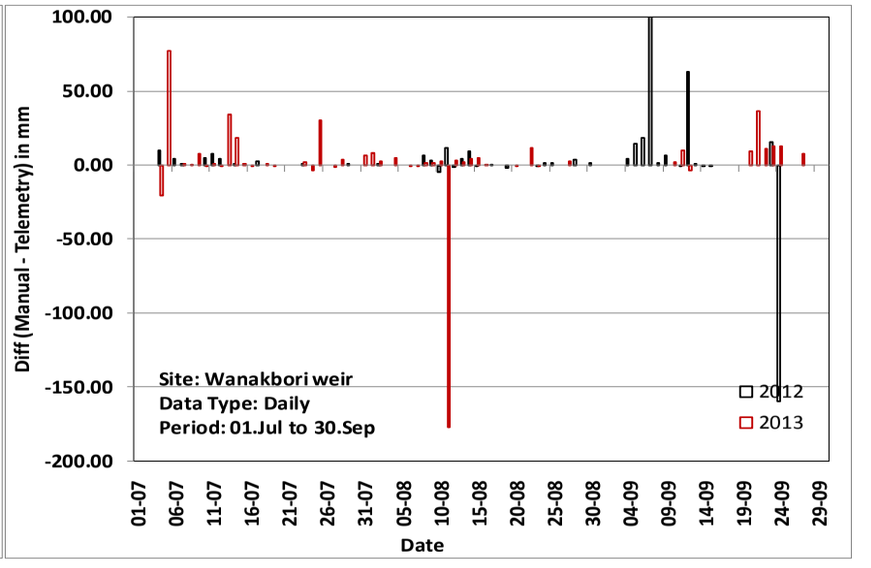
Water Level



Rainfall



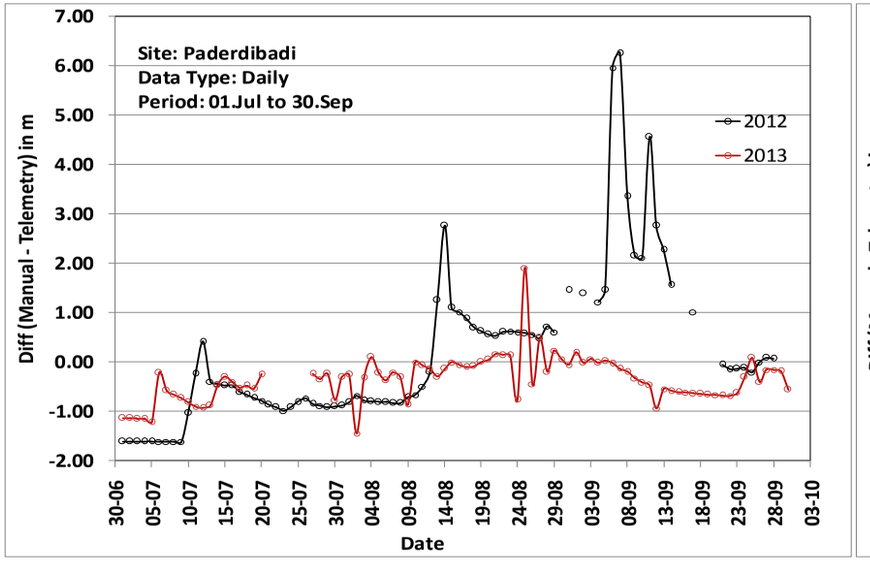




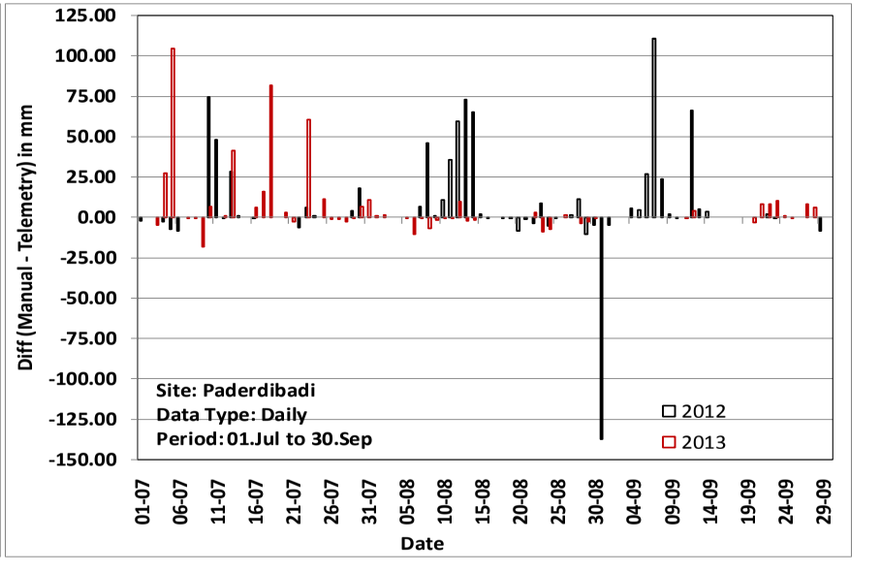
Note: Days with RF nil has been omitted.

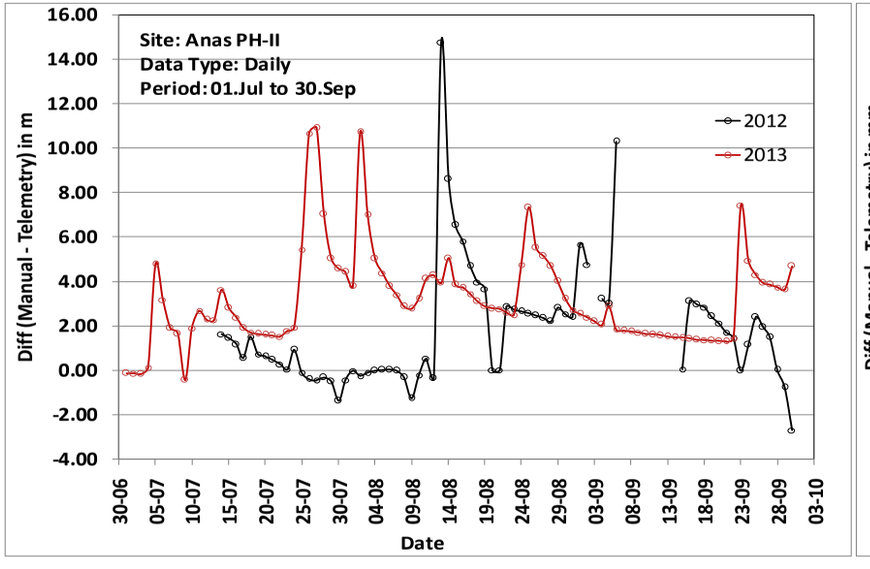
Comparison between Manually observed and Telemetred Water Level and Rainfall

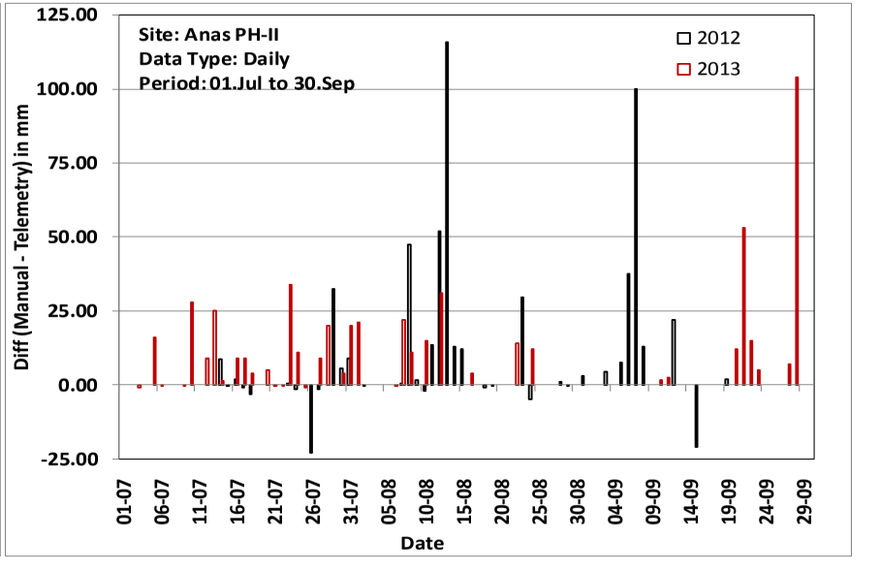
Water Level



Rainfall

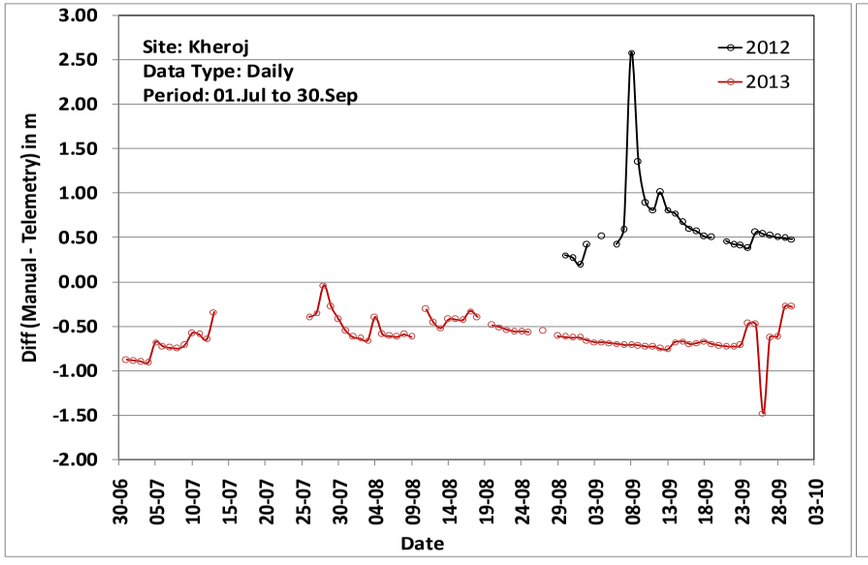




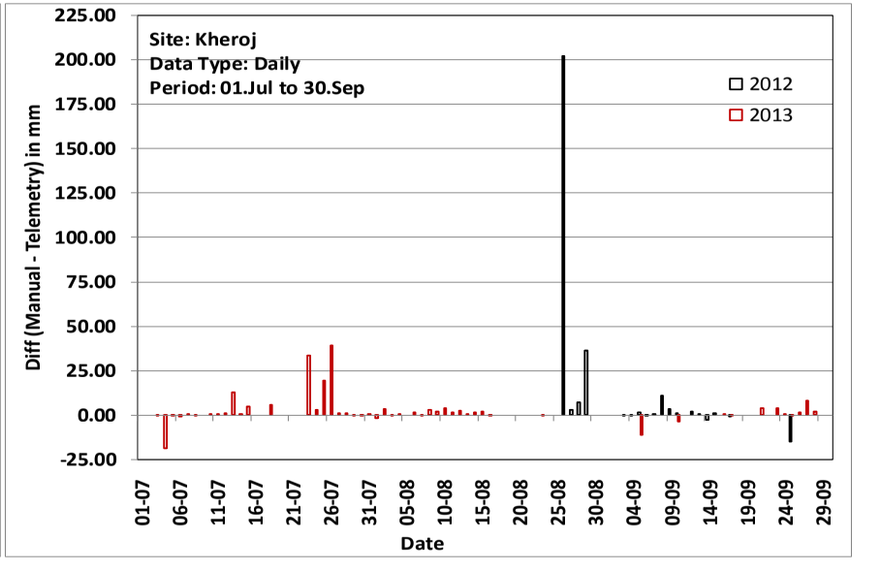


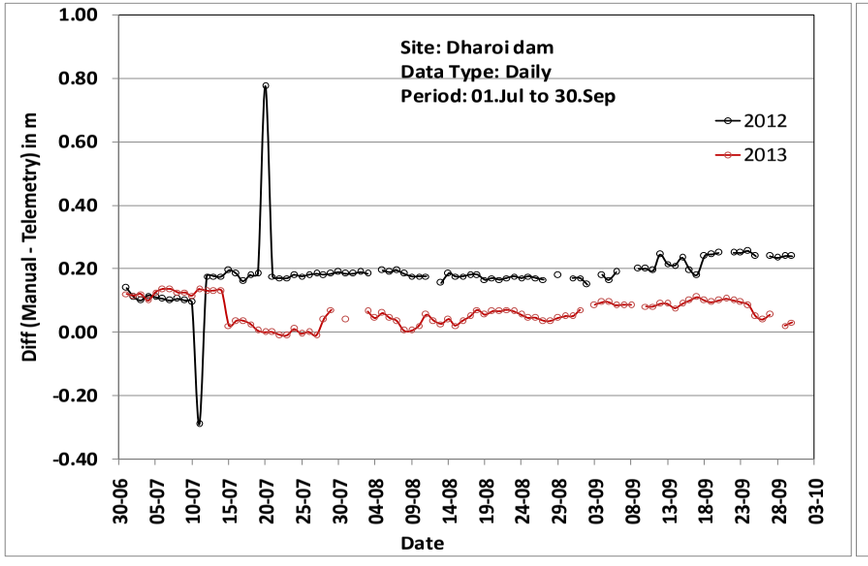
Comparison between Manually observed and Telemetred Water Level and Rainfall

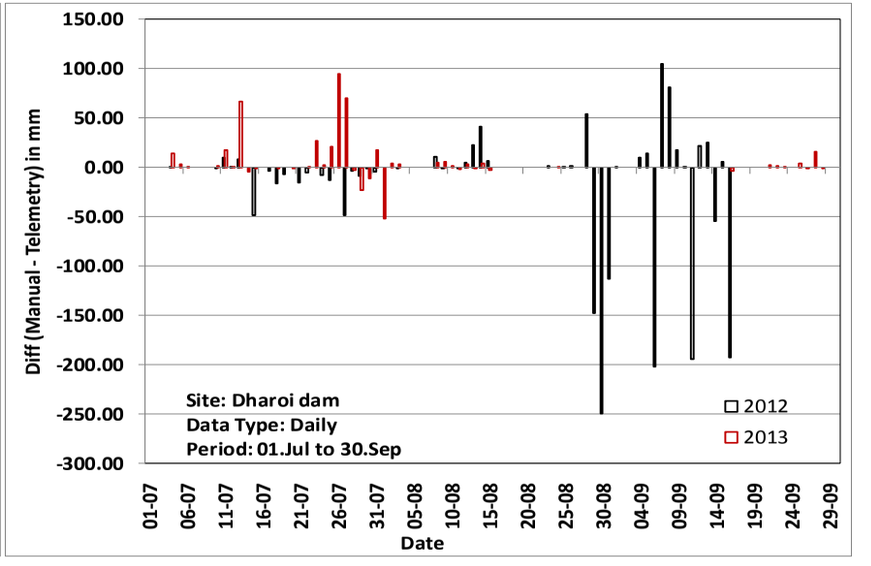
Water Level



Rainfall

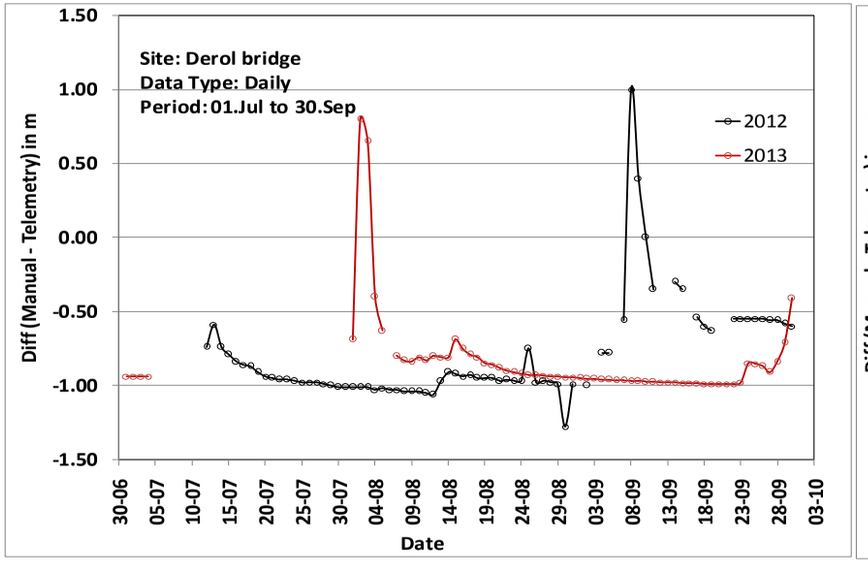




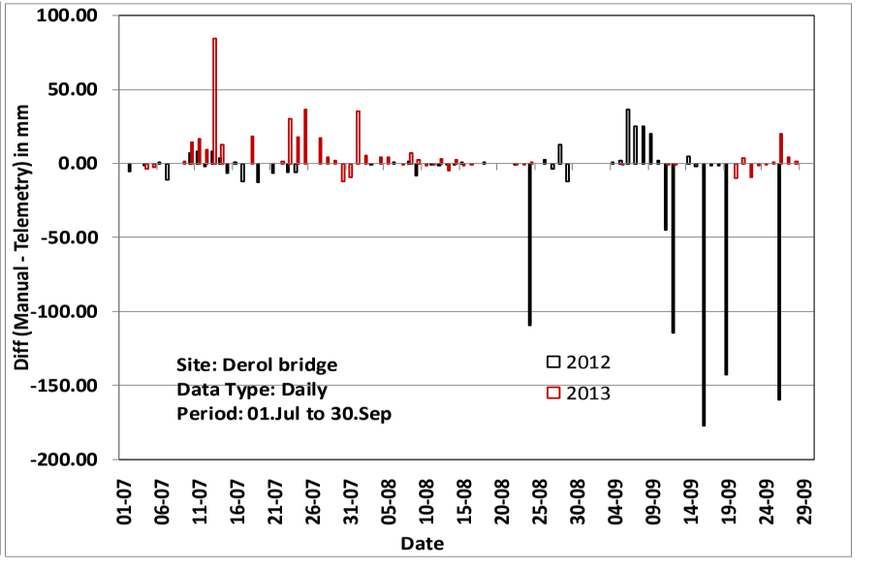


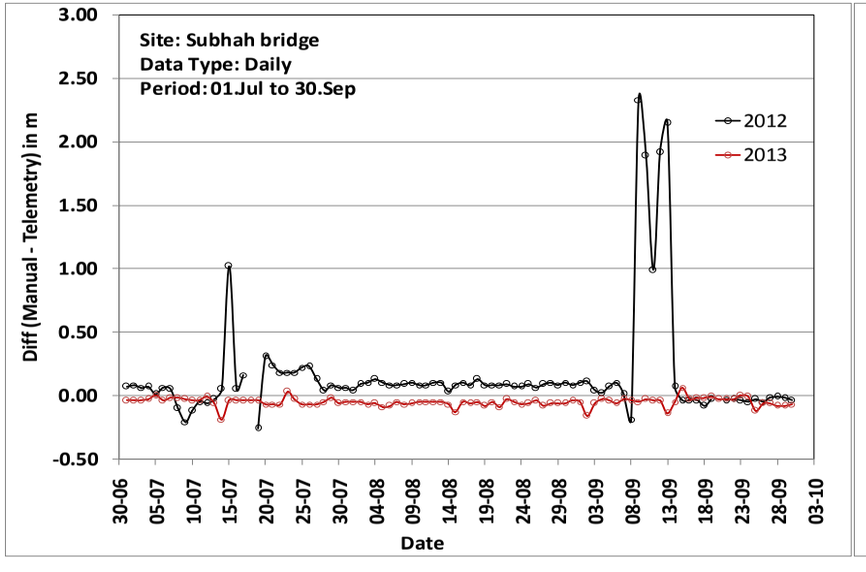
Comparison between Manually observed and Telemetred Water Level and Rainfall

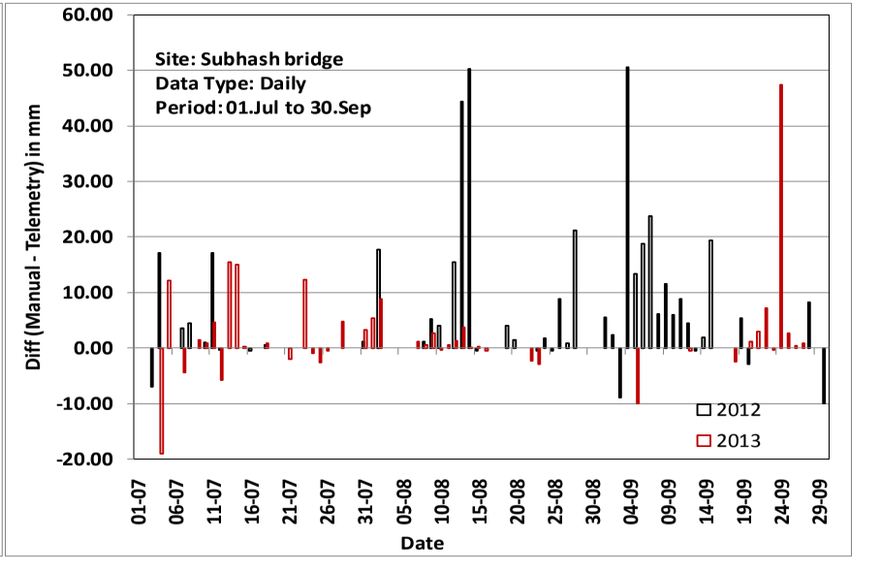
Water Level



Rainfall

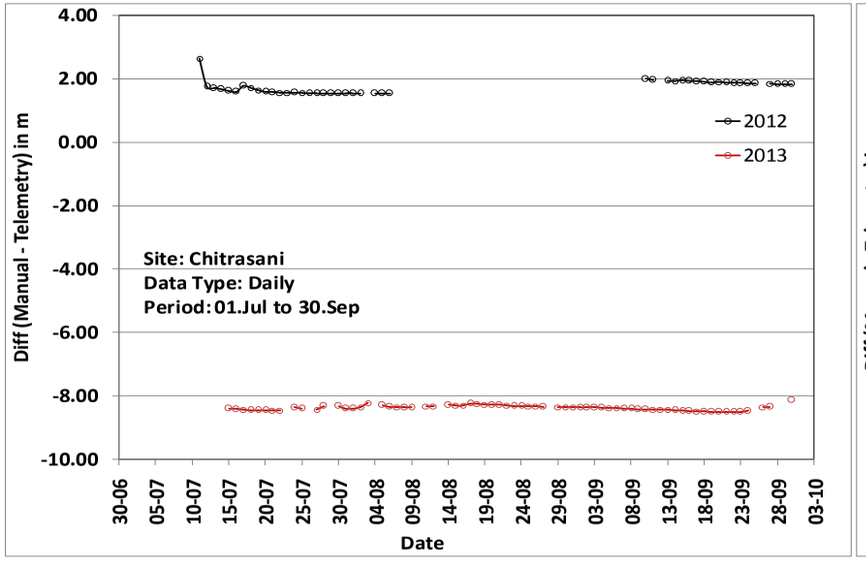




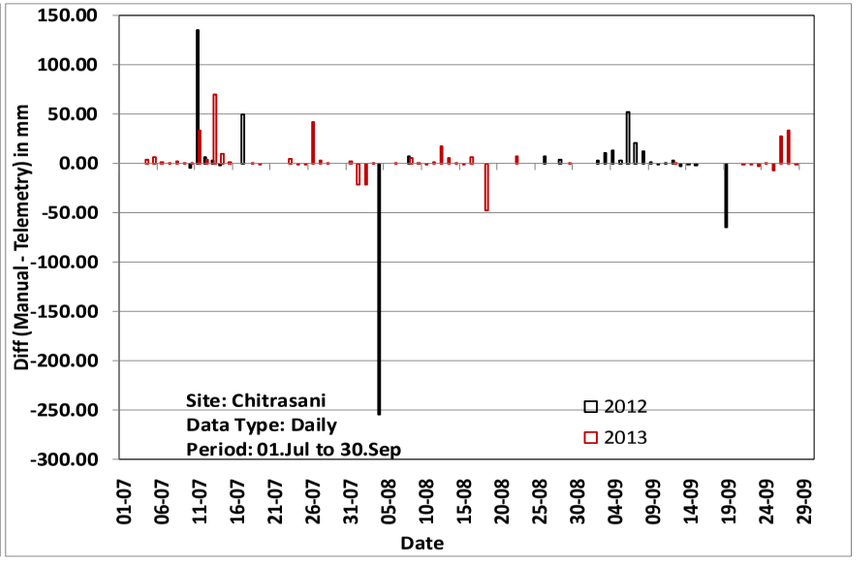


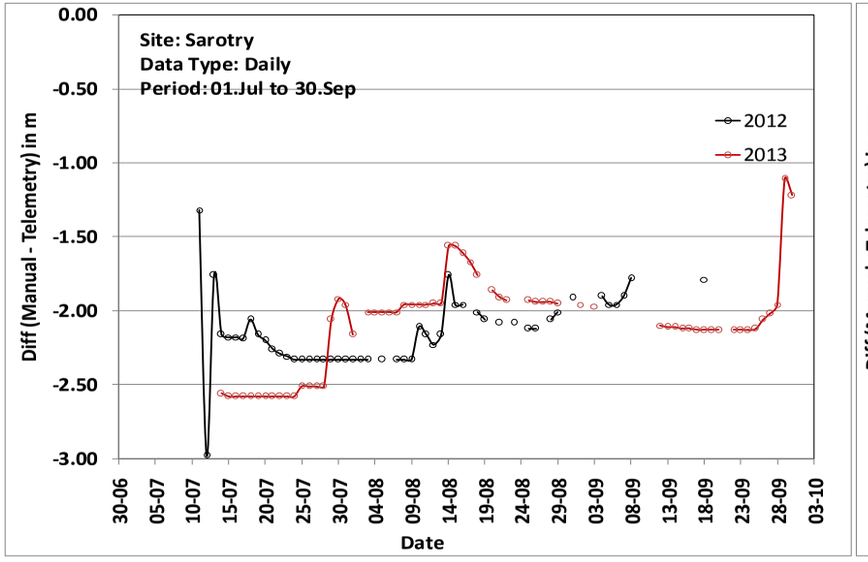
Comparison between Manually observed and Telemetred Water Level and Rainfall

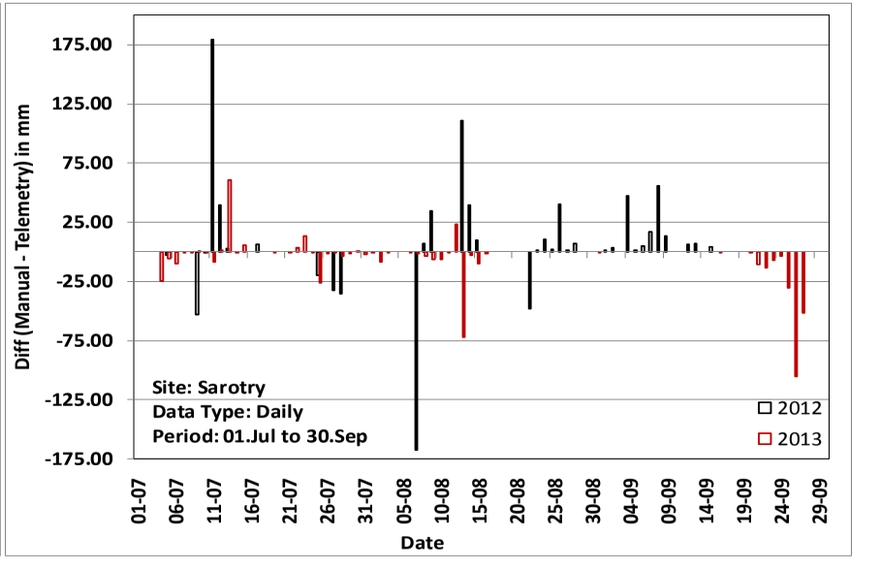
Water Level



Rainfall

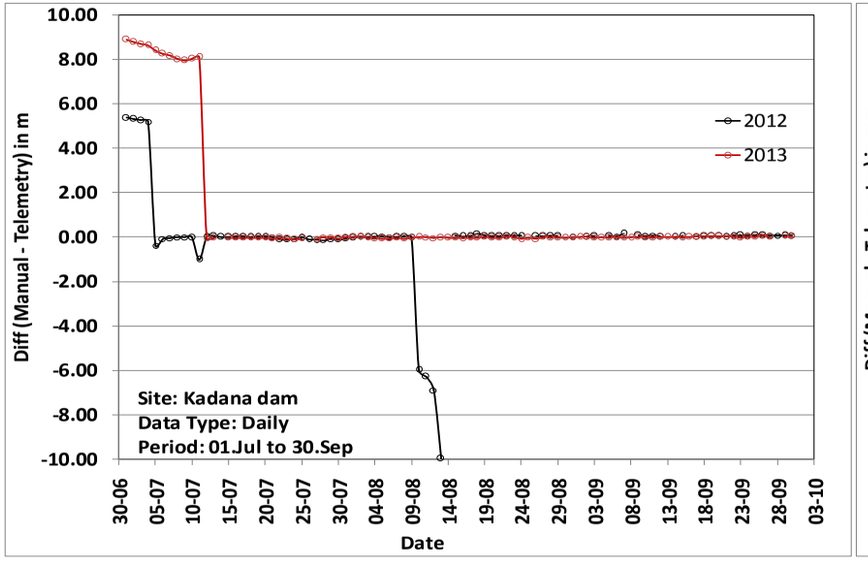






Comparison between Manually observed and Telemetred Water Level and Rainfall

Water Level



Rainfall