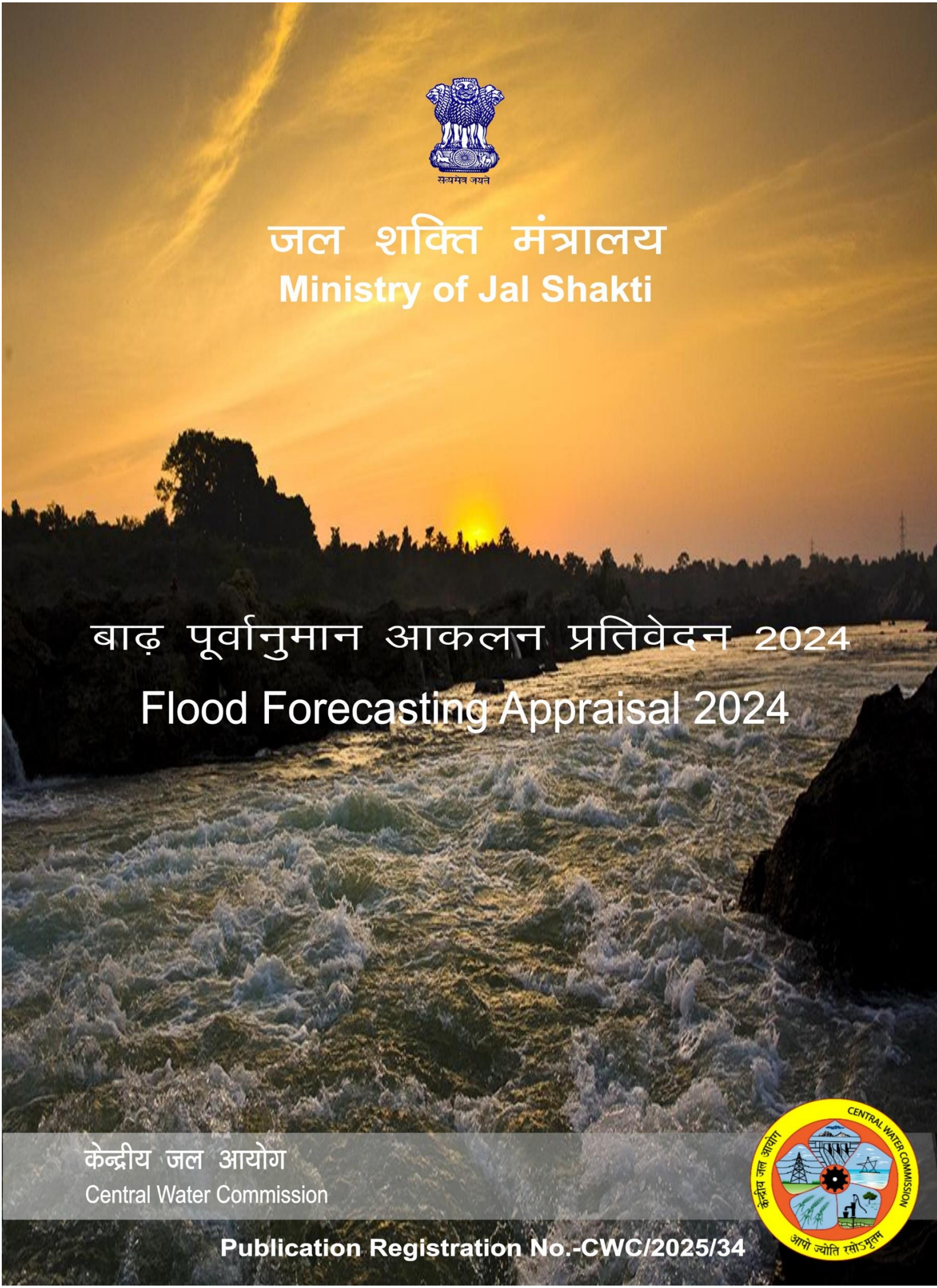
सत्यमेव जयते
जल शक्ति मंत्रालय
Ministry of Jal Shakti
बाढ़ पूर्वानुमान आकलन प्रतिवेदन 2024
Flood Forecasting Appraisal 2024
केन्द्रीय जल आयोग
Central Water Commission
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प्रस्तावना

भारतवर्ष एक विकासशील कृषि प्रधान देश है। यहाँ की लगभग दो-तिहाई जनसंख्या की आजीविका का साधन प्रत्यक्ष व अप्रत्यक्ष रुप में कृषि पर ही निर्भर है। कृषि कार्य के लिए जल परम आवश्यक है तथा पृथ्वी पर जल प्राप्ति का प्रमुख स्रोत वर्षा है।

भारतवर्ष की वर्षा मानसूनी है और मानसूनी वर्षा की यह विशेषता होती है कि स्थान-स्थान की भौगोलिक स्थितियों के अनुसार वर्षा की मात्रा एवं अवधि में काफी अंतर होता है। मानसूनी वर्षा का स्वरुप कभी समय से तो कभी समय से पूर्व एवं कभी समय के बाद तथा कभी सामान्य व कभी सामान्य से कम या बहुत ही कम तो कभी सामान्य से अधिक या बहुत ही अधिक हुआ करती है। इस प्रकार मानसूनी वर्षा में निश्चितता बहुत ही कम होती है। सामान्य वर्षा जहाँ देश के लिए खुशहाली व समृद्धि लाती है तो वहीं सामान्य से कम या अधिक वर्षा देश में सूखे व बाढ़ के रुप में त्राहि-त्राहि मचा देती है।

प्रकृति की इसी असमानता को दूर करने की दिशा में सरकारी स्तर पर अथक प्रयास किये जा रहे हैं। भारत सरकार, जल शक्ति मंत्रालय के अंतर्गत केंद्रीय जल आयोग का "नदी प्रबंध निदेशालय" इसी दिशा में निरंतर कार्यरत है। पृथ्वी पर वर्तमान जल संसाधनों की खोज तथा वर्षा से प्राप्त जल के समुचित प्रबंध तथा उपयोग में इस विभाग की महत्वपूर्ण भूमिका है। देश की भिन्न-भिन्न नदी प्रणालियों में गेज, निस्सारण एवं गाद प्रेक्षण, जल गुणवत्ता अध्ययन, वर्षा मापन, बाढ़ पूर्वानुमान एवं देश की लघु, मध्यम तथा प्रमुख सिंचाई परियोजनाओं का प्रबोधन इसके बहु-आयामी कार्यों में प्रमुख हैं।

नर्मदा मंडल, केंद्रीय जल आयोग, भोपाल की स्थापना सन 1976 में नर्मदा, तापी और उनकी सहायक नदियों पर गेज, निस्सारण तथा मौसम संबंधी आकड़ों के मापन हेतु 80 प्रमुख स्थल योजना के अंतर्गत हुई थी। मानसून वर्ष 2000 से ऊपरी नर्मदा के बाढ़ पूर्वानुमान का कार्य नर्मदा मंडल, भोपाल तथा निचली नर्मदा के बाढ़ पूर्वानुमान का कार्य तापी मंडल, सूरत द्वारा किया जा रहा है।

मानसून 2024 में वर्षा जून के तृतीय सप्ताह से प्रारंभ होकर अक्टूबर के प्रथम सप्ताह तक जारी रही एवं इस दौरान पूरे मध्यप्रदेश में सामान्य से अधिक वर्षा हुई । इस कार्यालय के अंतर्गत नर्मदा बेसिन में स्थित अधिकांश स्थलों पर औसत से अधिक वर्षा रिकॉर्ड की गई, जिसमें सबसे ज्यादा वर्षा स्थल पचमढ़ी में कुल 2085.8 मिलीमीटर एवं सबसे कम वर्षा कोगाँव में 725.8 मिलीमीटर दर्ज हुई है। इस कार्यालय के अंतर्गत कार्य करने वाले सभी अधिकारियों व कर्मचारियों के सहयोग से चौबीसों घंटे (24 X 7) दैनिक वर्षा का मापन एवं गेज प्रेक्षण का कार्य अनवरत किया गया जिसके आधार पर उपमंडल नर्मदापुरम द्वारा मंडला स्थल के लिए स्तर पूर्वानुमान एवं बाढ़ नियंत्रण कक्ष, नर्मदा मंडल, भोपाल द्वारा बरगी, तवा, बारना, इंदिरसागर एवं ओमकारेश्वर जलाशयों के इनफ्लो पूर्वानुमान का कार्य सफलतापूर्वक निष्पादित किया गया। इस मानसून के दौरान विभिन्न नदियों द्वारा 04 स्थलों पर नवीन उच्चतम जल स्तर अंकित किया गया ।

संपूर्ण मानसून काल के दौरान नर्मदा नदी के तट पर स्थित मंडला स्थल पर तीन बाढ़ की लहर आई, जिसके फलस्वरूप स्थल मंडला के लिए 27 स्तर पूर्वानुमान जारी किये गए जिनकी शुद्धता 100 प्रतिशत रही। इस मानसून काल में मंडल के क्षेत्राधिकार के अंतर्गत आने वाले पाँच बाँधों यथा - इंदिरासागर, ओमकारेश्वर, बरगी, तवा और बारना के लिए 105 इनफ्लो (अंतर्वाह) पूर्वानुमान जारी किये गए जिनकी शुद्धता 100 प्रतिशत रही। इस मानसून काल के दौरान MIKE-11 सॉफ्टवेयर के द्वारा मंडला स्थल के लिए स्तर बाढ़ पूर्वानुमान तथा बरगी, तवा, बारना, इंदिरसागर एवं ओंकारेश्वर जलाशयों के लिए इनफ्लो (अंतर्वाह) पूर्वानुमान की गणना का कार्य भी सफलतापूर्वक संपादित किया गया।

उक्त कार्य इस कार्यालय के अंतर्गत मानसून में कार्य करने वाले सभी अधिकारियों एवं कर्मचारियों के अद्वितीय सहयोग एवं कर्मठता के द्वारा ही संभव हो पाया है जिसके लिए मैं धन्यवाद एवं आभार व्यक्त करता हूँ, साथ ही भविष्य में इस कार्यालय के अंतर्गत कार्यरत सभी अधिकारयों व कर्मचारियों से आगामी मानसून में इसी तरह के सहयोग की अपेक्षा रखता हूँ।

प्रस्तुत आकलन प्रतिवेदन कुल 13 अध्यायों में विषयानुसार विभक्त है। इस प्रतिवेदन को सरल भाषा एवं वर्णनात्मक शैली में तैयार किया गया है तथा अध्यायों में वर्णित विषयों को 41 तालिकाओं, 54 चित्रकलाओं एवं 07 छायाचित्रों की सहायता से और अधिक सरल तथा बोधगम्य बनाने का सफलतम प्रयास किया गया है। मुझे आशा ही नहीं वरन पूर्ण विश्वास है कि यह आकलन प्रतिवेदन वर्ष 2024 के बाढ़ मौसम के दौरान नर्मदा मंडल, भोपाल के अंतर्गत संपादित सभी बाढ़ पूर्वानुमान कार्यों एवं कार्य संपादन के दौरान अनुभूत कठिनाइयों एवं उनके समाधान के लिए दिये गये सुझावों का संपूर्ण विवेचन प्रस्तुत करने में निस्संदेह सफल एवं अपने आप में अनूठा प्रतिवेदन सिद्ध होगा।

KSaini

(करन सिंह सैनी)
अधिशासी अभियंता

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ABBREVIATION AND SYMBOLS USED

CWC	:	Central Water Commission
IMD	:	India Meteorological Department
WRD of Govt. MP	:	Water Resources Department of Govt. of Madhya Pradesh
NCA	:	Narmada Control Authority
MCM	:	Million Cubic Metres
Cumecs	:	Cubic metre per second
ha	:	Hectare
M.S.L.	:	Mean sea level
FF	:	Flood forecasting
G	:	Gauge
hrs	:	Hours
mm	:	millimetre
m	:	Metre
m3/s	:	Cubic metre per second
°	:	Degree (00o)
’	:	Minute (00’)
”	:	Second (00”)
80 keys	:	80 key Hydrological Station Scheme
67 keys	:	67 key Hydrological Station Scheme

CHAPTER - 1
INTRODUCTION

1.1 DESCRIPTION

Flood forecasting and early warning systems are crucial for minimizing the devastating impacts of floods, which are one of the most common and destructive natural hazards worldwide. In India, the responsibility of developing scientific flood forecasting techniques and issuing warnings has been entrusted to the Central Water Commission (CWC), which is the apex body in the country for flood management. This work began in the late 1950s with the establishment of a small cell tasked with issuing flood warnings for the Yamuna River catchment. Over time, this initiative has grown significantly, evolving into the Central Flood Forecasting Organization (CFFO) under the CWC. This organization is now responsible for flood forecasting across almost all major interstate rivers in India.

Floods are the third most damaging natural hazard globally, following storms and earthquakes, and they are among the most common. Flooding is a major concern in India, as it is in many other parts of the world. Consequently, significant efforts have been made by the Indian research community to develop models and methodologies to understand and manage floods at various spatial scales. In recent years, notable contributions have been made in areas such as flood estimation, multivariate hydrologic modelling, uncertainty quantification, climate change impacts, and flood hazard and risk assessment.

The task of developing scientific techniques for flood forecasting and issuing flood warnings across different river basins was entrusted to the Central Water Commission (CWC). Initially, a small cell was created in the late 1950s to issue flood warnings in the Yamuna catchment area. This cell has since expanded and evolved into the Central Flood Forecasting Organization of the CWC, now covering almost all-important inter-state rivers in India.

1.2 FLOOD FORECASTING SETUP

The Narmada Division in Bhopal was established in February 1976, originally known as the Bhopal Gauging Division. It was created under the 80 Key-station schemes for the observation of gauge and discharge at various G&D sites along the Narmada and Tapi Rivers, as well as their tributaries. The flood forecasting responsibilities for the Narmada River were initially assigned to the Tapi Division in Surat, along with the G&D observations, until 1999-2000. From 2000-2001, the flood forecasting duties for the Narmada Basin were reallocated as follows:

Table 1.1: Division-wise Distribution of Flood Forecasting Stations:

S. No	Name of FF Station	Name of Division
1	Mandla	Narmada Division, Bhopal
2	Narmadapuram	Narmada Division, Bhopal
3	Garudeshwar	Tapi Division, Surat
4	Bharuch	Tapi Division, Surat

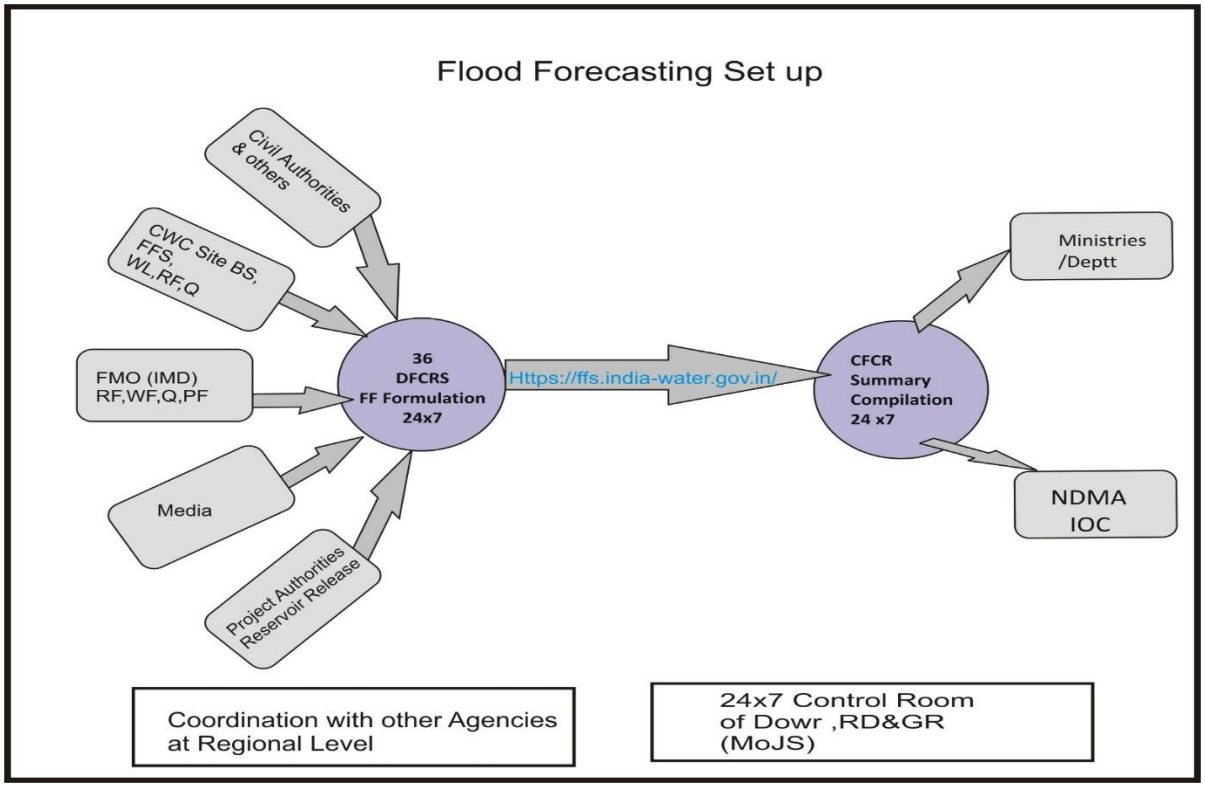


Figure- 1.1: Divisional Flood Control Room DFCR, Narmada Basin

The Narmada Division operates a Control Room in Bhopal, which is tasked with issuing flood forecasts to the relevant state authorities for the cities of Mandla and Narmadapuram. Starting with the monsoon of 2025, four additional flood cells will be established in Bhopal, Indore, Narmadapuram, and Jabalpur. These cells will significantly enhance the capacity for flood monitoring and forecasting across the Narmada Basin, strengthening the region's flood management efforts.

Level Forecast

A river level forecast predicts the water level at a specific location over a defined period, playing a crucial role in flood management, navigation, and environmental monitoring. It relies on data such as river discharge, rainfall, and upstream conditions. This information is used by the Divisional Flood Control Room to project future water levels, typically for a few hours or days ahead. The forecast helps determine the anticipated rise in river levels, enabling authorities to take proactive measures, such as evacuations or infrastructure protection, to mitigate potential risks.

The Narmada Division, Bhopal currently issues level forecasts for two stations:

1. Mandla
2. Narmadapuram

Inflow forecast

The forecasted inflow plays a crucial role in managing reservoir operations and significantly helps in moderating floodwaters. It is essential to account for the flow at any reservoir, barrage, station, or given reach, as this information is vital in determining added flows or extractions within any given reach during a specific duration. This helps in efficiently regulating reservoirs

by considering factors related to irrigation, power production, flood control, and minimizing inundation problems in both upstream and downstream areas, depending on the existing or forecasted flow conditions. These measures ensure the safety of downstream structures.

Currently, the Narmada Division in Bhopal issues advisory inflow forecasts for the following five dams:

1. Bargi Dam
2. Barna Dam
3. Tawa Dam
4. Indirasagar Dam
5. Omkareshwar Dam

Data Collection and Transmission

The flood forecasting system operates by aggregating data from a network of strategically located sites, including Dindori, Bamni, Mohgaon, Manot, Mukki, Mawai, Barmanghat, Sandia, Narmadapuram and Handia. This data is captured and transmitted in real time via telephone or mobile communication networks, ensuring the immediate availability of critical information. The collected data from these sites is then utilized to formulate the flood/inflow forecasts.

The responsibility for flood forecasting activities is entrusted to the Middle Narmada Sub-Division-I, Narmadapuram, under the Narmada Division, Bhopal. This Sub-Division collects water level and rainfall data from the designated sites and prepares flood forecasts for Mandla and Narmadapuram stations. The forecasts are then transmitted to the Divisional Flood Control Room (DFCR) for further dissemination to relevant stakeholders. Additionally, inflow forecasts are generated by the Divisional Flood Control Room (DFCR), Bhopal.

Dissemination of Forecasts

A flood level forecast, regardless of its accuracy, holds value only if it is swiftly communicated to the relevant users and beneficiaries. To ensure timely dissemination, forecasts are prioritized and shared through the CWC website, e-mail, mobile (WhatsApp Group), and telephone. Additionally, the information is sent to district collectors and key state officials to ensure the public is effectively informed well in advance.

Data dissemination is done through:

- Telephone
- WhatsApp Group
- E-mail messages to civil authorities, following the flood memorandum guidelines
- Uploading data on the WIMS platform to facilitate user agencies

Major recipients of the flood forecasts include:

- Flood Control Cell at the State Headquarters in Bhopal
- Local administrations
- Project authorities

- Disaster management authorities, etc.

Methodology

The methodology employed for issuing flood forecasts is in accordance with the CWC Manual on Flood Forecasting for level forecasts and inflow forecasts. Primarily, graphical techniques are utilised at most forecasting sites. These statistical methods are predominantly graphical or based on mathematical relationships, which are developed through the analysis of historical data using statistical techniques.

In the application of graphical methods, a range of correlation diagrams is meticulously prepared to depict the influence of basin parameters, and these diagrams are subjected to rigorous accuracy testing. The division has developed a series of correlation diagrams, stage-discharge curves/tables, and travel time curves for each forecasting site, based on data collected over a span of 10 to 15 years. These analytical tools are integral to the precision and reliability of the flood forecasting process.

1.3 UPLOADING FLOOD FORECAST DATA ON WIMS

The Central Water Commission (CWC), headquartered in Delhi, has undertaken a significant initiative to make all flood forecast-related data available to the general public by uploading it onto the WIMS platform via the internet. This platform facilitates public access to crucial flood forecasting information. During the Monsoon period, the Narmada Division, Bhopal successfully contributed to this endeavour by uploading the relevant flood forecast data. This effort marks a notable step towards ensuring transparency, enhancing accessibility to vital information, and improving public preparedness and response to flood events.

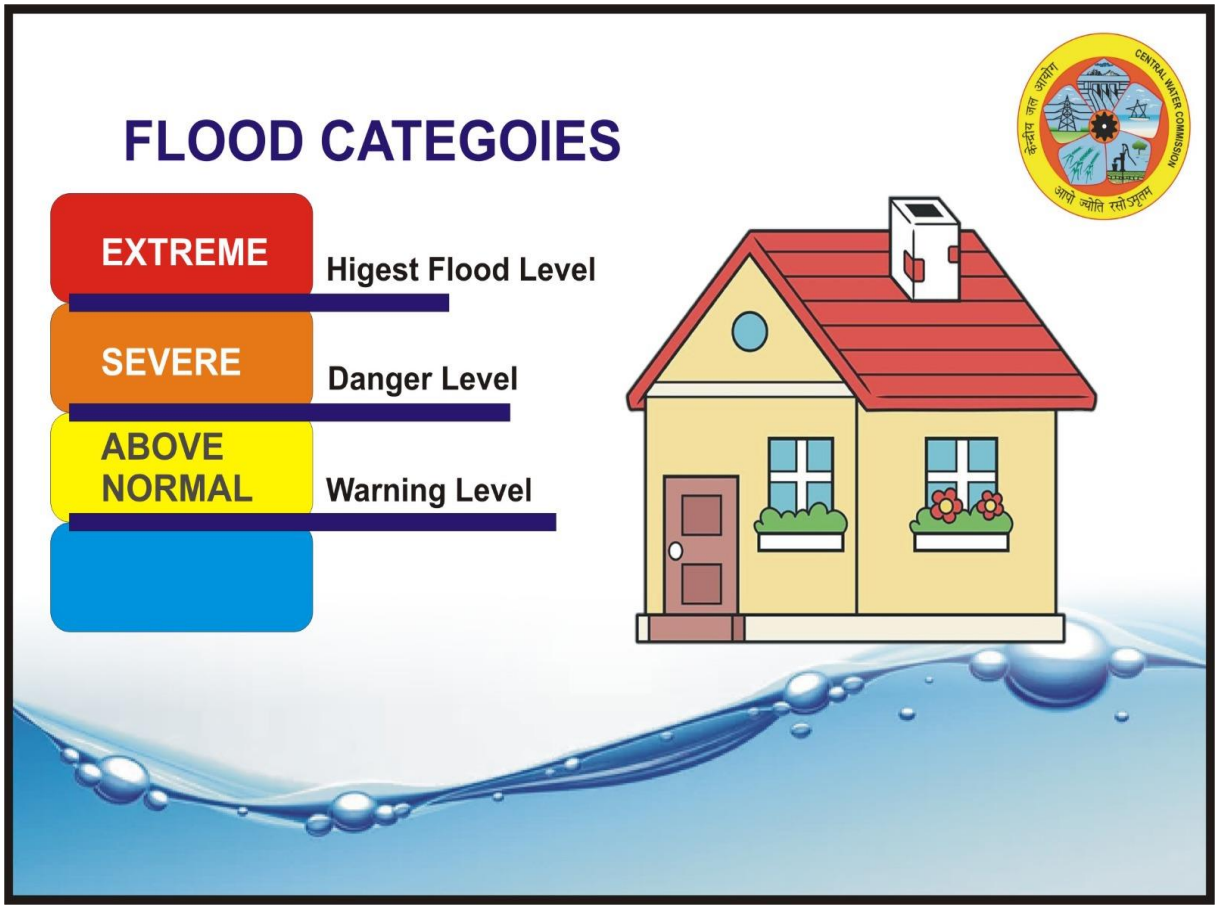


Figure- 1.2: SOP Flood Forecasting (Classification of Flood)

Table 1.2: New Classification of Flood:

1	Above Normal Flood	When the river water level reaches its warning level but remains below the danger level.
2	Severe Flood	When the river water level reaches the danger level but remains below the highest flood level.
3	Extreme Flood	When the river water level surpasses the highest flood level.

Works of divisional flood control room

- **Collection and Observation of Real-Time Data**
  Continuously observe and collect real-time data through telephone and mobile communications from various sites to the Sub-Divisions and Divisions.
- **Forecast Formulation and Analysis**
  Compile, analyse, and formulate flood forecasts for the required sites during critical situations, then communicate these forecasts back to User Agencies via available communication channels.
- **Communication with User Agencies**
  Notify User Agencies at State and District Headquarters, including Relief Commissioners, promptly and through all available means of communication.
- **Coordination with Central Water Commission (CWC)**
  Communicate essential flood data to CWC Headquarters for the compilation of the All India Bulletin.
- **Collaboration with National Agencies**
  CWC Headquarters, in turn, coordinates with the National Disaster Management Agency (NDMA), Integrated Operations Centre (IOC), Ministry of Home Affairs (MHA), and other pertinent offices and ministries.
- **Flood Review Meetings Coordination**
  Facilitate and coordinate flood review meetings at the Division/Sub-Division level, as well as at the National level, to assess the ongoing flood situation and provide recommendations for subsequent flood management strategies.
- **Support to Administration**
  Provide vital real-time updates and advanced warnings to assist the administration at various levels in managing the flood crisis.

- **Public Information Dissemination**

  Ensure timely communication to the public via the official website, keeping them informed about flood developments.

- **Preparation of Appraisal Report**

  Preparation of Appraisal Report for self-assessment, enabling future improvements in flood forecasting.

CHAPTER- 2

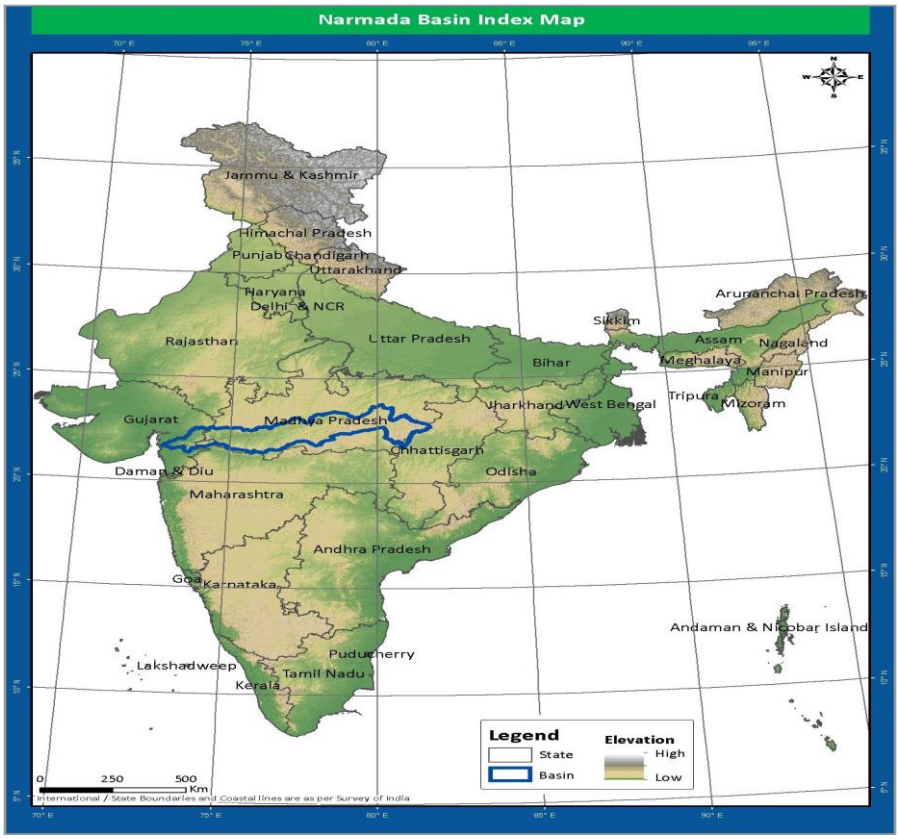
BASIN PHYSIOGRAPHY, RIVER SYSTEM AND RAINFALL

2.1 Narmada Basin and Physiography

The Narmada River is one of the major rivers in India, flowing from east to west, making it unique among Indian rivers. It originates from Amarkantak in the Maikal Hills of the Vindhyan Range in Madhya Pradesh, at an elevation of 1,057 meters. The river covers a total length of 1,312 kilometres and flows through the states of Madhya Pradesh, Maharashtra, and Gujarat, before emptying into the Gulf of Cambay near Bharuch in Gujarat. The Narmada Basin spans an area of approximately 98,796 square kilometres and lies between longitudes 72° 38' to 81° 43' E and latitudes 21° 27’ to 23° 37' N, located in the northern extremity of the Deccan Plateau. It covers parts of four states:

1. Madhya Pradesh: 82094.94 sq. km (88.58 % of the total basin area)
2. Chhattisgarh: 8326.34 sq. km (0.73 %)
3. Maharashtra: 1580 sq. km (1.7 %)
4. Gujarat: 8326.34 sq. km (8.98 %)

The basin is bounded on the north by the Vindhyas, on the east by the Maikala range, on the south by the Satpuras and on the west by the Arabian Sea. The basin has an elongated shape with a maximum length of 953 km. from east to west and a maximum width of 234 km from north to south. The hilly regions are in the upper part of the basin, and lower middle reaches are broad and fertile areas well suited for cultivation.



Physiographic Regions of the Narmada Basin

The basin has five well defined physiographic zones. They are - (i) The Upper hilly areas (ii) The Upper Plains (iii) The middle plains (iv) The lower hilly areas and (v) the lower plains

Table 2.1: Physiographic Regions of the Narmada Basin

Region	District Covered	Key Features
Vindhyanchal Baghelkhand Region (Upper Hilly Areas and Plains)	Anuppur, Shahdol, Dindori, Mandla, Balaghat, Jabalpur, Narsimhapur, Chhindwara	Composed of Vindhyan sandstones and Narmada-Son Trough (a structural dislocation at the junction of Archaeans, Bijawars, and Vindhyans). - Youthful topography with waterfalls, rapids, and gorges (e.g., Dhuandhar Falls near Bhedaghat). - Amarkantak Plateau (1,087 m) is a source of the river's radial drainage. - Landscape features flat-topped plateaus (Chhindwara, Seoni, Maikal).
Malwa Region (Middle Plains and Lower Hilly Areas)	Narmadapuram, Betul, East Nimar, West Nimar, Barwani, Dhar, Dewas, Sehore, Jhabua	Divided into three physiographic subunits: 1. West Vindhyas: Western part of the Vindhyan range. 2. West Narmada Trough: A low-lying area with fertile land. 3. West Satpuras: The western extension of the Satpura mountain range. - Known for undulating plains, hilly terrains, and fertile agricultural lands.

This table outlines the regions of the Narmada Basin, along with the covered districts and key physiographic features of each region.

Terrain and Soil Composition

The terrain of the Narmada Basin is varied, featuring both hilly and plain regions:

- Hilly Regions: Located in the upper part of the basin and in the lower middle reaches. These areas are well-forested and have steep slopes.
- Plain Regions: Situated between the hilly regions and in the lower reaches, these areas are broad, fertile, and well-suited for cultivation.

Soil Types:

- Predominant Soil: Black soils (mainly in the lower parts of the basin)
- Soil Distribution:
    - Upper Narmada: Red, yellow, shallow black, and skeletal soils
    - Middle Narmada: Medium black soils
    - Lower Narmada: Medium and deep black soils

Coastal Plains: Composed of alluvial clays with a layer of black soil on top.

The basin has an approximate cultivable area of 5.9 million hectares (mha), which constitutes 3% of the total area of the basin. Soil erosion is fairly severe in the upper hilly and upper plains regions in the Narmada basin. Severe erosion also occurs throughout course of the river in the lower plains. Else, the soil erosion in the middle and lower plain areas in the basin is of moderate intensity

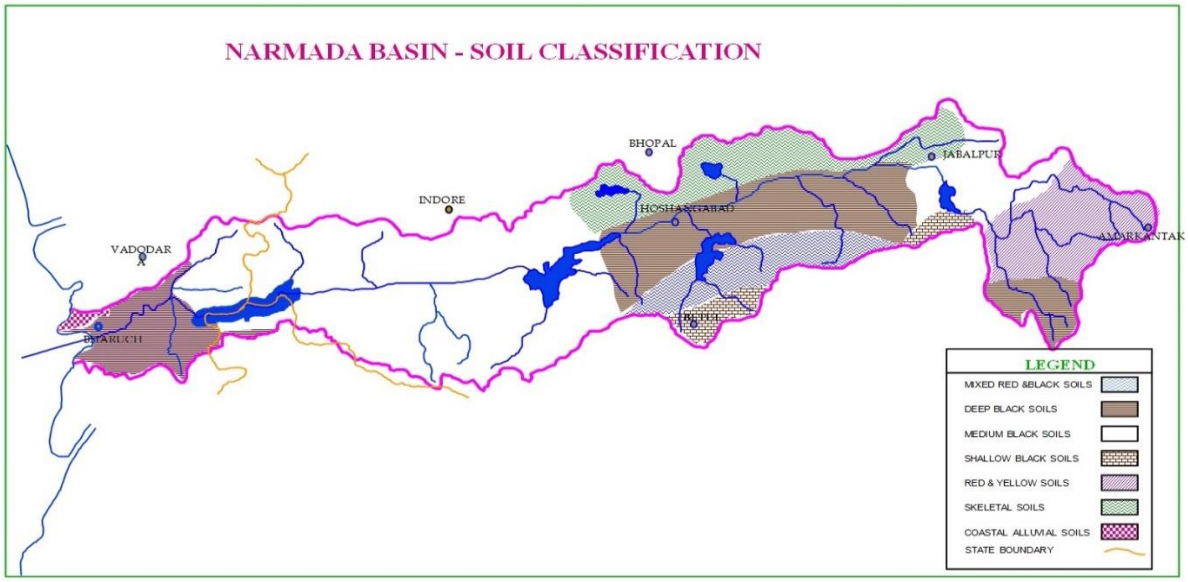


Figure- 2.1: Soil Classification of Narmada Basin

2.2 Narmada River: Sub-Basins

There are 41 tributaries of the Narmada River. Out of these, 8 important tributaries join the river from right bank and 11 important tributaries joins from the left bank. The first major tributary; the Burhner, joins Narmada from left. Further downstream, it receives the Banjar from the left. As Narmada enters the upper fertile plains, it receives the Hiran on the right bank. In continuation, the river receives several tributaries the Sher, the Shakkar, the Dudhi, the Tawa, the Ganjal from the left and the Tendoni, the Barna, the Kolar from the right. During its journey through the middle plains, it receives the Chhota Tawa, the Kundi from the left and the Man from the right. In the lower hilly regions, Narmada receives the Goi from the left and the Uri, the Hatni from the right. The Karjan from the left and the Orsang from the right are the important tributaries joining the river in the lower plains. Beyond Bharuch, the valley widens into an estuary. Finally, the river enters the Gulf of Khambhat. (Source: Report of Irrigation Commission, 1972).

Table 2.2: Length of the Major River

S. No	Name of River	Length*(KM)
1	Narmada	1,312
2	Hiran	205
3	Tendoni	111.30
4	Barna	111.67
5	Kolar	104.3
6	Man	89.6
7	Uri	74.6

8	Htni	111.5
9	Orsang	152.30
10	Burhner	182.2
11	Banjar	266.7
12	Sher	135.8
13	Shakkar	167.4
14	Dudhi	171.23
15	Tawa	164.7
16	Ganjal	110.8
17	Chhota Tawa	54
18	Kundi	107.6
19	Goi	137.3
20	Karjan	85.7

The Narmada Basin extends over an area of about 98,796 sq. km, and is partitioned into three sub-basins: the Narmada Upper, Narmada Middle, and Narmada Lower Sub-basins. The Upper Sub-basin dominates in terms of area, occupying the most significant proportion of the basin. The Middle Sub-basin follows closely, covering a substantial area, while the Lower Sub-basin is comparatively smaller, covering the least expanse.

1 The Narmada Upper Sub-basin encompasses the largest expanse, constituting 46.61% of the total basin area. It is the predominant sub-basin in terms of its spatial coverage.
2 The Narmada Middle Sub-basin occupies 43.78% of the basin’s geographical extent, forming a substantial portion of the river's course.
3 The Narmada Lower Sub-basin, in contrast, represents a comparatively modest 9.61% of the total area, situated downstream, and is the smallest of the three sub-basins.

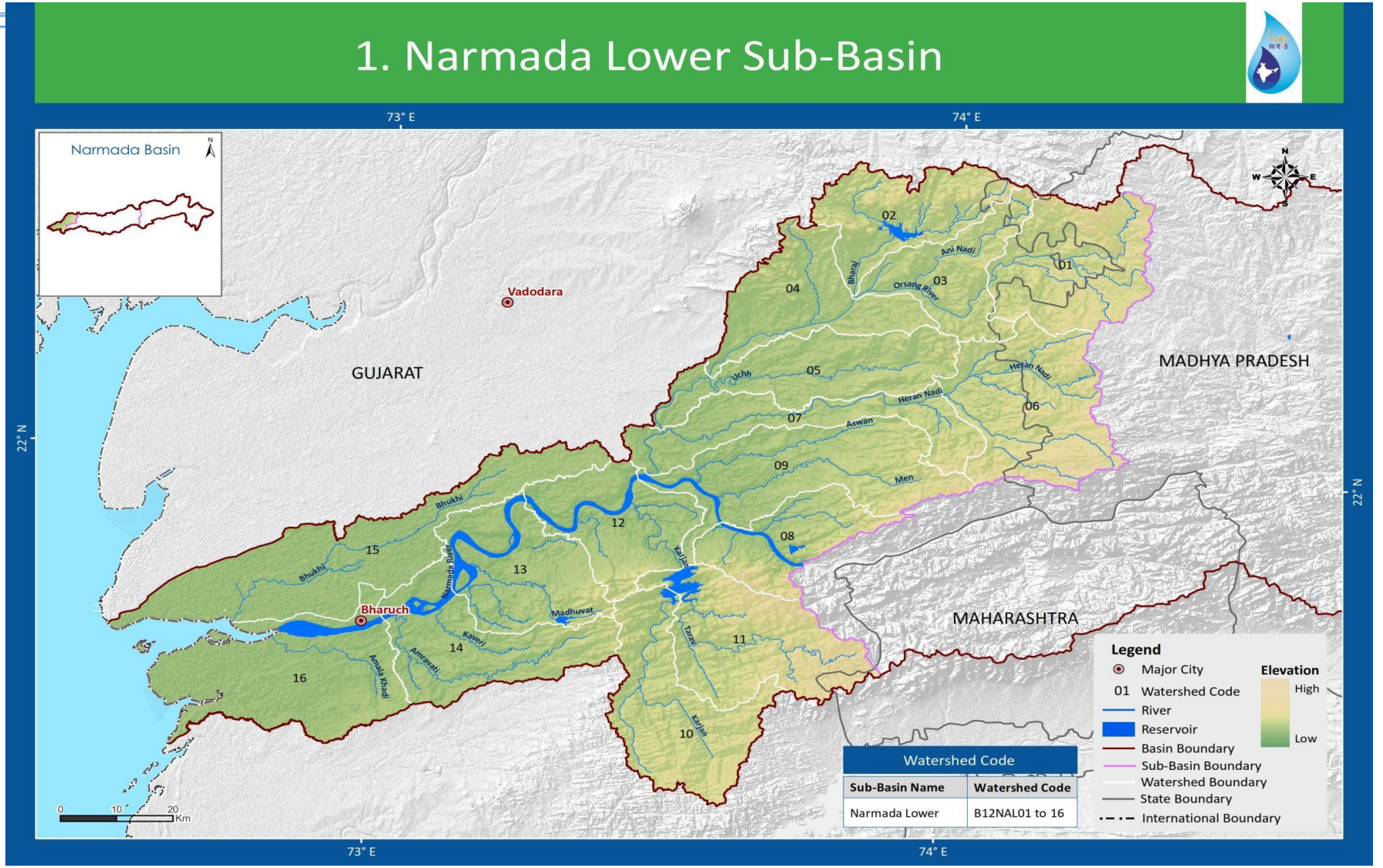


Figure:2.2 Narmada Lower Sub-Basin

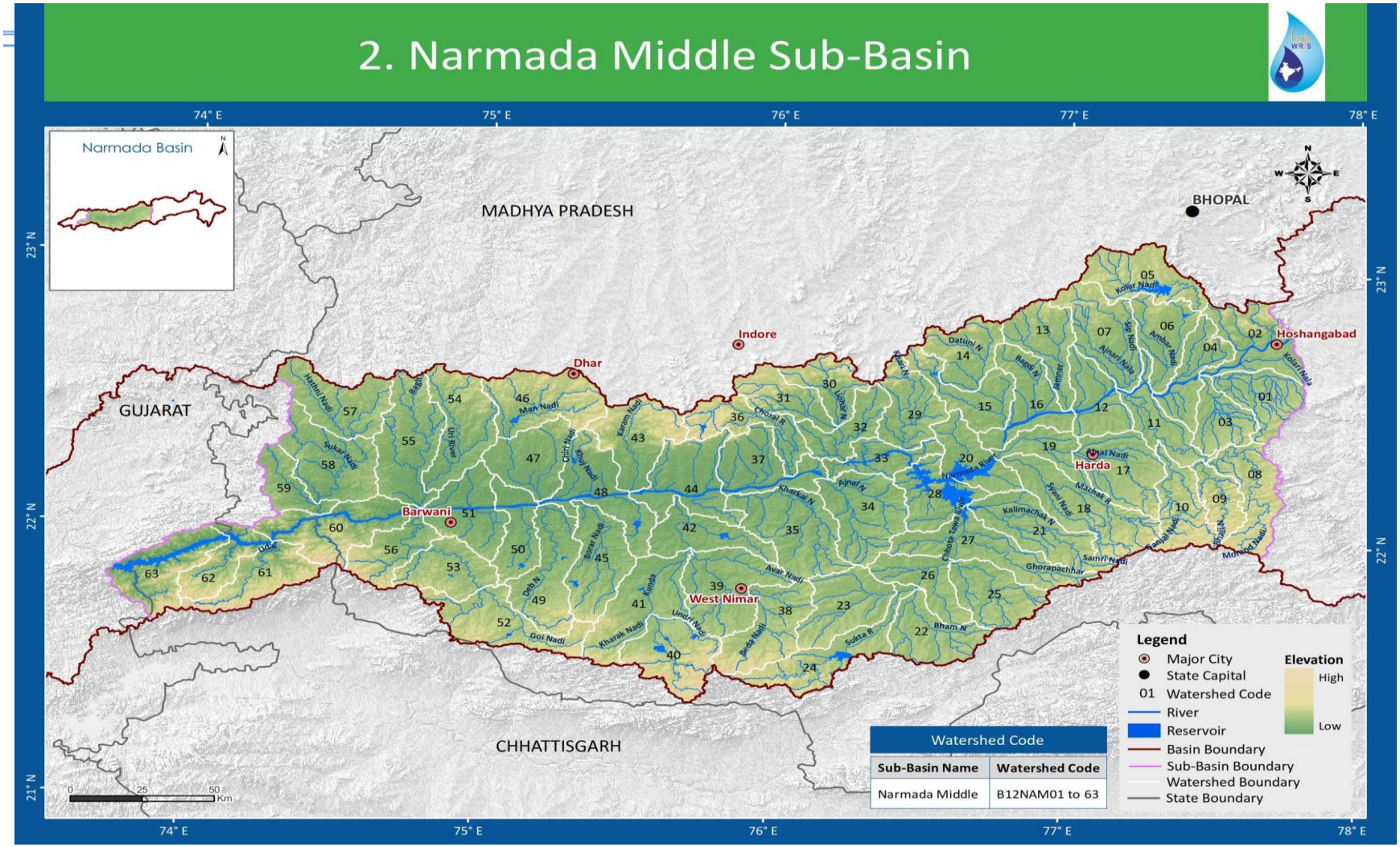


Figure:2.3 Narmada Middle Sub-Basin

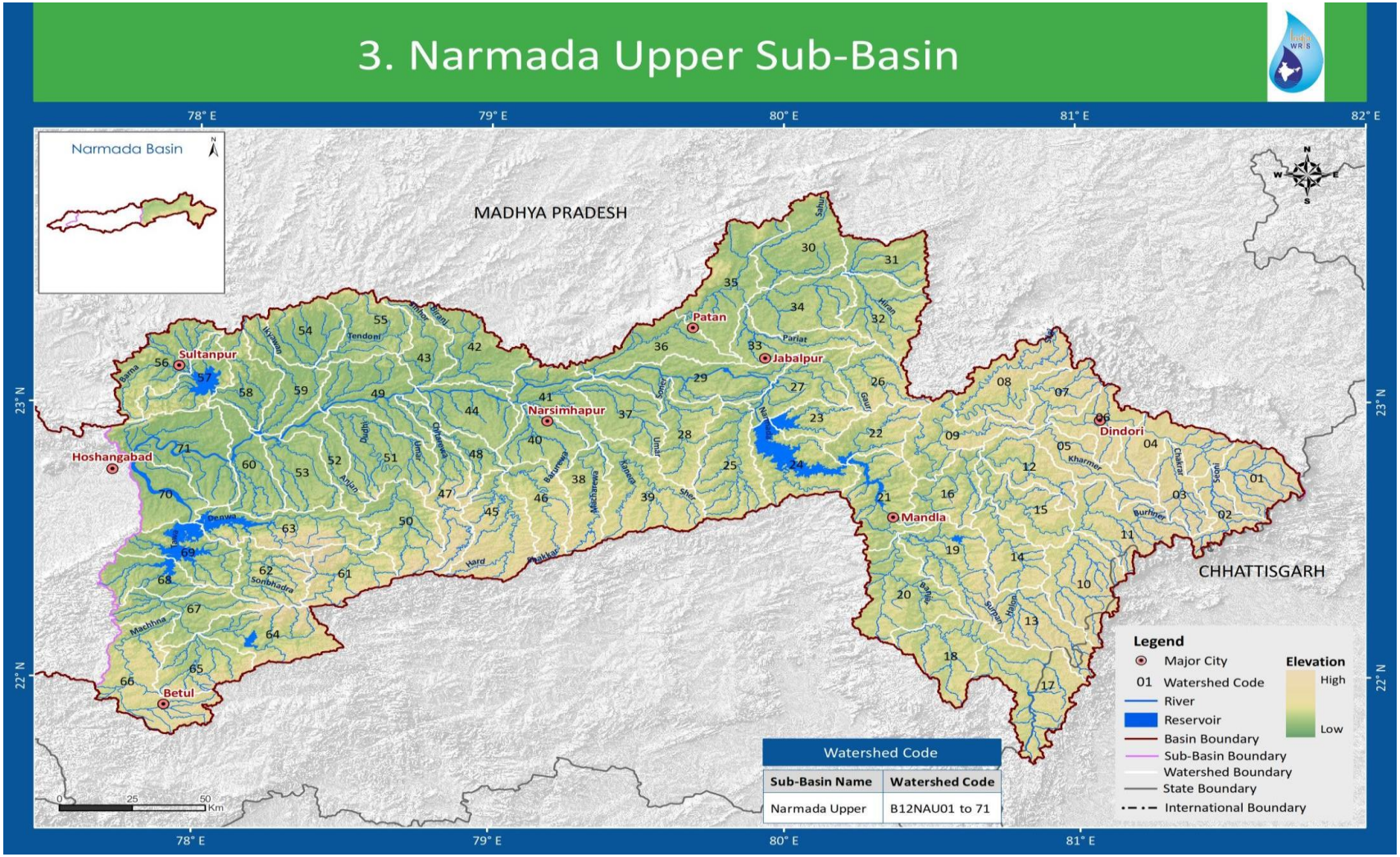


Figure:2.4 Narmada Upper Sub-Basin

2.3 Rainfall

The rainfall distribution in the Narmada Basin exhibits significant variation across different regions:

- Upper Hilly and Upper Plains Areas: These areas experience heavy rainfall, which gradually decreases towards the lower plains and lower hilly regions. However, the rainfall increases again towards the coast and the southwestern parts of the basin.
- Upper Hilly Areas: In general, the annual rainfall in this region exceeds 1400 mm, with some areas receiving up to 1650 mm of rainfall.
- Upper Plains: The rainfall here decreases from 1400 mm near Jabalpur to less than 1000 mm near the Punasa Dam site. A notable high rainfall zone is around Pachmarhi, where the annual rainfall exceeds 1800 mm.
- Lower Plains: The annual rainfall decreases sharply from 1000 mm in the eastern parts of the basin to less than 650 mm around Barwani, which represents the most arid part of the Narmada Basin.
- Lower Hilly Areas: In this region, the annual rainfall increases to just over 750 mm. (Source: www.nca.gov.in).

Precipitation Patterns:

- The majority of the precipitation in the basin occurs during the Southwest Monsoon, contributing between 85% and 95% of the total rainfall.
- The post-monsoon period accounts for around 9% of the total precipitation.
- The combined contribution from the Winter and Pre-Monsoon periods is a maximum of 10% of the total rainfall.

The rainfall intensity data from the Central Water Commission over fifty years reveals that the southern section of the upper Narmada basin experiences the heaviest rainfall, with up to 360 mm in 24 hours. In contrast, the lower middle part of the basin receives the least intense rainfall, with less than 260 mm in 24 hours. The majority of rainfall, nearly 90%, occurs during the monsoon months from June to October, with the peak rainfall concentrated in July and August, accounting for about 60% of the total.

CHAPTER- 3

JURISDICTION AND NETWORK OF SITES NARMADA DIVISION, BHOPAL

3.1 NARMADA DIVISION NETWORK

The Narmada Division maintains various sites established to collect real-time data from the Narmada River and its tributaries and sub-tributaries. The division is organized into four sub divisions:

1. Upper Narmada Sub-Division, Jabalpur
2. Middle Narmada Sub-Division-I, Narmadapuram
3. Middle Narmada Sub-Division-II, Bhopal
4. Middle Narmada Sub-Division-III, Indore

The details of sites including their location, river, and coordinates are as follows:

Table 3.1 Network of Sites under the Jurisdiction of Narmada Division, Bhopal

S.No.	Site Name	Tributary/ Sub Tributary	District	Latitude (Deg. Min. Sec.)	Longitude (Deg. Min. Sec.)	Danger Level	H.F.L with Date		Year of Opening
UNSD, Jabalpur									
1	Dindori	-	Dindori	22° 56' 52"	81° 04' 34"		669.640	23.08.1991	26/06/1988
2	Mohgaon	Burhner	Mandla	22° 45′ 57"	80° 37′ 24"	-	467.300	08.08.2004	13.01.1977
3	Manot	-	Mandla	22° 44′ 09"	80° 30′ 47"	462.150	459.650	18.08.1984	16/12/1976
4	Mandla	-	Mandla	22° 35' 54"	80° 21' 55"	437.800	439.405	15.07.1974	19.05.1975
5	Bamni	Banjar	Mandla	22° 29' 06"	80° 22' 35"	-	448.500	18.09.1999	20/06/1999
6	Mawai	-	Mandla	22° 29' 58"	81° 03' 59"	-	-	-	04.06.1987
7	Mukki	Banjar	Balaghat	22°08'58"	80°39'56"	-	680.28	11.09.2024	22.06.1988
8	Patan	Hiran	Jabalpur	23°18'42"	79°39'46"	-	356.830	07.06.2005	30.08.1979
9	Bargi Reservoir	-	Jabalpur	22°56'16"	79°55'15"	422.76	425.700	-	01.04.2001
10	Matiyari at Katangitola	Banjar	Mandla	22° 31' 40"	80° 24' 24"	-	446.720	08.08.2019	15.01.2019
11	Balai at Naryanganj	Balai	Mandla	22° 50' 20"	80° 14' 57"	-	423.590	11.09.2024	15.06.2015
12	Hiran at singaldeep	Hiran	Jabalpur	23°23'10"	79°54'32"	-	366.160	04.08.2023	15.01.2019
13	Pariyat at Matamar	Hiran	Jabalpur	23°17'24"	79°52'24"	-	389.940	18.08.2020	15.09.2019
14	Saner at Chargawan	Saner	Jabalpur	23°30'12"	79°35'57"	-	347.81	11.09.2019	15.01.2019
15	Belkund at Ghughara	Hiran	Jabalpur	23°29'11"	80°11'47"	-	382.820	24.07.2024	15.01.2019
16	Gaur at Bhalwara	Gour	Jabalpur	23°06'32"	79°59'18"	-	395.05	03.08.2023	15.01.2019
17	Narmada at Maalpur	-	Dindori	23° 03' 23"	80° 50' 14"	-	615.890	21.08.2022	14.11.2016
18	Chakrar at Gadasarai	Chakrar	Dindori	22° 49' 35"	81° 19' 28"	-	727.65	29.07.2023	15.01.2019
19	Machrar at Gidha	Machrar	Dindori	22° 54' 31"	81° 11' 38"	-	696.820	18.08.2020	01.11.2016
20	Silgi at Kotrai	Silgi	Dindori	22° 59′ 07"	80° 35′ 46"	-	514.980	03.08.2023	15.01.2019
21	Halon at Baratola	Burhner	Mandla	22° 36′ 26"	80° 42′ 19"	-	520.460	18.08.2020	12.12.2016

22	Phen at Parasatola	Burhner	Mandla	22° 31’ 44''	80° 59’ 18''	-	591.170	18.08.2020	07.12.2016
23	Narmada at Gorakhpur	-	Dindori	22° 46' 10"	81° 27' 15"	-	745.750	03.08.2023	03.11.2016
MNSD-1, Narmadapuram									
24	Narmadapuram	-	Narmadapuram	22° 45' 21"	77° 43' 60"	293.830	301.330	30.08.1973	21/05/1972
25	Sandia	-	Narmadapuram	22° 54' 58"	78° 20' 51"	-	318.550	30.08.1973	01.03.1978
26	Gadarwara	Shakkar	Narsinghpur	22° 55' 24"	78° 47' 22"	-	332.470	08.09.1999	01.02.1977
27	Barmanghat	-	Narsinghpur	23° 01' 50"	79° 00' 57"	323.000	331.320	30.08.1973	09.12.1970
28	Belkhedi	Sher	Narsinghpur	22° 55' 44"	79° 20' 25"		359.950	27.07.1994	16/03/1977
29	Pachmarhi	-	Narmadapuram	22° 27' 17"	78° 25' 36"	-	-	-	01.06.1987
30	Tawa reservoir	Tawa	Narmadapuram	22°33'48"	77°58'05"	355.397	356.692	-	01.06.1974
31	Barna Reservoir	Barna	Raisen	23° 02' 59"	78° 03'42"	348.500	351.450	-	10.02.2015
32	Palakmati at Sohagpur	Palakmati	Narmadapuram	22° 41' 49"	78°12'5"	-	326.300	15.08.2022	15.01.2019
33	Narmada at Naseerabad	Narmada	Narmadapuram	22° 49' 37"	77° 58' 45"	-	304.600	30.08.2020	15.01.2017
34	Denwa at Matkuli	Denwa	Narmadapuram	22° 35' 08"	78°27' 34"	-	399.00	16.08.2022	01.06.2019
35	Tenduni at Maheshwar	Tenduni	Raisen	22° 58' 45"	78° 19' 15"	-	315.500	22.08.2021	15.01.2019
36	Dudhi at Panagar	Dudhi	Narsinghpur	22° 50' 13"	78° 36' 10"	-	332.000	15.08.2022	15.01.2019
37	Sher at Kacchara	Sher	Narsinghpur	22° 49' 25"	79° 27' 28"	-	406.950	29.08.2020	15.01.2019
38	Machrewa at Bakori	Machrewa	Narsinghpur	22° 50' 39"	79° 21' 56"	-	383.800	29.08.2020	15.01.2017
39	Umar at Imaliya	Umar	Narsinghpur	22° 59' 53"	79° 25' 47"	-	361.900	14.08.2019	15.01.2017
40	Machna at Shahpur	Machana	Betul	22°11'41"	77°53'54"	-	384.300	16.09.2023	15.01.2019
41	Tawa at Tawakathi	Tawa	Betul	22°12'51"	77°57'22"	-	373.05	27.07.2020	15.01.2019
MNSD-2, Bhopal									
42	ChhotaTawa at Bhamgarh	Chhota Tawa	Khandwa	21°50'37"	76°30'14"	-	275.250	16.09.2023	15/01/2019
43	Kolar dam	Kolar	Sehore	22°57'47"	77°20'25"	-	463.300	-	07/03/2017
44	Kolar at Mahgaon	Kolar	Sehore	22°42'49"	77°21'59"	-	301.960	11.09.2019	15.01.2019
45	Sip at Dholpur	Sip	Sehore	22°36'21"	77°11'44"	-	276.680	05.09.2021	15.01.2019
46	Jamner at Sandalpur	Jamner	Dewas	22°34'39"	76°58'17"	-	287.200	01.08.2020	15/01/2019
47	Datuni at Dudwas	Datauni	Dewas	22°34'20"	76°41'18"	-	292.100	16.09.2023	15.01.2019
48	Machak at Barangi	Machak	Harda	22°13'01"	76°56'42"	-	276.700	18.07.2022	15/01/2019
49	Kalimachak at Charuwa	Kalimachak	Harda	22°04'25"	76°54'52"	-	287.00	16.09.2023	16.11.2016
50	Narmada at Awalighat	Narmada	Sehore	22°38'45"	77°29'15"	-	293.650	13.09.2019	08/10/2016
51	Handia	-	Harda	22°29'31"	76°59'36"	-	274.900	30.08.2020	09/02/1977
52	Chhidgaon	Ganjal	Harda	22°24'22"	77°18'29"	-	301.920	08.07.2007	22/12/1976
53	Abna at khandwa	Abna	Khandwa	21°48'58"	76°19'31"	-	302.950	16.09.2023	15.01.2019
54	Hathed at Misrod	Hathed	Narmadapuram	22° 38' 19"	77° 33' 34"	-	297.800	16.09.2023	15.01.2019
55	Indra at Khapariya	Indra	Narmadapuram	22° 34' 20"	77° 28' 54"	-	296.800	31.08.2020	15.01.2019

MNSD-3, Indore									
56	Narmada at Mandleshwar	-	Khargone	22°10'18"	75°39'40"	-	158.400	16.09.2023	16/12/1970
57	Kogaon	Kundi	Khargone	22°06'04"	75°41'05"	-	164.250	09.09.2010	03.02.1978
58	Mortakka	-	Khandwa	22°13'23"	76°02'38"		173.736	16.09.1961	01.07.1999
59	Dhulsar	Uri	Dhar	22°12'24"	74°51'05"	-	159.215	27.08.1994	15.03.1999
60	Pati	Goi	Barwani	21°56'37"	74°44'45"	-	207.100	07.08.2006	31.10.2021
61	Beda at Satwadi (Gogawa)	Beda	Khargone	21°55'05"	75°44'54"	-	205.700	16.09.2023	15.01.2019
62	Choral at Barwah	Choral	Khargone	22°14'45"	76°03'04"	-	175.400	16.09.2023	15/10/2019
63	Kaner at Mendhikheda	Kaner	Khargone	22°24'31"	76°03'04"	-	217.700	16.09.2023	01.06.2019
64	Borad at Thikri	Borad	Barwani	22°04'23"	75°24'14"	-	168.330	16.09.2023	15.01.2019
65	Deb at Khajuri	Deb	Barwani	21°58'15"	75°15'28"	-	181.380	16.09.2023	30/09/2019
66	Karam at Dahiwar	Karam	Dhar	22°13'22"	75°31'51"	-	169.660	16.09.2023	15.01.2019
67	Maan at Gopalpura	Maan	Dhar	22°15'41"	75°06'07"	-	196.300	17.09.2023	15.01.2019
68	Indira Sagar Reservoir	-	Khandwa	22°17.14"	76°28'20"	262.130	263.350	-	17/10/2016

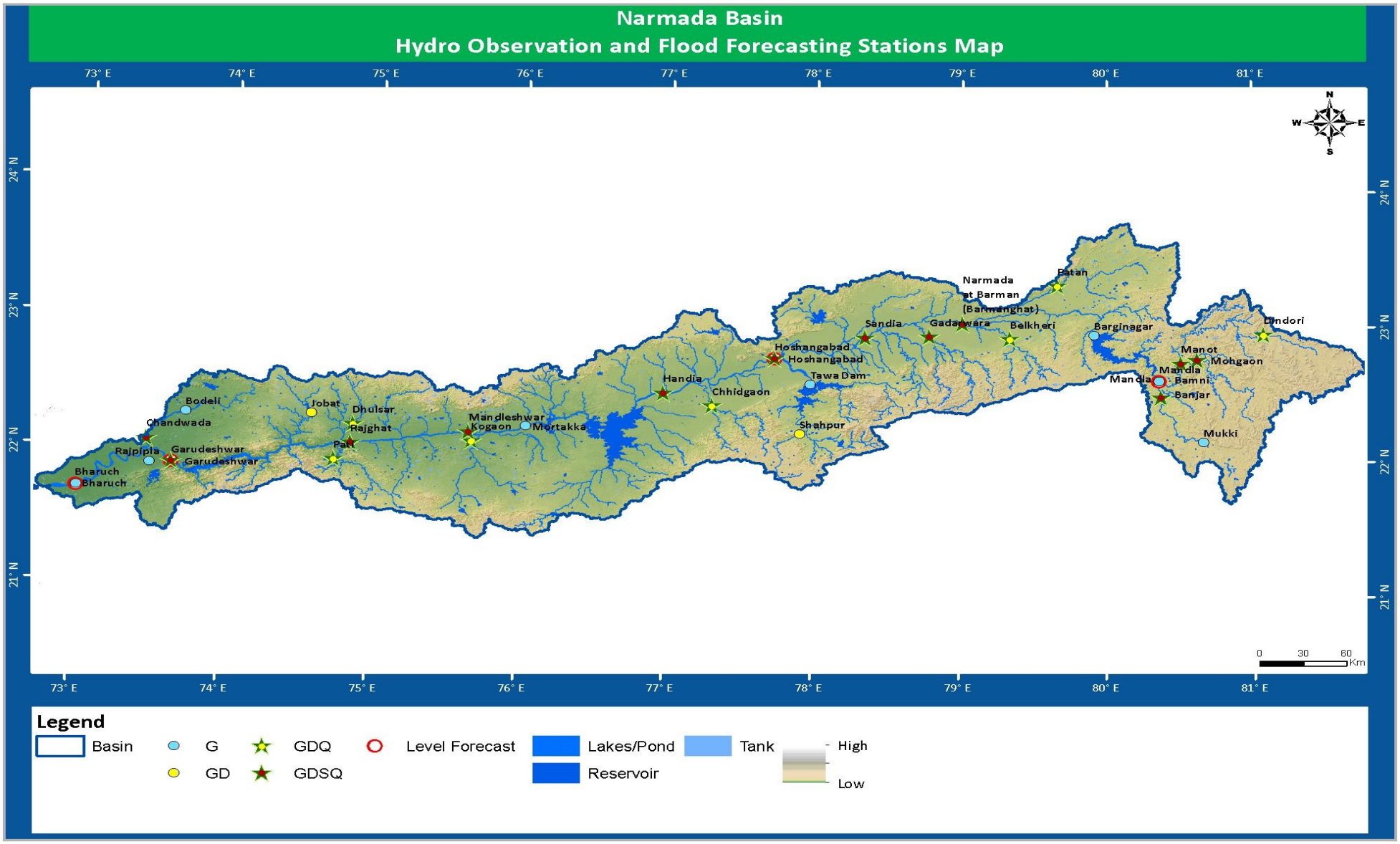


Figure- 3.1: Narmada Basin Hydro Observation and Flood Forecasting Stations Map, Bhopal

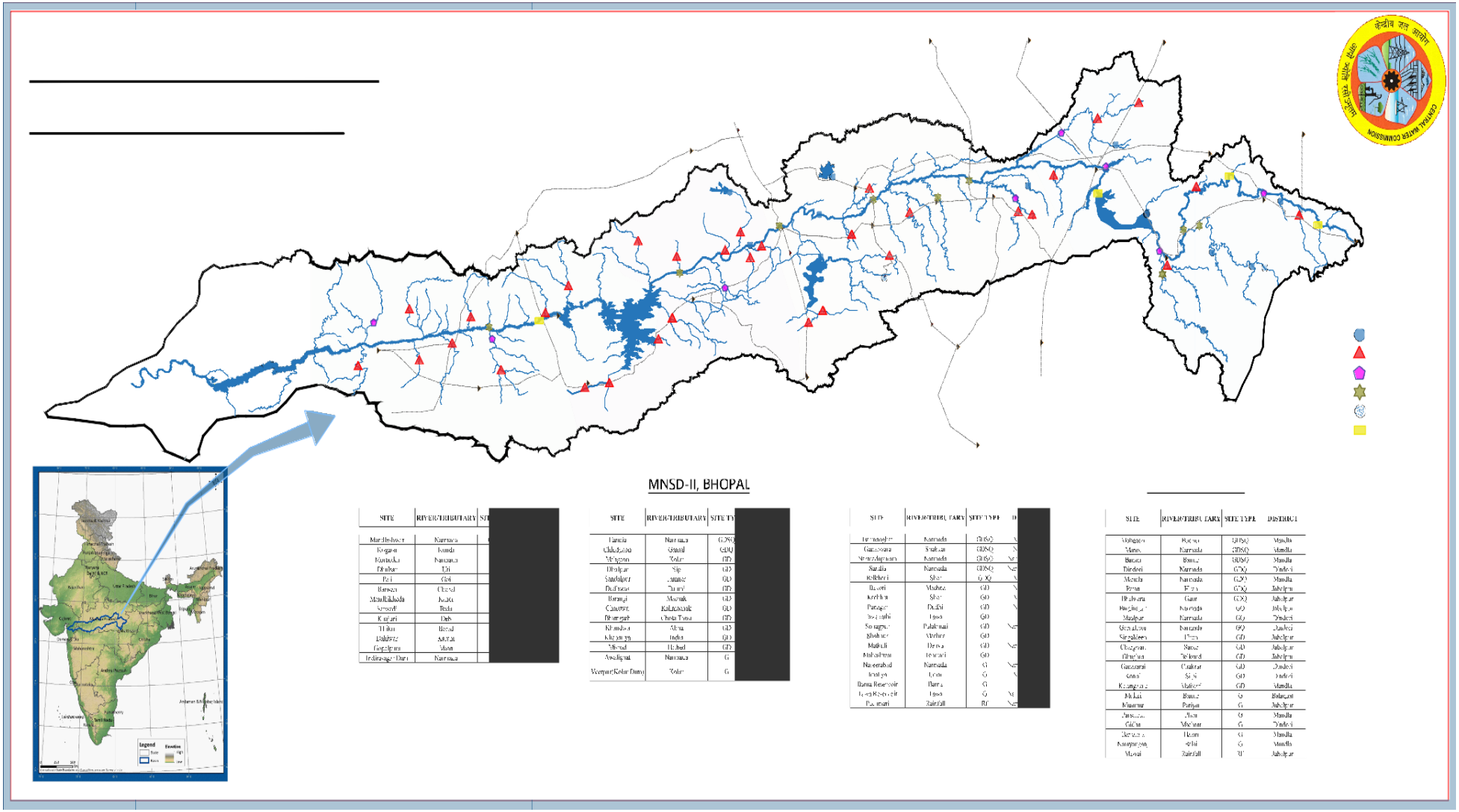


Figure- 3.2: Narmada Basin Map, Bhopal

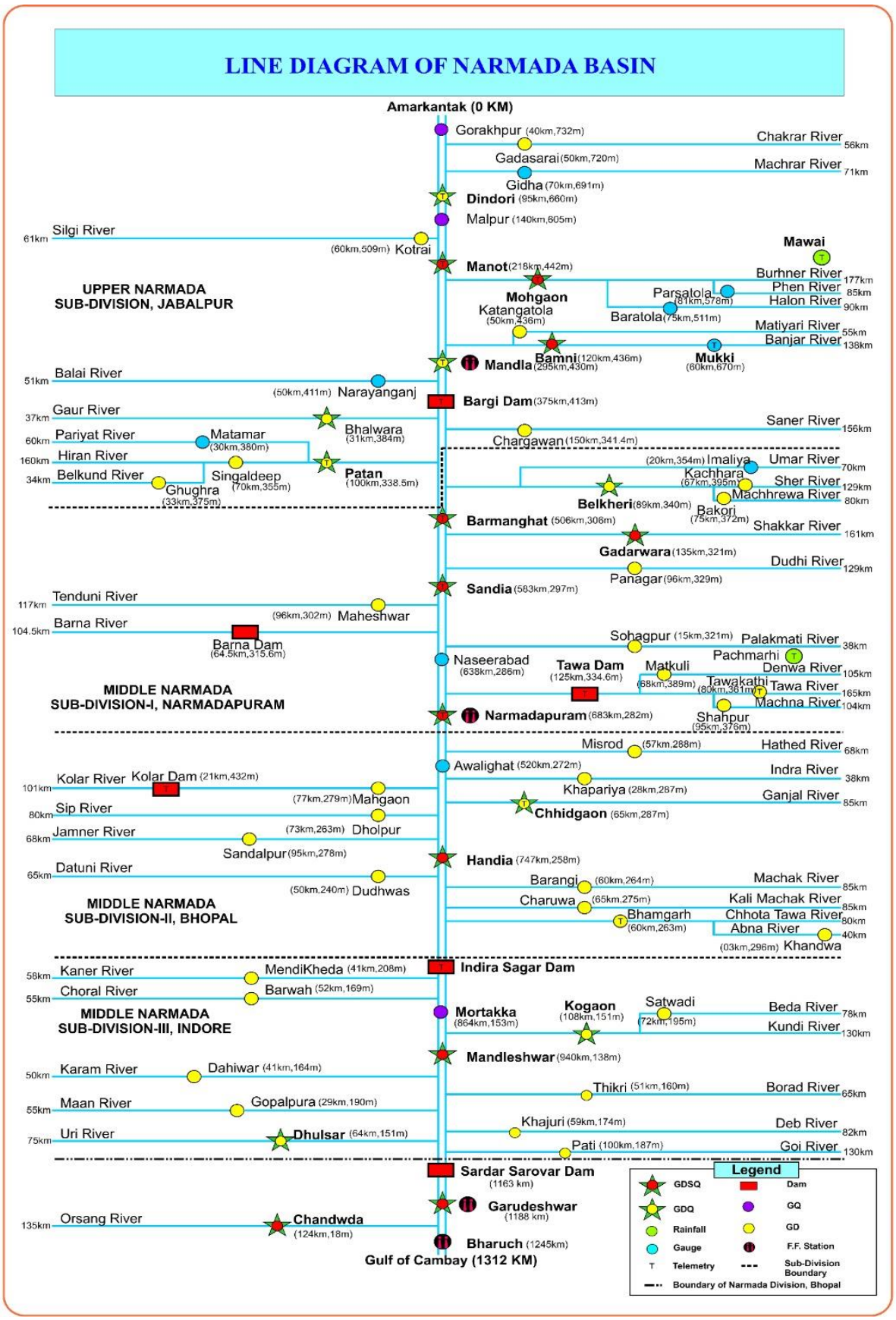


Figure- 3.3: Line Diagram of Narmada Basin

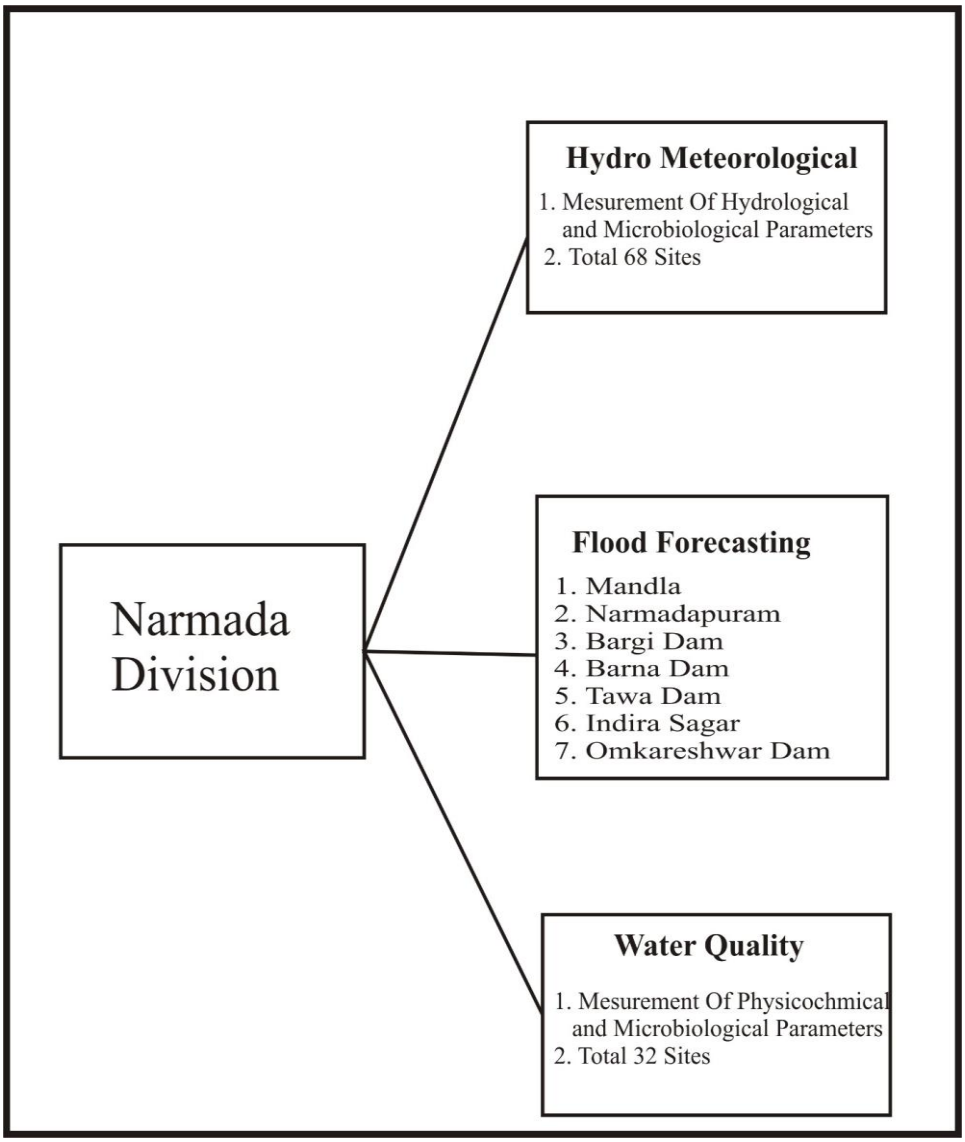


Figure- 3.4: Works of Narmada Division Bhopal

CHAPTER- 4

FLOOD FORECAST STATIONS AND RESERVOIRS

LEVEL FORECAST STATIONS

4.1 MANDLA

Mandla District, located in the Satpura hills of Madhya Pradesh, India, is surrounded on three sides by the Narmada River, which flows through the north-western part of the district. The river traverses a deep bed, uninterrupted by rocks. The most fertile area of the district lies within the Banjar River valley, a tributary of the Narmada. To the south, the district features hilly terrain covered by dense forests.

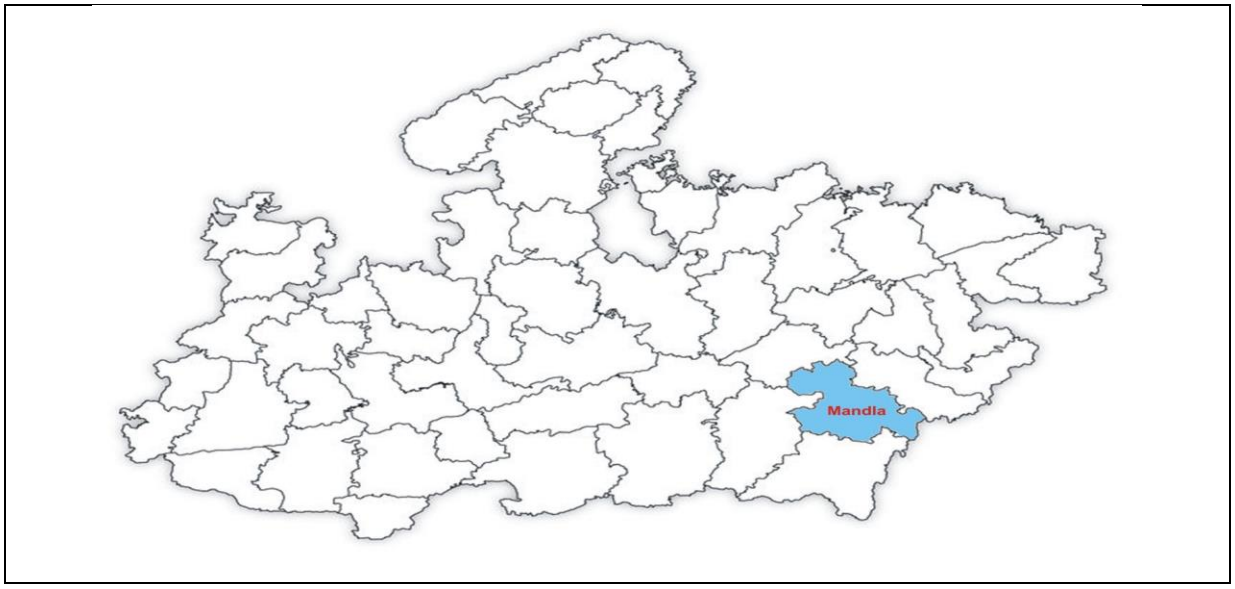


Figure- 4.1: Location of Mandla in M.P.

Photograph-1: Photograph of Rapta Ghat, Mandla during Flood.

4.2 NARMADAPURAM

Narmadapuram district, situated in the heart of Madhya Pradesh, holds significant geographical and administrative importance. Named after the Narmada River, the district lies along the river's southern and western peripheries, with the Narmada flowing through its boundaries. The city of Narmadapuram, the district headquarters, is located at coordinates 22.75°N latitude and 77.72°E longitude, at an elevation of 331 meters (1,086 feet) above sea level. The district itself has an average elevation of 278 meters (912 feet).

The climate of Narmadapuram is characterized by distinct seasonal variations, typical of central India. Summers can be quite hot, with maximum temperatures reaching up to 40°C, while winters are cooler, with minimum temperatures dropping to around 19°C. The area receives an average annual rainfall of 134 cm, contributing to a moderate climate.

One of the district's key landmarks is Sethani Ghat, located on the banks of the Narmada River, about 7 km downstream from the confluence of the Tawa and Narmada rivers. This historic and scenic spot adds to the cultural and natural beauty of Narmadapuram, making it a notable location for both locals and visitors alike. Narmadapuram's strategic position, combined with the presence of the Narmada River, makes it an important hub for administration, culture, and geography in the region.

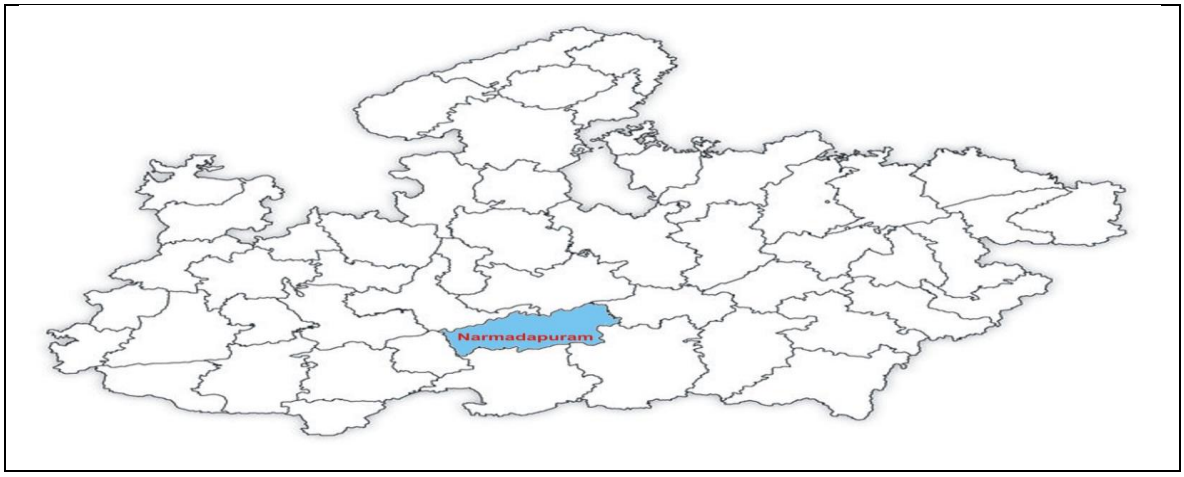


Figure- 4.2: Location of Narmadapuram in M.P.

Photograph -2: Photograph of Sethani Ghat, Narmadapuram

INFLOW FORECAST STATIONS (RESERVOIRS)

4.3 BARGI DAM

The Bargi Dam is one of the first completed projects in a series of 30 major dams planned along the Narmada River in Madhya Pradesh, India. Situated on the river, the dam has significantly altered the landscape, with the Bargi River being completely submerged by the Narmada, making it virtually unidentifiable. Two key irrigation projects, the Bargi Diversion Project and the Rani Avantibai Lodhi Sagar Project, were developed alongside the dam, greatly enhancing agricultural activities in the region.

The concept for the dam's construction was proposed by the Central Water and Power Commission in 1968, aiming to irrigate an area of 2,980 square kilometres and generate 100 MW of hydropower (comprising 2x45 MW and 2x5 MW units). The project was later expanded through the Bargi Diversion Scheme, which increased its irrigation potential to 4,370 square kilometres. Construction of the dam began in 1974 and was completed in 1990, when it was filled to its full capacity.

While the original power generation target was 105 MW, the current output stands at 90 MW, provided by the Hydropower Generation Plant. Although it has not fully achieved the projected power generation, the Bargi Dam has played a crucial role in both irrigation and energy production, contributing significantly to the economic development of Madhya Pradesh.

Table 4.1 Salient Features of Bargi Dam

S. No.	Item	Details
1	Name of Reservoir	Bargi
2	Basin	Narmada
3	River	Narmada River
4	State	Madhya Pradesh
5	District	Jabalpur
6	Nearest City	Jabalpur
7	Operating and Maintenance Agency	NVDA
8	Type of dam	Gravity and Masonry Dam
9	Purpose of Dams	Hydroelectric, Irrigation, Drinking/Water supply
10	Seismic Zone	Seismic Zone-III
11	Latitude	22° 56’ 30” N
12	Longitude	79° 55’ 30” E
13	Year of Commencement	1975
14	Year of Completion	1988
15	Length of Dam	5357
16	Catchment Area	14556 sq. km
17	Full Reservoir Level	422.76 m
18	Maximum Water Level	425.70 m
19	Minimum Water Level	403.55 m
20	Warning level	422.500 m
21	Danger Level	422.760
22	Gross Storage (MCM)	3920
23	Dead Storage (MCM)	740
24	Live Storage (MCM)	3180

25	Threshold Limit	200 MCM
26	Max. Height Above foundation	69.8
27	Total Volume content of Dam	8771
28	Design Flood (cumec)	51510
29	Type of Spillway	Other
30	Length of Spillway	385.72
31	Crest Level of Spillway	407.51
32	Spillway Capacity(cumec)	43000
33	Type of Spillway gates	Radial
34	No. of Spillway gates	21
35	Size of Spillway gates	13.715*15.25
36	NRLD No.	MP39HH0676

Photograph -3: Photograph of Bargi Dam, Jabalpur.

4.4 TAWA DAM

The Tawa Reservoir is situated on the Tawa River in central India, near Itarsi, within the Narmadapuram District of Madhya Pradesh. The construction of the Tawa Dam, which began in 1958, was completed in 1978. The dam provides irrigation to several thousand hectares of agricultural land in both Narmadapuram and Harda Districts. It also serves as a popular tourist destination during the monsoon season.

Furthermore, a small hydropower plant is located on the left bank of the reservoir, utilising the tailrace water for irrigation purposes. This private-sector hydroelectric power plant, established by the LNJ Bhilwara Group, consists of two units, each generating 2 × 6.75 MW. Power production commenced in 1998, and the construction of the project was completed in a remarkable 22 months.

Table 4.2 Salient Features of Tawa Dam

S. No.	Item	Details
1	Name of Reservoir	Tawa
	Basin	Narmada
2	River	Tawa River
3	State	Madhya Pradesh
4	District	Narmadapuram (Narmadapuram)
5	Nearest City	Itarsi
6	Latitude	22° 33’ 40” N
7	Longitude	77° 58’ 30” E
8	Type of dam	Earthen and Masonry Dam
9	Catchment Area	5982.90 sq. km
10	Full Reservoir Level	355.397 m
11	Maximum Water Level	356.692 m
12	Minimum Water Level	309.677 m
13	Threshold Limit	100 MCM
14	Gross Storage (MCM)	2311.5
15	Dead Storage (MCM)	367.6
16	Live Storage (MCM)	1943.96 Cumec
17	Designed Flood Discharge	0.308 Lakh Cumec
19	Observed Flood Discharge	0.243 Lakh Cumec
20	Lowest River Bed	309.679m
21	Deepest Foundation Level	301.752m
22	Water Spreaded area	20055.00 Ha
23	Village Under Submerge (Revenue+Forest)	17+27=44
24	Forest	15506Ha
25	Max. Height of Dam	57.91 m (190.0 ft)
26	Type of Spillway	Radial
27	Crest Level of Spillway	343.205m
28	Spillway Capacity(cumec)	20,500 m3/s (720,000 cu ft/s)
29	No. of Spillway gates	13
30	Size of Spillway gates	15.24*12.19

Photograph -4: Photograph of Tawa Dam, Narmadapuram

4.5 BARNA DAM

The Barna Dam is a gravity dam situated on the Barna River in Badi Tehsil, Raisen District, Madhya Pradesh. It lies approximately 100 km (62 miles) east of Bhopal. Built by the Madhya Pradesh Water Resources Department, the dam's primary purpose is irrigation. It was completed in 1978.

Table 4.3 Salient Features of Barna Dam

S. No.	Item	Details
1	Name of Reservoir	Barna
2	Basin	Narmada
3	River	Barna River
4	State	Madhya Pradesh
5	District	Raisen
6	Nearest City	Bareli
7	Purpose of Dams	Irrigation, Pisciculture
8	Operating and Maintenance Agency	WRD Government of MP
9	Type of dam	Gravity and Masonary Dam
10	Type of Spillway	Ogee
11	Type of Spillway gates	Radial
12	Latitude	23° 03’ 03” N
13	Longitude	78° 03’ 44.5” E
14	Length of Dam	432
15	Catchment Area	1176 sq. km
16	Maximum Water Level	351.45 m
17	Full Reservoir Level	348.55 m
18	Threshold Limit	100MCM

19	Minimum Water Level	315.60 m
20	Gross Storage (MCM)	539
21	Dead Storage (MCM)	83.2
22	Live Storage (MCM)	455.8
23	Year of Completion	1977
24	Max. Height Above foundation	47.7
25	Design Flood (cumec)	6850
26	Length of Spillway	115
27	Crest Level of Spillway	341.7
28	Spillway Capacity(cumec)	13556
29	No. of Spillway gates	8
30	Size of Spillway gates	12.20*6.85
31	NRLD No.	MP08HH0239

Photograph -5: Photograph of Barna Dam, Raisen.

4.6 INDIRASAGAR DAM

The Indira Sagar Dam is a multipurpose project located on the Narmada River in Khandwa District, Madhya Pradesh. The foundation stone for the project was laid by the late Smt. Indira Gandhi, former Prime Minister of India, on 23 October 1984, and the construction of

the main dam commenced in 1992. The downstream projects associated with the Indira Sagar Project include the Omkareshwar, Maheshwar, and Sardar Sarovar Projects.

This project involves the construction of a 92-metre high and 653-metre long concrete gravity dam. It provides irrigation to 1,230 square kilometres of land and generates an annual power production of 2.7 billion units for the Khandwa and Khargone districts in Madhya Pradesh. The reservoir created by the dam holds a capacity of 12.22 billion cubic metres (12,200,000,000 m^3), making it the largest reservoir in India by water storage capacity.

A joint venture between Madhya Pradesh Irrigation and the National Hydroelectric Power Corporation, the dam was commissioned in May 2005. The Indira Sagar Project has an installed capacity of 1,000 MW, producing 2,698 million units annually in Stage I, 1,850 million units in Stage II, and 1,515 million units in Stage III. It also provides annual irrigation to 265,000 hectares across a Culturable Command Area (CCA) of 123,000 hectares. The total catchment area at the dam site is 61,642 km^2.

Table 4.4 Salient Features of Indirasagar Dam

S. No.	Item	Details
1	Name of Reservoir	Indirasagar Dam
2	Basin	Narmada
3	River	Narmada River
4	State	Madhya Pradesh
5	District	Khandwa
6	Nearest City	Khandwa
7	Type of dam	Earthen Dam, Gravity Masnory
8	Purpose of Dams	Hydroelectric, irrigation
9	Operating and Maintenance Agency	NHDC
10	Type of Spillway gates	Radial
11	Latitude	22° 14’ 25”
12	Longitude	76° 09’ 45”
13	Spillway Capacity(cumec)	65670
14	No. of Spillway gates	20
15	Size of Spillway gates	20*17
16	Year of Completion	2006
17	Length of Dam	654
18	Catchment Area	61642 sq. km.
19	Maximum Water Level	263.35 m
20	Full Reservoir Level	262.13 m
21	Minimum Water Level	243.23 m
22	Threshold Limit	300MCM
23	Gross Storage (MCM)	12211.6
24	Dead Storage (MCM)	2470
25	Live Storage (MCM)	9750
26	Max. Height Above foundation	91.4
27	Design Flood (cumec)	83543
28	Type of Spillway	Ogge

29	Length of Spillway	495
30	Crest Level of Spillway	245.13
31	National Register of Large Dams (NRLD No.)	MP30HH0870
32	Danger Level	262.130m
33	Total Volume content of Dam	1400

Photograph -6: Photograph of Indirasagar Dam, Khandwa.

4.7 OMKARESHWAR DAM

The Omkareshwar Dam is a gravity dam located on the Narmada River, just upstream of Mandhata in Khandwa District, Madhya Pradesh, India. It is named after the Omkareshwar Temple, which is situated just downstream. Construction of the dam took place between 2003 and 2007, with the primary objective of providing irrigation to 132,500 hectares (or 327,000 acres) of agricultural land.

The Omkareshwar Dam is a 949-metre long and 33-metre-high concrete gravity dam. It has an installed hydroelectric power generation capacity of 520 MW, with the associated power station located at the base of the dam. This project was one of the fastest hydroelectric developments in the country, completed between 2004 and 2006.

Table 4.5 Salient Features of Omkareshwar Dam

S. No.	Item	Details
	Name of Reservoir	Omkareshwar
1	Basin	Narmada
2	River	Narmada River

3	State	Madhya Pradesh
4	District	Khandwa
5	Nearest City	Khandwa
6	Purpose of Dams	Hydroelectric, irrigation Drinking/Water supply
7	Operating and Maintenance Agency	NHDC
8	Latitude	22° 14’ 25” N
9	Longitude	76° 09’ 45” E
10	Type of dam	Gravity and Masonary Dam
11	Catchment Area	64880 sq. km
12	Maximum Water Level	199.62 m
13	Full Reservoir Level	196.60 m
14	Threshold Limit	300MCM
15	Dead Storage (MCM)	688
16	Live Storage (MCM)	299
17	Year of Completion	2007
18	Length of Dam	949
19	Max. Height Above foundation	64
20	Total Volume content of Dam	900
21	Design Flood (cumec)	88315
22	Type of Spillway	Ogge
23	Length of Spillway	570
24	Crest Level of Spillway	179.6
25	Spillway Capacity(cumec)	88315
26	Type of Spillway gates	Radial
27	No. of Spillway gates	23
28	Size of Spillway gates	20*17
29	NRLD No.	MP30HH0871
30	Danger Level	196.000m

Photograph -7: Photograph of Omkareshwar Dam, Khandwa

CHAPTER-5
METEOROLOGICAL DATA

5.1 ROLE OF METEOROLOGICAL DATA

Meteorological phenomena are the prime natural causes of flooding. The ability to forecast critical events, in both time and space and also quantitatively, is of significant value in flood forecasting and warning. Meteorological knowledge associated with flood warning issues fall into two broad areas, namely the climatology behind flooding and the operational meteorology involved. Climatology includes the understanding of rain bearing systems, their seasonality and the extremes of their behaviour. Understanding the types of weather systems from which flooding can originate will contribute largely to decisions about what sort of observational and forecast systems may be required.

Hydro-meteorological statistics (primarily rainfall, but also evaporation) are vital to flood forecasting and warning operations and they are usually dealt with separately from climatology data. The purpose of the data and statistics is to estimate the severity and probability of actual or predicted events. Long-term records are essential and this requires investment to install and maintain rain gauge networks (plus evaporation). Hydro-meteorological data are vitally required in real time for the formulation of flood forecasts and warnings.

In flood forecasting both weather forecast and actual rainfalls received in the basin play vital role in the formulation of correct forecast. Although weather forecast does not indicate the magnitude of flood, yet it is useful to anticipate the probability of floods in their respective areas. Actual rainfall received in the basin helps in assessing the correct magnitude of floods. Hence, an adequate network of rain gauge with arrangements to transmit rainfall data on real time and the arrangements for obtaining weather forecasts like QPF/ Inference etc. are the basic needs of flood forecasting network.

5.2 ARRANGEMENT FOR RECEIVING WEATHER FORECAST

Flood Met Office; Ahmadabad is helping this office in the field of weather forecast. F.M.O., Ahmedabad and Tapi Division are connected by Telephone for communication of weather warnings, storm movements, QPF/WAR and daily rainfall etc.

Heavy rainfall warnings are also received through e-mail from I.M.D. Bombay/ Nagpur/ Bhopal/ Ahmadabad. As such this office is getting following weather information from I.M.D.

a) Heavy rainfall warnings

b) Regional weather summary

c) Weightage Average Rainfall of sub basins

d) Q.P.F for next 12/24/48 hrs.

Inference information about the movement of depression/storm formed in Bay of Bengal/ Arabian Sea.

Satellite images and weather reports available in Website of Indian Meteorological Department also helped a lot in monitoring the movement of storm/ depression zone over the basin during the flood.

5.3 RAINGAUGE NETWORK IN NARMADA BASIN

At present 25 nos. of rain gauges have been installed in Narmada basin. Out of which 1no SRRG and 12 Nos. ORG by the CWC and remaining by IMD.

Daily rainfall data recorded at all the stations are transmitted to controlling Sub Division/ Division on real time twice a day or even at shorter intervals like hourly/ 3 hourly, if required. Arrangements for rainfall by Telephone to our nearest stations are also made by I.M.D. for some key Rain gauge stations. The flood forecast is formulated more accurately and well in advance for both the forecasting sites by giving the weightage to heavy rainfall warnings, QPF, movement of depression and rainfall data received on real time.

The table below shows the list of Rain gauge stations with their locations under Narmada Division, Bhopal which helps immensely in understanding the type and amount of Rainfall in catchment area for flood forecasting activities.

Table 5.1 List of Rain gauge Stations under Narmada Basin

S. No.	Name of Division/ Sub-Division/Site	Location		River/ Tributary	State - Madhya Pradesh District
		Latitude	Longitude		
1	Dindori	22° 56' 52"	81° 04' 34"	Narmada	Dindori
2	Manot	22° 44' 09"	80° 30' 47"	Narmada	Mandla
3	Mawai	22° 29' 58"	81° 03' 59"	-	Mandla
4	Mohgaon	22° 45' 57"	80° 37' 24"	Burhner	Mandla
5	Mukki	22° 08' 58"	80° 39' 56"	Banjar	Balaghat
6	Bamni Banjar	22° 29' 06"	80° 22' 35"	Banjar	Mandla
7	Mandla	22° 35' 54"	80° 21' 55"	Narmada	Mandla
8	Bargi Dam	22° 56' 16"	79° 55' 15"	Narmada	Jabalpur
9	Patan	23° 18' 42"	79° 39' 46"	Hiran	Jabalpur
10	Belkhedi	22° 55' 44"	79° 20' 25"	Sher	Narsinghpur
11	Barmanghat	23° 01' 50"	79° 00' 57"	Narmada	Narsinghpur
12	Gadarwara	22° 55' 24"	78° 47' 22"	Shakkar	Narsinghpur
13	Sandia	22° 54' 58"	78° 20' 51"	Narmada	Pipariya
14	Narmadapuram	22° 45' 21"	77° 43' 60"	Narmada	Narmadapuram
15	Pachmarhi	22° 27' 17"	78° 25' 36"	-	Narmadapuram
16	Tawa Dam	22° 33' 48"	77° 58' 3"	Tawa	Narmadapuram
17	Handia	22° 29' 31"	76° 59' 36"	Narmada	Harda
18	Chhidgaon	22° 24' 22"	77° 18' 29"	Ganjal	Harda
19	Mortakka	22° 13' 23"	76° 02' 38"	Narmada	Khandwa
20	Kogaon	22° 06' 04"	75° 41' 05"	Kundi	Khargone
21	Mandleshwar	22° 10' 18"	75° 39' 40"	Narmada	Khargone
22	Dhulsar	22° 12' 24"	74° 51' 05"	Uri	Dhar
23	Pati	21° 56' 37"	74° 44' 45"	Goi	Barwani
24	Barna Dam	22° 03' 59"	78° 03'42"	Narmada	Raisen
25	Indirasagar Dam	22° 17' 14"	76° 28' 20"	Narmada	Khandawa

CHAPTER-6

METHODOLOGY

For Flood Forecasting of Mandla and Narmadapuram, and Inflow forecasts of various Dams, the methodology adopted is detailed below:

6.1 FLOOD FORECASTING SITE- MANDLA

The flood forecasting process for Mandla is designed to predict potential flood events based on rainfall and water level changes in the upstream catchment areas of the Narmada River and its tributaries, Burhner and Banjar. Whenever flash or appreciable rain occurs in the upper catchment area of Narmada and its tributaries Burhner and Banjar the water level of Dindori on Narmada, Mohgaon on Burhner and Mukki on Banjar starts rising. This results in consecutive rise in water levels at Manot and Mohagon and if the water level at Mandla is expected to reach warning level 437.00 m, the Flood-forecast is issued.

As per the existing arrangement, the forecast for the Mandla site is issued based on the discharge method. The discharge data from Manot, Mohgaon, and Bamni have been incorporated, and the resulting discharge is then converted into a predicted water level for Mandla, taking into account a travel time of three hours in advance.

The impact of antecedent rainfall on the intervening catchment between manot and Mandla is also taken into account providing a more comprehensive and accurate final forecast. For this a certain amount of discharge added before reaching the final forecast.

Table 6.1 Real Time Data Availability from Origin to Mandla

Station Name	Catchment area in Sq. km.	Type of Data
Dindori	2292	Hourly water level, Discharge and daily/3-hourly rainfall.
Manot	4667	Hourly water level, Discharge and daily/3-hourly rainfall.
Mohgaon	4090	Hourly water level, Discharge and daily/3-hourly rainfall.
Mukki	968	Hourly water level and daily/3-hourly rainfall.
Mandla	13000	Hourly water level, Discharge and daily/3-hourly rainfall.
Mawai	-	Daily / 3 hourly rainfall.
Bamni	1864	Hourly water level, Discharge and daily/3-hourly rainfall.

Table 6.2 Travel Time from Base Stations to Mandla

Station	Travel Time in Hours
Dindori to Mandla	11
Manot to Mandla	03
Mohgaon to Mandla	04
Mukki to Mandla	12
Dindori to Manot	08

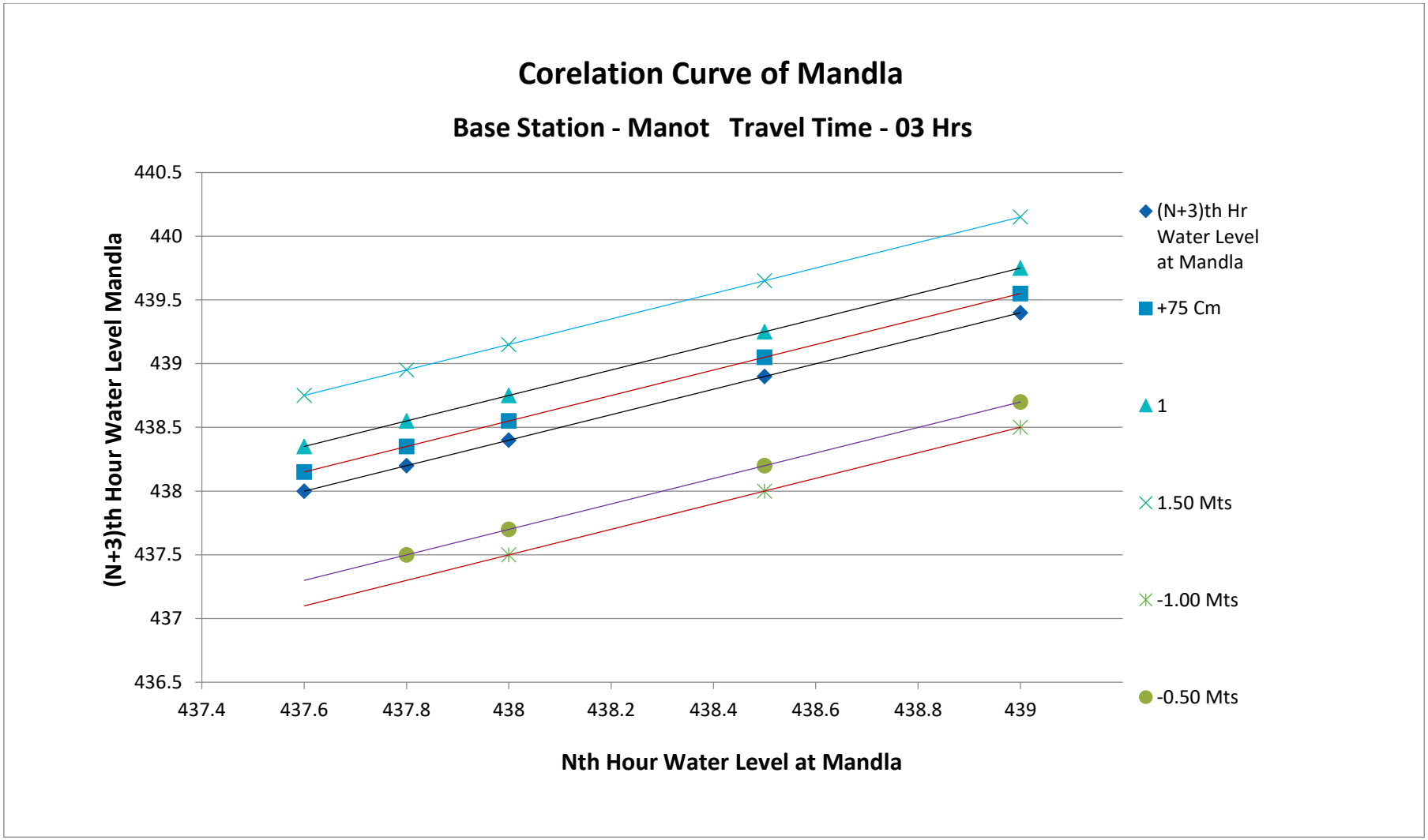


Figure-6.1: Correlation Curves for Mandla

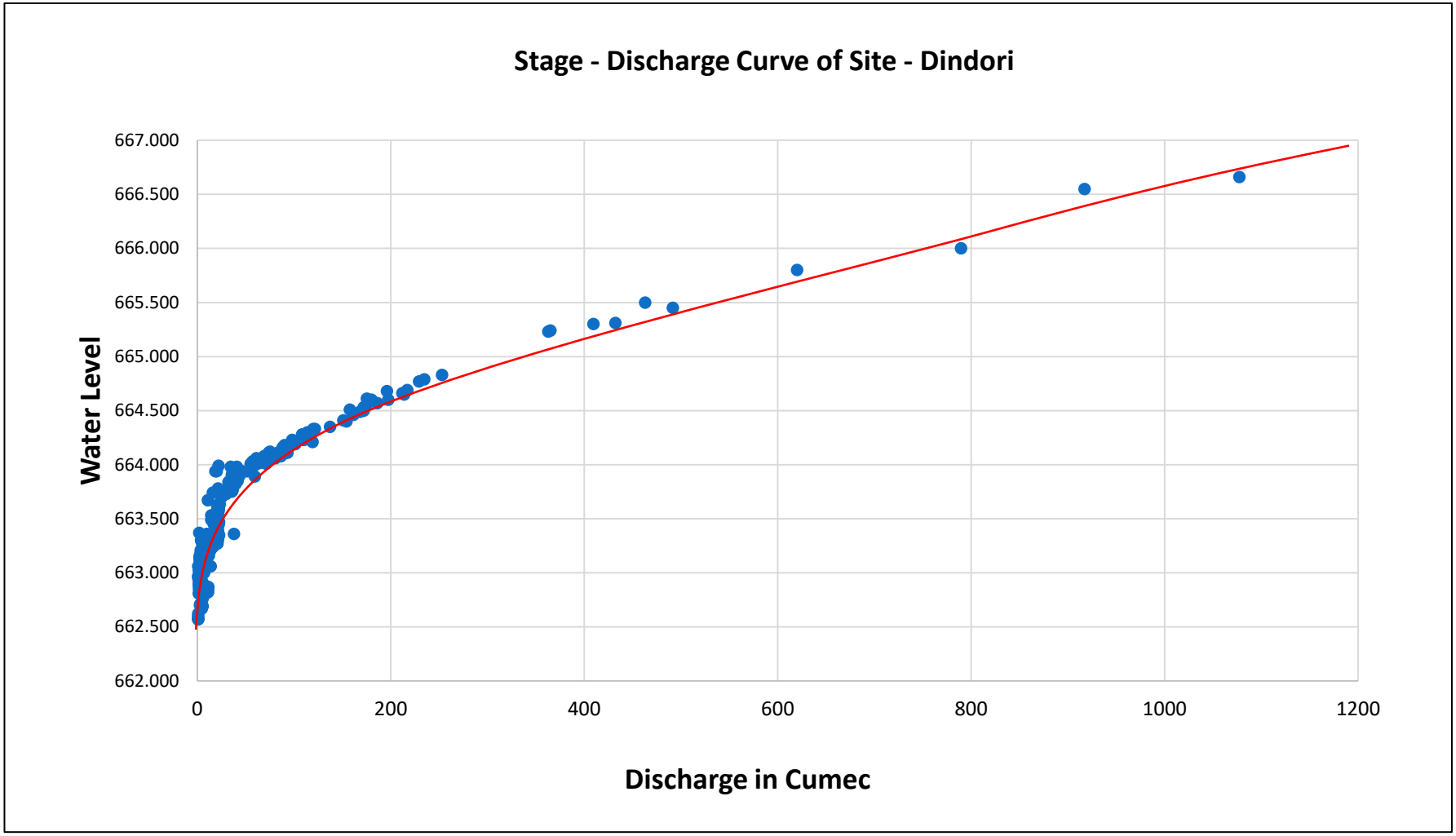


Figure-6.2: Stage-Discharge Curve of Site- Dindori

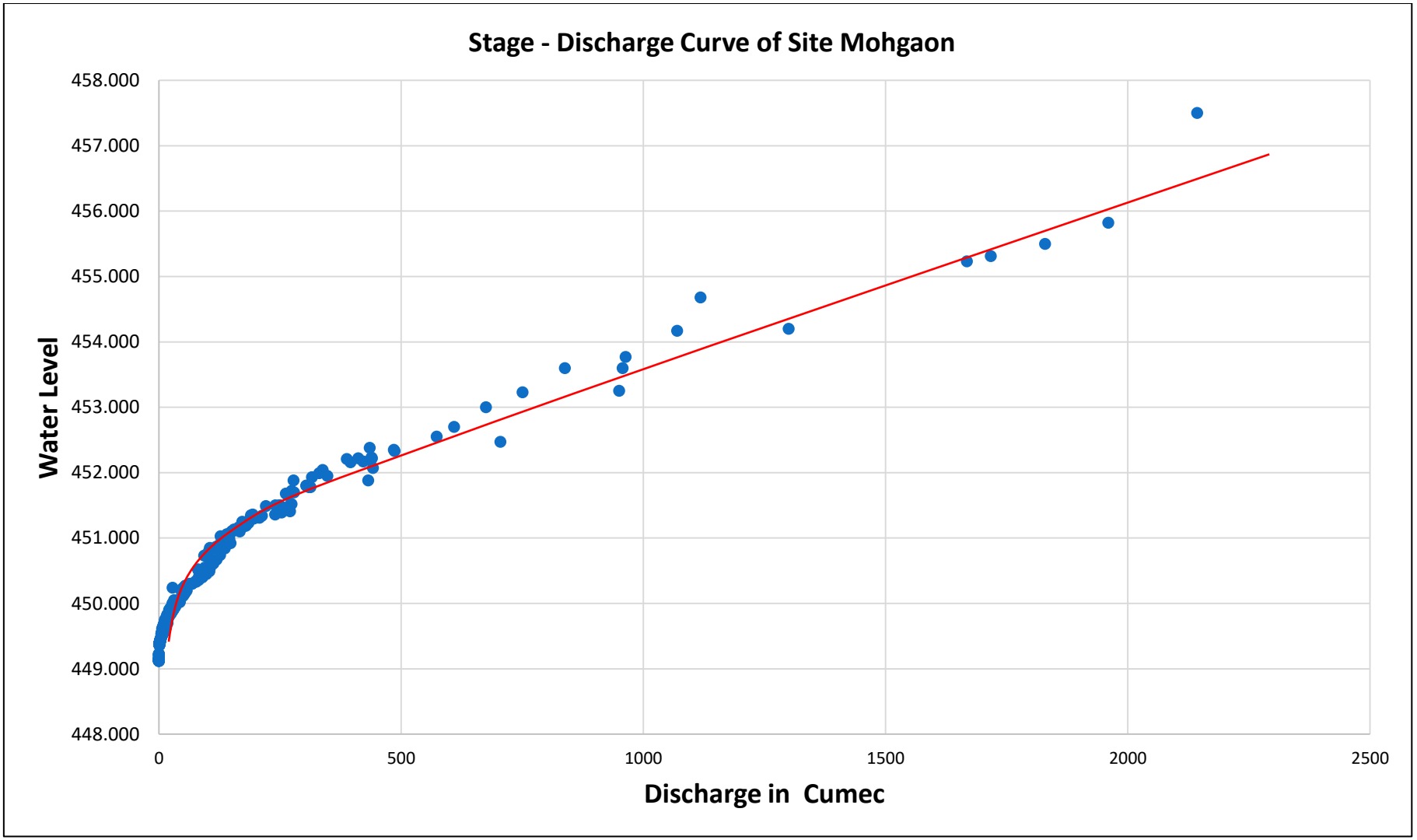


Figure-6.3: Stage-Discharge Curve of Site- Mohgaon

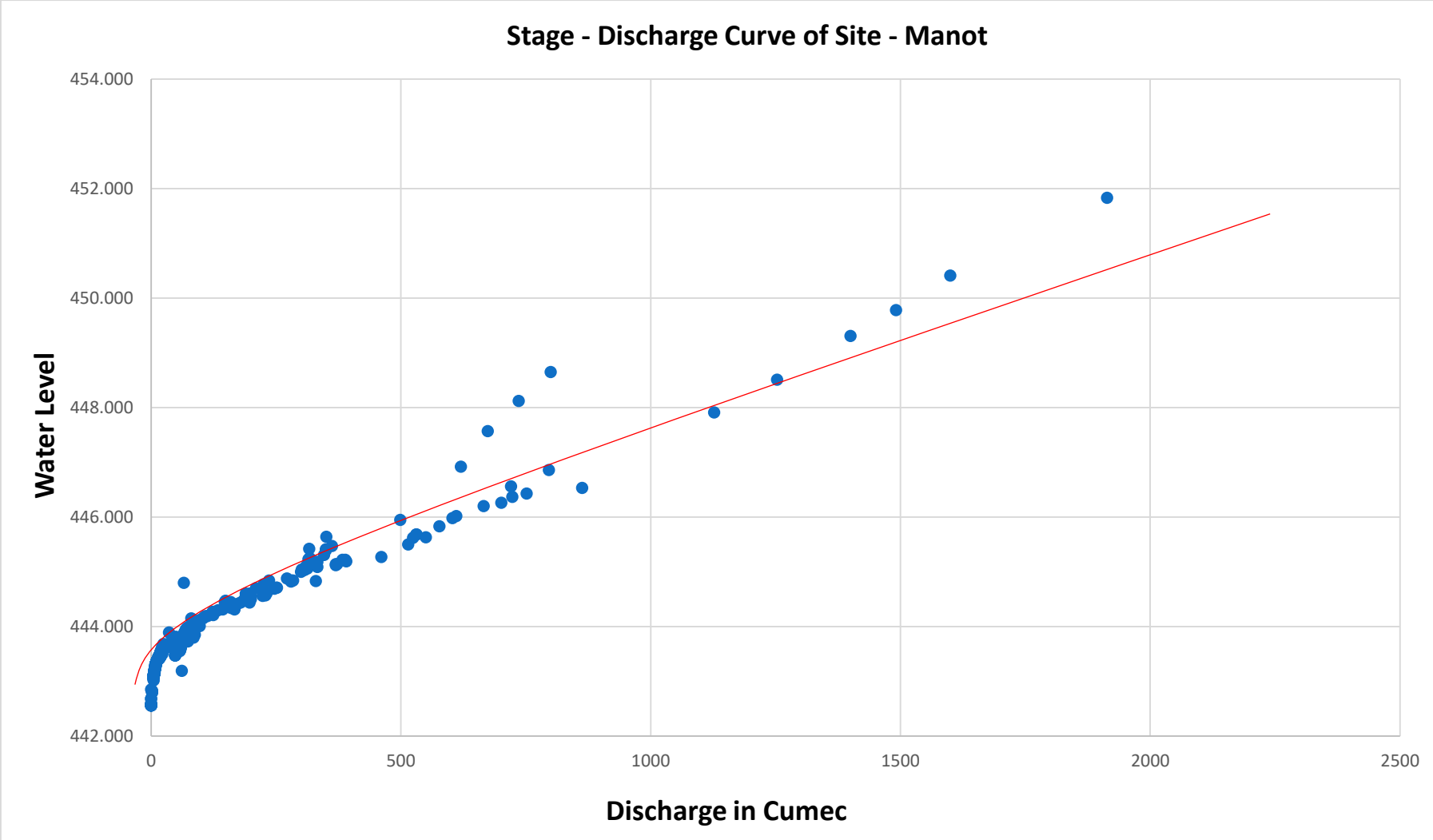


Figure-6.4: Stage-Discharge Curve of Site- Manot

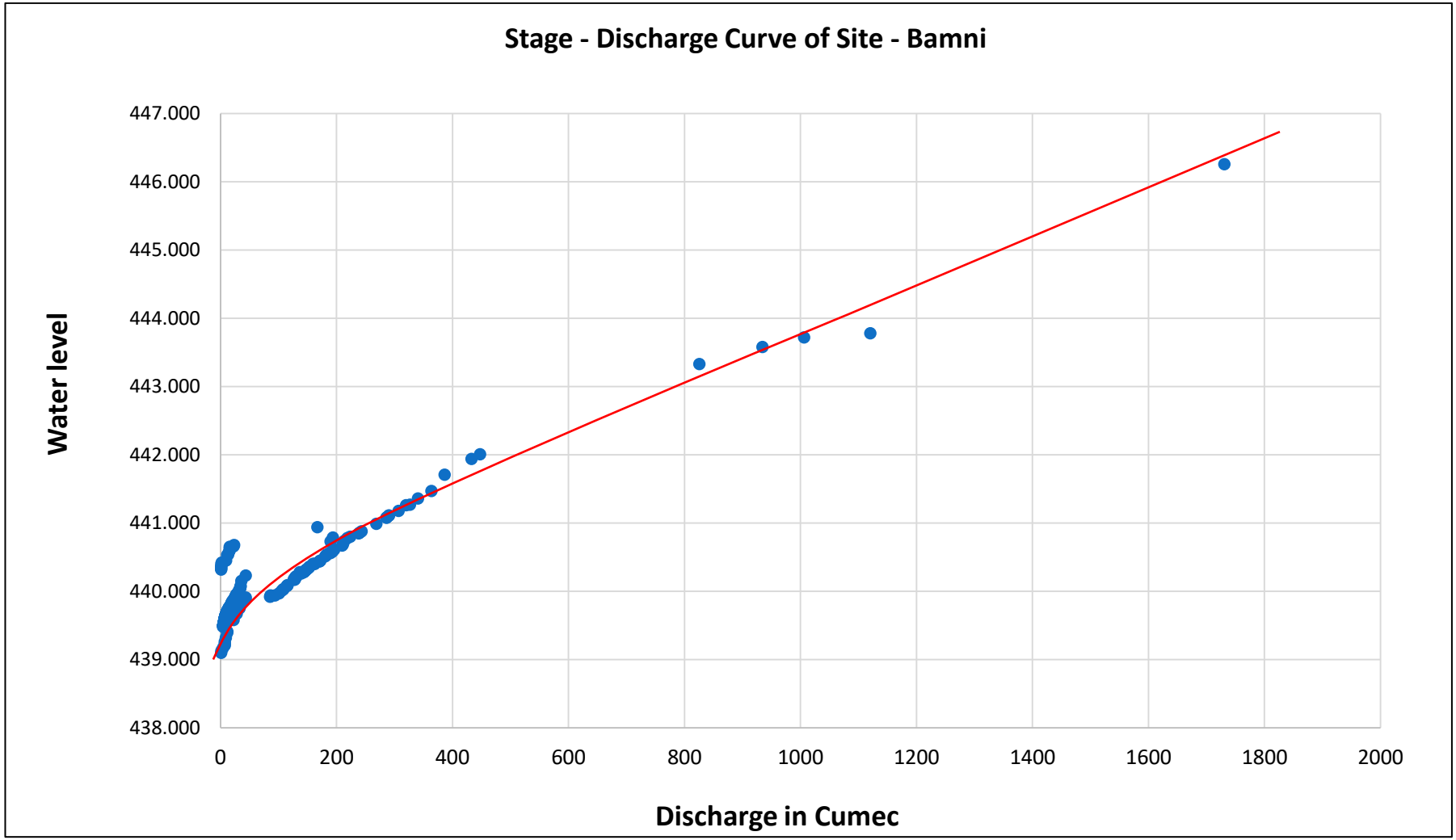


Figure-6.5: Stage-Discharge Curve of Site- Bamni

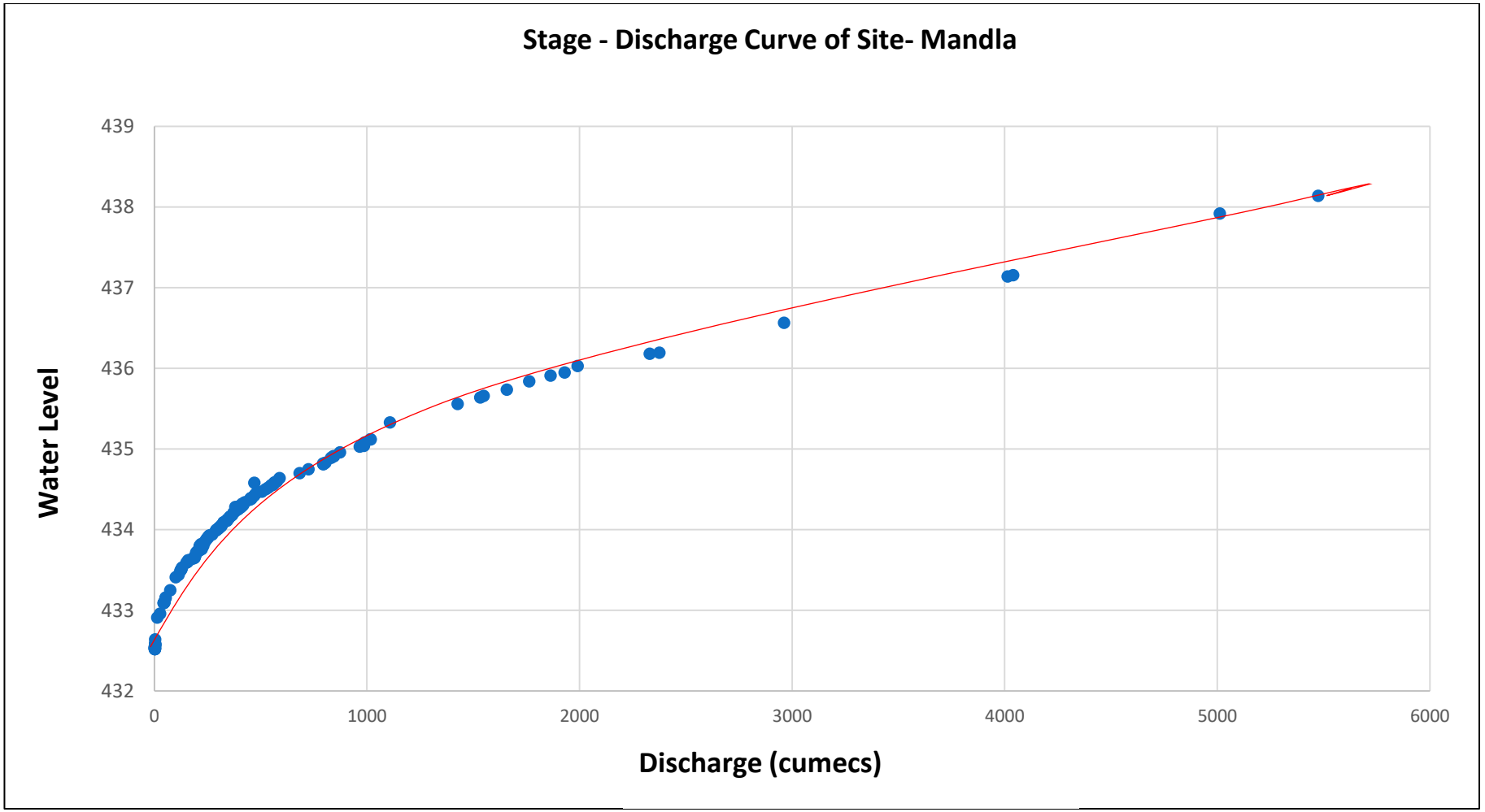


Figure-6.6: Stage-Discharge Curve of Site- Mandla

6.2 FLOOD FORECASTING SITE- NARMADAPURAM

The flood forecast for Narmadapuram is issued whenever the water level at the Narmadapuram station is expected to reach or exceed the critical warning level of 292.830 meters. This threshold triggers the issuance of a flood warning, allowing authorities to take necessary precautions and initiate flood management measures to minimize the impact on the region.

With the help of available correlation curves, procedure adopted for the formulation of flood forecast is as follows: The flood forecasting system for Narmadapuram is based on a comprehensive analysis that incorporates a correlation curve between Sandia and Narmadapuram, as well as the Gauge-Discharge curves for both sites. This analytical approach helps establish a clear relationship between water levels and discharge rates at Sandia and Narmadapuram, which is crucial for accurately predicting potential flooding at Narmadapuram. By using this data, the flood forecast is generally prepared 10 to 12 hours in advance. However, the final forecast is issued with a travel time of 3 to 6 hours, taking into account the releases from Tawa and Barna Dams, which influence the water flow and reduce the overall travel time.

To further improve the accuracy of the flood forecast, the releases from the Tawa and Barna Dams are factored into the forecasting system. These releases play a significant role in affecting the water flow into the Narmadapuram region, which in turn impacts the water levels and discharge rates. By incorporating these factors, the system ensures a more precise and reliable forecast, providing sufficient time for authorities to take appropriate precautionary actions before potential flooding occurs.

The core of the forecast involves the correlation between Sandia and Narmadapuram, which helps predict the rise in water levels at Narmadapuram based on data from Sandia. If this forecast predicts that the water level at Narmadapuram will exceed the critical warning level of 292.830 meters, a flood warning is issued to alert authorities and the public.

However, the forecast is not always final and can be subject to revision if necessary. This is especially true when there are substantial contributions from the Tawa River due to releases from the Tawa Dam, or when there is significant rainfall in the intervening catchment area between Sandia and Narmadapuram. These additional factors can influence water flow and may lead to adjustments in the original forecast. By continuously monitoring the situation and incorporating new information, the system ensures that the final flood forecast remains as accurate as possible, providing timely warnings and enabling effective flood management.

Table 6.3 Real Time Data Availability from Bargi Dam to Narmadapuram

Station	Catchment area in Sq. km.	Type of Data
Bargi	14456	Hourly water level, daily/3-hourly rainfall and releases from Dam
Barmanghat	26453	Hourly water level, Discharge and daily/3-hourly rainfall
Sandia	33954	Hourly water level, Discharge and daily/3-hourly rainfall
Tawa dam	6060	Hourly water level, daily/3-hourly rainfall and releases from Dam
Narmadapuram	44548	Hourly water level, Discharge and daily/3-hourly rainfall

Table 6.4 Travel Time from Base Stations to Narmadapuram

Station	Travel Time in Hours
Bargi to Narmadapuram	38
Barmanghat to Narmadapuram	22
Sandia to Narmadapuram	10 - 12
Tawa Dam to Narmadapuram	06 - 08
Barmanghat to Sandia	12

6.3 INFLOW FORECAST

Inflow forecasting is one of the most difficult tasks in hydrology. It is characteristically dynamic, uncertain, and nonlinear. However, it is important to have accurate estimates of the variables involved. The various features which help in proper estimation of inflow into the reservoir are as follows:

1. Flow prevailing in the river (Discharge)
2. Weather Forecasts issued by IMD
3. Rainfall in the Catchment area
4. Characteristics of Basin

The above factors govern the inflow into the reservoir which can be estimated based on the prevailing conditions. Under Narmada Division, Bhopal, Inflow Forecasts are issued for five no. of reservoirs listed below:

1. Bargi Dam
2. Tawa Dam
3. Barna Dam
4. Indirasagar Dam
5. Omkareshwar Dam

The Inflow forecast for the above listed reservoirs are currently in practical stage and basin specific MIKE-11 models developed are in calliberational stage. The target year for issuing all inflow forecasts for reservoirs on regular basis will be effective from Monsoon 2025. As Omkareshwar Reservoir is receiving controlled and pre-informed release from Indira Sagar Dam therefore no Advisory Inflow Forecast issued.

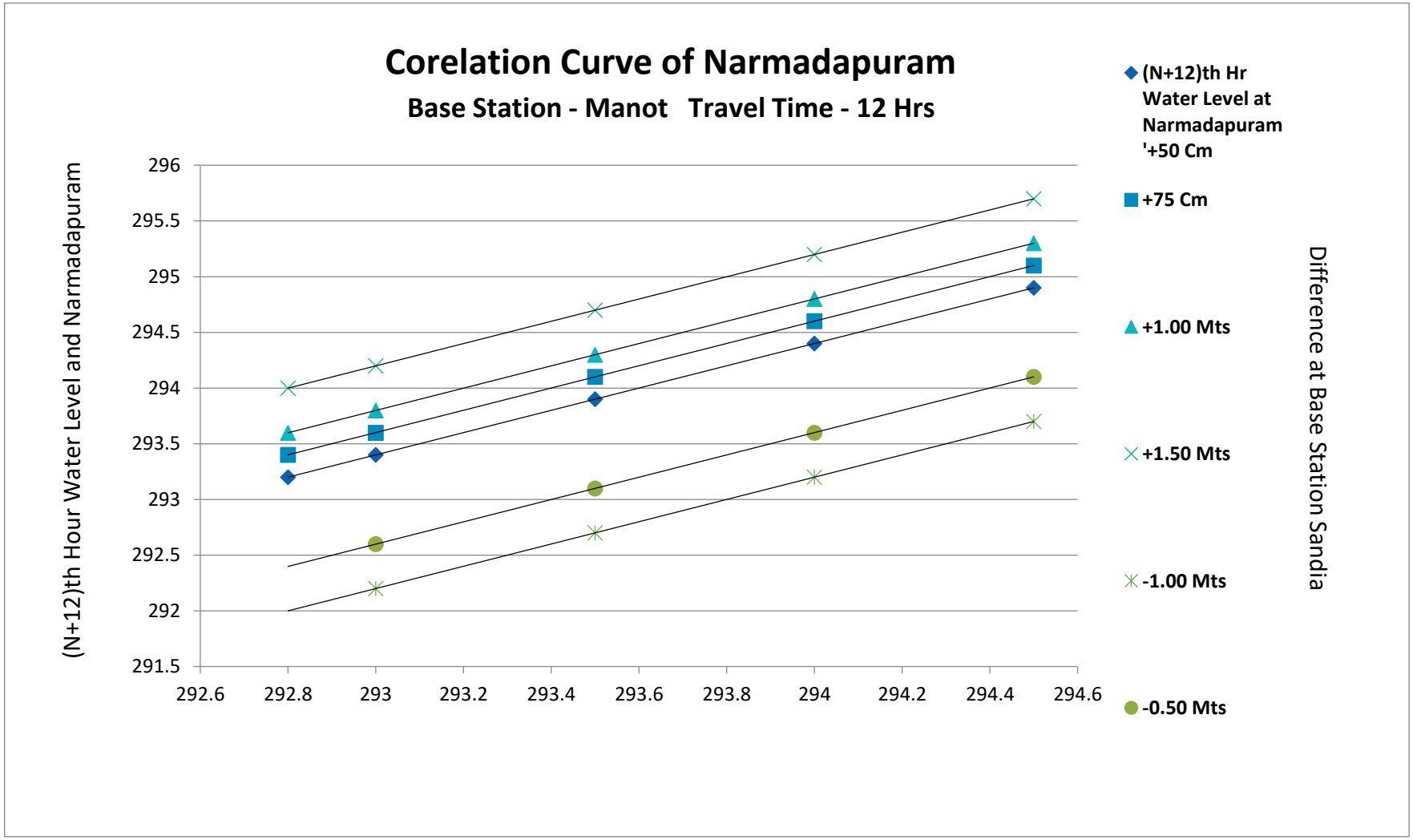


Figure-6.7: Correlation curves for Narmadapuram

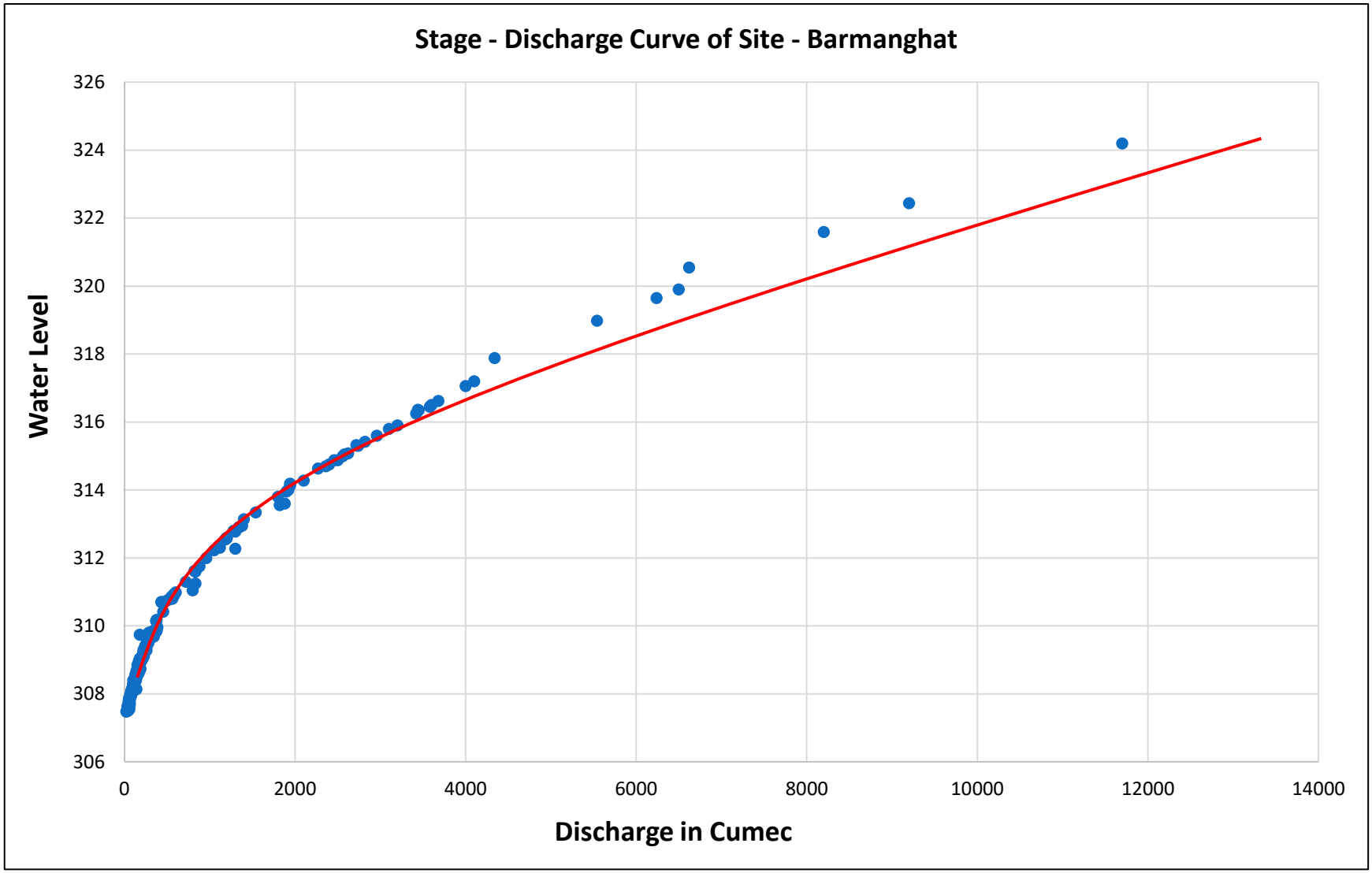


Figure-6.8: Stage-Discharge Curve of Site- Barmanghat

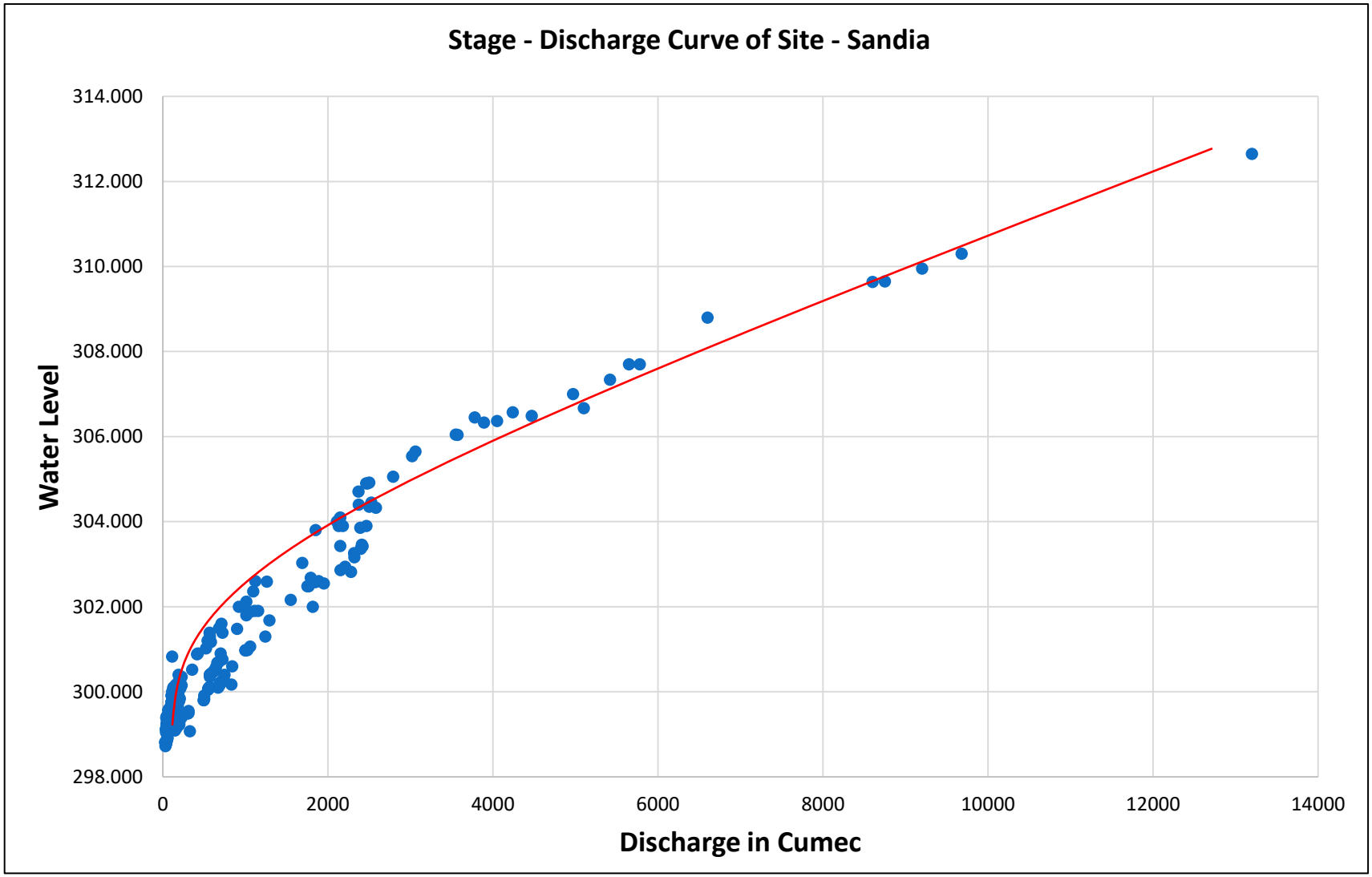


Figure-6.9: Stage-Discharge Curve of Site- Sandia

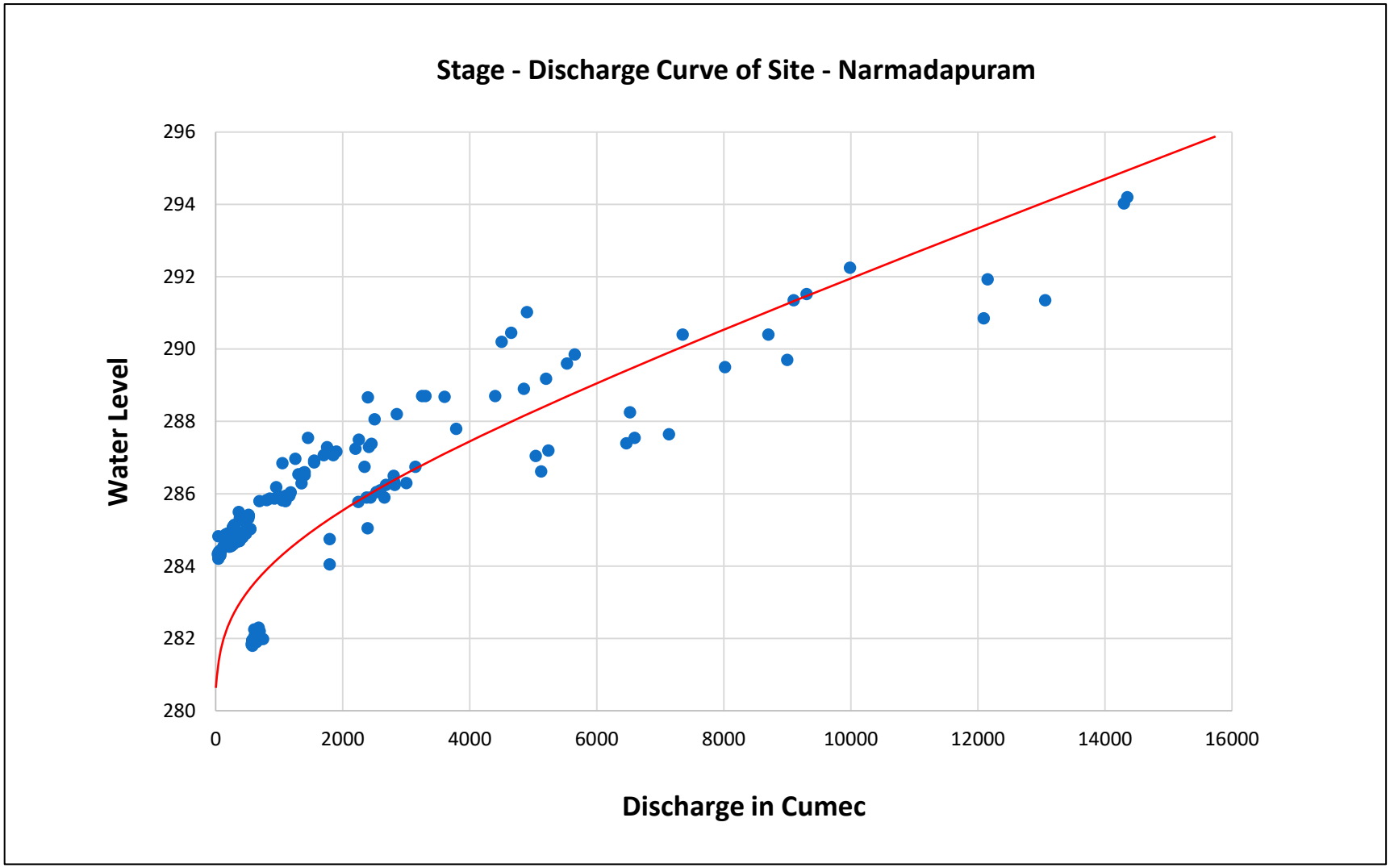


Figure-6.10: Stage-Discharge Curve of Site- Narmadapuram

CHAPTER- 7

BRIEF DESCRIPTION OF HYDROLOGICAL & METEOROLOGICAL EVENTS RESPONSIBLE FOR FLOODS DURING 2024

7.1 EVENTS AND SPELLS

This year, monsoon spells started in third week of June and showered up to the first week of October. The rainfall pattern was uneven having less number of rainy days in June. The rainfall was slightly higher to the Normal rainfall in most of the parts and below normal in other parts in the Narmada Basin. Most of the rain took place in the months of July, August and September with moderate to high intensity. All the reservoirs situated in Narmada Basin touched their FRL in September itself and the Dam authorities were compelled to release the excess water cautiously to prevent flooding in downstream areas.

The pictorial view of advancement of South-West Monsoon and District wise comparison between normal rainfall and actual rainfall occurred (Monsoon-2024) is shown in the form of tabular view and bar chart as follows:

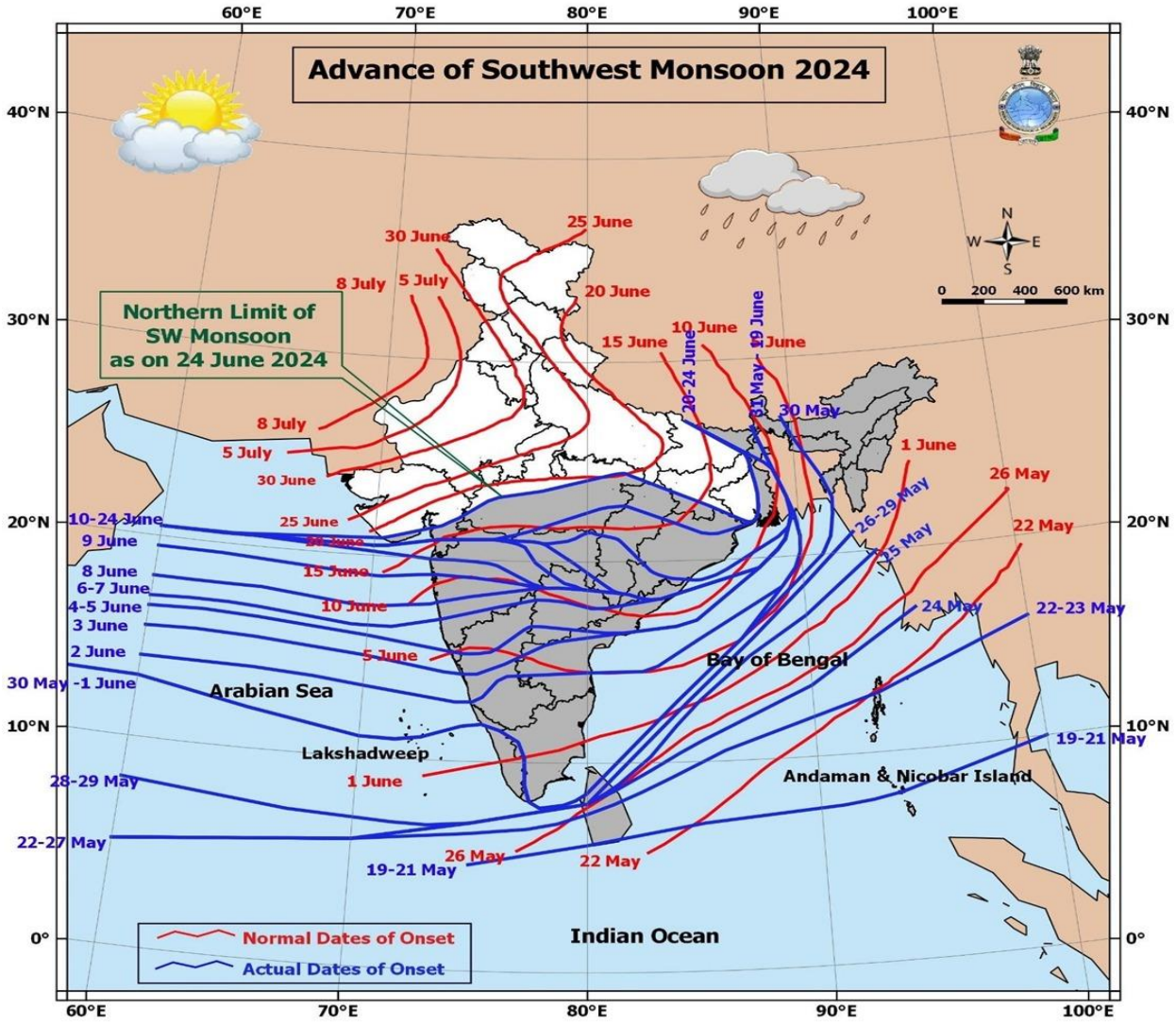


Figure- 7.1: Advance of Southwest Monsoon 2024

Table: 7.1 Normal Rainfall and Actual Rainfall 2024 in Narmada Basin

S. No	District Name	Actual Rainfall in mm	Normal Rainfall in mm	Percentage Departure
1	Balaghat	1218.5	1239.4	-2
2	Dindori	1301.0	1183.2	10
3	Jabalpur	1152.0	1130.1	2
4	Mandla	1540.4	1197.1	29
5	Narsinghpur	1137.8	1051.8	8
6	Barwani	843.5	669.4	26
7	Betul	1011.9	1038.1	-3
8	Bhopal	1319.3	956.2	38
9	Dewas	1071.3	904.7	18
10	Dhar	891.6	818.8	9
11	Harda	1042.2	1078.8	-3
12	Narmadapuram	1259.6	1259.1	0
13	Indore	850.3	868.1	-2
14	Khandwa	916.4	789.1	16
15	Khargone	919.2	719.3	28
16	Raisen	1252.8	1084.6	16
17	Sehore	1135.4	1070.3	6

Source: IMD, Bhopal

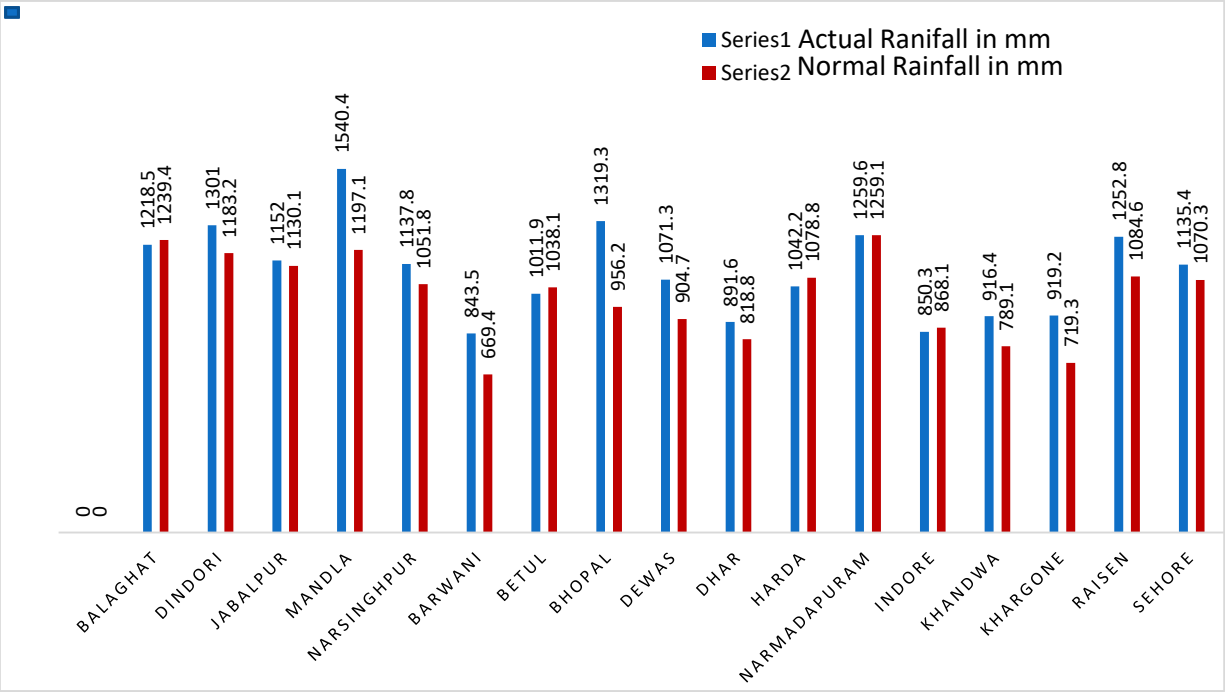


Figure- 7.2: Normal Rainfall and Actual Rainfall 2024 (Source: IMD, Bhopal)

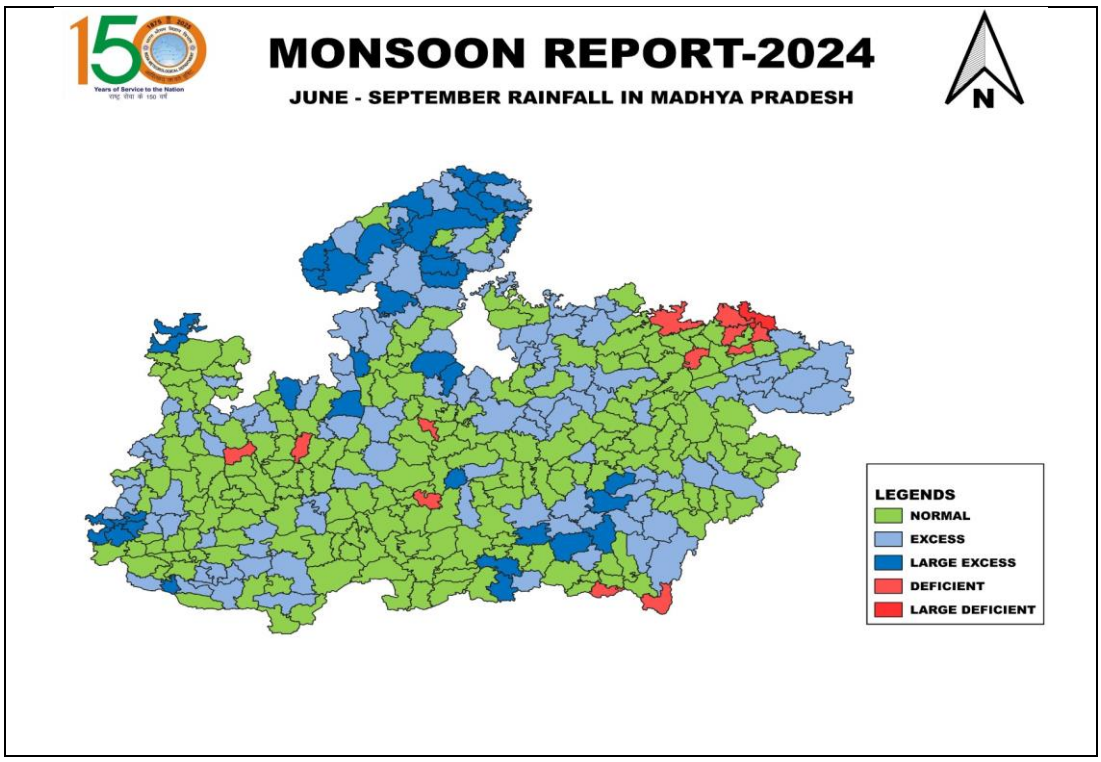


Figure- 7.3: Monsoon Report 2024

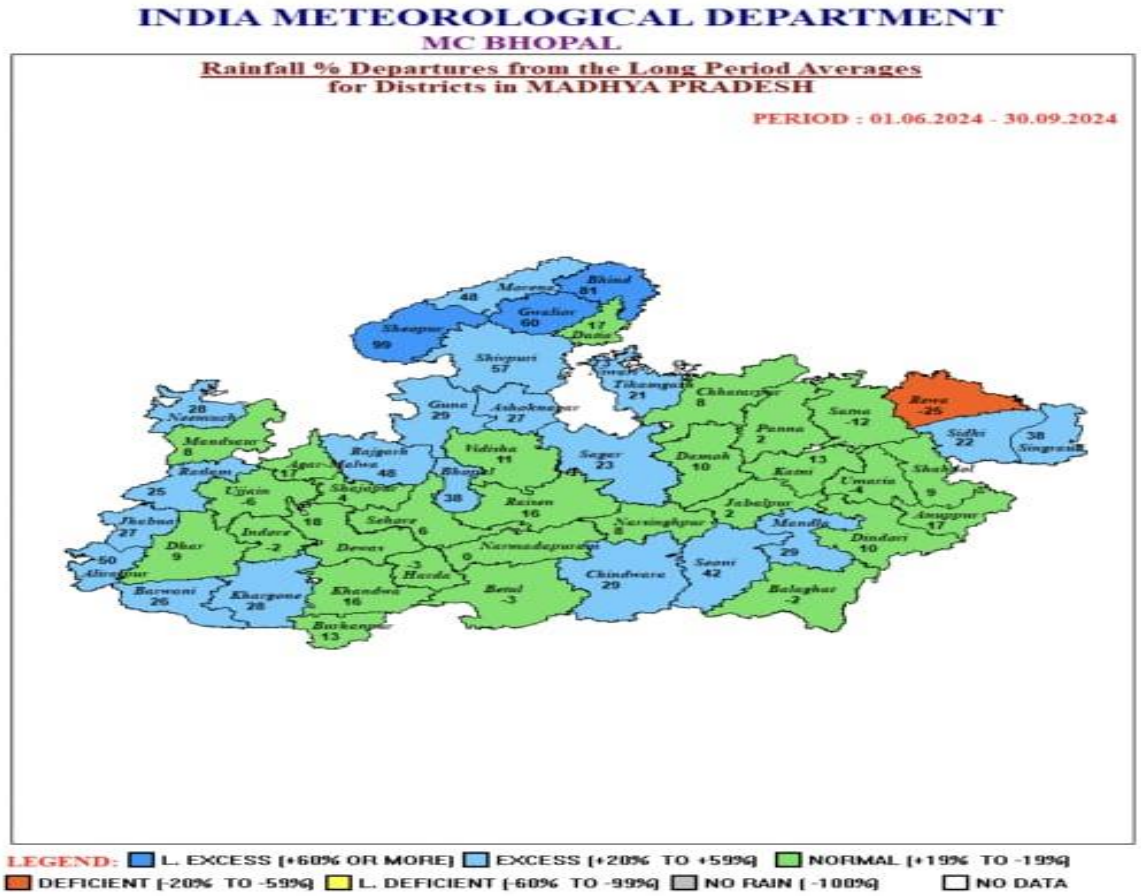


Figure- 7.4: Rainfall Percentage Departure from Long Period Averages (IMD, Bhopal)

Table 7.2 Cumulative Rainfall in mm during Monsoon 2024 in Narmada Basin

S. No.	Cumulative Rainfall in MM During Monsoon 2024						
	Name of Site	**June**	**July**	**August**	**Sept**	**Oct**	**Total Rainfall**
1	Dindori	178.6	312.8	566.0	212.8	56.2	1326.4
2	Mohgaon	205.3	450.8	516.6	280.2	17.4	1470.3
3	Manot	168.0	641.8	436.2	250.6	8.8	1505.4
4	Mukki	136.7	423.4	374.6	307.0	4.0	1245.7
5	Mawai	172.2	462.0	398.6	179.4	88.8	1301.0
6	Bamni	62.2	663.8	488.6	406.4	1.6	1622.6
7	Mandla	152.4	848.2	429.0	387.0	12.6	1829.2
8	Bargi	201.4	448.1	482.8	473.8	0.0	1606.1
9	Barmanghat	76.8	464.4	268.4	370.0	16.2	1195.8
10	Sandia	75.4	533.0	310.6	309.4	36.2	1264.6
11	Tawa	90.8	289.6	205.5	315.2	40.4	941.5
12	Pachmarhi	245.4	757.2	610.8	340.8	131.6	2085.8
13	Narmadapuram	95.0	575.8	367.6	123.4	41.6	1203.4
14	Mortakka	53.2	367.2	219.0	165.4	20.4	825.2
15	Patan	225.4	408.0	425.2	270.2	1.2	1330.0
16	Belkhedi	165.0	503.8	360.2	308.8	14.0	1351.8
17	Gadarwara	181.6	440.1	328.8	203.4	18.6	1172.5
18	Handia	43.0	345.9	259.2	206.0	57.4	911.5
19	Chhidgaon	62.6	249.2	418.2	173.6	137.8	903.6
20	Kogaon	105.5	226.7	259.6	107.2	26.8	725.8
21	Mandleshwar	64.2	257.8	282.8	103.6	20.0	728.4
22	Dhulsar	192.4	194.0	145.0	214.2	69.6	815.2
23	Pati	187.0	314.6	618.0	755.4	63.8	1938.8
24	Indirasagar dam	93.0	364.2	298.0	107.4	31.6	894.2
25	Barna dam	127.5	546.0	376.0	233.5	29.0	1312.0

7.2 WEATHER SITUATION DURING FIRST FLOOD WAVE 28.07.2024 TO 01.08.2024

Date	Weather System	Rainfall Forecast
28.07.2024	A cyclonic circulation over north Chhattisgarh & neighbourhood in lower & middle tropospheric levels. The Monsoon trough is active and south of its normal position at mean sea level. The shear zone now runs roughly along 21°N over Indian region in lower & middle tropospheric levels. The off-shore trough at mean sea level now runs along South Gujarat to north Kerala coast.	Very heavy rainfall very likely at isolated places over Madhya Pradesh, Vidarbha on 28th July; Gujarat Region on 28th & 29th July; Saurashtra & Kutch on 29th July; Konkan & Goa, Madhya Maharashtra on 28th July & 1st August. Heavy rainfall very likely at isolated places over Madhya Pradesh and Vidarbha on 29th, 31st July & 1st August; Chhattisgarh during 28th &30th July-1st August; Konkan & Goa and Madhya Maharashtra during 29th to 31st July, Saurashtra & Kutch on 28th & 30th July; Gujarat Region during 30th July-1st August.
29.07.2024	The Monsoon trough is active and south of its normal position at mean sea level. It is likely to shift gradually northwards during next 4-5 days. A cyclonic circulation over southeast Madhya Pradesh & neighbourhood in lower & middle tropospheric levels. The shear zone now runs roughly along 20°N over Indian region between 3.1 & 7.6 km above mean sea level tilting southwards with height. The off-shore trough at mean sea level now runs along South Gujarat to Kerala coast. A cyclonic circulation lies over northeast Arabian Sea and adjoining Saurashtra in lower tropospheric levels.	Very heavy rainfall very likely at isolated places over Gujarat Region on 29th; Saurashtra & Kutch on 29th & 30th; Konkan & Goa on 01st August; East Madhya Pradesh during 31st July 02nd August; Ghats areas of Madhya Maharashtra, Chhattisgarh on 01st & 02nd August, , West Madhya Pradesh on 02nd August. Heavy rainfall very likely at isolated places over Konkan & Goa, Madhya Maharashtra, Gujarat Region, West Madhya Pradesh during 29th July-02nd August, East Madhya Pradesh, Chhattisgarh during 30th July – 02nd August, Vidarbha on 29th July, 01st & 02nd August
30.07.2024	The Monsoon trough is active and south of its normal position at mean sea level. It is likely to shift gradually northwards during next 4-5 days. A cyclonic circulation over Jharkhand & neighbourhood in lower & middle tropospheric levels tilting southwards with height. The off-shore trough at mean sea level now runs along South Gujarat to Kerala coast. A cyclonic circulation lies over northeast Arabian Sea and adjoining Saurashtra in lower & middle	Isolated extremely heavy rainfall very likely over Madhya Maharashtra during 01st-03rd August. Very heavy rainfall very likely at isolated places over Konkan & Goa during 30th July - 03rd August; Madhya Maharashtra on 30th & 31st July; Gujarat State on 30th July; West Madhya Pradesh, Chhattisgarh during 01st – 03rd August; East Madhya Pradesh

	tropospheric levels tilting southwards with height.	during 31st July – 03rd August; Vidarbha on 02nd August
31.07.2024	The Monsoon trough is active and near of its normal position at mean sea level. It is likely to persist near its normal position during next 3 days and gradually shift southwards thereafter. A cyclonic circulation over Gangetic West Bengal & neighbourhood in lower & middle tropospheric levels. The off-shore trough at mean sea level runs along South Gujarat to Kerala coast. A shear zone runs roughly along 20°N in lower & middle tropospheric levels tilting southwards with height. A cyclonic circulation lies over north Arabian Sea in lower tropospheric levels tilting southwards with height.	Isolated extremely heavy rainfall very likely over Madhya Maharashtra during 01st-03rd August; East Madhya Pradesh on 01st & 02nd; Konkan & Goa on 02nd & 03rd and Gujarat Region on 03rd August. Very heavy rainfall very likely at isolated places over Konkan & Goa during 31st July, 01st & 04th August; Madhya Maharashtra on 31st July & 04th August; Vidarbha, Chhattisgarh during 31st July-02nd August; West Madhya Pradesh during 01st – 03rd August; East Madhya Pradesh on 31st July & 03rd August; Saurashtra & Kutch on 03rd August and Gujarat Region on 04th August.
01.08.2024	The Monsoon trough is active and near of its normal position at mean sea level. It is likely to persist near its normal position during next 4-5 days. The off-shore trough at mean sea level runs along South Gujarat to Kerala coast. A cyclonic circulation over Gangetic West Bengal & adjoining south Bangladesh in lower & middle tropospheric tilting southwards with height and a trough from above cyclonic circulation to northeast Bihar in lower tropospheric levels. A cyclonic circulation lies over northeast Rajasthan & neighbourhood in lower tropospheric levels. A trough runs from West Uttar Pradesh to cyclonic circulation over Gangetic West Bengal in lower & middle tropospheric levels. A cyclonic circulation lies over Punjab & neighbourhood in lower & middle tropospheric levels.	Heavy to very heavy rainfall very likely at isolated places over Konkan & Goa, Madhya Maharashtra, Gujarat Region during 01st-05th; Madhya Pradesh during 01st–04th; Vidarbha, Chhattisgarh during 01st-03rd and Saurashtra & Kutch on 03rd August. Heavy rainfall very likely at isolated places over Marathwada on 03rd and Saurashtra & Kutch on 04th August.

QPF Issued During First Flood Wave

Name of Station	QPF Issued for Upper Narmada									
	Year 2024									
	28.07	Actual Rainfall	29.07	Actual Rainfall	30.07	Actual Rainfall	31.07	Actual Rainfall	01.08	Actual Rainfall
Dindori		48.8		0.0		0.8		0.0		66.4
Manot		69.6		1.8		2.4		1.8		70.8
Mawai		6.4		3.2		3.8		0.0		43.6
Mohgaon	26-50	29.5	0.1-10	9.2	11-25	1.6	11-25	0.0	26-50	145.2
Mukki		3.0		5.4		0.0		36.8		54.2
Bamni		10		23		3.2		0.0		29.4
Mandla		42.4		14.6		4.8		13.4		54.2

7.3 WEATHER SITUATION DURING SECOND FLOOD WAVE 01.08.2024 TO 05.08.2024

Date	Weather System	Rainfall Forecast
01.08.2024	The Monsoon trough is active and near of its normal position at mean sea level. It is likely to persist near its normal position during next 4-5 days. The off-shore trough at mean sea level runs along South Gujarat to Kerala coast. A cyclonic circulation over Gangetic West Bengal & adjoining south Bangladesh in lower & middle tropospheric tilting southwards with height and a trough from above cyclonic circulation to northeast Bihar in lower tropospheric levels. A cyclonic circulation lies over northeast Rajasthan & neighbourhood in lower tropospheric levels. A trough runs from West Uttar Pradesh to cyclonic circulation over Gangetic West Bengal in lower & middle tropospheric levels. A cyclonic circulation lies over Punjab & neighbourhood in lower & middle tropospheric levels.	Heavy to very heavy rainfall very likely at isolated places over Madhya Pradesh during 01st–04th;

02.08.2024	The Low Pressure Area over Gangetic West Bengal and adjoining Jharkhand persists and associated cyclonic circulation in middle & upper tropospheric levels. It is likely to move west-north-westwards and intensify into a Depression over Jharkhand and neighbourhood during next 24 hours. The Monsoon trough is active and near of its normal position at mean sea level. It is likely to persist near its normal position during next 4-5 days.	Heavy to very heavy rainfall very likely at isolated places over West Madhya Pradesh during 02nd – 05th; East Madhya Pradesh during 02nd – 04th August. Heavy rainfall very likely at isolated places
03.08.2024	The Low Pressure Area over Gangetic West Bengal and adjoining Jharkhand moved west-north-westwards, intensified into a depression at 1730 hours IST of 02nd August. It further intensified into a deep depression and lay centered at 0830 hours IST of today, the 03rd August over southwest Bihar and adjoining northwest Jharkhand near latitude 24.4°N and longitude 84.4°E, about 50 km northeast of Daltonganj (Jharkhand), 60 km south-southeast of Dehri (Bihar) and 140 km east-southeast of Churk (Uttar Pradesh).	East Madhya Pradesh: Light to moderate rainfall at most places with heavy to very heavy rainfall at isolated places is very likely on 3rd & 4th and extremely heavy rainfall at isolated places is also very likely on 3rd August. West Madhya Pradesh: Light to moderate rainfall at most places is very likely with heavy to very heavy rainfall at isolated places is very likely during 3rd to 5th and extremely heavy rainfall at isolated places is also very likely on 3rd and 4th August.
04.08.2024	The deep depression lay centered at 0830 hours IST of today, the 4th August over northeast Madhya Pradesh & adjoining south Uttar Pradesh near latitude 25.0°N and longitude 80.7°E, about 60 km south-southeast of Banda (Uttar Pradesh), 120 km west-southwest of Khajuraho (Madhya Pradesh) and 220 km east-southeast of Jhansi of (Uttar Pradesh).	Isolated extremely heavy rainfall very likely over West Madhya Pradesh, Gujarat Region. Konkan & ghat area Madhya Maharashtra on 04th August. Heavy to very heavy rainfall very likely at isolated places over East Madhya Pradesh on 04th, Gujarat Region on 04th & 05th, Madhya Maharashtra on 05th August. Heavy rainfall very likely at isolated places over West Madhya Pradesh during 05th -10th, East Madhya Pradesh on 05th, 07th, 09th & 10th,
05.08.2024	Yesterday's deep depression over northeast Madhya Pradesh and adjoining south Uttar Pradesh moved west-north-westwards, weakened into a depression in the morning (0530 hours IST) and lay centered at 0830 hours IST of today, the 5th August over Northeast Rajasthan and neighbourhood near latitude 26.5°N and longitude 75.6°E, about 40 km south-southwest of Jaipur (Rajasthan), 100 km east of Ajmer (Rajasthan), 130 km south-southeast of Sikar (Rajasthan) and 280 km southeast of Bikaner (Rajasthan).	West Madhya Pradesh: Light to moderate rainfall at most places is very likely with heavy rainfall at isolated places on 05th August.

QPF Issued During Second Flood Wave

Name of Station	QPF Issued for Upper Narmada									
	Year 2024									
	01.08	Actual Rainfall	02.08	Actual Rainfall	03.08	Actual Rainfall	04.08	Actual Rainfall	05.08	Actual Rainfall
Dindori	26-50	66.4	26-50	6.2	51-100	15.6	26-50	85.8	0.1-10	0.4
Manot		70.8		0.0		15.8		77.8		8.8
Mawai		43.6		19.8		22.4		101.2		6.4
Mohgaon		145.2		6.4		31		112.4		5.0
Mukki		54.2		8.6		54.8		34.0		5.2
Bamni		29.4		5.2		18.6		59.4		1.2
Mandla		54.2		7.2		14.8		44.0		2.4

7.4 WEATHER SITUATION DURING THIRD FLOOD WAVE 08.09.2024 TO 12.09.2024

Date	Weather System	Rainfall Forecast
10.09.2024	Yesterday's depression over North Chhattisgarh & adjoining interior Odisha moved west-north-westwards with a speed of 20 kmph during past 6 hours and lay centered at 0830 hours IST of today, the 10th September, 2024 over North Chhattisgarh near latitude 21.9°N and longitude 82.8°E, 70 km east-southeast of Bilaspur (Chhattisgarh), 140 km northeast of Raipur (Chhattisgarh) and 220 km east of Malanjkhand (East Madhya Pradesh).It is very likely to move west-north-westwards across north Chhattisgarh and weaken into a well-marked low pressure area over Chhattisgarh and adjoining East Madhya Pradesh around evening of 10th September. The monsoon trough is active and south of its normal position at mean sea level. It is likely to continue so for next 3-4 days. A cyclonic circulation lies over south Gujarat at lower tropospheric levels.	Isolated extremely heavy rainfall very likely over East Madhya Pradesh on 10th and over West Madhya Pradesh on 11th September. Isolated very heavy rainfall very likely over Gujarat Region, Chhattisgarh on 10th; Vidarbha on 10th & 11th; Madhya Pradesh during 10th -14th September. Isolated heavy rainfall very likely over Madhya Pradesh during next 7 days; Vidarbha, Konkan & Goa, ghats areas of Madhya Maharashtra, Gujarat Region on 10th & 11th; Chhattisgarh during 14th - 16th September.
11.09.2024	The depression lay centred at 0830 hours IST of today, the 11th September over Northeast Madhya Pradesh near latitude 24.0°N and longitude 80.0°E, about 60 km east-northeast of Damoh (Madhya	Isolated extremely heavy rainfall very likely over West Madhya Pradesh on 11th & 12th; East Madhya Pradesh on 11th

	Pradesh), 110 km south of Khajuraho (Madhya Pradesh), 110 km southwest of Satna (Madhya Pradesh) and 210 km southeast of Jhansi (Uttar Pradesh). It is likely to move slowly north-north-westwards during next 24 hrs. The system is under continuous surveillance of Doppler Weather Radar at Bhopal (Madhya Pradesh). The monsoon trough is active and south of its normal position at mean sea level. It is likely to continue so for next 3-4 days. A cyclonic circulation lies over south Gujarat at middle tropospheric levels.	September. Isolated very heavy rainfall very likely over West Madhya Pradesh in 13th & 14th; East Madhya Pradesh on 12th; Gujarat Region on 11th September. Isolated heavy rainfall very likely over Konkan & Goa on 11th; Madhya Maharashtra on 11th & 12th; Madhya Pradesh during 11th - 15th; Chhattisgarh during 15th - 17th September
12.09.2024	The depression over Northwest Madhya Pradesh and neighbourhood moved north-north-eastwards with a speed of 10 kmph during past 6 hours and lay centred at 0830 hours IST of today, the 12th September over Southwest Uttar Pradesh and neighbourhood near latitude 27.0°N and longitude 78.5°E, about 50 km east-southeast of Agra (Uttar Pradesh), 90 km north-northeast of Gwalior (Madhya Pradesh), 110 km south-southeast of Aligarh (Uttar Pradesh) and 180 km south-southwest of Bareilly (Uttar Pradesh). It is likely to continue to move north-north-eastwards and maintain its intensity today, the 12th September and weaken gradually thereafter from tomorrow, the 13th September. The system is under continuous surveillance of Doppler Weather Radars at Delhi and Lucknow. An upper air cyclonic circulation lies over southeast Bangladesh & neighbourhood in lower & middle tropospheric levels. Under its influence, a low pressure area is likely to form over coastal Bangladesh & adjoining north Bay of Bengal during next 24 hours. Thereafter, it is likely to move slowly west-north-westwards and concentrate into a depression over coastal west Bengal and adjoining northwest Bay of Bengal during subsequent 48 hours. The monsoon trough is near normal position at mean sea level.	Fairly widespread to widespread light/moderate rainfall very likely over Madhya Pradesh, Konkan & Goa; Scattered to Fairly widespread light/moderate rainfall very likely over Vidarbha, Chhattisgarh; Isolated to Scattered light/moderate rainfall very likely over Madhya Maharashtra, Marathwada, Gujarat State during the week. Isolated very heavy rainfall very likely over West Madhya Pradesh on 12th; East Madhya Pradesh & Chhattisgarh on 16th & 17th September. Isolated heavy rainfall very likely over West Madhya Pradesh during 12th, 13th, 17th & 18th; East Madhya Pradesh during 12th, 13th & 15th -18th; Chhattisgarh during 15th -17th; Madhya Maharashtra, Konkan & Goa on 12th September

QPF Issued During Third Flood Wave

Name of Station	QPF Issued for Upper Narmada									
	Year 2024									
	08.09	Actual Rainfall	09.09	Actual Rainfall	10.09	Actual Rainfall	11.09	Actual Rainfall	12.09	Actual Rainfall
Dindori	11-25	46.2	11-25	1.6	26-50	56.4	11-25	25	11-25	1.6
Manot		0.0		11		22		88.4		7.8
Mawai		0.0		0.0		23.6		29.2		4.2
Mohgaon		0.0		0.0		20.6		95.6		6.6
Mukki		2.4		8.4		69.6		141.4		1.6
Bamni		0.0		0.0		93.8		94		85.8
Mandla		0.0		0.8		57.2		90.8		7.4

CHAPTER- 8

FLOOD AND INFLOW FORECAST (MONSOON 2024)

During entire monsoon period river Narmada experienced three flood waves at Mandla. The river was flowing below the warning level with rising and falling trend at Narmadapuram during entire monsoon period. During the season 04 Nos. of sites recorded New HFL details of which are given below in table. In this season 27 Nos. of level forecasts were issued for Mandla with 100% accuracy. Apart from these 105 Nos. of Advisory Inflow forecasts for four Reservoirs were issued with 100% accuracy.

In the existing practice, River flood forecast is to be formulated at Middle Narmada Sub Division-I, Narmadapuram and analysed and approved by Divisional office. Inflow Forecasts of Dams are issued by the Division itself.

Table 8.1 New HFL Recorded During Monsoon 2024

S.No.	Name of River	Name of Station	Old HFL	Date	New HFL	Date	Time
1	Saner	Chargawan	347.810	11.09.2019	349.200	23.07.2024	18:00
2	Belkund	Ghughra	379.740	03.08.2023	382.820	24.07.2024	22:00
3	Balai	Narayanganj	423.02	13.10.2022	423.590	11.09.2024	14:00
4	Banjar	Mukki	678.96	30.06.2005	680.28	11.09.2024	08:00

8.1 FLOOD FORECAST FOR MANDLA

This year river Narmada experienced three flood waves. Two flood waves in the first week of August and third wave in second week of September. During first flood wave river Narmada crossed its warning level only but in second and third wave it crossed danger level at Mandla. River Narmada at Mandla experienced above normal to severe flood situation. In third Wave River Narmada at Mandla recorded maximum water level. The details are shown below-

Table: 8.2 Details of Flood Waves 2024

Flood Wave	Duration	Forecast Issued	Forecast Accuracy	% Accuracy	Maximum Level with Date and Time	
First Wave	01.08.2024 13:00 to 01.08.2024 19:00	3	3	100	437.27	01.08.2024 14:00
Second Wave	03.08.2024 23:00 to 05.08.2024 04:00	11	11	100	438.04	04.08.2024 12:00
Third Wave	10.09.2024 21:00 to 12.09.2024 10:00	13	13	100	438.74	11.09.2024 10:00

Table: 8.3 Rainfall Above 50 mm Responsible For The Flood Events 2024

1. First Flood wave

S.No.	Station Name	28.07.2024	29.07.2024	30.07.2024	31.07.2024
1	Dindori	-	-	-	-
2	Manot	69.6	-	-	-
3	Mawai	-	-	-	-
4	Mohgaon	-	-	-	-
5	Mukki	-	-	-	-
6	Bamni	-	-	-	-
7	Mandla	-	-	-	-

2. Second Flood Wave

S.No.	Station Name	01.08.2024	02.08.2024	03.08.2024	04.08.2024	05.08.2024
1	Dindori	66.4	-	-	85.8	-
2	Manot	70.8	-	-	77.8	-
3	Mawai	-	-	-	101.2	-
4	Mohgaon	145.2	-	-	112.4	-
5	Mukki	54.2	-	54.8	-	-
6	Bamni	-	-	-	59.4	-
7	Mandla	-	-	-	-	-

3. Third Flood Wave

S.No.	Station Name	08.09.2024	09.09.2024	10.09.2024	11.09.2024	12.09.2024
1	Dindori	-	-	56.4	-	-
2	Manot	-	-	-	88.4	-
3	Mawai	-	-	-	-	-
4	Mohgaon	-	-	-	95.6	-
5	Mukki	-	-	69.6	141.4	-
6	Bamni	-	-	93.8	94	85.8
7	Mandla	-	-	57.2	90.8	-

8.2 FLOOD FORECAST FOR NARMADAPURAM

This year river Narmada at Narmadapuram was flowing well below the warning level during entire monsoon period.

Table 8.4 Periods above Warning/ Danger / HFL of Forecast Stations

Above Normal Flood Period

S No	Name of FF Site	River	Warning Level (m)	Danger Level (m)	Above Normal Flood Period (Water level equalled or exceeded Warning level but below Danger level)		No of Days
					From	To	
1	Mandla	Narmada	437.00	437.80	1/8/2024 13:00	1/8/2024 19:00	1
					3/8/2024 23:00	4/8/2024 5:00	2
					4/8/2024 19:00	5/8/2024 16:00	1
					10/9/2024 21:00	11/9/2024 3:00	2
					12/9/2024 0:00	12/9/2024 10:00	1
Total No of Days							**7**

Severe Flood Period

S No	Name of FF Site	River	Warning Level (m)	Danger Level (m)	Severe Flood Period (Water level equalled or exceeded danger level but below HFL)		No. of Days
					From	To	
1	Mandla	Narmada	437.00	437.00	4/8/2024 6:00	4/8/2024 18:00	1
					11/9/2024 4:00	11/9/2024 23:00	1
Total No of Days							2
2	Narmadapuram	Narmada	292.83	293.83	--	--	--
Total No of Days							**--**

Extreme Flood Period

No extreme flood occurred during monsoon 2024.

Table 8.5 Details of HFL, FRL and Maximum Water Level of Sites under Narmada Division, Bhopal

S. No.	Name of River	Location	Highest Flood Level/Full Reservoir Level			Maximum Water Level During Flood Season 2024		
			Level (m)	Date	Time	Max. Level (m)	Date	Time
1	Narmada	Dindori	669.640	23/08/1991	10:00	666.68	04/08/2024	05:00
2	Narmada	Manot	459.650	18/08/1984	22:00	451.80	11/09/2024	11:00
3	Narmada	Mandla	439.405	15/07/1974	08:00	438.74	11/09/2024	10:00
4	Narmada	Barmanghat	331.320	21/08/1973	06:00	325.00	12/09/2024	23:00
5	Narmada	Sandia	318.550	21/08/1973	18:00	311.08	30/08/2024	01:00
6	Narmada	Narmadapuram	301.330	27/08/1972	08:00	291.95	13/09/2024	19:00
7	Narmada	Handia	274.460	22/08/2013	24:00	268.44	14/09/2024	02:00
8	Narmada	Mortakka	173.736	16/09/1961	08:00	163.35	14/09/2024	08:00
9	Narmada	Mandleshwar	157.290	31/08/1973	09:00	146.95	14/09/2024	13:00
10	Burhner	Mohgaon	467.300	08/08/2004	15:00	459.20	04/08/2024	05:00
11	Banjar	Mukki	97.600	30/06/2005	10:00	680.28	11/09/2024	08:00
12	Banjar	Bamni	448.500	18/09/1999	15:00	447.57	11/09/2024	07:00
13	Hiran	Patan	356.830	06/07/2005	08:00	353.50	05/08/2024	17:00
14	Sher	Belkhedi	359.950	27/07/1994	18:00	347.99	22/07/2024	06:00
15	Shakkar	Gadarwara	330.260	15/07/1999	15:00	325.10	21/07/2024	09:00
16	Ganjal	Chhidgaon	301.920	08/07/2007	11:00	291.50	28/07/2024	22:00
17	Kundi	Kogaon	164.250	09/09/2010	09:00	157.78	02/09/2024	12:00
18	Uri	Dhulsar	156.300	08-08-2007	08:00	154.80	03/09/2024	09:00
19	Goi	Pati	207.100	07-08-2006	01:00	192.30	27/08/2024	11:00
20	Narmada	Bargi Dam	425.700	-	-	423.50	11/09/2024	17:00
21	Narmada	Indirasagar Dam	263.350	-	-	262.13	12/09/2024	04:00
22	Barna	Barna Dam	351.450	-	-	348.59	19/09/2024	18:00
23	Tawa	Tawa Dam	356.692	-	-	355.55	21/10/2024	07:00

Table 8.6 Details of Level Forecast Issued During Monsoon 2024

S. No.	Name of station	Warning Level	Danger Level	Highest Flood Level	Forecast issued During Flood Season2024		
					Forecast Issued	Forecast within Limit ± 15 cm	% Accuracy
1	Mandla	437.00	437.800	439.405	27	27	100
2	Narmadapuram	292.830	293.830	301.33	00	00	100
Total					**27**	**27**	**100**

Table 8.7 Details of Level Forecast Issued for Mandla (Monsoon 2024)

Mandla Level Forecast (Monsoon 2024)						
Warning level - 437.00 meters Danger level - 437.80 meters						
Forecast no	**Issued date time**	**Forecasted date time**	**Level (m)**	**Trend**	**Actual level (m)**	**Variation of forecast from actual ± 15 cm**
1	1/8/2024 11:40	1/8/2024 14:00	437.4	Rising	437.27	-0.13
2	1/8/2024 14:13	1/8/2024 17:00	437.4	Rising	437.26	-0.14
3	1/8/2024 17:15	1/8/2024 20:00	436.9	Falling	436.98	0.08
4	3/8/2024 21:26	4/8/2024 0:00	437.2	Rising	437.22	0.02
5	4/8/2024 0:08	4/8/2024 3:00	437.4	Rising	437.53	0.13
6	4/8/2024 3:06	4/8/2024 6:00	437.78	Rising	437.85	0.07
7	4/8/2024 6:08	4/8/2024 9:00	438.1	Rising	437.97	-0.13
8	4/8/2024 9:14	4/8/2024 12:00	438.05	Rising	438.04	-0.01
9	4/8/2024 11:59	4/8/2024 15:00	438.04	Steady	437.95	-0.09
10	4/8/2024 14:58	4/8/2024 18:00	437.75	Falling	437.81	0.06
11	4/8/2024 18:05	4/8/2024 21:00	437.55	Falling	437.59	0.04
12	4/8/2024 21:09	5/8/2024 0:00	437.25	Falling	437.37	0.12
13	5/8/2024 0:10	5/8/2024 3:00	437.1	Falling	437.12	0.02
14	5/8/2024 3:13	5/8/2024 6:00	436.75	Falling	436.86	0.11
15	10/9/2024 19:10	10/9/2024 22:00	437.2	Rising	437.23	0.03
16	10/9/2024 22:08	11/9/2024 1:00	437.5	Rising	437.55	0.05
17	11/9/2024 1:10	11/9/2024 4:00	437.75	Rising	437.88	0.13
18	11/9/2024 4:15	11/9/2024 7:00	438.4	Rising	438.45	0.05
19	11/9/2024 7:06	11/9/2024 10:00	438.88	Rising	438.74	-0.14
20	11/9/2024 10:21	11/9/2024 13:00	438.6	Falling	438.65	0.05

21	11/9/2024 13:04	11/9/2024 16:00	438.45	Falling	438.5	0.05
22	11/9/2024 16:04	11/9/2024 19:00	438.2	Falling	438.26	0.06
23	11/9/2024 19:01	11/9/2024 22:00	437.9	Falling	437.9	0
24	11/9/2024 22:07	12/9/2024 1:00	437.4	Falling	437.5	0.1
25	12/9/2024 1:10	12/9/2024 4:00	437.3	Falling	437.28	-0.02
26	12/9/2024 4:14	12/9/2024 8:00	436.98	Falling	437.06	0.08
27	12/9/2024 8:06	12/9/2024 11:00	436.96	Falling	436.96	0.06

8.3 ADVISORY INFLOW FORECASTS FOR RESERVOIR

After the commencement of monsoon season, 2024 from 21.07.2024 Advisory Inflow Forecast for 5 Dams was started for next 24-hour basis. The Threshold Limits of all the Dams have not still been fixed by the Dam authority despite of several correspondence made through letters, e-mails, telephones and by direct personal contact. Therefore, Narmada Division itself fixed the Threshold Limits of all the Dams after consulting D.D. (Hydromet) CWC New Delhi to facilitate the Dam Authorities with a request to fix the limit in near future because the same has to be fixed by them only. The Threshold Limits of All 5 Dams in monsoon season 2024 was as under: -

Table 8.8 Threshold Limits of Reservoirs

S. No.	Name of Dam	Threshold Limit in (MCM) for Flood Season 2024
1.	Indirasagar Dam	300
2.	Omkareshwar Dam	300
3.	Bargi	200
4.	Tawa	100
5.	Barna	100

Table 8.9 Details of Inflow Forecasts Issued During Monsoon 2024

Inflow Forecast							
S. No	**Name of station**	**Warning Level**	**Danger Level**	**Full Reservoir Level**	**Forecast issued During Flood Season2024**		
					Forecast Issued	**Forecast within Limit ± 20 %**	**% Accuracy**
1	Bargi Dam	-	-	425.700	22	22	100
2	Indira Sagar Dam	-	-	263.35	65	65	100
3	Omakreshawr Dam	-	-	199.62	0	0	100
4	Tawa Dam	-	-	356.692	11	11	100
5	Barna Dam	-	-	351.450	07	07	100
Total					**105**	**105**	**100**

8.3.1 Bargi Dam

This year first inflow forecast for Bargi Dam was issued on 23-07-2024 at 21:00 hrs. The final forecast was issued on 28-09-2024 at 18:00 hrs.
Total 22 no. of Inflow forecasts were issued for the reservoir with 100% accuracy.

Table 8.10 Details of Advisory Inflow Forecast Issued for Bargi Dam (Monsoon 2024)

Forecast no	Issued date time	Forecasted date time	Inflow (cumecs)	Trend	Actual inflow (cumecs)	Percentage variation of forecast from actual inflow
1	23-07-2024 21:07	24-07-2024 21:00	2000.0	Rising	1900.0	-5.26
2	24-07-2024 21:33	25-07-2024 21:00	2150.0	Rising	2550.0	15.69
3	01-08-2024 16:24	02-08-2024 16:00	4500.0	Rising	4250.0	-5.88
4	02-08-2024 09:50	03-08-2024 12:00	4100.0	Steady	3450.0	Modified
4	02-08-2024 21:20	03-08-2024 12:00	3000.0	Steady	3450.0	13.04
5	03-08-2024 10:13	04-08-2024 12:00	2500.0	Rising	3800.0	Modified
5	04-08-2024 03:59	04-08-2024 12:00	3200.0	Rising	3800.0	15.79
6	04-08-2024 15:23	05-08-2024 15:00	6500.0	Falling	5750.0	-13.04
7	05-08-2024 16:09	06-08-2024 16:00	4000.0	Falling	3600.0	-11.11
8	06-08-2024 16:49	07-08-2024 16:00	2500.0	Falling	2250.0	-11.11
9	08-08-2024 18:03	09-08-2024 18:00	4000.0	Falling	3800.0	-5.26
10	09-08-2024 18:40	10-08-2024 18:00	2500.0	Steady	2400.0	-4.17
11	22-08-2024 19:31	23-08-2024 19:00	2000.0	Rising	2050.0	2.44

12	23-08-2024 18:50	24-08-2024 18:00	2100.0	Steady	2180.0	3.67
13	24-08-2024 18:54	25-08-2024 18:00	2000.0	Steady	2200.0	9.09
14	25-08-2024 18:36	26-08-2024 18:00	2400.0	Steady	2050.0	-17.07
15	26-08-2024 18:40	27-08-2024 18:00	1250.0	Falling	1100.0	-13.64
16	10-09-2024 18:40	11-09-2024 18:00	3400.0	Rising	4000.0	15.0
17	11-09-2024 18:55	12-09-2024 18:00	8200.0	Falling	7100.0	-15.49
18	12-09-2024 18:27	13-09-2024 18:00	4500.0	Falling	4150.0	-8.43
19	13-09-2024 19:27	14-09-2024 18:00	1350.0	Falling	1480.0	8.78
20	14-09-2024 18:35	15-09-2024 18:00	1200.0	Falling	1010.0	Modified
20	15-09-2024 10:58	15-09-2024 18:00	850.0	Falling	1010.0	15.84
21	27-09-2024 19:08	28-09-2024 18:00	1250.0	Rising	1200.0	-4.17
22	28-09-2024 18:16	29-09-2024 18:00	1000.0	Falling	980.0	-2.04

8.3.2 Tawa Dam

This year first inflow forecast for Tawa Dam was issued on 27-07-2024 at 21:00 hrs. The final forecast was issued on 12-09-2024 at 18:00 hrs.
Total 11 no. of Inflow forecasts were issued for the reservoir with 100% accuracy.

Table 8.11 Details of Advisory Inflow Forecast Issued for Tawa Dam (Monsoon 2024)

Forecast no	Issued date time	Forecasted date time	Inflow (cumec)	Trend	Actual inflow (cumec)	Percentage variation of forecast from actual
1	27-07-2024 21:17	28-07-2024 21:00	1600.0	Steady	1490.0	-7.38
2	28-07-2024 21:12	29-07-2024 21:00	1650.0	Steady	1400.0	-17.86
3	02-08-2024 09:50	03-08-2024 12:00	1100.0	Rising	1850.0	Modified
3	02-08-2024 21:20	03-08-2024 12:00	2000.0	Rising	1850.0	-8.11
4	03-08-2024 10:13	04-08-2024 12:00	1200.0	Steady	1150.0	-4.35
5	04-08-2024 15:23	05-08-2024 15:00	1650.0	Rising	1750.0	5.71
6	25-08-2024 08:59	25-08-2024 18:00	1000.0	Rising	1160.0	13.79
7	25-08-2024 18:36	26-08-2024 18:00	800.0	Falling	680.0	-17.65
8	26-08-2024 18:40	27-08-2024 18:00	500.0	Falling	420.0	Modified
8	27-08-2024 08:56	27-08-2024 18:00	350.0	Falling	420.0	16.67
9	10-09-2024 20:13	11-09-2024 20:00	1500.0	Rising	1650.0	9.09
10	11-09-2024 18:55	12-09-2024 18:00	1300.0	Steady	1150.0	-13.04
11	12-09-2024 18:27	13-09-2024 18:00	450.0	Falling	450.0	0.0

8.3.3 Barna Dam

This year first inflow forecast for Barna Dam was issued on 02-08-2024 at 10:00 hrs. The final forecast was issued on 12-09-2024 at 10:00 hrs.
Total 7 no. of Inflow forecasts were issued for the reservoir with 100% accuracy.

Table 8.12 Details of Advisory Inflow Forecast Issued for Barna Dam (Monsoon 2024)

5555Forecast no	Issued date time	Forecasted date time	Inflow (cumecs)	Trend	Actual inflow (cumecs)	Percentage variation of forecast from actual inflow
1	02-08-2024 09:50	03-08-2024 12:00	1000.0	Rising	1690.0	Modified
1	02-08-2024 21:20	03-08-2024 12:00	1800.0	Rising	1690.0	-6.51
2	03-08-2024 10:13	04-08-2024 12:00	850.0	Falling	710.0	-19.72
3	04-08-2024 15:23	05-08-2024 15:00	900.0	Rising	780.0	-15.38
4	25-08-2024 09:00	25-08-2024 18:00	150.0	Rising	130.0	-15.38
5	25-08-2024 18:36	26-08-2024 18:00	100.0	Steady	90.0	-11.11
6	26-08-2024 18:58	27-08-2024 18:00	70.0	Falling	65.0	-7.69
7	11-09-2024 18:55	12-09-2024 18:00	450.0	Steady	200.0	Modified
7	12-09-2024 10:53	12-09-2024 18:00	180.0	Falling	200.0	10.0

8.3.4 Indirasagar Dam

This year first inflow forecast for Indirasagar Dam was issued on 23/07/2024 at 21:00 hrs. The final forecast was issued on 05-10-2024 at 18:00 hrs.
Total 65 no. of Inflow forecasts were issued for the reservoir with 100% accuracy.

Table 8.13 Details of Advisory Inflow Forecast Issued for Indirasagar Dam (Monsoon 2024)

Forecast no.	Issued date time	Forecasted date time	Inflow (cumecs)	Trend	Actual inflow (cumecs)	Percentage variation of forecast from actual inflow
1	23-07-2024 21:07	24-07-2024 21:00	3500.0	Falling	3150.0	-11.11
2	24-07-2024 21:29	25-07-2024 21:00	4000.0	Rising	4200.0	4.76
3	25-07-2024 21:15	26-07-2024 21:00	3500.0	Falling	4100.0	Modified
3	26-07-2024 12:47	26-07-2024 21:00	4400.0	Falling	4100.0	-7.32
4	26-07-2024 21:05	27-07-2024 21:00	3500.0	Falling	3850.0	9.09
5	27-07-2024 21:17	28-07-2024 21:00	6500.0	Rising	5850.0	-11.11
6	28-07-2024 21:12	29-07-2024 21:00	6000.0	Steady	5250.0	-14.29
7	29-07-2024 21:28	30-07-2024 21:00	4100.0	Falling	4250.0	3.53
8	30-07-2024 21:08	31-07-2024 21:00	3650.0	Falling	3400.0	-7.35
9	02-08-2024 09:57	03-08-2024 12:00	4500.0	Rising	7250.0	Modified
9	02-08-2024 21:20	03-08-2024 12:00	7500.0	Rising	7250.0	-3.45
10	03-08-2024 10:05	04-08-2024 12:00	10500.0	Rising	9850.0	-6.6
11	04-08-2024 15:23	05-08-2024 15:00	8500.0	Steady	9500.0	10.52

12	05-08-2024 16:09	06-08-2024 16:00	12000.0	Rising	10400.0	-15.38
13	06-08-2024 16:49	07-08-2024 16:00	7200.0	Falling	6400.0	-12.5
14	07-08-2024 17:15	08-08-2024 17:00	5500.0	Falling	6550.0	16.03
15	08-08-2024 18:03	09-08-2024 18:00	6500.0	Falling	6680.0	2.69
16	09-08-2024 18:40	10-08-2024 18:00	6100.0	Steady	6000.0	-1.67
17	10-08-2024 18:14	11-08-2024 18:00	5850.0	Steady	5750.0	-1.74
18	11-08-2024 18:11	12-08-2024 18:00	5500.0	Falling	5550.0	0.9
19	12-08-2024 18:20	13-08-2024 18:00	5000.0	Falling	4600.0	-8.7
20	13-08-2024 18:37	14-08-2024 18:00	3500.0	Falling	3150.0	-11.11
21	22-08-2024 19:31	23-08-2024 19:00	2100.0	Steady	2250.0	6.67
22	23-08-2024 18:50	24-08-2024 18:00	2900.0	Rising	3050.0	4.92
23	24-08-2024 18:54	25-08-2024 18:00	3200.0	Rising	4400.0	Modified
23	25-08-2024 09:14	25-08-2024 18:00	4500.0	Rising	4400.0	-2.27
24	25-08-2024 18:36	26-08-2024 18:00	6600.0	Rising	5800.0	-13.79
25	26-08-2024 18:40	27-08-2024 18:00	5000.0	Falling	5080.0	1.57
26	27-08-2024 18:41	28-08-2024 18:00	4500.0	Falling	4350.0	-3.45
27	28-08-2024 18:46	29-08-2024 18:00	3600.0	Falling	3750.0	4.0
28	29-08-2024 19:19	30-08-2024 18:00	3100.0	Falling	3050.0	-1.64
29	30-08-2024 18:36	31-08-2024 18:00	2250.0	Falling	2200.0	-2.27
30	31-08-2024 18:49	01-09-2024 18:00	2050.0	Steady	2100.0	2.38
31	01-09-2024 19:09	02-09-2024 18:00	2300.0	Rising	2500.0	8.0
32	02-09-2024 18:44	03-09-2024 18:00	3600.0	Rising	3450.0	-4.35
33	03-09-2024 18:52	04-09-2024 18:00	2900.0	Falling	2800.0	-3.57
34	04-09-2024 18:15	05-09-2024 18:00	2300.0	Falling	2240.0	-2.68
35	05-09-2024 19:13	06-09-2024 18:00	2000.0	Falling	1860.0	-7.53
36	06-09-2024 18:42	07-09-2024 18:00	1380.0	Falling	1540.0	10.39
37	07-09-2024 18:34	08-09-2024 18:00	1300.0	Falling	1400.0	7.14
38	08-09-2024 18:51	09-09-2024 18:00	1250.0	Falling	1350.0	Modified
38	09-09-2024 08:59	09-09-2024 18:00	1425.0	Rising	1350.0	-5.56
39	09-09-2024 18:35	10-09-2024 18:00	1850.0	Rising	2150.0	13.95
40	10-09-2024 18:32	11-09-2024 18:00	2400.0	Rising	2750.0	12.73
41	11-09-2024 18:55	12-09-2024 18:00	8000.0	Rising	9200.0	Modified
41	12-09-2024 09:18	12-09-2024 18:00	10000.0	Rising	9200.0	-8.7
42	12-09-2024 18:27	13-09-2024 18:00	9000.0	Falling	10000.0	10.0
43	13-09-2024 19:27	14-09-2024 18:00	8750.0	Falling	10500.0	16.66
44	14-09-2024 18:35	15-09-2024 18:00	8000.0	Falling	8100.0	1.23
45	15-09-2024 18:36	16-09-2024 18:00	3900.0	Falling	3750.0	-4.0
46	16-09-2024 18:15	17-09-2024 18:00	2350.0	Falling	2750.0	14.55
47	17-09-2024 18:30	18-09-2024 18:00	2400.0	Falling	2350.0	-2.13
48	18-09-2024 19:02	19-09-2024 19:00	3000.0	Rising	2850.0	-5.26
52	22-09-2024 18:50	23-09-2024 18:00	1920.0	Falling	2150.0	10.7
53	23-09-2024 18:37	24-09-2024 18:00	1800.0	Falling	1850.0	2.7
54	24-09-2024 18:58	25-09-2024 18:00	1650.0	Falling	1710.0	3.51
55	25-09-2024 19:09	26-09-2024 18:00	1300.0	Falling	1400.0	7.14
56	27-09-2024 09:07	27-09-2024 18:00	1300.0	Steady	1380.0	5.8

57	27-09-2024 19:08	28-09-2024 18:00	1450.0	Rising	1510.0	3.97
58	28-09-2024 18:16	29-09-2024 18:00	1800.0	Steady	1820.0	1.1
59	29-09-2024 18:38	30-09-2024 18:00	1750.0	Falling	1700.0	-2.94
60	30-09-2024 18:55	01-10-2024 18:00	1500.0	Falling	1650.0	9.09
61	01-10-2024 18:27	02-10-2024 18:00	1610.0	Falling	1760.0	Modified
61	02-10-2024 07:50	02-10-2024 18:00	1900.0	Rising	1760.0	-7.95
62	02-10-2024 18:52	03-10-2024 18:00	1950.0	Falling	1980.0	1.52
63	03-10-2024 18:22	04-10-2024 18:00	1620.0	Falling	1530.0	-5.88
64	04-10-2024 19:01	05-10-2024 18:00	1230.0	Falling	1360.0	9.56
65	05-10-2024 18:38	06-10-2024 18:00	1300.0	Falling	1110.0	-17.12

8.3.5 Omkareshwar Dam

This year no inflow forecasts were issued as the reservoir gets regulated discharge from Indirasagar Dam.

Table 8.14 Details of Advisory Inflow Forecast Issued for Omkareshwar Dam (Monsoon2024)

Forecast no	Issued date time	Forecasted date time	Inflow (cumecs)	Trend	Actual inflow (cumecs)	Percentage variation of forecast from actual inflow
-	-	-	-	-	-	-

Table 8.15 Performance of Level Forecast during Flood Season 2024

Performance of Level Forecast during Flood Season 2024			
Name of Station	**Number of forecasts issued**	**Number of forecasts within permissible limit of accuracy ± 15 cm**	**Percentage of accuracy**
Mandla	27	27	100
Narmadapuram	00	00	100
Total number of forecasts	27	27	100

Table 8.16 Performance of Level Forecast during Monsoon 2024 (If Not Modified)

Performance of Level Forecast during Flood Season 2024 (If Not Modified)			
Name of Station	**Number of Forecasts Issued**	**Number of Forecasts Within Permissible Limit of Accuracy ± 15 cm**	**Percentage of Accuracy**
Mandla	27	27	100
Narmadapuram	00	00	100
Total number of forecasts	27	27	100

Table 8.17 Performance of Inflow Forecast during Monsoon 2024

Performance of Inflow Forecast during Flood Season 2024			
Name of Dam	**Number of Forecasts Issued**	**Number of Forecasts Within Permissible Limit of Accuracy (20%)**	**Percentage of Accuracy**
Indirasagar dam	65	65	100
Bargi dam	22	22	100
Tawa dam	11	11	100
Barna dam	07	07	100
Omkareshwar dam	0	0	-
Total number of forecasts	105	105	100

Table 8.18 Performance of Inflow Forecast during Monsoon 2024 (If Not Modified)

Performance of Inflow Forecast During Flood Season 2024 (If Not Modified)			
Name of Dam	**Number of Forecasts Issued**	**Number of Forecasts Within Permissible Limit of Accuracy (20%)**	**Percentage of Accuracy**
Indirasagar dam	65	63	96.92
Bargi dam	22	21	95.45
Tawa dam	11	10	90.90
Barna dam	07	05	71.42
Omkareshwar dam	0	0	-
Total number of forecasts	105	99	94.28

Table 8.19 Performance of Total Forecast during Monsoon 2024

Performance of Forecast During Flood Season 2024			
Details of Forecast	**Number of Forecasts Issued**	**Number of Forecasts Within Permissible Limit of Accuracy**	**Percentage of Accuracy**
Level forecast	27	27	100
Inflow forecast	105	105	100
Total number of forecasts	132	132	100

8.4 COMPARISION OF PERFORMANCE WITH PREVIOUS YEARS FORECAST

The flood forecasting work for Mandla & Narmadapuram was allocated to this Division in the year 2000. The details of forecasts issued during Monsoon 2024 alongwith their performance is tabulated below:

Average forecast performance including 2024 remained stable for both the sites as indicated below:

Table 8.20 Yearwise Details of Flood Forecast Performance and Accuracy

Narmada at Mandla Commencement year 1989				**Narmada at Narmadapuram Commencement year 1973**			
Year	**Total Forecast**	**Within ± 15 cm**	**% Accuracy**	**Year**	**Total Forecast**	**Within ± 15 cm**	**% Accuracy**
2010	0	0	-	2010	0	0	-
2011	7	7	100	2011	0	0	-
2012	0	0	-	2012	15	15	100
2013	0	0	-	2013	47	46	97.9
2014	13	13	100	2014	0	0	-
2015	02	02	100	2015	0	0	-
2016	09	09	100	2016	05	05	100
2017	0	0	-	2017	0	0	-
2018	07	06	85	2018	0	0	-
2019	36	35	97	2019	26	26	100
2020	24	24	100	2020	28	28	100
2021	0	0	-	2021	0	0	-
2022	19	19	100	2022	22	22	100
2023	16	16	100	2023	3	3	100
2024	27	27	100	2024	0	0	-

Flood Forecasts Performance of Narmada Division during the last 15 years (2010-2024) is tabulated as follows:

Table 8.21 Flood Forecast Performance of Narmada Division Year (2010-2024)

Year	Total forecast issued	Forecast within admissible limit	Overall performance of the Division in %	Forecasting Division
2010	0	0	0	Narmada Division Bhopal
2011	7	7	100	
2012	15	15	100	
2013	47	46	97.9	
2014	13	13	100	
2015	02	02	100	
2016	14	14	100	
2017	0	0	0	
2018	07	06	85	
2019	62	61	98	
2020	175	175	100	
2021	35	35	100	
2022	123	123	100	
2023	56	56	100	
2024	132	132	100	

FLOOD DAMAGES

No flood damage report received from the state authorities for Narmada Basin during flood season 2024.

GOOGLE CAP ALERT

Google Cap alert is not used in monsoon 2024 due to unavailability of Login Id and Password.

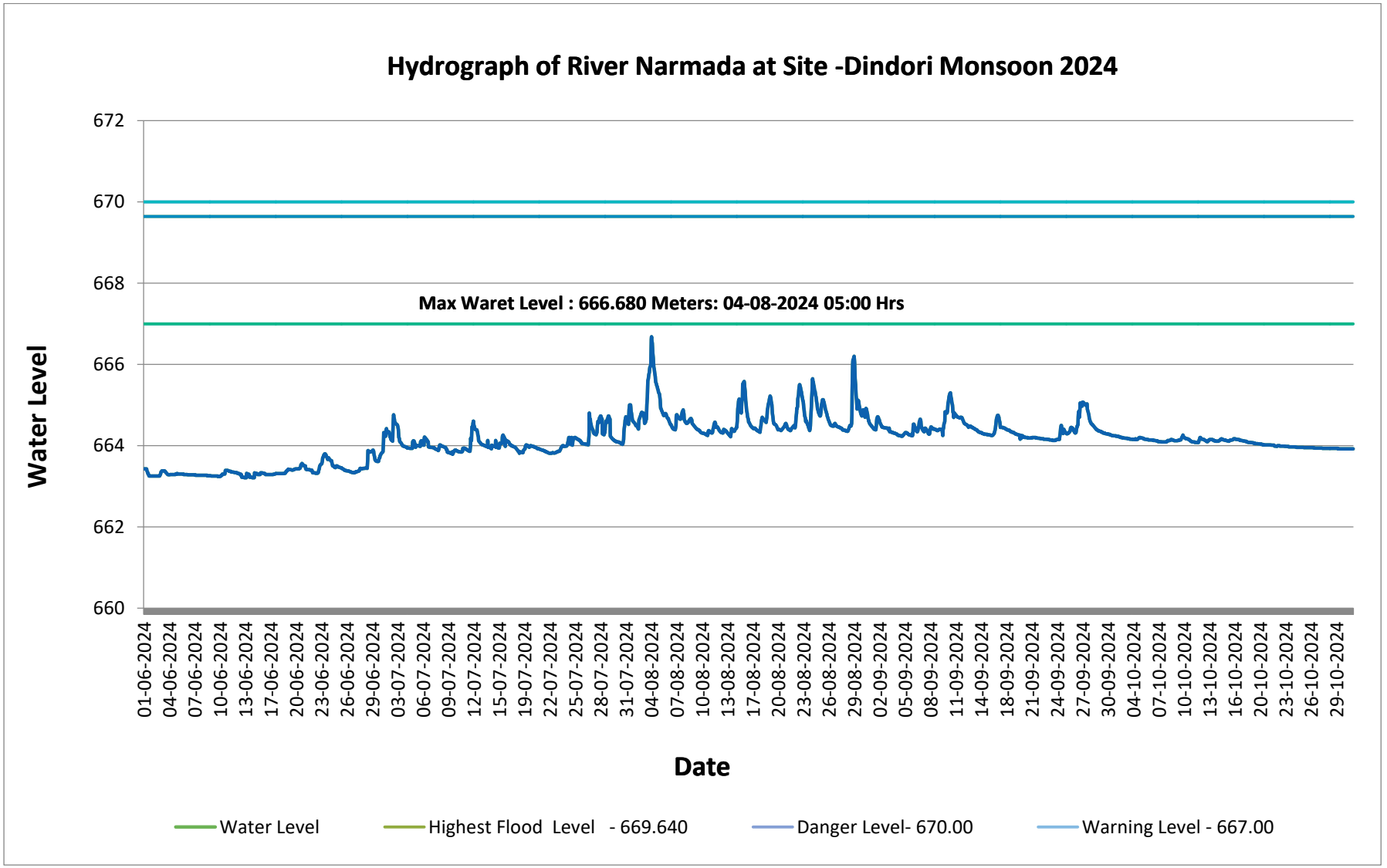


Figure- 8.1: Hydrograph of Site- Dindori (Monsoon 2024)

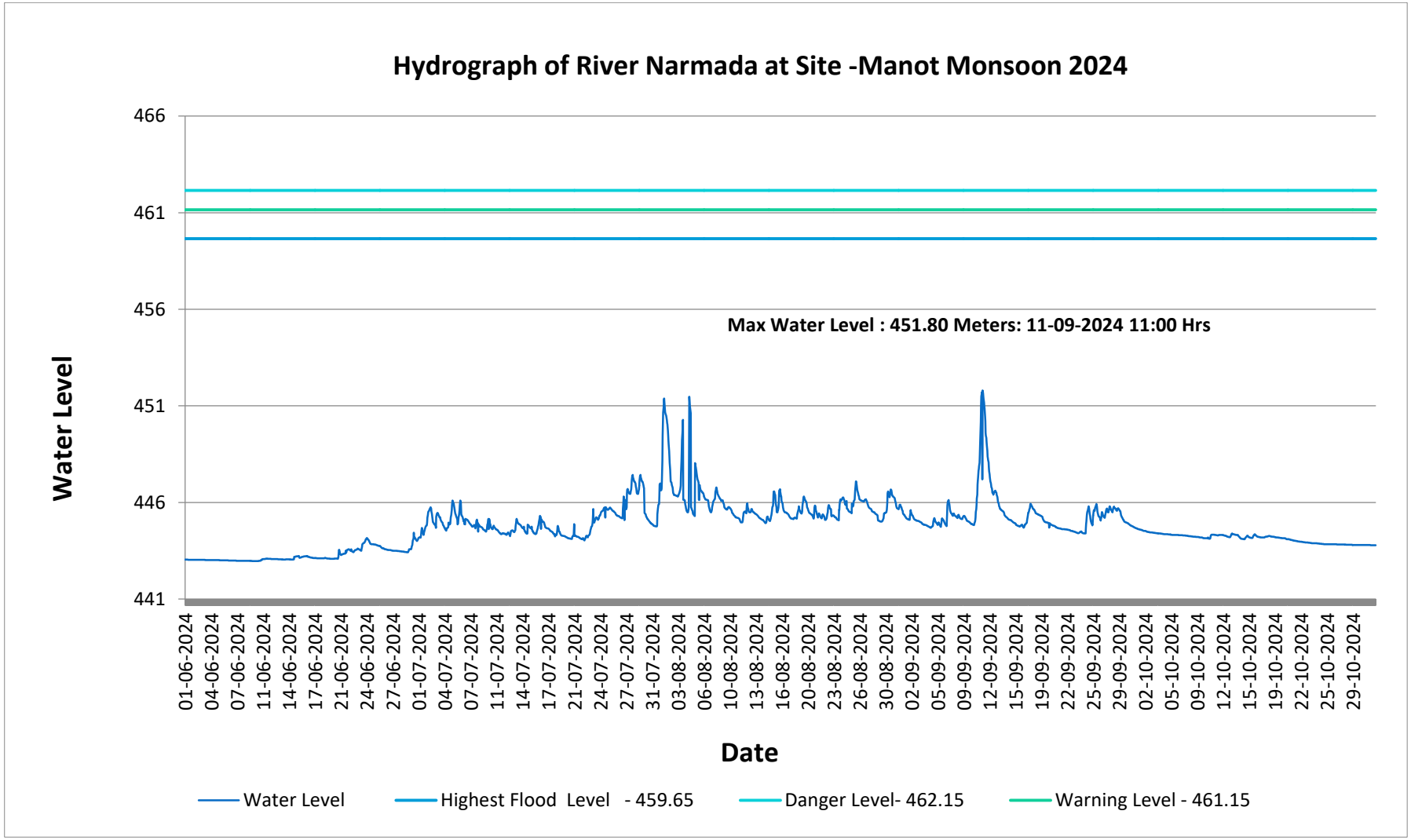


Figure- 8.2: Hydrograph of Site- Manot (Monsoon 2024)

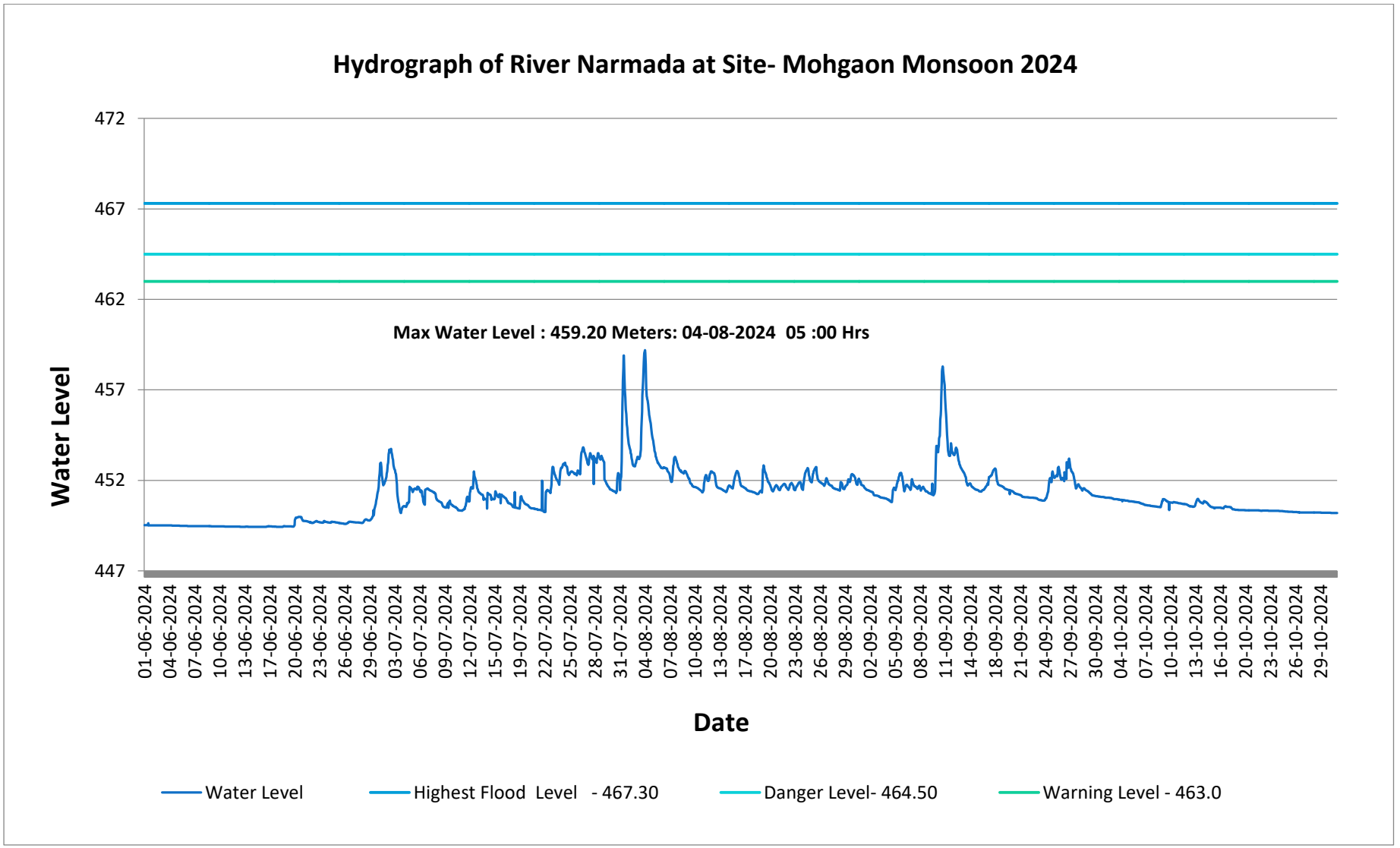


Figure- 8.3: Hydrograph of Site- Mohgaon (Monsoon 2024)

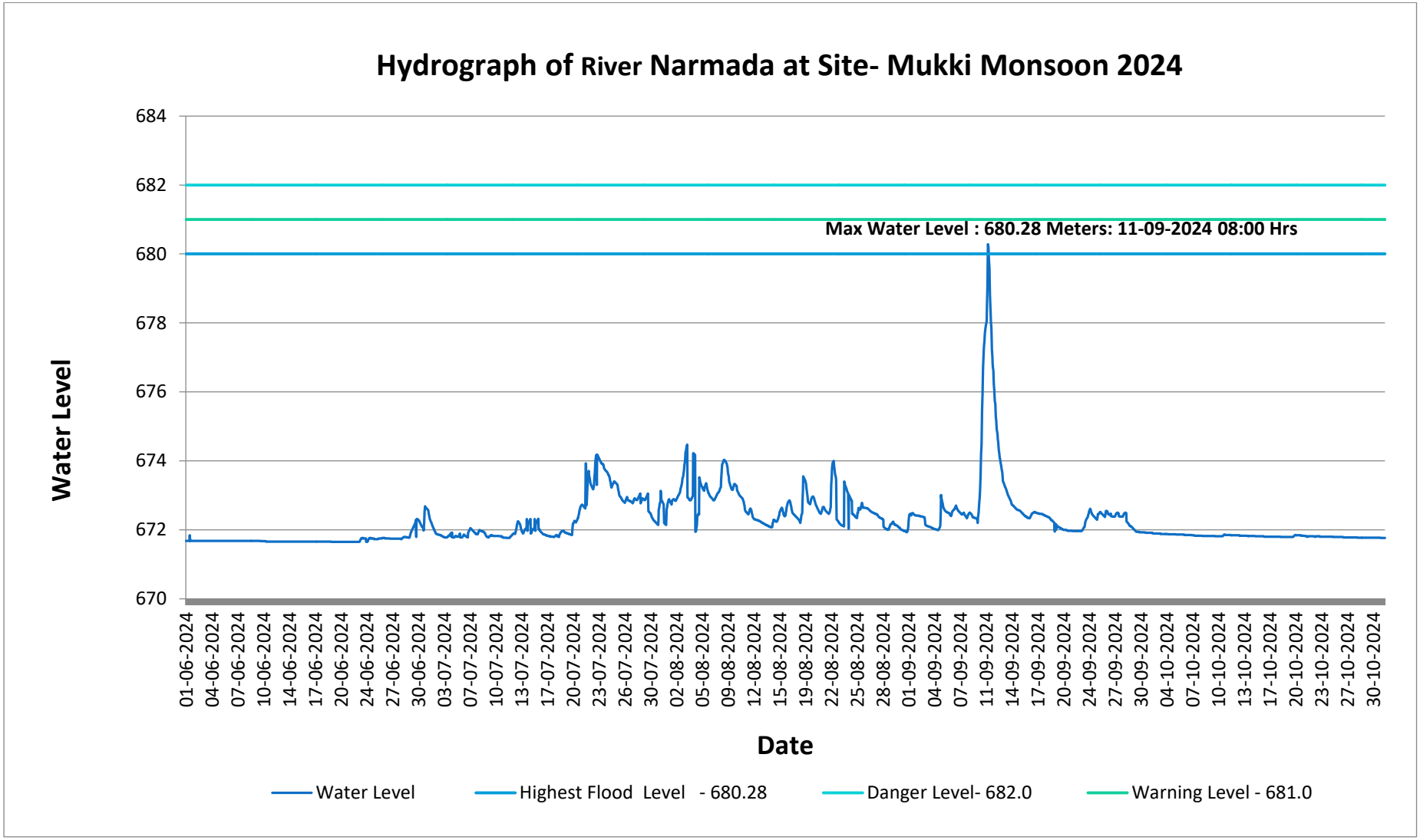


Figure- 8.4: Hydrograph of Site- Mukki (Monsoon 2024)

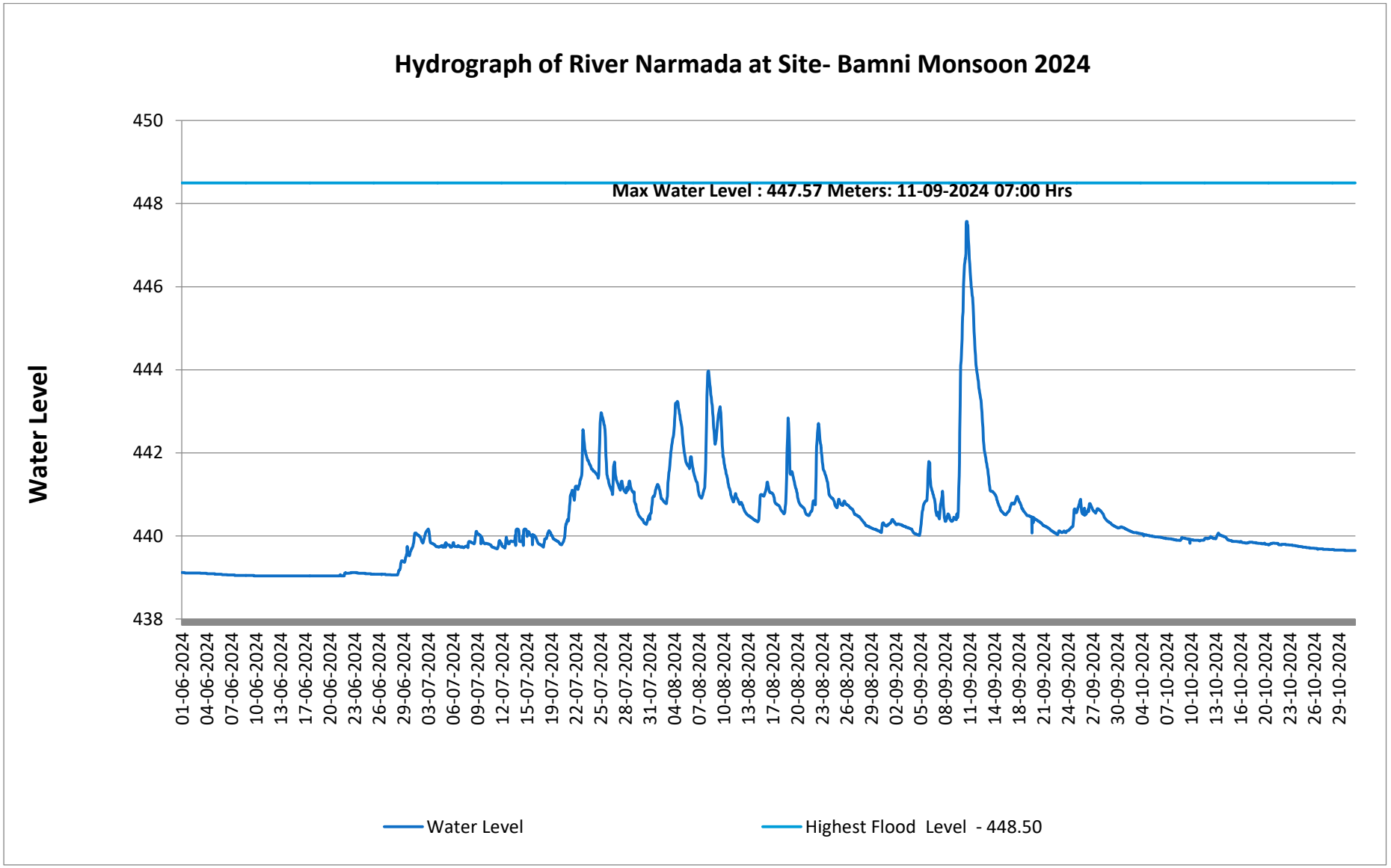


Figure- 8.5: Hydrograph of Site- Bamni Banjar (Monsoon 2024)

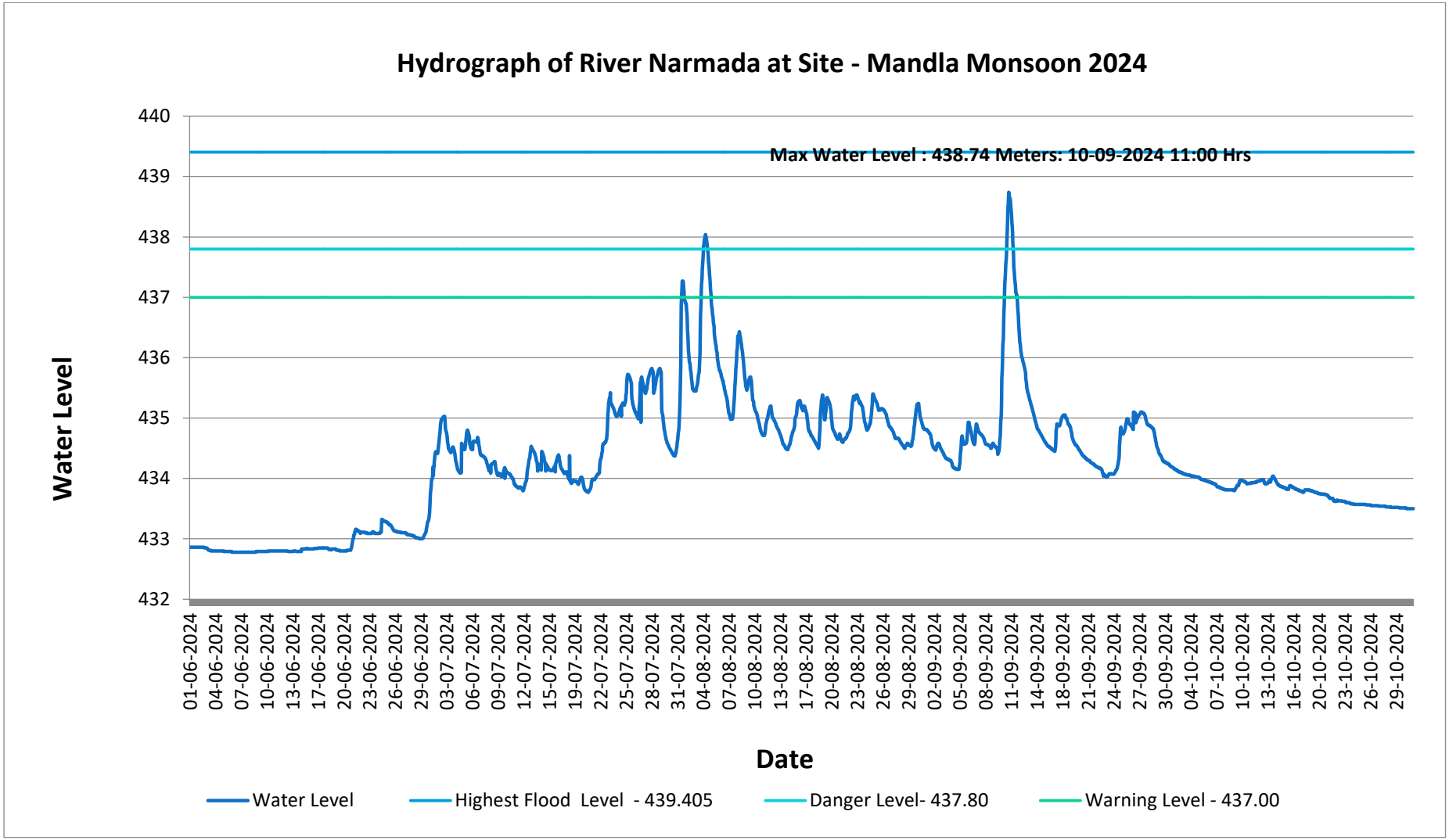


Figure- 8.6: Hydrograph of Site- Mandla (Monsoon 2024)

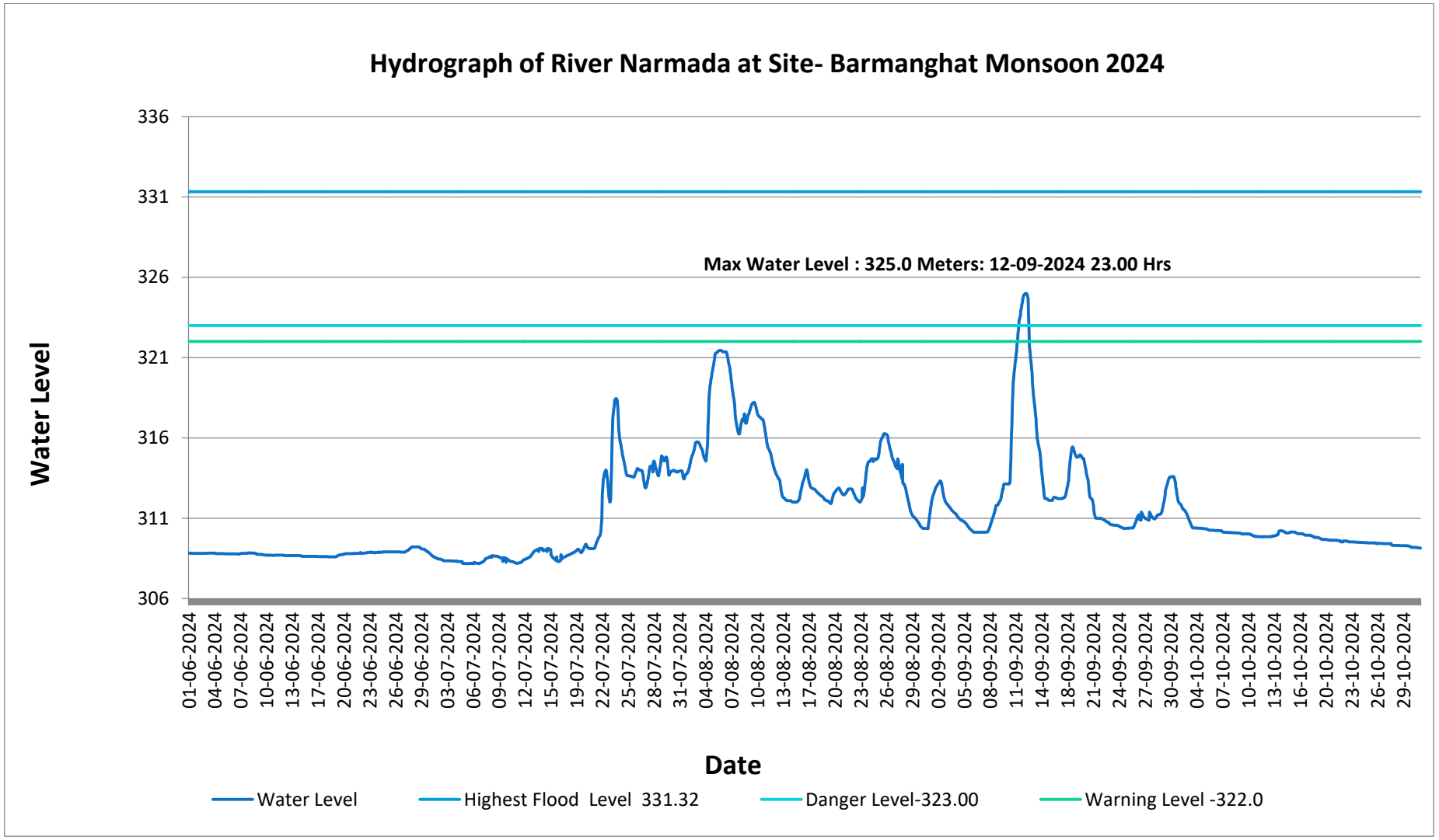


Figure- 8.7: Hydrograph of Site- Barmanghat (Monsoon 2024)

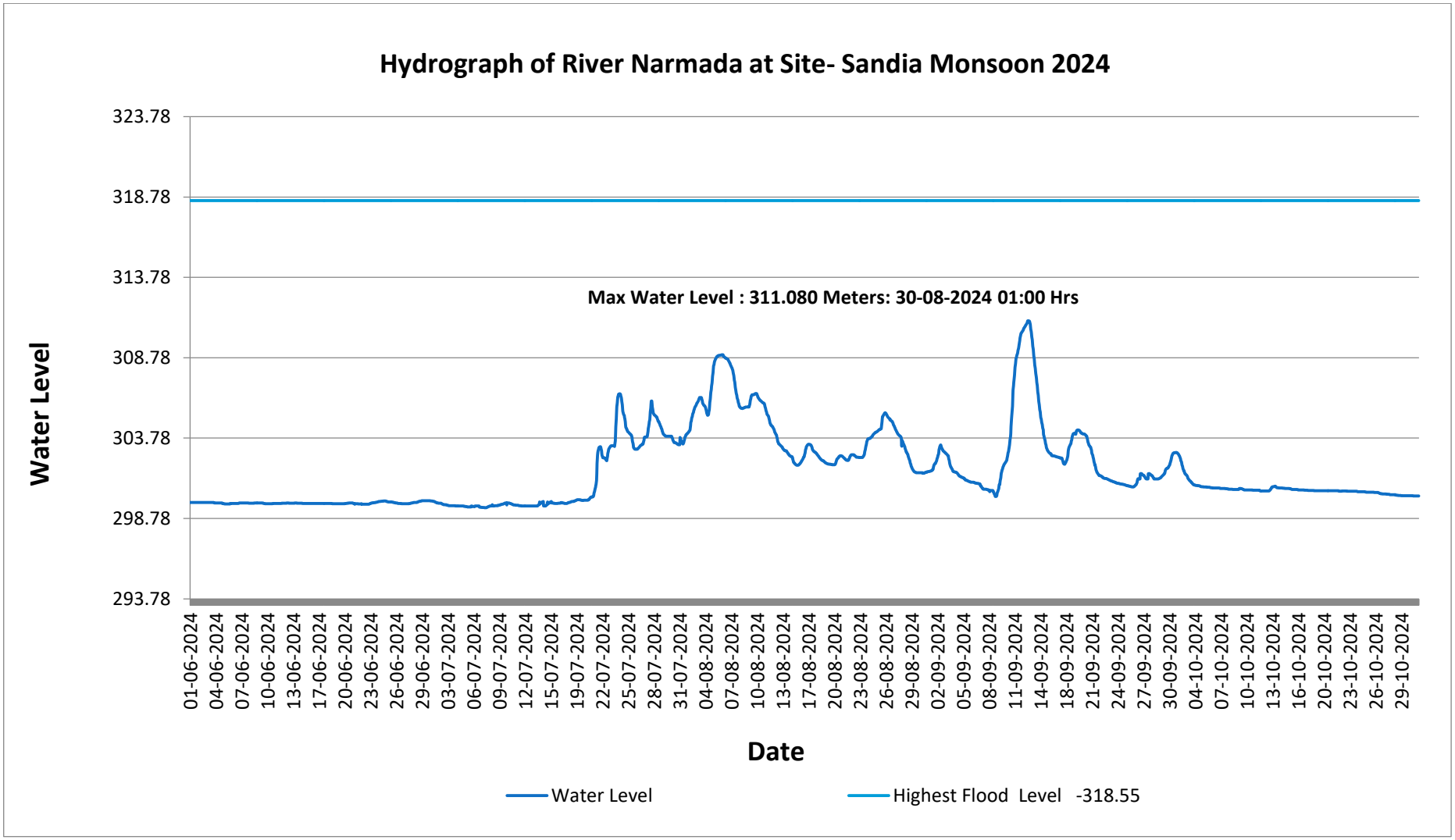


Figure- 8.8: Hydrograph of Site- Sandia (Monsoon 2024)

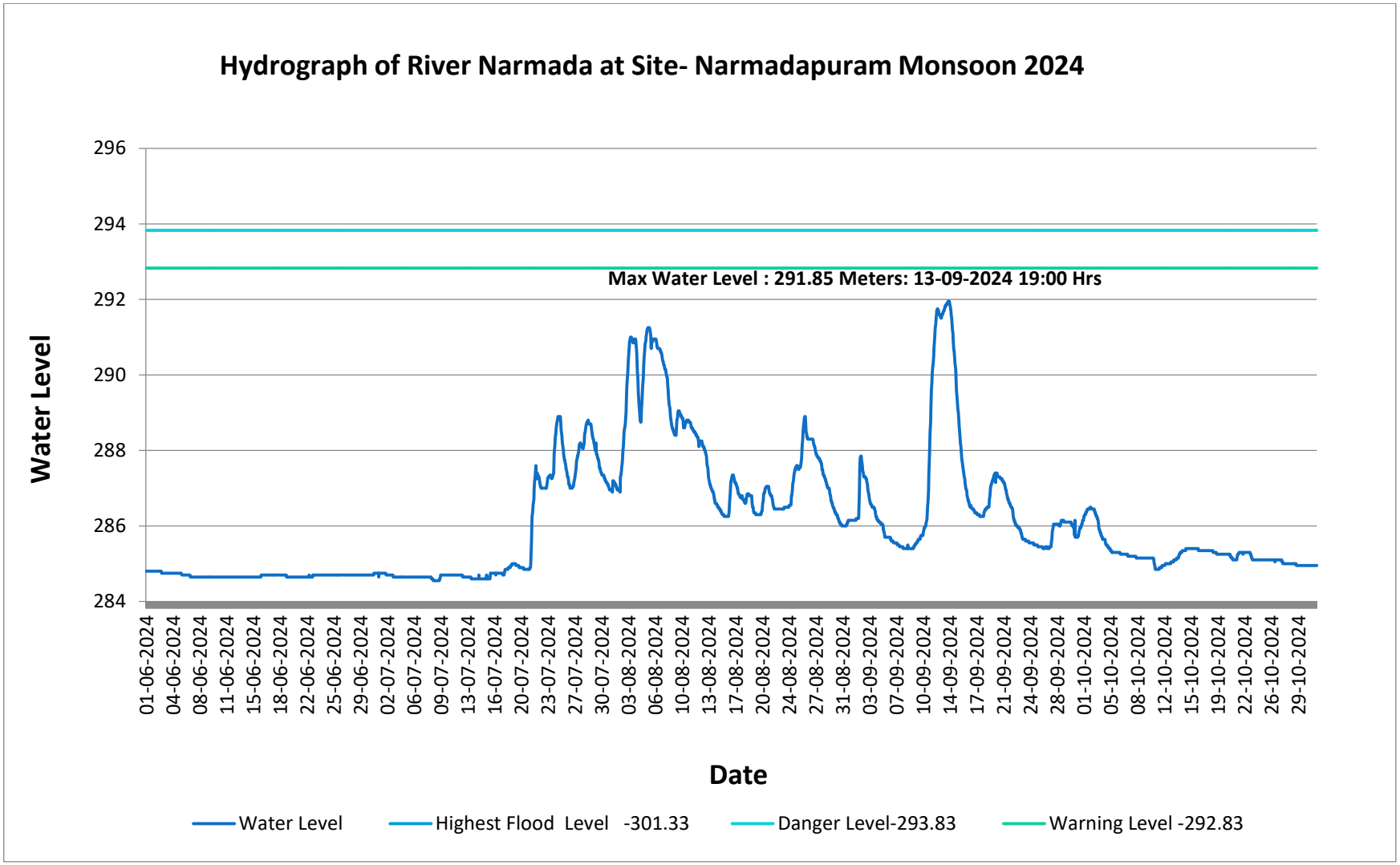


Figure- 8.9: Hydrograph of Site- Narmadapuram (Monsoon)

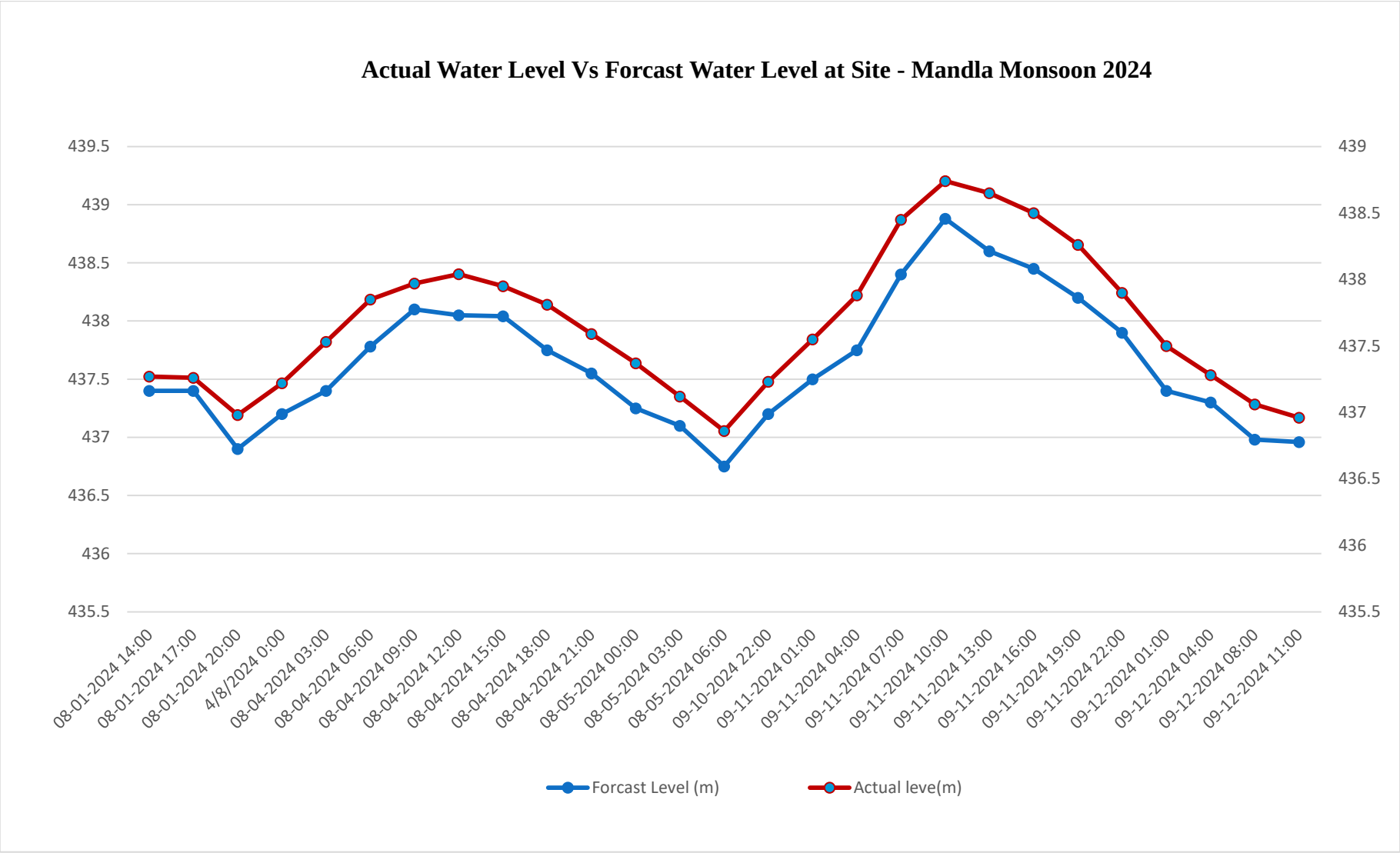


Figure- 8.10: Actual Water Level Vs Forecast Water Level at Site - Mandla

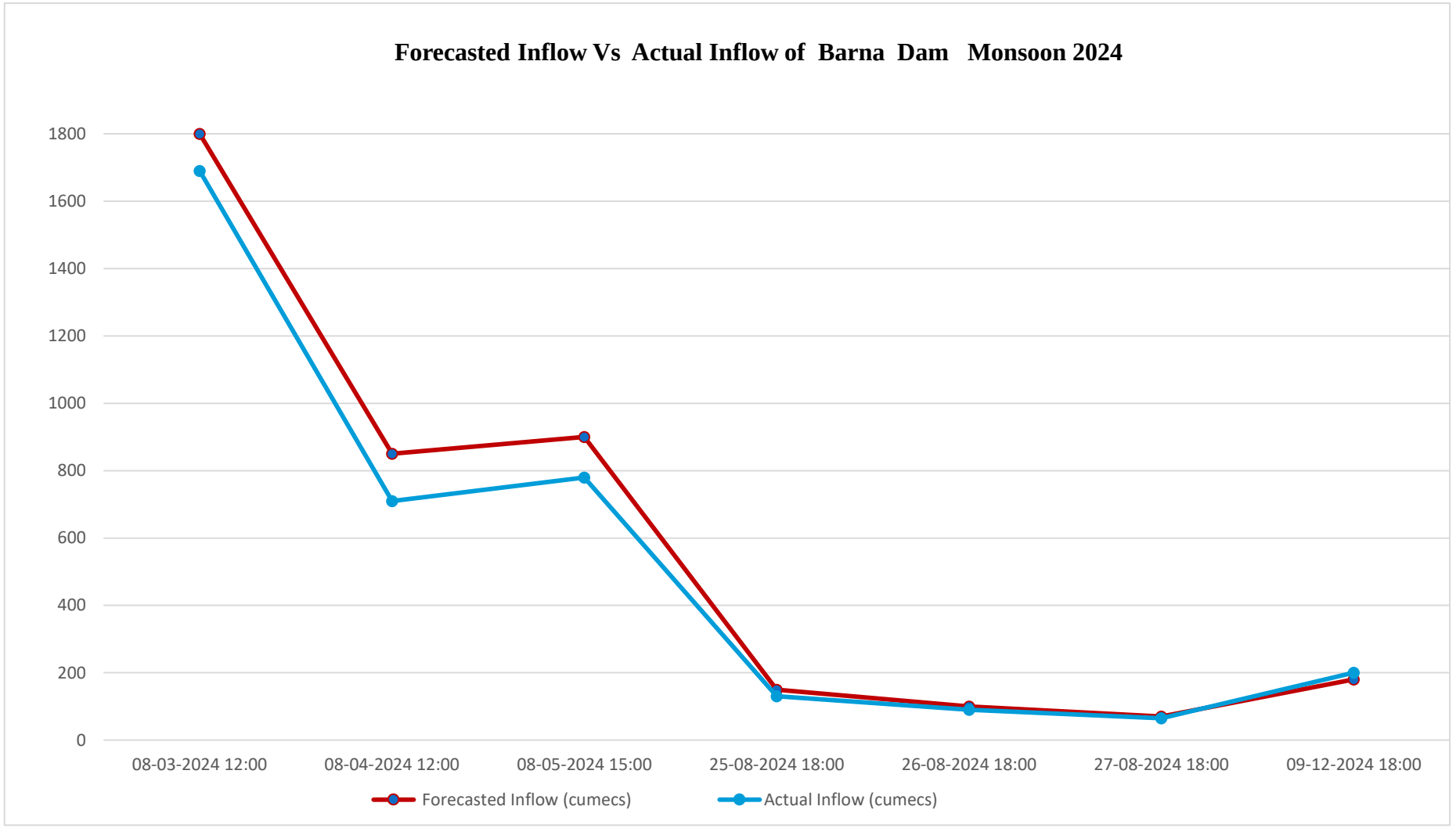


Figure- 8.11: Forecasted Inflow Vs Actual Inflow of Barna Dam Monsoon 2024

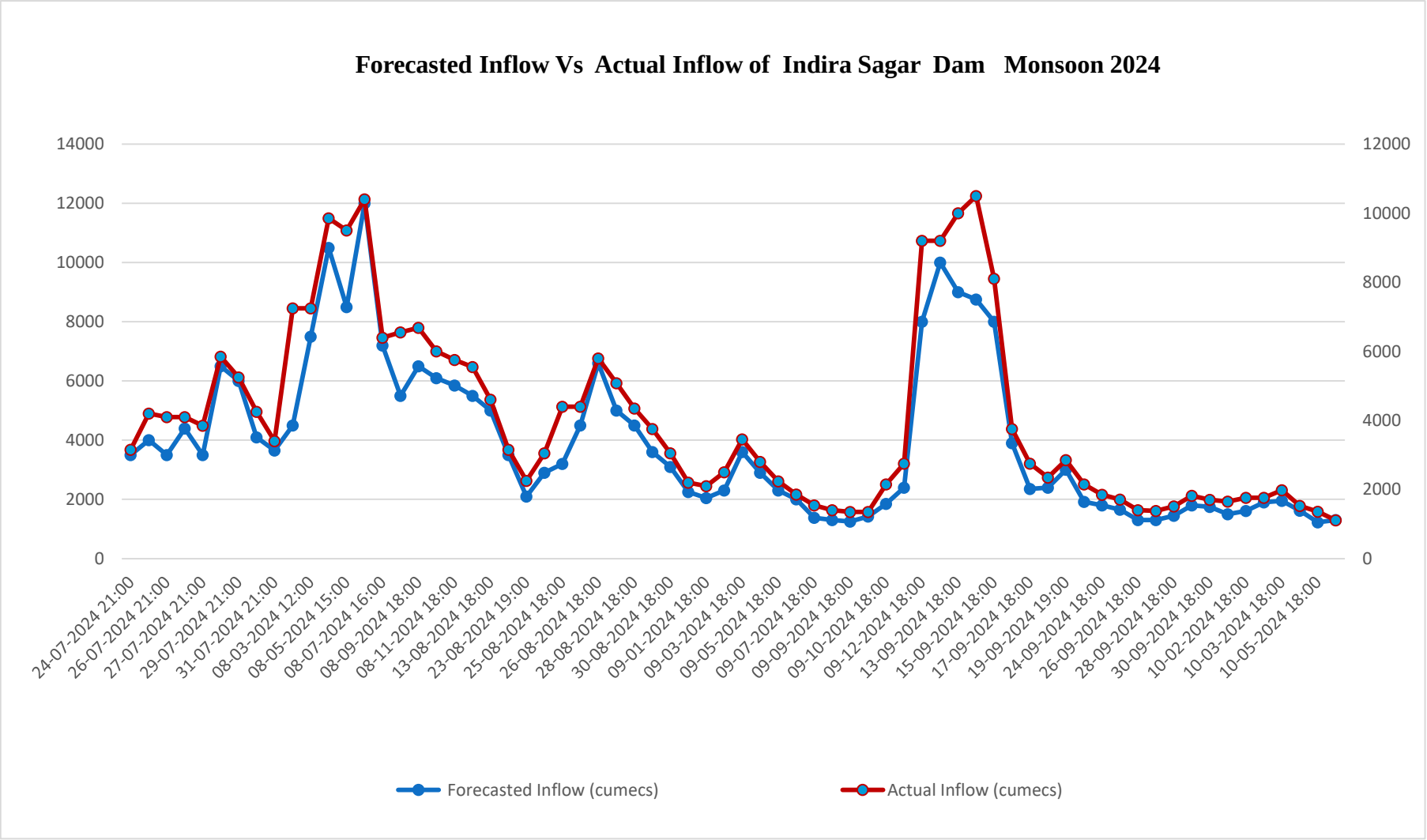


Figure- 8.12: Forecasted Inflow Vs Actual Inflow of Indira Sagar Dam Monsoon 2024

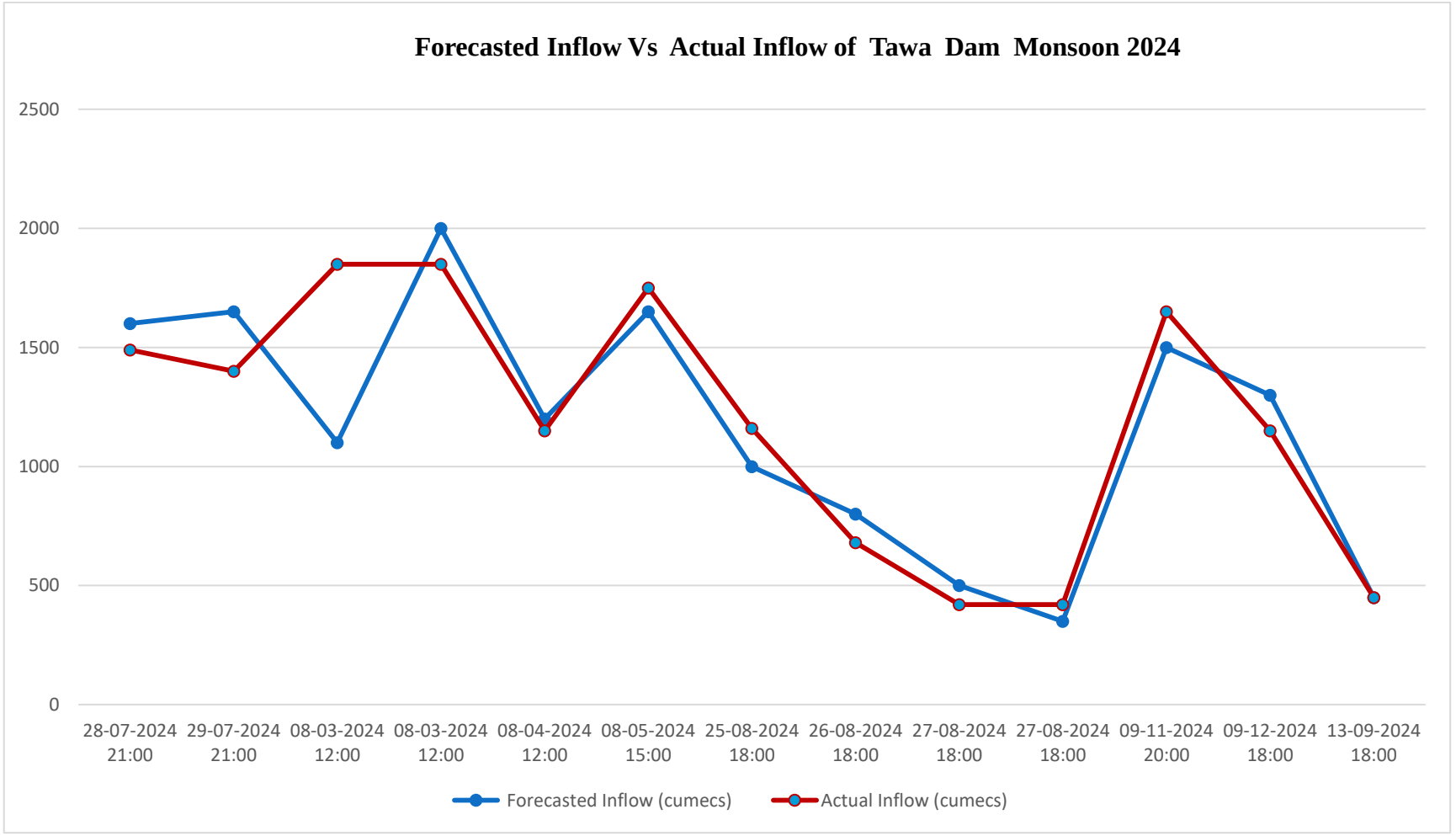


Figure- 8.13: Forecasted Inflow Vs Actual Inflow of Tawa Dam Monsoon 2024

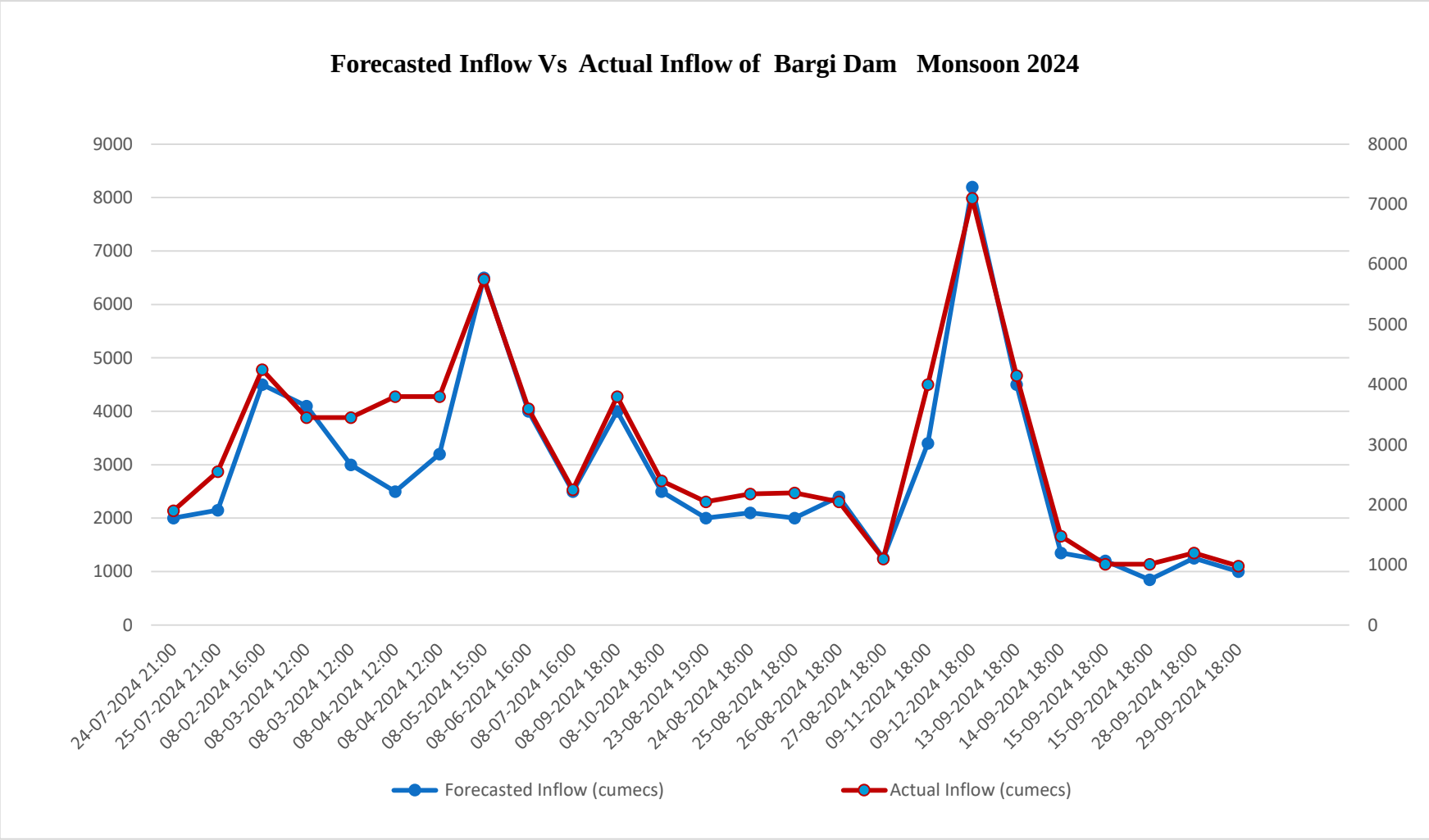


Figure- 8.14: Forecasted Inflow Vs Actual Inflow of Bargi Dam Monsoon 2024

CHAPTER-9

COMPARISON OF OBSERVED DATA WITH TELEMETRY DATA

Under the jurisdiction of the Narmada Division, Bhopal, a total of 13 telemetry stations have been installed at various pre-existing sites across different sub-divisions for the purpose of flood forecasting. During the first and second flood waves, the telemetry station at Mandla was non-operational, resulting in the absence of data for flood forecasting. However, during the third wave, gauge and rainfall data were successfully collected and used to generate effective level forecasts as well as to determine inflows for inflow forecasting activities.

The following table provides detailed information regarding the various telemetry stations under the Narmada Division, Bhopal, along with the types of data collected at each station.

Table 9.1 Details of Telemetry Stations - Narmada Division Bhopal

S. No.	Sub-Division	Name of Site	Station Identification Code	Type of Data Collected	Type of Telemetry	Type of Sensor	Distance of RTDAS from Station Gauge Line in Km.
1	UNSD, Jabalpur	Dindori	738F33BC	Gauge and Rainfall	Radar Type	AWLR & ARG	0.217
2		Mawai	738F5888	Rainfall		ARG	-
3		Mukki	739578A8	Gauge and Rainfall		AWLR & ARG	0.200
4		Mohgaon	738F452C	Gauge and Rainfall		AWLR & ARG	0.166
5		Manot	738F3D6E	Gauge and Rainfall		AWLR & ARG	0.220
6		Mandla	738F4BFE	Gauge and Rainfall		AWLR & ARG	0.600
7		Bargi Dam	7395767A	Gauge and Rainfall		AWLR & ARG	-
8		Patan	739586FE	Gauge and Rainfall		AWLR & ARG	0.315
9	MNSD-I, Narmadapuram	Barman	73959588	Gauge and Rainfall		AWLR & ARG	1.500
10		Sandia	7395882C	Gauge and Rainfall		AWLR & ARG	1.000
11		Pachmarhi	73959B5A	Rainfall		ARG	-
12		Narmadapuram	738F565A	Gauge and Rainfall		AWLR & ARG	5.000
13		Tawa Dam	7395A012	Gauge and Rainfall		AWLR & ARG	-

Based on the type of sensor installed at telemetry locations, during monsoon period 2024 hourly water level and 3-hourly rainfall were collected. The collected hourly water level data of all sites has been compared with actual observed data and used for flood forecasting activities of Narmada Division, Bhopal. The graphical comparison of water level data is as follows:

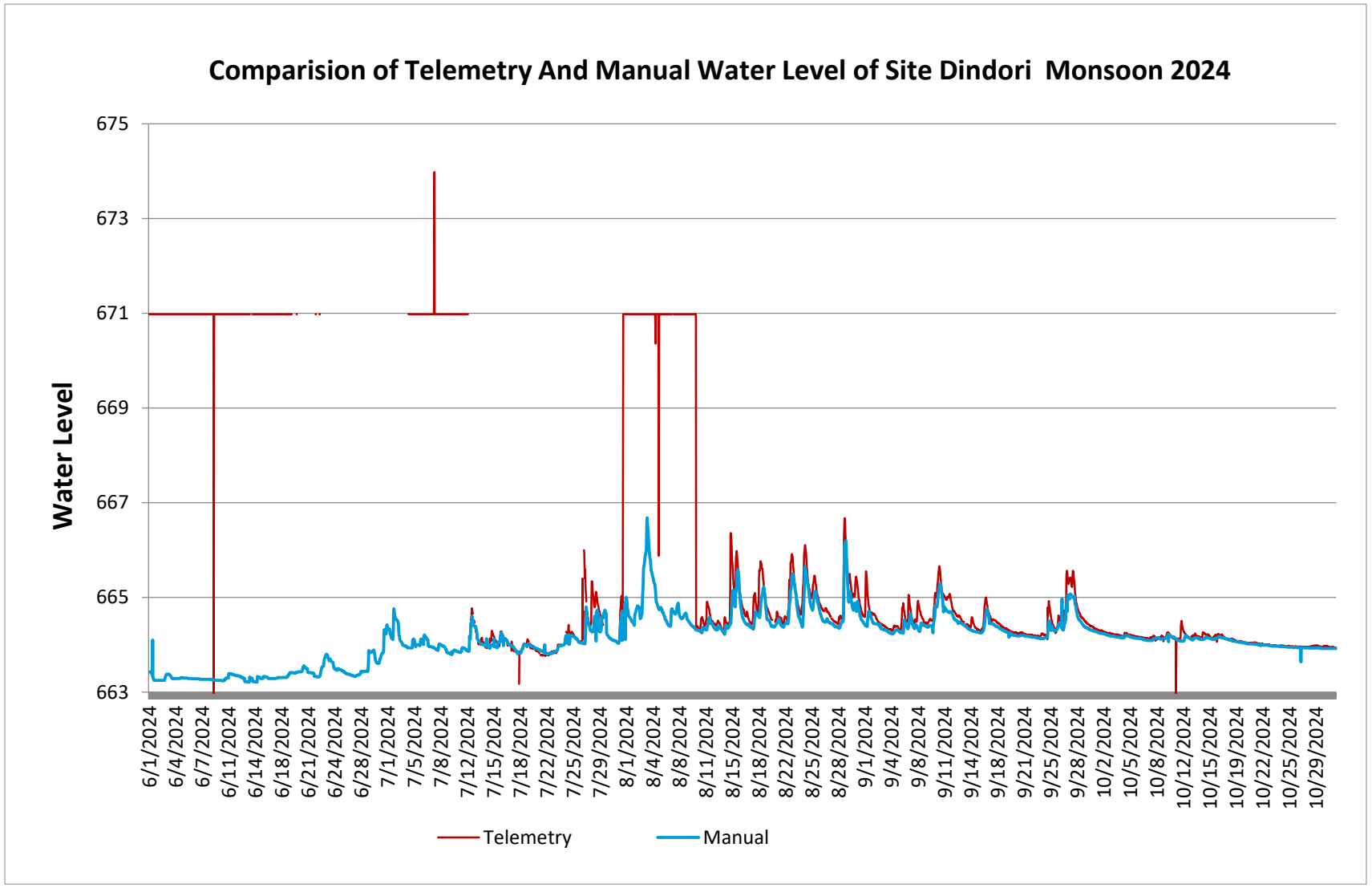

Comparision of Telemetry And Manual Water Level of Site Dindori Monsoon 2024
Water Level
675
673
671
669
667
665
663
6/1/2024
6/4/2024
6/7/2024
6/11/2024
6/14/2024
6/18/2024
6/21/2024
6/24/2024
6/28/2024
7/1/2024
7/5/2024
7/8/2024
7/12/2024
7/15/2024
7/18/2024
7/22/2024
7/25/2024
7/29/2024
8/1/2024
8/4/2024
8/8/2024
8/11/2024
8/15/2024
8/18/2024
8/22/2024
8/25/2024
8/28/2024
9/1/2024
9/4/2024
9/8/2024
9/11/2024
9/14/2024
9/18/2024
9/21/2024
9/25/2024
9/28/2024
10/2/2024
10/5/2024
10/8/2024
10/12/2024
10/15/2024
10/19/2024
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.1

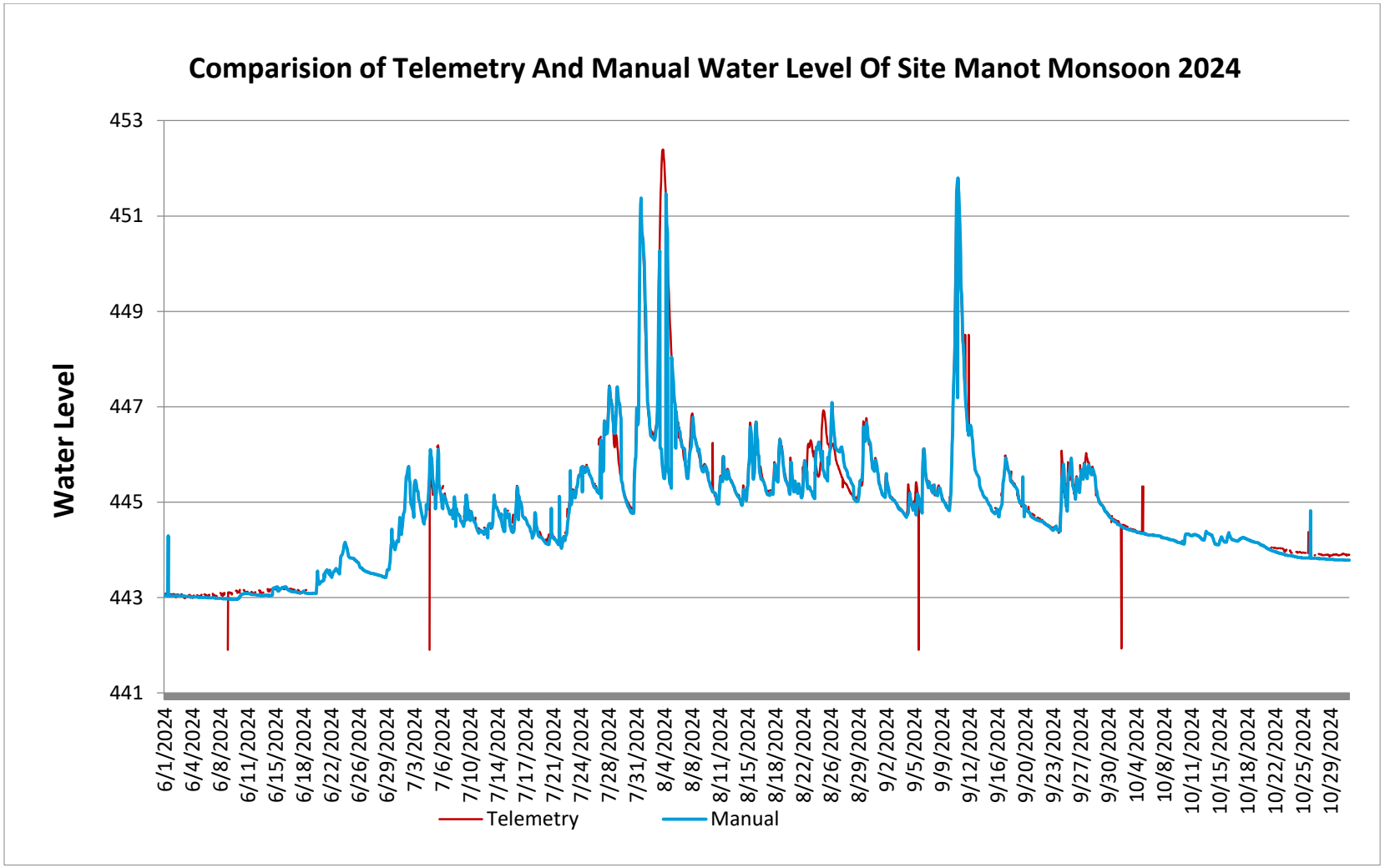

Comparision of Telemetry And Manual Water Level Of Site Manot Monsoon 2024
Water Level
453
451
449
447
445
443
441
6/1/2024
6/4/2024
6/8/2024
6/11/2024
6/15/2024
6/18/2024
6/22/2024
6/26/2024
6/29/2024
7/3/2024
7/6/2024
7/10/2024
7/14/2024
7/17/2024
7/21/2024
7/24/2024
7/28/2024
7/31/2024
8/4/2024
8/8/2024
8/11/2024
8/15/2024
8/18/2024
8/22/2024
8/26/2024
8/29/2024
9/2/2024
9/5/2024
9/9/2024
9/12/2024
9/16/2024
9/20/2024
9/23/2024
9/27/2024
9/30/2024
10/4/2024
10/8/2024
10/11/2024
10/15/2024
10/18/2024
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.2

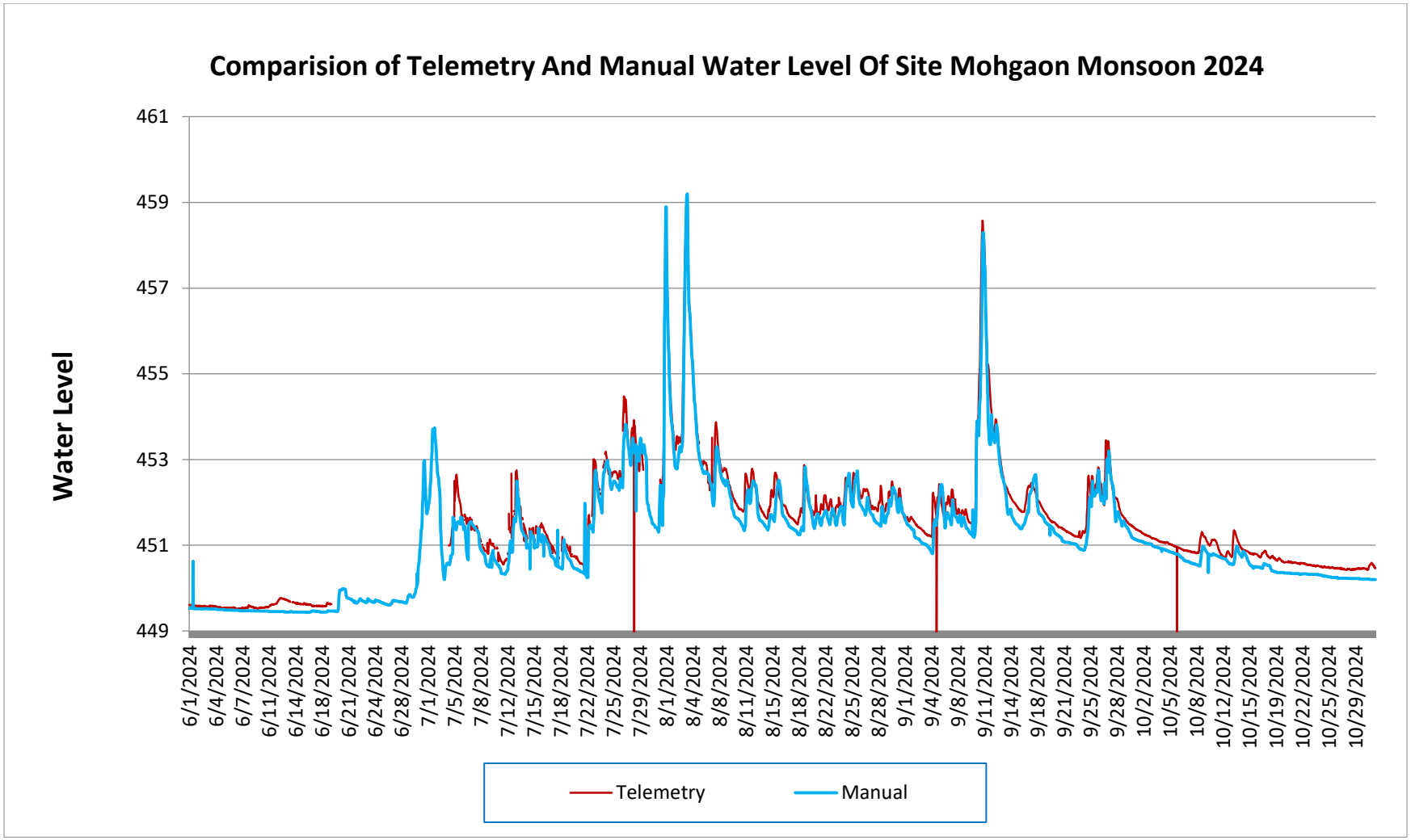

Comparision of Telemetry And Manual Water Level Of Site Mohgaon Monsoon 2024
Water Level
461
459
457
455
453
451
449
6/1/2024
6/4/2024
6/7/2024
6/11/2024
6/14/2024
6/18/2024
6/21/2024
6/24/2024
6/28/2024
7/1/2024
7/5/2024
7/8/2024
7/12/2024
7/15/2024
7/18/2024
7/22/2024
7/25/2024
7/29/2024
8/1/2024
8/4/2024
8/8/2024
8/11/2024
8/15/2024
8/18/2024
8/22/2024
8/25/2024
8/28/2024
9/1/2024
9/4/2024
9/8/2024
9/11/2024
9/14/2024
9/18/2024
9/21/2024
9/25/2024
9/28/2024
10/2/2024
10/5/2024
10/8/2024
10/12/2024
10/15/2024
10/19/2024
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.3

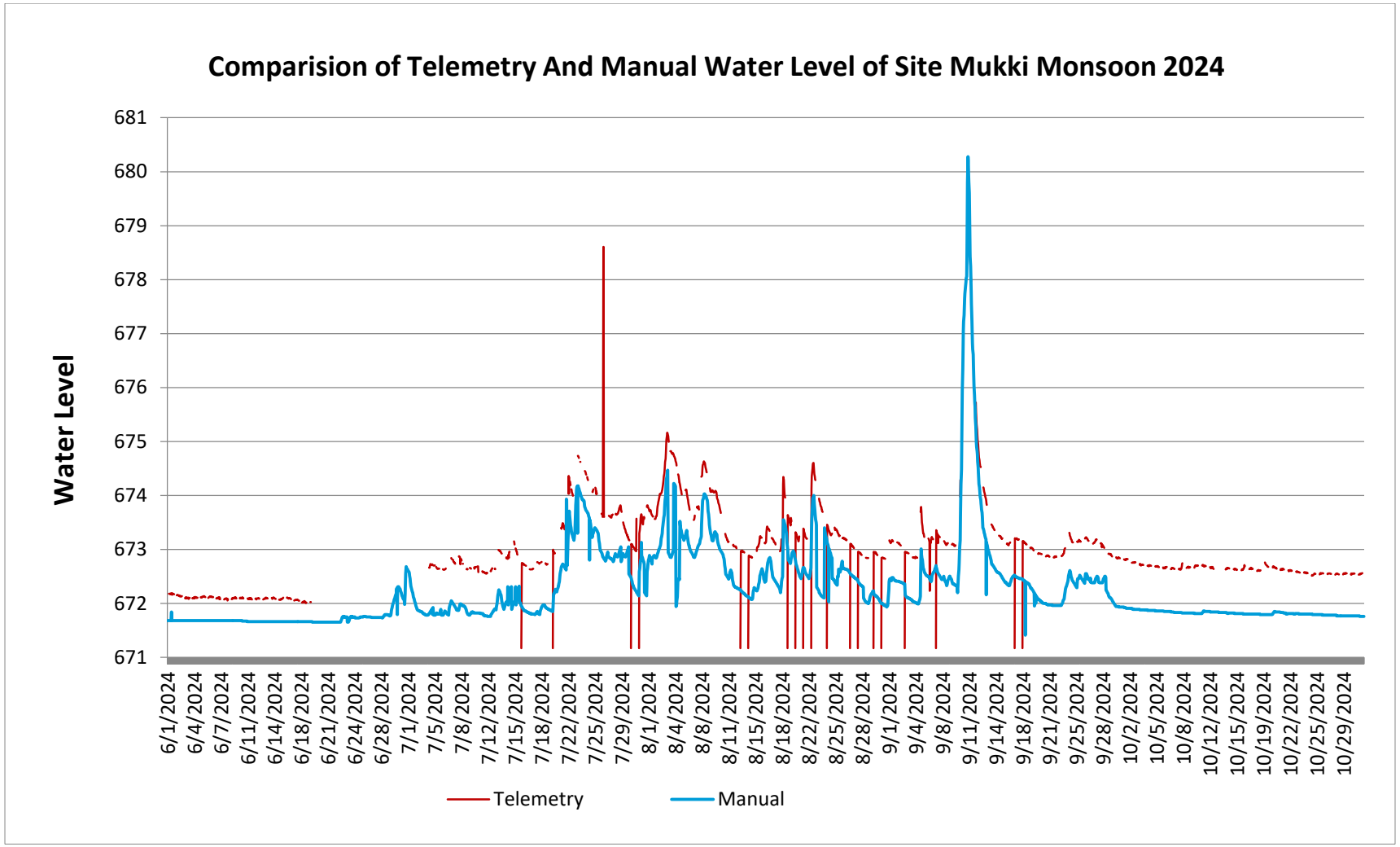

Comparision of Telemetry And Manual Water Level of Site Mukki Monsoon 2024
Water Level
681
680
679
678
677
676
675
674
673
672
671
6/1/2024
6/4/2024
6/7/2024
6/11/2024
6/14/2024
6/18/2024
6/21/2024
6/24/2024
6/28/2024
7/1/2024
7/5/2024
7/8/2024
7/12/2024
7/15/2024
7/18/2024
7/22/2024
7/25/2024
7/29/2024
8/1/2024
8/4/2024
8/8/2024
8/11/2024
8/15/2024
8/18/2024
8/22/2024
8/25/2024
8/28/2024
9/1/2024
9/4/2024
9/8/2024
9/11/2024
9/14/2024
9/18/2024
9/21/2024
9/25/2024
9/28/2024
10/2/2024
10/5/2024
10/8/2024
10/12/2024
10/15/2024
10/19/2024
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.4

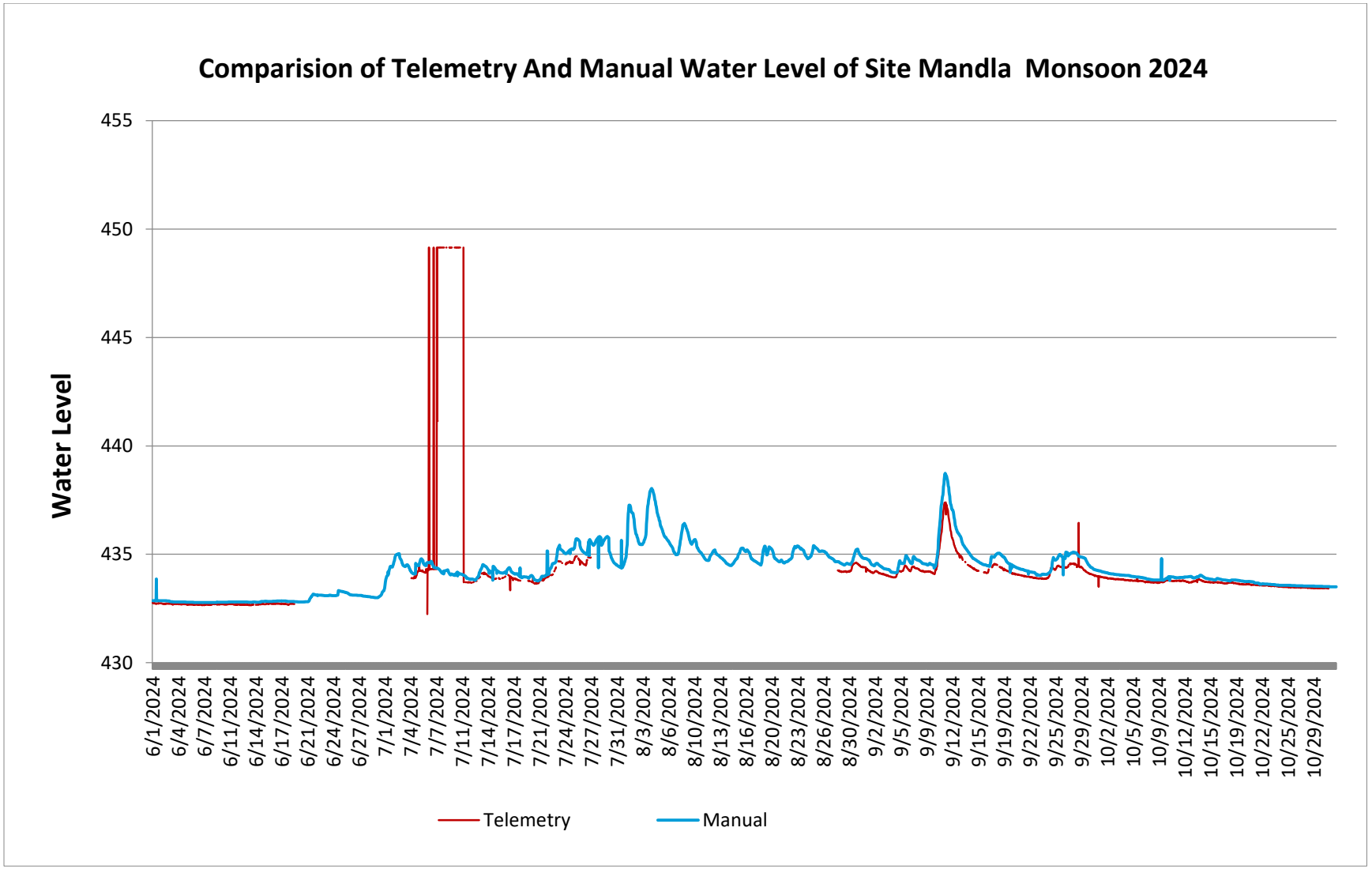

Comparision of Telemetry And Manual Water Level of Site Mandla Monsoon 2024
Water Level
455
450
445
440
435
430
6/1/2024
6/4/2024
6/7/2024
6/11/2024
6/14/2024
6/17/2024
6/21/2024
6/24/2024
6/27/2024
7/1/2024
7/4/2024
7/7/2024
7/11/2024
7/14/2024
7/17/2024
7/21/2024
7/24/2024
7/27/2024
7/31/2024
8/3/2024
8/6/2024
8/10/2024
8/13/2024
8/16/2024
8/20/2024
8/23/2024
8/26/2024
8/30/2024
9/2/2024
9/5/2024
9/9/2024
9/12/2024
9/15/2024
9/19/2024
9/22/2024
9/25/2024
9/29/2024
10/2/2024
10/5/2024
10/9/2024
10/12/2024
10/15/2024
10/19/2024
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.5

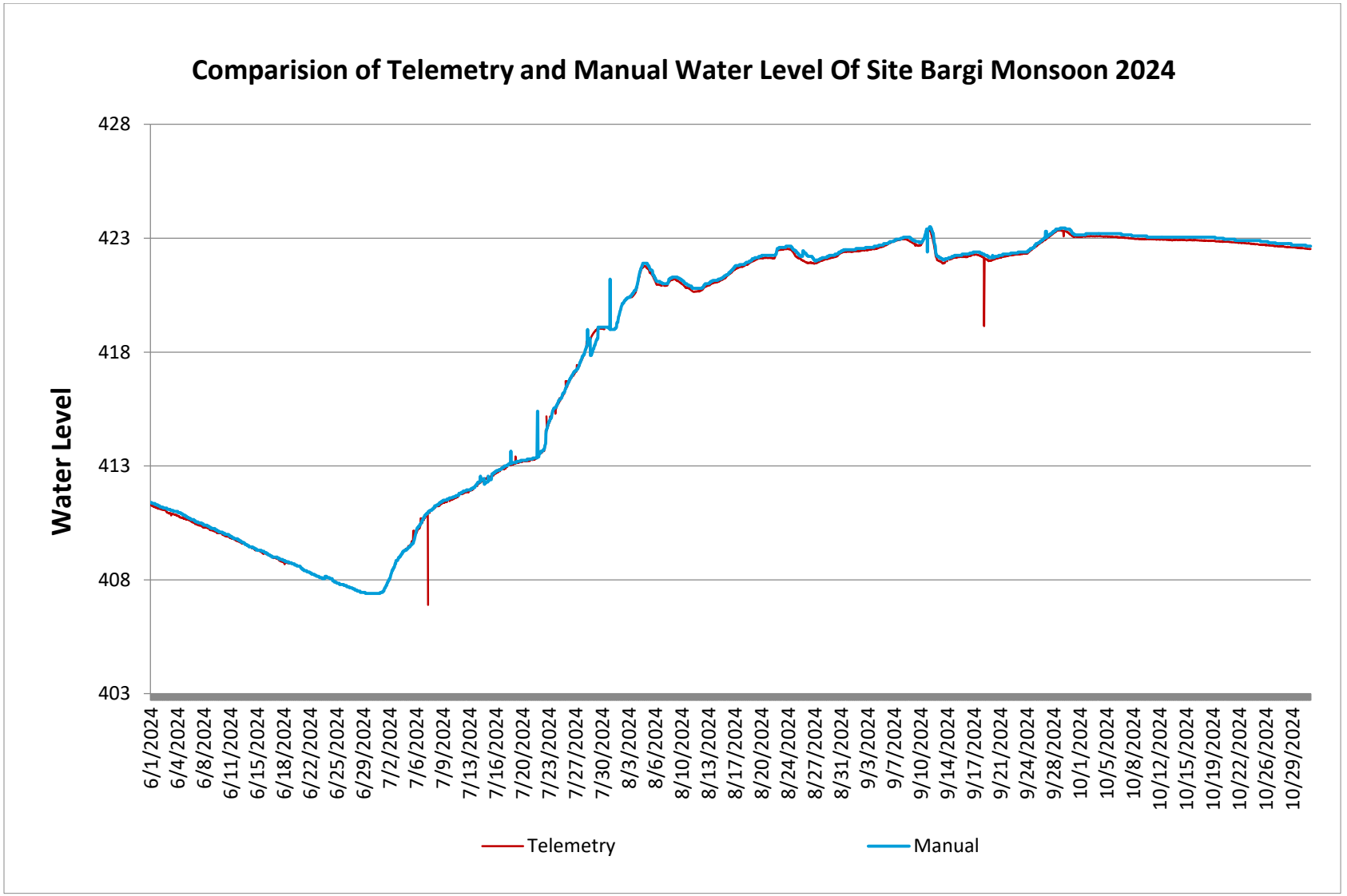

Comparision of Telemetry and Manual Water Level Of Site Bargi Monsoon 2024
Water Level
428
423
418
413
408
403
6/1/2024
6/4/2024
6/8/2024
6/11/2024
6/15/2024
6/18/2024
6/22/2024
6/25/2024
6/29/2024
7/2/2024
7/6/2024
7/9/2024
7/13/2024
7/16/2024
7/20/2024
7/23/2024
7/27/2024
7/30/2024
8/3/2024
8/6/2024
8/10/2024
8/13/2024
8/17/2024
8/20/2024
8/24/2024
8/27/2024
8/31/2024
9/3/2024
9/7/2024
9/10/2024
9/14/2024
9/17/2024
9/21/2024
9/24/2024
9/28/2024
10/1/2024
10/5/2024
10/8/2024
10/12/2024
10/15/2024
10/19/2024
10/22/2024
10/26/2024
10/29/2024
Telemetry
Manual

Figure- 9.6

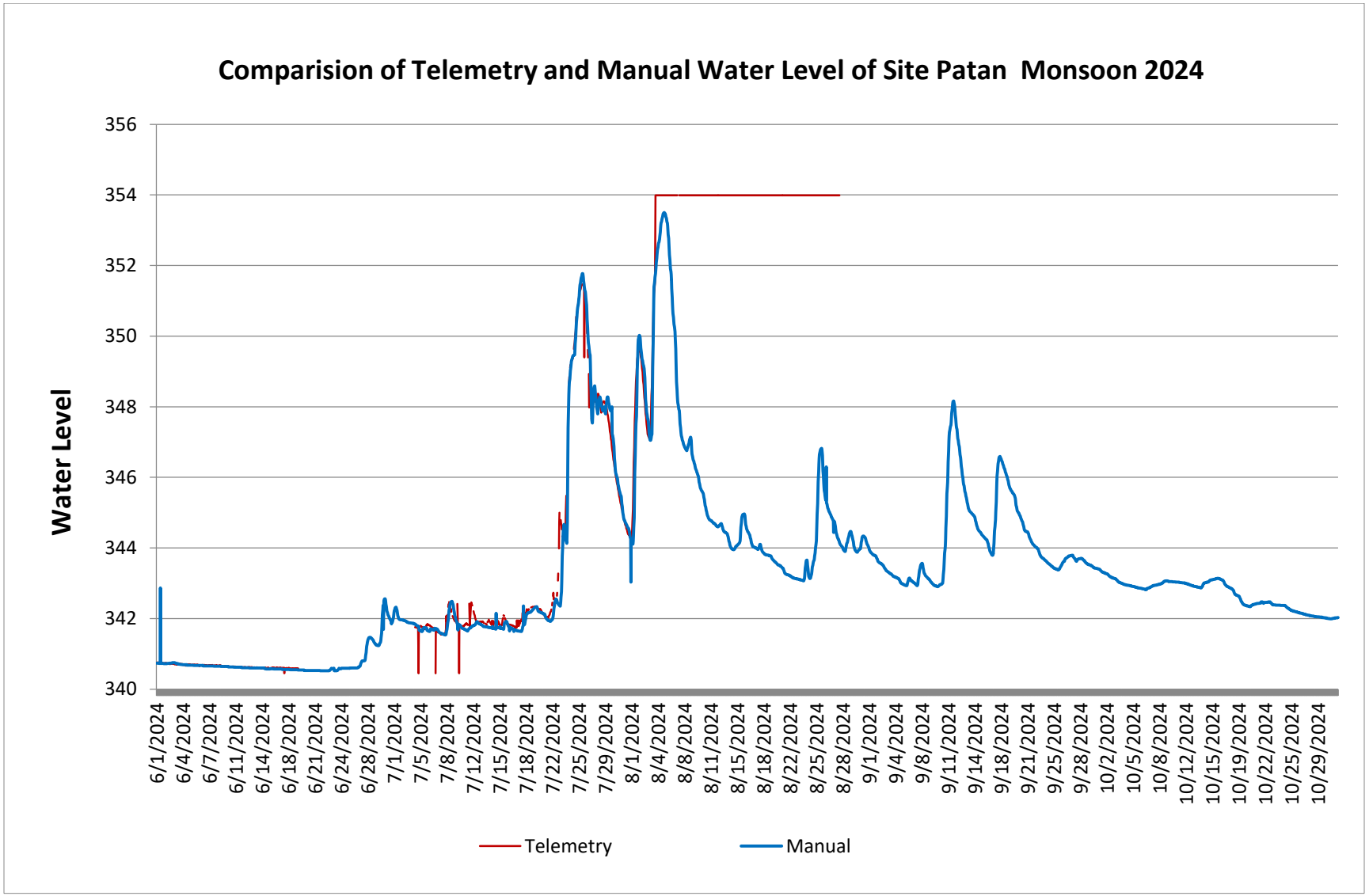

Comparision of Telemetry and Manual Water Level of Site Patan Monsoon 2024
Water Level
356
354
352
350
348
346
344
342
340
6/1/2024
6/4/2024
6/7/2024
6/11/2024
6/14/2024
6/18/2024
6/21/2024
6/24/2024
6/28/2024
7/1/2024
7/5/2024
7/8/2024
7/12/2024
7/15/2024
7/18/2024
7/22/2024
7/25/2024
7/29/2024
8/1/2024
8/4/2024
8/8/2024
8/11/2024
8/15/2024
8/18/2024
8/22/2024
8/25/2024
8/28/2024
9/1/2024
9/4/2024
9/8/2024
9/11/2024
9/14/2024
9/18/2024
9/21/2024
9/25/2024
9/28/2024
10/2/2024
10/5/2024
10/8/2024
10/12/2024
10/15/2024
10/19/2024
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.7

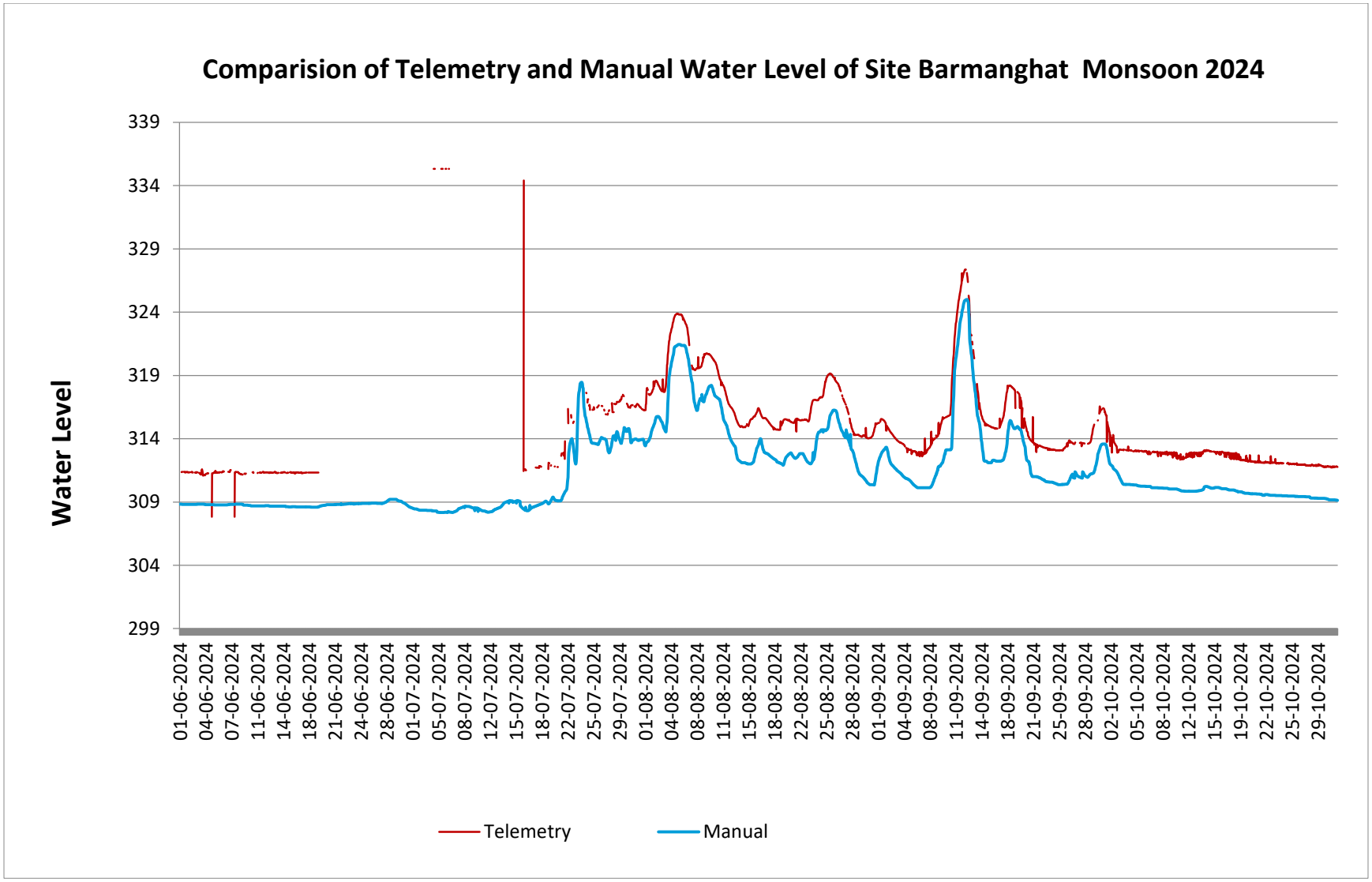
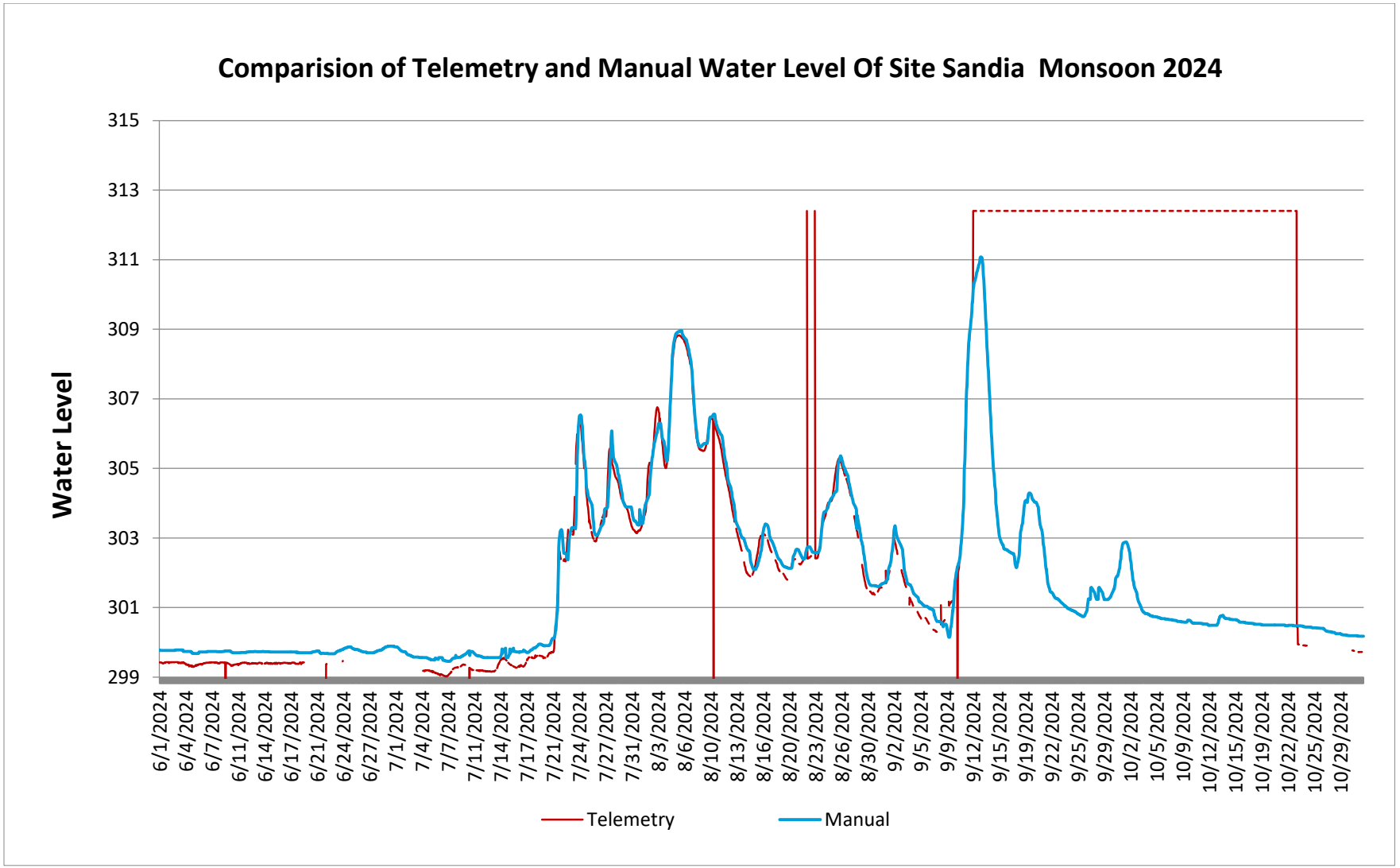

Comparision of Telemetry and Manual Water Level of Site Barmanghat Monsoon 2024
Water Level
339
334
329
324
319
314
309
304
299
01-06-2024
04-06-2024
07-06-2024
11-06-2024
14-06-2024
18-06-2024
21-06-2024
24-06-2024
28-06-2024
01-07-2024
05-07-2024
08-07-2024
12-07-2024
15-07-2024
18-07-2024
22-07-2024
25-07-2024
29-07-2024
01-08-2024
04-08-2024
08-08-2024
11-08-2024
15-08-2024
18-08-2024
22-08-2024
25-08-2024
28-08-2024
01-09-2024
04-09-2024
08-09-2024
11-09-2024
14-09-2024
18-09-2024
21-09-2024
25-09-2024
28-09-2024
02-10-2024
05-10-2024
08-10-2024
12-10-2024
15-10-2024
19-10-2024
22-10-2024
25-10-2024
29-10-2024
Telemetry
Manual

Figure- 9.8


Comparision of Telemetry and Manual Water Level Of Site Sandia Monsoon 2024
Water Level
315
313
311
309
307
305
303
301
299
6/1/2024
6/4/2024
6/7/2024
6/11/2024
6/14/2024
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6/21/2024
6/24/2024
6/27/2024
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7/11/2024
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7/17/2024
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7/24/2024
7/27/2024
7/31/2024
8/3/2024
8/6/2024
8/10/2024
8/13/2024
8/16/2024
8/20/2024
8/23/2024
8/26/2024
8/30/2024
9/2/2024
9/5/2024
9/9/2024
9/12/2024
9/15/2024
9/19/2024
9/22/2024
9/25/2024
9/29/2024
10/2/2024
10/5/2024
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10/12/2024
10/15/2024
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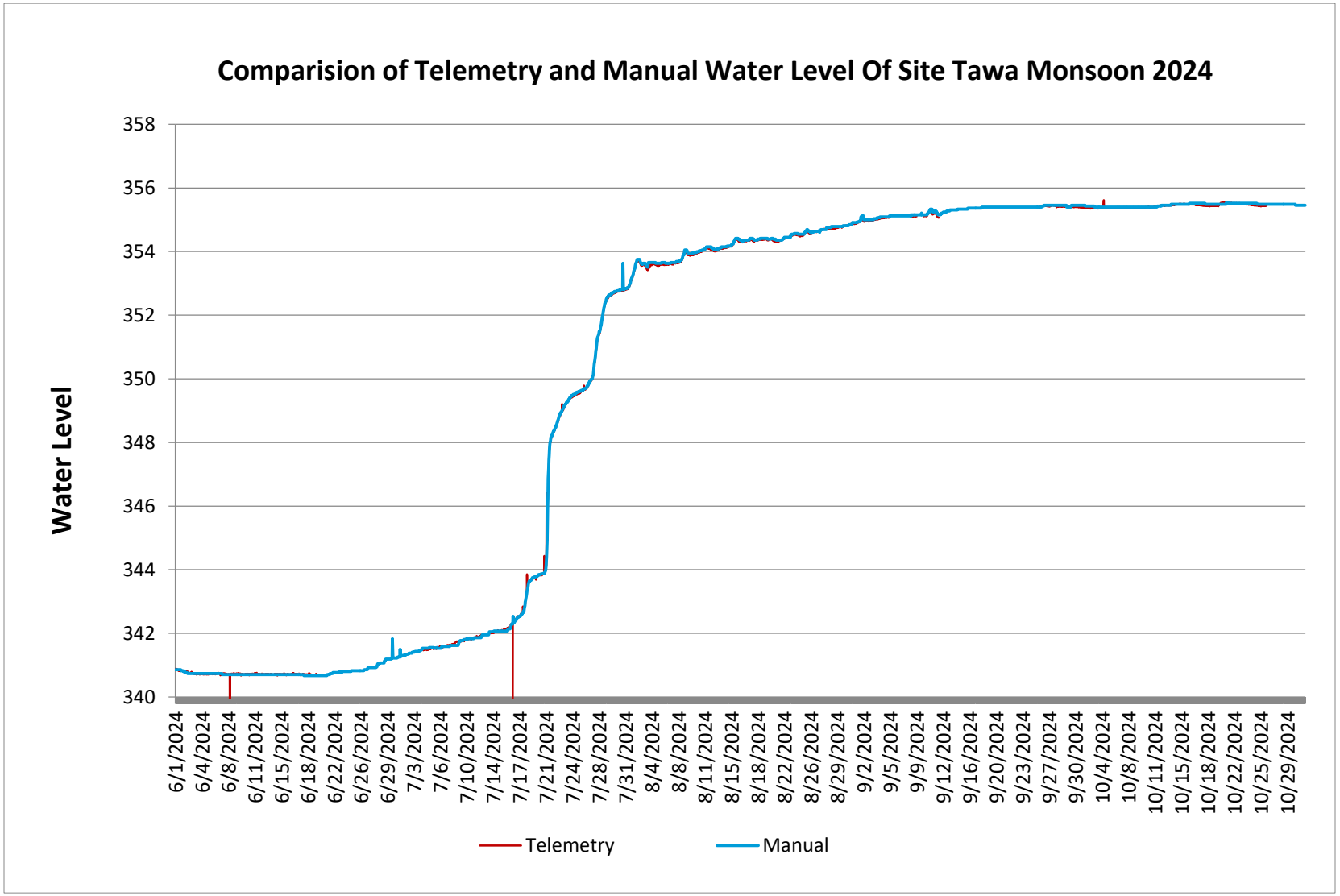
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.9


Comparision of Telemetry and Manual Water Level Of Site Tawa Monsoon 2024
Water Level
358
356
354
352
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348
346
344
342
340
6/1/2024
6/4/2024
6/8/2024
6/11/2024
6/15/2024
6/18/2024
6/22/2024
6/26/2024
6/29/2024
7/3/2024
7/6/2024
7/10/2024
7/14/2024
7/17/2024
7/21/2024
7/24/2024
7/28/2024
7/31/2024
8/4/2024
8/8/2024
8/11/2024
8/15/2024
8/18/2024
8/22/2024
8/26/2024
8/29/2024
9/2/2024
9/5/2024
9/9/2024
9/12/2024
9/16/2024
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10/11/2024
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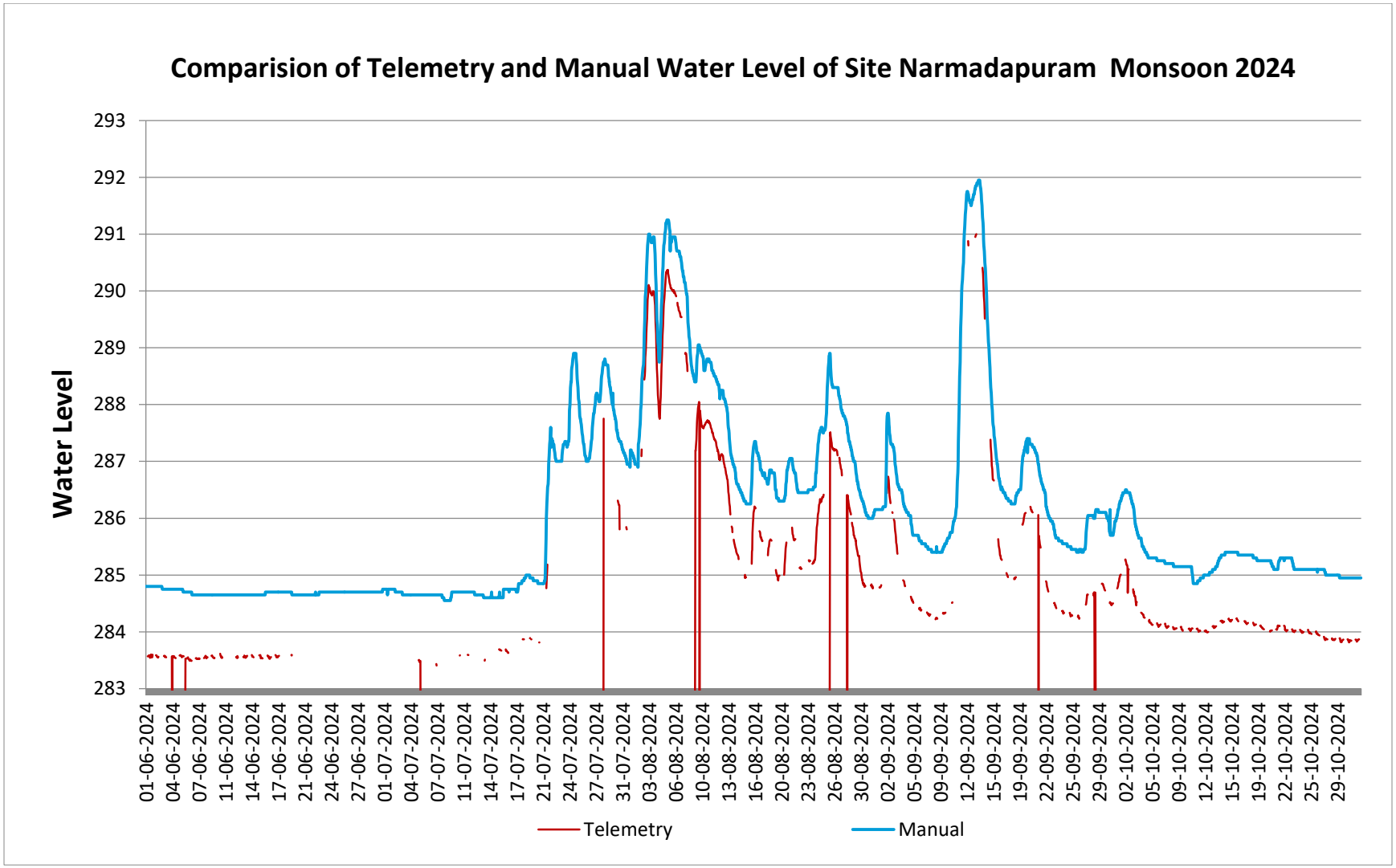
10/22/2024
10/25/2024
10/29/2024
Telemetry
Manual

Figure- 9.10


Comparision of Telemetry and Manual Water Level of Site Narmadapuram Monsoon 2024
Water Level
293
292
291
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286
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284
283
01-06-2024
04-06-2024
07-06-2024
11-06-2024
14-06-2024
17-06-2024
21-06-2024
24-06-2024
27-06-2024
01-07-2024
04-07-2024
07-07-2024
11-07-2024
14-07-2024
17-07-2024
21-07-2024
24-07-2024
27-07-2024
31-07-2024
03-08-2024
06-08-2024
10-08-2024
13-08-2024
16-08-2024
20-08-2024
23-08-2024
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30-08-2024
02-09-2024
05-09-2024
09-09-2024
12-09-2024
15-09-2024
19-09-2024
22-09-2024
25-09-2024
29-09-2024
02-10-2024
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12-10-2024
15-10-2024
19-10-2024
22-10-2024
25-10-2024
29-10-2024
Telemetry
Manual

Figure- 9.11

9.1 PERFORMANCE OF MIKE-11 SOFTWARE DURING FLOOD SEASON-2024:

Narmada Basin specific forecast model have been developed by CWC for level and inflow forecasting. Most of these models are still in its calibration stage and are giving good results. This year 27 level and 105 inflow forecasts were issued by the division with the help of this model. In both level and inflow forecast the results were nearby too actual one.

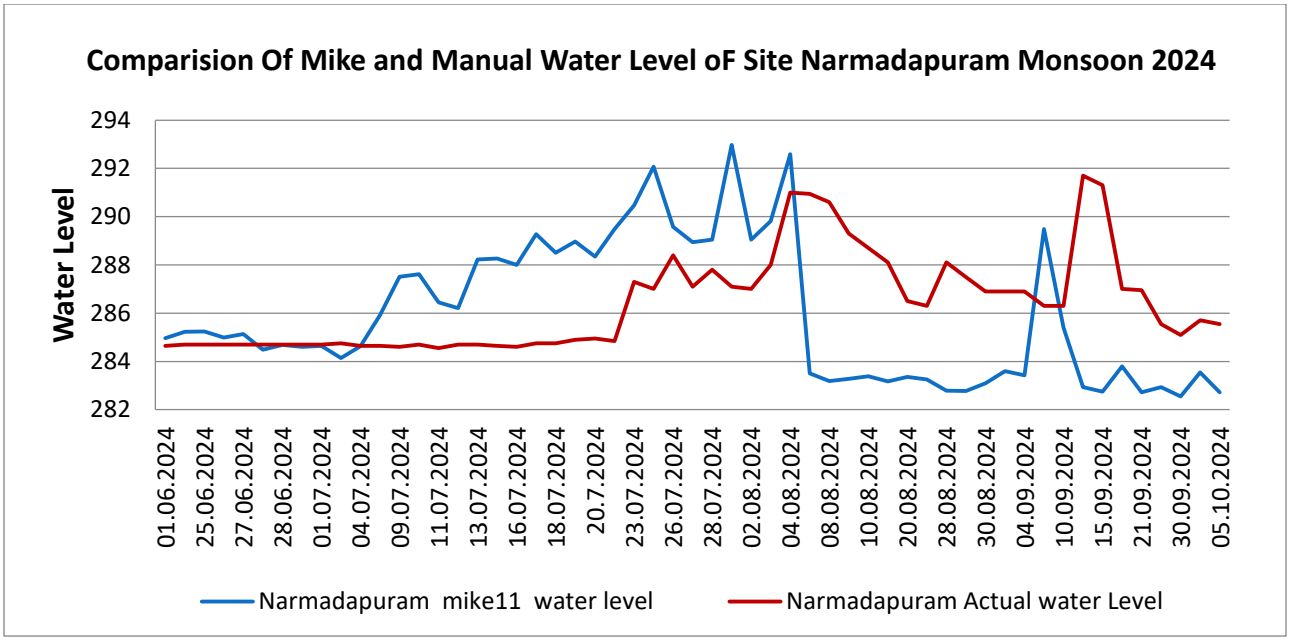

Figure- 9.12

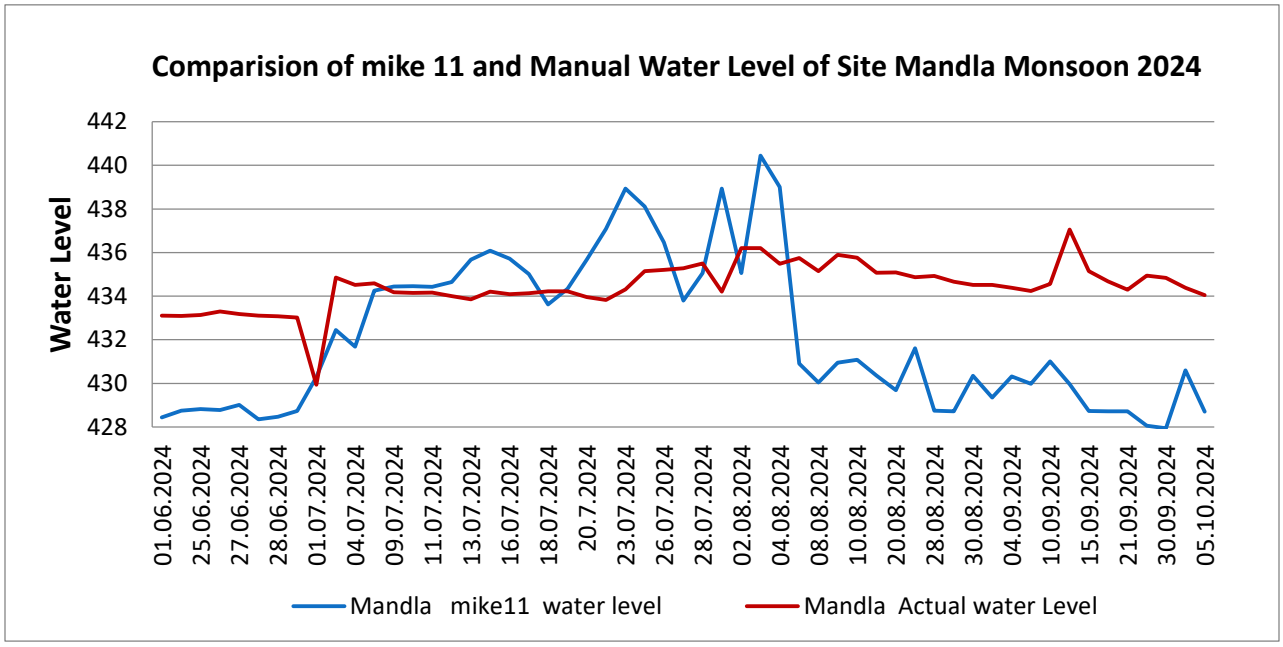

Figure- 9.13

9.2 PERFORMANCE OF CENTRAL WATER COMMISSION ADVISORY FLOOD FORECAST BETA VERSION DAY ONE DURING FLOOD SEASON-2024

During flood season 2024 Central Water Commission Advisory Flood Forecast Beta Version Tabular view and forecast Hydrograph helped very much in predicting the future levels / inflows.

Table 9.2 Performance of Central Water Commission Advisory Flood Forecast Beta Day One during Flood Season-2024

Date	Reservoir name	GS (MCM)	FRL (m)	Date	Advisory Inflow (MCM)	Advisory Inflow (CUMEC)	Actual Inflow (CUMECS)	Difference	% Difference
16.06.2024	Bargi_dam	3920.00	422.00	17/06/24 09:00	4.19	48.48	6.00	42.48	87.62
	Barna	539.00	348.55	17/06/24 09:00	0.10	1.16		1.16	100.00
	Indira_sagar_da	12200.00	263.13	17/06/24 09:00	25.23	291.91	183.00	108.91	37.31
	Omkareshwar	1500.00	201.20	17/06/24 09:00	20.65	238.92	74.00	164.92	69.03
	Tawa_dam	2310.00	355.40	17/06/24 09:00	0.35	4.05	6.00	-1.95	-48.17
17.06.2024	Bargi_dam	3920.00	422.00	18/06/24 09:00	4.29	49.64	6.00	43.64	87.91
	Barna	539.00	348.55	18/06/24 09:00	0.10	1.16		1.16	100.00
	Indira_sagar_da	12200.00	263.13	18/06/24 09:00	25.23	291.91	8.00	283.91	97.26
	Omkareshwar	1500.00	201.20	18/06/24 09:00	20.65	238.92	46.00	192.92	80.75
	Tawa_dam	2310.00	355.40	18/06/24 09:00	0.33	3.82	6.00	-2.18	-57.15
18.06.2024	Bargi_dam	3920.00	422.00	19/06/24 09:00	4.43	51.26	6.00	45.26	88.29
	Barna	539.00	348.55	19/06/24 09:00	0.10	1.16		1.16	100.00
	Indira_sagar_da	12200.00	263.13	19/06/24 09:00	25.25	292.14	191.00	101.14	34.62
	Omkareshwar	1500.00	201.20	19/06/24 09:00	20.23	234.06	37.00	197.06	84.19
	Tawa_dam	2310.00	355.40	19/06/24 09:00	2.91	33.67		33.67	100.00
19.06.2024	Bargi_dam	3920.00	422.00	20/06/24 09:00	4.32	49.98	6.00	43.98	88.00
	Barna	539.00	348.55	20/06/24 09:00	0.33	3.82		3.82	100.00
	Indira_sagar_da	12200.00	263.13	20/06/24 09:00	25.45	294.46	247.00	47.46	16.12
	Omkareshwar	1500.00	201.20	20/06/24 09:00	20.00	231.40	53.00	178.40	77.10
	Tawa_dam	2310.00	355.40	20/06/24 09:00	9.74	112.69		112.69	100.00
20.06.2024	Bargi_dam	3920.00	422.00	21/06/24 09:00	5.26	60.86	6.00	54.86	90.14
	Barna	539.00	348.55	21/06/24 09:00	1.45	16.78		16.78	100.00
	Indira_sagar_da	12200.00	263.13	21/06/24 09:00	26.07	301.63	71.00	230.63	76.46
	Omkareshwar	1500.00	201.20	21/06/24 09:00	23.53	272.24	34.00	238.24	87.51
	Tawa_dam	2310.00	355.40	21/06/24 09:00	47.57	550.38		550.38	100.00
21.06.2024	Bargi_dam	3920.00	422.00	22/06/24 09:00	4.91	56.81	6.00	50.81	89.44
	Barna	539.00	348.55	22/06/24 09:00	0.44	5.09		5.09	100.00
	Indira_sagar_da	12200.00	263.13	22/06/24 09:00	26.36	304.99	266.00	38.99	12.78
	Omkareshwar	1500.00	201.20	22/06/24 09:00	23.57	272.70	57.00	215.70	79.10
	Tawa_dam	2310.00	355.40	22/06/24 09:00	4.24	49.06		49.06	100.00

22.06.2024	Bargi_dam	3920.00	422.00	23/06/24 09:00	5.39	62.36	6.00	56.36	90.38
	Barna	539.00	348.55	23/06/24 09:00	0.43	4.98		4.98	100.00
	Indira_sagar_da	12200.00	263.13	23/06/24 09:00	26.83	310.42	291.00	19.42	6.26
	Omkareshwar	1500.00	201.20	23/06/24 09:00	25.51	295.15	69.00	226.15	76.62
	Tawa_dam	2310.00	355.40	23/06/24 09:00	16.24	187.90		187.90	100.00
23.06.2024	Bargi_dam	3920.00	422.00	24/06/24 09:00	6.64	76.82	6.00	70.82	92.19
	Barna	539.00	348.55	24/06/24 09:00	2.71	31.35		31.35	100.00
	Indira_sagar_da	12200.00	263.13	24/06/24 09:00	28.85	333.79	81.00	252.79	75.73
	Omkareshwar	1500.00	201.20	24/06/24 09:00	26.48	306.37	71.00	235.37	76.83
	Tawa_dam	2310.00	355.40	24/06/24 09:00	23.78	275.13		275.13	100.00
24.06.2024	Bargi_dam	3920.00	422.00	25/06/24 09:00	4.34	50.21	6.00	44.21	88.05
	Barna	539.00	348.55	25/06/24 09:00	0.10	1.16		1.16	100.00
	Indira_sagar_da	12200.00	263.13	25/06/24 09:00	26.22	303.37	488.00	-184.63	-60.86
	Omkareshwar	1500.00	201.20	25/06/24 09:00	24.97	288.90		288.90	100.00
	Tawa_dam	2310.00	355.40	25/06/24 09:00	2.42	28.00	45.00	-17.00	-60.72
25.06.2024	Bargi_dam	3920.00	422.00	26/06/24 09:00	4.38	50.68	6.00	44.68	88.16
	Barna	539.00	348.55	26/06/24 09:00	0.15	1.74		1.74	100.00
	Indira_sagar_da	12200.00	263.13	26/06/24 09:00	25.91	299.78	448.00	-148.22	-49.44
	Omkareshwar	1500.00	201.20	26/06/24 09:00	20.61	238.46	45.00	193.46	81.13
	Tawa_dam	2310.00	355.40	26/06/24 09:00	1.04	12.03		12.03	100.00
26.06.2024	Bargi_dam	3920.00	422.00	27/06/24 09:00	4.83	55.88	6.00	49.88	89.26
	Barna	539.00	348.55	27/06/24 09:00	0.14	1.62		1.62	100.00
	Indira_sagar_da	12200.00	263.13	27/06/24 09:00	25.96	300.36	134.00	166.36	55.39
	Omkareshwar	1500.00	201.20	27/06/24 09:00	19.06	220.52	77.00	143.52	65.08
	Tawa_dam	2310.00	355.40	27/06/24 09:00	2.45	28.35		28.35	100.00
27.06.2024	Bargi_dam	3920.00	422.00	28/06/24 09:00	4.64	53.68	6.00	47.68	88.82
	Barna	539.00	348.55	28/06/24 09:00	0.32	3.70		3.70	100.00
	Indira_sagar_da	12200.00	263.13	28/06/24 09:00	27.14	314.01	341.00	-26.99	-8.60
	Omkareshwar	1500.00	201.20	28/06/24 09:00	27.19	314.59	283.00	31.59	10.04
	Tawa_dam	2310.00	355.40	28/06/24 09:00	10.07	116.51		116.51	100.00
28.06.2024	Bargi_dam	3920.00	422.00	29/06/24 09:00	4.68	54.15	6.00	48.15	88.92
	Barna	539.00	348.55	29/06/24 09:00	2.32	26.84		26.84	100.00
	Indira_sagar_da	12200.00	263.13	29/06/24 09:00	28.92	334.60	248.00	86.60	25.88
	Omkareshwar	1500.00	201.20	29/06/24 09:00	27.92	323.03	489.00	-165.97	-51.38
	Tawa_dam	2310.00	355.40	29/06/24 09:00	24.20	279.99	71.00	208.99	74.64
29.06.2024	Bargi_dam	3920.00	422.00	30/06/24 09:00	5.08	58.78	50.00	8.78	14.93
	Barna	539.00	348.55	30/06/24 09:00	0.10	1.16		1.16	100.00

	Indira_sagar_da	12200.00	263.13	30/06/24 09:00	28.44	329.05	261.00	68.05	20.68
	Omkareshwar	1500.00	201.20	30/06/24 09:00	21.32	246.67	284.00	-37.33	-15.13
	Tawa_dam	2310.00	355.40	30/06/24 09:00	2.36	27.31	56.00	-28.69	-105.09
30.07.2024	Bargi_dam	3920.00	422.00	45298.38	0.90	10.41	101.00	-90.59	-869.94
	Barna	539.00	348.55	45298.38	2.57	29.73	0.00	29.73	100.00
	Indira_sagar_da	12200.00	263.13	45298.38	22.60	261.48	425.00	-163.52	-62.54
	Omkareshwar	1500.00	201.20	45298.38	39.25	454.12	318.00	136.12	29.97
	Tawa_dam	2310.00	355.40	45298.38	29.06	336.22	35.00	301.22	89.59
01.07.2024	Bargi_dam	3920.00	422.00	45329.38	16.14	186.74	561.00	-374.26	-200.42
	Barna	539.00	348.55	45329.38	0.82	9.49	0.00	9.49	100.00
	Indira_sagar_da	12200.00	263.13	45329.38	26.53	306.95	146.00	160.95	52.44
	Omkareshwar	1500.00	201.20	45329.38	19.73	228.28	270.00	-41.72	-18.28
	Tawa_dam	2310.00	355.40	45329.38	24.10	278.84	56.00	222.84	79.92
02.07.2024	Bargi_dam	3920.00	422.00	45358.38	55.34	640.28	111.00	529.28	82.66
	Barna	539.00	348.55	45358.38	0.31	3.59	0.00	3.59	100.00
	Indira_sagar_da	12200.00	263.13	45358.38	26.17	302.79	208.00	94.79	31.30
	Omkareshwar	1500.00	201.20	45358.38	21.46	248.29	209.00	39.29	15.82
	Tawa_dam	2310.00	355.40	45358.38	13.76	159.20	56.00	103.20	64.82
03.07.2024	Bargi_dam	3920.00	422.00	45389.38	66.97	774.84	621.00	153.84	19.85
	Barna	539.00	348.55	45389.38	0.12	1.39	9.91	-8.52	-613.77
	Indira_sagar_da	12200.00	263.13	45389.38	32.54	376.49	79.00	297.49	79.02
	Omkareshwar	1500.00	201.20	45389.38	27.67	320.14	203.00	117.14	36.59
	Tawa_dam	2310.00	355.40	45389.38	8.15	94.30	71.00	23.30	24.70
04.07.2024	Bargi_dam	3920.00	422.00	45419.38	58.15	672.80	447.00	225.80	33.56
	Barna	539.00	348.55	45419.38	2.12	24.53	9.91	14.62	59.60
	Indira_sagar_da	12200.00	263.13	45419.38	39.83	460.83	286.00	174.83	37.94
	Omkareshwar	1500.00	201.20	45419.38	41.17	476.34	404.00	72.34	15.19
	Tawa_dam	2310.00	355.40	45419.38	19.73	228.28	207.00	21.28	9.32
05.07.2024	Bargi_dam	3920.00	422.00	45450.38	111.39	1288.78	1128.00	160.78	12.48
	Barna	539.00	348.55	45450.38	2.89	33.44	9.91	23.53	70.36
	Indira_sagar_da	12200.00	263.13	45450.38	34.64	400.78	67.00	333.78	83.28
	Omkareshwar	1500.00	201.20	45450.38	33.63	389.10	136.00	253.10	65.05
	Tawa_dam	2310.00	355.40	45450.38	13.33	154.23	35.00	119.23	77.31
06.07.2024	Bargi_dam	3920.00	422.00	45480.38	43.71	505.72	802.00	-296.28	-58.58
	Barna	539.00	348.55	45480.38	1.22	14.12	0.00	14.12	100.00
	Indira_sagar_da	12200.00	263.13	45480.38	21.36	247.14	76.00	171.14	69.25
	Omkareshwar	1500.00	201.20	45480.38	-0.45	-5.21		-5.21	100.00
	Tawa_dam	2310.00	355.40	45480.38	15.00	173.55	35.00	138.55	79.83
07.07.2024	Bargi_dam	3920.00	422.00	45511.38	46.69	540.20	416.00	124.20	22.99
	Barna	539.00	348.55	45511.38	0.63	7.29	0.00	7.29	100.00

	Indira_sagar_da	12200.00	263.13	45511.38	25.09	290.29	23.22	267.07	92.00
	Omkareshwar	1500.00	201.20	45511.38	-0.07	-0.81	141.00	-0.81	100.00
	Tawa_dam	2310.00	355.40	45511.38	25.89	299.55	35.00	264.55	88.32
08.07.2024	Bargi_dam	3920.00	422.00	45542.38	39.94	462.11	451.00	46.11	9.98
	Barna	539.00	348.55	45542.38	4.17	48.25	0.00	48.25	100.00
	Indira_sagar_da	12200.00	263.13	45542.38	39.80	460.49	708.00	437.27	94.96
	Omkareshwar	1500.00	201.20	45542.38	-1.24	-14.35	350.00	-155.35	1082.80
	Tawa_dam	2310.00	355.40	45542.38	19.45	225.04	71.00	190.04	84.45
09.07.2024	Bargi_dam	3920.00	422.00	45572.38	28.64	331.36	399.00	-119.64	-36.10
	Barna	539.00	348.55	45572.38	2.18	25.22	0.00	25.22	100.00
	Indira_sagar_da	12200.00	263.13	45572.38	55.13	637.85	344.00	-70.15	-11.00
	Omkareshwar	1500.00	201.20	45572.38	-0.82	-9.49	576.00	-359.49	3789.10
	Tawa_dam	2310.00	355.40	45572.38	12.87	148.91	59.00	77.91	52.32
10.07.2024	Bargi_dam	3920.00	422.00	45603.38	18.47	213.70	281.00	-185.30	-86.71
	Barna	539.00	348.55	45603.38	1.66	19.21	0.00	19.21	100.00
	Indira_sagar_da	12200.00	263.13	45603.38	91.79	1062.01	372.00	718.01	67.61
	Omkareshwar	1500.00	201.20	45603.38	-0.63	-7.29	897.00	-583.29	8002.21
	Tawa_dam	2310.00	355.40	45603.38	25.72	297.58	35.00	238.58	80.17
11.07.2024	Bargi_dam	3920.00	422.00	45633.38	14.15	163.72	430.00	-117.28	-71.64
	Barna	539.00	348.55	45633.38	1.14	13.19	0.00	13.19	100.00
	Indira_sagar_da	12200.00	263.13	45633.38	67.95	786.18	160.00	414.18	52.68
	Omkareshwar	1500.00	201.20	45633.38	-0.43	-4.98	432.00	-901.98	18129.79
	Tawa_dam	2310.00	355.40	45633.38	12.67	146.59	71.00	111.59	76.12
12.07.2024	Bargi_dam	3920.00	422.00	13/07/24 09:00	9.81	113.50	600.00	-316.50	-278.85
	Barna	539.00	348.55	13/07/24 09:00	0.62	7.17	0.00	7.17	100.00
	Indira_sagar_da	12200.00	263.13	13/07/24 09:00	56.29	651.28	348.00	491.28	75.43
	Omkareshwar	1500.00	201.20	13/07/24 09:00	-0.45	-5.21	609.00	-437.21	8397.32
	Tawa_dam	2310.00	355.40	13/07/24 09:00	21.19	245.17	35.00	174.17	71.04
13.07.2024	Bargi_dam	3920.00	422.00	14/07/24 09:00	9.20	106.44	600.00	-493.56	-463.68
	Barna	539.00	348.55	14/07/24 09:00	0.41	4.74	0.00	4.74	100.00
	Indira_sagar_da	12200.00	263.13	14/07/24 09:00	43.65	505.03	348.00	157.03	31.09
	Omkareshwar	1500.00	201.20	14/07/24 09:00	-0.14	-1.62	609.00	-610.62	37697.23
	Tawa_dam	2310.00	355.40	14/07/24 09:00	13.11	151.68	35.00	116.68	76.93
14.07.2024	Bargi_dam	3920.00	422.00	15/07/24 09:00	16.84	194.84	450.00	-405.16	-207.95
	Barna	539.00	348.55	15/07/24 09:00	1.82	21.06	0.00	21.06	100.00

	Indira_sagar_da	12200.00	263.13	15/07/24 09:00	43.36	501.68	806.00	153.68	30.63
	Omkareshwar	1500.00	201.20	15/07/24 09:00	-1.46	-16.89	592.00	-625.89	3705.21
	Tawa_dam	2310.00	355.40	15/07/24 09:00	17.72	205.02	71.00	170.02	82.93
15.07.2024	Bargi_dam	3920.00	422.00	16/07/24 09:00	25.95	300.24	458.00	-149.76	-49.88
	Barna	539.00	348.55	16/07/24 09:00	1.18	13.65	0.00	13.65	100.00
	Indira_sagar_da	12200.00	263.13	16/07/24 09:00	141.33	1635.19	356.00	829.19	50.71
	Omkareshwar	1500.00	201.20	16/07/24 09:00	24.78	286.70	101.00	-305.30	-106.48
	Tawa_dam	2310.00	355.40	16/07/24 09:00	71.39	825.98	118.00	754.98	91.40
16.07.2024	Bargi_dam	3920.00	422.00	17/07/24 09:00	31.79	367.81	458.00	-90.19	-24.52
	Barna	539.00	348.55	17/07/24 09:00	0.55	6.36	0.00	6.36	100.00
	Indira_sagar_da	12200.00	263.13	17/07/24 09:00	154.38	1786.18	1181.00	1430.18	80.07
	Omkareshwar	1500.00	201.20	17/07/24 09:00	40.90	473.21	1277.00	372.21	78.66
	Tawa_dam	2310.00	355.40	17/07/24 09:00	35.25	407.84	177.00	289.84	71.07
17.07.2024	Bargi_dam	3920.00	422.00	18/07/24 09:00	29.29	338.89	451.00	-119.11	-35.15
	Barna	539.00	348.55	18/07/24 09:00	4.00	46.28	0.00	46.28	100.00
	Indira_sagar_da	12200.00	263.13	18/07/24 09:00	226.67	2622.57	972.00	1441.57	54.97
	Omkareshwar	1500.00	201.20	18/07/24 09:00	55.12	637.74	927.00	-639.26	-100.24
	Tawa_dam	2310.00	355.40	18/07/24 09:00	45.80	529.91	1440.00	352.91	66.60
18.07.2024	Bargi_dam	3920.00	422.00	19/07/24 09:00	25.02	289.48	214.00	-161.52	-55.80
	Barna	539.00	348.55	19/07/24 09:00	7.28	84.23	35.00	84.23	100.00
	Indira_sagar_da	12200.00	263.13	19/07/24 09:00	203.96	2359.82	617.00	1387.82	58.81
	Omkareshwar	1500.00	201.20	19/07/24 09:00	29.60	342.47	955.00	-584.53	-170.68
	Tawa_dam	2310.00	355.40	19/07/24 09:00	82.73	957.19	120.00	-482.81	-50.44
19.07.2024	Bargi_dam	3920.00	422.00	20/07/24 09:00	17.50	202.48	214.00	-11.53	-5.69
	Barna	539.00	348.55	20/07/24 09:00	7.42	85.85	35.00	50.85	59.23
	Indira_sagar_da	12200.00	263.13	20/07/24 09:00	156.99	1816.37	619.00	1199.37	66.03
	Omkareshwar	1500.00	201.20	20/07/24 09:00	12.02	139.07	955.00	-815.93	-586.70

	Tawa_dam	2310.00	355.40	20/07/24 09:00	47.80	553.05	120.00	433.05	78.30
20.07.2024	Bargi_dam	3920.00	422.00	21/07/24 09:00	16.57	191.71	293.00	-101.29	-52.83
	Barna	539.00	348.55	21/07/24 09:00	6.30	72.89	14.05	58.84	80.72
	Indira_sagar_da	12200.00	263.13	21/07/24 09:00	112.09	1296.88	514.00	782.88	60.37
	Omkareshwar	1500.00	201.20	21/07/24 09:00	7.43	85.97	727.00	-641.03	-745.69
	Tawa_dam	2310.00	355.40	21/07/24 09:00	36.26	419.53	8635.00	-8215.47	-1958.26
21.07.2024	Bargi_dam	3920.00	422.00	22/07/24 09:00	16.10	186.28	506.00	-319.72	-171.64
	Barna	539.00	348.55	22/07/24 09:00	10.91	126.23	199.48	-73.25	-58.03
	Indira_sagar_da	12200.00	263.13	22/07/24 09:00	134.49	1556.05	723.00	833.05	53.54
	Omkareshwar	1500.00	201.20	22/07/24 09:00	17.46	202.01	467.00	-264.99	-131.17
	Tawa_dam	2310.00	355.40	22/07/24 09:00	178.15	2061.20	3140.00	-1078.80	-52.34
22.07.2024	Bargi_dam	3920.00	422.00	23/07/24 09:00	17.57	203.28	2052.00	-1848.72	-909.42
	Barna	539.00	348.55	23/07/24 09:00	14.71	170.19	116.35	53.84	31.64
	Indira_sagar_da	12200.00	263.13	23/07/24 09:00	419.01	4847.95	4014.00	833.95	17.20
	Omkareshwar	1500.00	201.20	23/07/24 09:00	35.71	413.16	373.00	40.16	9.72
	Tawa_dam	2310.00	355.40	23/07/24 09:00	172.03	1990.39	804.00	1186.39	59.61
23.07.2024	Bargi_dam	3920.00	422.00	24/07/24 09:00	66.57	770.21	1513.00	-742.79	-96.44
	Barna	539.00	348.55	24/07/24 09:00	19.36	224.00	86.90	137.10	61.20
	Indira_sagar_da	12200.00	263.13	24/07/24 09:00	88.61	1025.22	2713.00	-1687.78	-164.63
	Omkareshwar	1500.00	201.20	24/07/24 09:00	42.20	488.25	152.00	336.25	68.87
	Tawa_dam	2310.00	355.40	24/07/24 09:00	288.41	3336.90	557.00	2779.90	83.31
24.07.2024	Bargi_dam	3920.00	422.00	25/07/24 09:00	12.22	141.39	1326.00	-1184.61	-837.86
	Barna	539.00	348.55	25/07/24 09:00	90.04	1041.76	48.85	992.91	95.31
	Indira_sagar_da	12200.00	263.13	25/07/24 09:00	520.81	6025.77	3508.00	2517.77	41.78
	Omkareshwar	1500.00	201.20	25/07/24 09:00	53.37	617.49	143.00	474.49	76.84
	Tawa_dam	2310.00	355.40	25/07/24 09:00	137.15	1586.83	253.00	1333.83	84.06
25.07.2024	Bargi_dam	3920.00	422.00	26/07/24 09:00	227.87	2636.46	1165.00	1471.46	55.81

	Barna	539.00	348.55	26/07/24 09:00	6.19	71.62	145.44	-73.82	-103.08
	Indira_sagar_da	12200.00	263.13	26/07/24 09:00	278.59	3223.29	5904.00	-2680.71	-83.17
	Omkareshwar	1500.00	201.20	26/07/24 09:00	63.87	738.98	8310.00	-7571.02	-1024.53
	Tawa_dam	2310.00	355.40	26/07/24 09:00	34.88	403.56	175.00	228.56	56.64
26.07.2024	Bargi_dam	3920.00	422.00	27/07/24 09:00	125.58	1452.96	1130.00	322.96	22.23
	Barna	539.00	348.55	27/07/24 09:00	5.37	62.13	740.05	-677.92	-1091.11
	Indira_sagar_da	12200.00	263.13	27/07/24 09:00	359.04	4154.09	2864.00	1290.09	31.06
	Omkareshwar	1500.00	201.20	27/07/24 09:00	83.95	971.30	426.00	545.30	56.14
	Tawa_dam	2310.00	355.40	27/07/24 09:00	17.96	207.80	429.00	-221.20	-106.45
27.07.2024	Bargi_dam	3920.00	422.00	28/07/24 09:00	92.50	1070.23	1784.00	-713.78	-66.69
	Barna	539.00	348.55	28/07/24 09:00	15.35	177.60	55.04	122.56	69.01
	Indira_sagar_da	12200.00	263.13	28/07/24 09:00	333.55	3859.17	5113.00	-1253.83	-32.49
	Omkareshwar	1500.00	201.20	28/07/24 09:00	157.38	1820.89	393.00	1427.89	78.42
	Tawa_dam	2310.00	355.40	28/07/24 09:00	78.25	905.35	2351.00	-1445.65	-159.68
28.07.2024	Bargi_dam	3920.00	422.00	29/07/24 09:00	123.31	1426.70	1848.00	-421.30	-29.53
	Barna	539.00	348.55	29/07/24 09:00	15.61	180.61	214.22	-33.61	-18.61
	Indira_sagar_da	12200.00	263.13	29/07/24 09:00	380.86	4406.55	5741.00	-1334.45	-30.28
	Omkareshwar	1500.00	201.20	29/07/24 09:00	176.83	2045.92	102.00	1943.92	95.01
	Tawa_dam	2310.00	355.40	29/07/24 09:00	105.73	1223.30	1905.00	-681.70	-55.73
29.07.2024	Bargi_dam	3920.00	422.00	30/07/24 09:00	94.11	1088.85	1400.00	-311.15	-28.58
	Barna	539.00	348.55	30/07/24 09:00	5.82	67.34	73.54	-6.20	-9.21
	Indira_sagar_da	12200.00	263.13	30/07/24 09:00	425.32	4920.95	6542.00	-1621.05	-32.94
	Omkareshwar	1500.00	201.20	30/07/24 09:00	190.94	2209.18	1398.00	811.18	36.72
	Tawa_dam	2310.00	355.40	30/07/24 09:00	69.87	808.40	449.00	359.40	44.46
31.07.2024	Bargi_dam	3920.00	422.00	45299.38	44.56	515.56	1206.00	-690.44	-133.92
	Barna	539.00	348.55	45299.38	2.66	30.78	88.38	-57.60	-187.17
	Indira_sagar_da	12200.00	263.13	45299.38	288.07	3332.97	2734.00	598.97	17.97
	Omkareshwar	1500.00	201.20	45299.38	103.42	1196.57	287.00	909.57	76.01

	Tawa_dam	2310.00	355.40	45299.38	14.11	163.25	148.00	15.25	9.34
01.08.2024	Bargi_dam	3920.00	422.00	45330.38	37.09	429.13	5257.00	-4827.87	-1125.03
	Barna	539.00	348.55	45330.38	3.48	40.26	578.59	-538.33	-1337.01
	Indira_sagar_da	12200.00	263.13	45330.38	216.22	2501.67	2599.00	-97.33	-3.89
	Omkareshwar	1500.00	201.20	45330.38	95.00	1099.15	287.00	812.15	73.89
	Tawa_dam	2310.00	355.40	45330.38	20.36	235.57	148.00	87.57	37.17
02.08.2024	Bargi_dam	3920.00	422.00	45359.38	481.08	5566.10	5096.00	470.10	8.45
	Barna	539.00	348.55	45359.38	8.52	98.58	170.47	-71.89	-72.93
	Indira_sagar_da	12200.00	263.13	45359.38	350.88	4059.68	6655.00	-2595.32	-63.93
	Omkareshwar	1500.00	201.20	45359.38	150.29	1738.86	1692.00	46.86	2.69
	Tawa_dam	2310.00	355.40	45359.38	16.22	187.67	1944.00	-1756.33	-935.89
03.08.2024	Bargi_dam	3920.00	422.00	45390.38	643.12	7440.90	5831.00	1609.90	21.64
	Barna	539.00	348.55	45390.38	26.10	301.98	534.08	-232.10	-76.86
	Indira_sagar_da	12200.00	263.13	45390.38	356.60	4125.86	9612.00	-5486.14	-132.97
	Omkareshwar	1500.00	201.20	45390.38	113.41	1312.15	1890.00	-577.85	-44.04
	Tawa_dam	2310.00	355.40	45390.38	272.09	3148.08	1108.00	2040.08	64.80
04.08.2024	Bargi_dam	3920.00	422.00	45420.38	471.31	5453.06	8152.00	-2698.94	-49.49
	Barna	539.00	348.55	45420.38	124.04	1435.14	354.38	1080.76	75.31
	Indira_sagar_da	12200.00	263.13	45420.38	684.76	7922.67	9063.00	-1140.33	-14.39
	Omkareshwar	1500.00	201.20	45420.38	220.93	2556.16	2121.00	435.16	17.02
	Tawa_dam	2310.00	355.40	45420.38	415.95	4812.54	2385.00	2427.54	50.44
06.08.2024	Bargi_dam	3920.00	422.00	45481.38	218.53	2528.39	7103.00	-4574.61	-180.93
	Barna	539.00	348.55	45481.38	39.69	459.21	89.00	370.21	80.62
	Indira_sagar_da	12200.00	263.13	45481.38	583.73	6753.76	6253.00	500.76	7.41
	Omkareshwar	1500.00	201.20	45481.38	369.61	4276.39	1891.00	2385.39	55.78
	Tawa_dam	2310.00	355.40	45481.38	76.98	890.66	348.00	542.66	60.93
07.08.2024	Bargi_dam	3920.00	422.00	45512.38	143.00	1654.51	6092.00	-4437.49	-268.21
	Barna	539.00	348.55	45512.38	46.82	541.71	77.56	464.15	85.68
	Indira_sagar_da	12200.00	263.13	45512.38	557.73	6452.94	7759.00	-1306.06	-20.24
	Omkareshwar	1500.00	201.20	45512.38	45.72	528.98	3355.00	-2826.02	-534.24
	Tawa_dam	2310.00	355.40	45512.38	240.54	2783.05	221.00	2562.05	92.06
08.08.2024	Bargi_dam	3920.00	422.00	45543.38	680.12	7868.99	3431.00	4437.99	56.40
	Barna	539.00	348.55	45543.38	2.71	31.35	89.62	-58.27	-185.83
	Indira_sagar_da	12200.00	263.13	45543.38	369.94	4280.21	10484.00	-6203.79	-144.94
	Omkareshwar	1500.00	201.20	45543.38	171.77	1987.38	9501.00	-7513.62	-378.07
	Tawa_dam	2310.00	355.40	45543.38	49.11	568.20	1356.00	-787.80	-138.65
09.08.2024	Bargi_dam	3920.00	422.00	45573.38	275.43	3186.73	2543.00	643.73	20.20
	Barna	539.00	348.55	45573.38	2.91	33.67	50.86	-17.19	-51.06
	Indira_sagar_da	12200.00	263.13	45573.38	618.09	7151.30	10496.00	-3344.70	-46.77
	Omkareshwar	1500.00	201.20	45573.38	239.33	2769.05	10712.00	-7942.95	-286.85

	Tawa_dam	2310.00	355.40	45573.38	56.30	651.39	372.00	279.39	42.89
10.08.2024	Bargi_dam	3920.00	422.00	45604.38	83.10	961.47	1649.00	-687.53	-71.51
	Barna	539.00	348.55	45604.38	1.85	21.40	60.68	-39.28	-183.49
	Indira_sagar_da	12200.00	263.13	45604.38	293.35	3394.06	6613.00	-3218.94	-94.84
	Omkareshwar	1500.00	201.20	45604.38	205.96	2382.96	8498.00	-6115.04	-256.62
	Tawa_dam	2310.00	355.40	45604.38	28.85	333.79	319.00	14.79	4.43
11.08.2024	Bargi_dam	3920.00	422.00	45634.38	147.93	1711.55	1187.00	524.55	30.65
	Barna	539.00	348.55	45634.38	2.04	23.60	60.68	-37.08	-157.09
	Indira_sagar_da	12200.00	263.13	45634.38	495.13	5728.65	6739.00	-1010.35	-17.64
	Omkareshwar	1500.00	201.20	45634.38	212.01	2452.96	7267.00	-4814.04	-196.25
	Tawa_dam	2310.00	355.40	45634.38	22.33	258.36	702.00	-443.64	-171.72
12.08.2024	Bargi_dam	3920.00	422.00	13/08/24 09:00	41.15	476.11	1357.00	-880.89	-185.02
	Barna	539.00	348.55	13/08/24 09:00	2.46	28.46	50.56	-22.10	-77.64
	Indira_sagar_da	12200.00	263.13	13/08/24 09:00	409.69	4740.11	3042.00	1698.11	35.82
	Omkareshwar	1500.00	201.20	13/08/24 09:00	175.90	2035.16	3827.00	-1791.84	-88.04
	Tawa_dam	2310.00	355.40	13/08/24 09:00	21.06	243.66	352.00	-108.34	-44.46
13.08.2024	Bargi_dam	3920.00	422.00	14/08/24 09:00	109.26	1264.14	1057.00	207.14	16.39
	Barna	539.00	348.55	14/08/24 09:00	2.52	29.16	46.42	-17.26	-59.21
	Indira_sagar_da	12200.00	263.13	14/08/24 09:00	396.68	4589.59	2763.00	1826.59	39.80
	Omkareshwar	1500.00	201.20	14/08/24 09:00	35.70	413.05	2180.00	-1766.95	-427.78
	Tawa_dam	2310.00	355.40	14/08/24 09:00	175.60	2031.69	214.00	1817.69	89.47
14.08.2024	Bargi_dam	3920.00	422.00	15/08/24 09:00	41.18	476.45	894.00	-417.55	-87.64
	Barna	539.00	348.55	15/08/24 09:00	2.16	24.99	43.98	-18.99	-75.98
	Indira_sagar_da	12200.00	263.13	15/08/24 09:00	306.60	3547.36	3038.00	509.36	14.36
	Omkareshwar	1500.00	201.20	15/08/24 09:00	17.12	198.08	2209.00	-2010.92	-1015.21
	Tawa_dam	2310.00	355.40	15/08/24 09:00	141.08	1632.30	316.00	1316.30	80.64
15.08.2024	Bargi_dam	3920.00	422.00	16/08/24 09:00	45.04	521.11	1382.00	-860.89	-165.20
	Barna	539.00	348.55	16/08/24 09:00	2.72	31.47	46.42	-14.95	-47.50
	Indira_sagar_da	12200.00	263.13	16/08/24 09:00	143.91	1665.04	3039.00	-1373.96	-82.52
	Omkareshwar	1500.00	201.20	16/08/24 09:00	117.45	1358.90	2124.00	-765.10	-56.30

	Tawa_dam	2310.00	355.40	16/08/24 09:00	17.73	205.14	1008.00	-802.86	-391.38
16.08.2024	Bargi_dam	3920.00	422.00	17/08/24 09:00	56.47	653.36	1540.00	-886.64	-135.71
	Barna	539.00	348.55	17/08/24 09:00	8.05	93.14	46.42	46.72	50.16
	Indira_sagar_da	12200.00	263.13	17/08/24 09:00	195.54	2262.40	3157.00	-894.60	-39.54
	Omkareshwar	1500.00	201.20	17/08/24 09:00	175.37	2029.03	2138.00	-108.97	-5.37
	Tawa_dam	2310.00	355.40	17/08/24 09:00	60.99	705.65	236.00	469.65	66.56
17.08.2024	Bargi_dam	3920.00	422.00	18/08/24 09:00	63.77	737.82	902.00	-164.18	-22.25
	Barna	539.00	348.55	18/08/24 09:00	3.35	38.76	27.61	11.15	28.77
	Indira_sagar_da	12200.00	263.13	18/08/24 09:00	254.93	2949.54	4140.00	-1190.46	-40.36
	Omkareshwar	1500.00	201.20	18/08/24 09:00	206.35	2387.47	2207.00	180.47	7.56
	Tawa_dam	2310.00	355.40	18/08/24 09:00	32.26	373.25	399.00	-25.75	-6.90
18.08.2024	Bargi_dam	3920.00	422.00	19/08/24 09:00	53.45	618.42	1424.00	-805.58	-130.27
	Barna	539.00	348.55	19/08/24 09:00	4.58	52.99	28.63	24.36	45.97
	Indira_sagar_da	12200.00	263.13	19/08/24 09:00	252.51	2921.54	2580.00	341.54	11.69
	Omkareshwar	1500.00	201.20	19/08/24 09:00	205.57	2378.44	2259.00	119.44	5.02
	Tawa_dam	2310.00	355.40	19/08/24 09:00	31.16	360.52	270.00	90.52	25.11
19.08.2024	Bargi_dam	3920.00	422.00	20/08/24 09:00	44.70	517.18	1229.00	-711.82	-137.64
	Barna	539.00	348.55	20/08/24 09:00	2.51	29.04	0.00	29.04	100.00
	Indira_sagar_da	12200.00	263.13	20/08/24 09:00	190.01	2198.42	2397.00	-198.58	-9.03
	Omkareshwar	1500.00	201.20	20/08/24 09:00	20.72	239.73	2182.00	-1942.27	-810.19
	Tawa_dam	2310.00	355.40	20/08/24 09:00	156.01	1805.04	436.00	1369.04	75.85
20.08.2024	Bargi_dam	3920.00	422.00	21/08/24 09:00	65.45	757.26	1098.00	-340.74	-45.00
	Barna	539.00	348.55	21/08/24 09:00	3.38	39.11	0.00	39.11	100.00
	Indira_sagar_da	12200.00	263.13	21/08/24 09:00	174.63	2020.47	2213.00	-192.53	-9.53
	Omkareshwar	1500.00	201.20	21/08/24 09:00	164.26	1900.49	2262.00	-361.51	-19.02
	Tawa_dam	2310.00	355.40	21/08/24 09:00	42.27	489.06	822.00	-332.94	-68.08
21.08.2024	Bargi_dam	3920.00	422.00	22/08/24 09:00	51.72	598.40	965.00	-366.60	-61.26

	Barna	539.00	348.55	22/08/24 09:00	1.54	17.82	27.89	-10.07	-56.53
	Indira_sagar_da	12200.00	263.13	22/08/24 09:00	200.41	2318.74	2580.00	-261.26	-11.27
	Omkareshwar	1500.00	201.20	22/08/24 09:00	172.67	1997.79	2190.00	-192.21	-9.62
	Tawa_dam	2310.00	355.40	22/08/24 09:00	59.28	685.87	246.00	439.87	64.13
22.08.2024	Bargi_dam	3920.00	422.00	23/08/24 09:00	46.47	537.66	2407.00	-1869.34	-347.68
	Barna	539.00	348.55	23/08/24 09:00	1.45	16.78	24.86	-8.08	-48.18
	Indira_sagar_da	12200.00	263.13	23/08/24 09:00	201.33	2329.39	3297.00	-967.61	-41.54
	Omkareshwar	1500.00	201.20	23/08/24 09:00	172.84	1999.76	2259.00	-259.24	-12.96
	Tawa_dam	2310.00	355.40	23/08/24 09:00	37.13	429.59	316.00	113.59	26.44
23.08.2024	Bargi_dam	3920.00	422.00	24/08/24 09:00	77.13	892.39	1938.00	-1045.61	-117.17
	Barna	539.00	348.55	24/08/24 09:00	2.13	24.64	93.49	-68.85	-279.36
	Indira_sagar_da	12200.00	263.13	24/08/24 09:00	220.91	2555.93	3315.00	-759.07	-29.70
	Omkareshwar	1500.00	201.20	24/08/24 09:00	219.33	2537.65	2561.00	-23.35	-0.92
	Tawa_dam	2310.00	355.40	24/08/24 09:00	46.43	537.20	567.00	-29.80	-5.55
24.08.2024	Bargi_dam	3920.00	422.00	25/08/24 09:00	251.38	2908.47	2032.00	876.47	30.14
	Barna	539.00	348.55	25/08/24 09:00	8.83	102.16	68.67	33.49	32.78
	Indira_sagar_da	12200.00	263.13	25/08/24 09:00	274.65	3177.70	5151.00	-1973.30	-62.10
	Omkareshwar	1500.00	201.20	25/08/24 09:00	358.96	4153.17	2709.00	1444.17	34.77
	Tawa_dam	2310.00	355.40	25/08/24 09:00	54.15	626.52	751.00	-124.48	-19.87
25.08.2024	Bargi_dam	3920.00	422.00	26/08/24 09:00	261.17	3021.74	1829.00	1192.74	39.47
	Barna	539.00	348.55	26/08/24 09:00	8.99	104.01	169.30	-65.29	-62.77
	Indira_sagar_da	12200.00	263.13	26/08/24 09:00	287.60	3327.53	5505.00	-2177.47	-65.44
	Omkareshwar	1500.00	201.20	26/08/24 09:00	508.31	5881.15	4293.00	1588.15	27.00
	Tawa_dam	2310.00	355.40	26/08/24 09:00	87.59	1013.42	1038.00	-24.58	-2.43
26.08.2024	Bargi_dam	3920.00	422.00	27/08/24 09:00	125.67	1454.00	1549.00	-95.00	-6.53
	Barna	539.00	348.55	27/08/24 09:00	7.00	80.99	93.05	-12.06	-14.89
	Indira_sagar_da	12200.00	263.13	27/08/24 09:00	880.66	10189.24	5311.00	4878.24	47.88

	Omkareshwar	1500.00	201.20	27/08/24 09:00	565.15	6538.79	4939.00	1599.79	24.47
	Tawa_dam	2310.00	355.40	27/08/24 09:00	54.43	629.76	450.00	179.76	28.54
27.08.2024	Bargi_dam	3920.00	422.00	28/08/24 09:00	90.46	1046.62	870.00	176.62	16.88
	Barna	539.00	348.55	28/08/24 09:00	3.92	45.35	24.88	20.47	45.14
	Indira_sagar_da	12200.00	263.13	28/08/24 09:00	447.62	5178.96	5035.00	143.96	2.78
	Omkareshwar	1500.00	201.20	28/08/24 09:00	372.64	4311.44	4566.00	-254.56	-5.90
	Tawa_dam	2310.00	355.40	28/08/24 09:00	26.47	306.26	249.00	57.26	18.70
28.08.2024	Bargi_dam	3920.00	422.00	29/08/24 09:00	61.56	712.25	735.00	-22.75	-3.19
	Barna	539.00	348.55	29/08/24 09:00	2.58	29.85	27.02	2.83	9.48
	Indira_sagar_da	12200.00	263.13	29/08/24 09:00	331.59	3836.50	5589.00	-1752.50	-45.68
	Omkareshwar	1500.00	201.20	29/08/24 09:00	14.84	171.70	5684.00	-5512.30	-3210.45
	Tawa_dam	2310.00	355.40	29/08/24 09:00	277.60	3211.83	179.00	3032.83	94.43
29.08.2024	Bargi_dam	3920.00	422.00	30/08/24 09:00	50.78	587.52	726.00	-138.48	-23.57
	Barna	539.00	348.55	30/08/24 09:00	1.95	22.56	35.80	-13.24	-58.68
	Indira_sagar_da	12200.00	263.13	30/08/24 09:00	331.09	3830.71	3365.00	465.71	12.16
	Omkareshwar	1500.00	201.20	30/08/24 09:00	210.71	2437.91	4907.00	-2469.09	-101.28
	Tawa_dam	2310.00	355.40	30/08/24 09:00	13.25	153.30	315.00	-161.70	-105.48
30.08.2024	Bargi_dam	3920.00	422.00	31/08/24 09:00	63.21	731.34	1127.00	-395.66	-54.10
	Barna	539.00	348.55	31/08/24 09:00	1.74	20.13	116.00	-95.87	-476.20
	Indira_sagar_da	12200.00	263.13	31/08/24 09:00	273.74	3167.17	2211.00	956.17	30.19
	Omkareshwar	1500.00	201.20	31/08/24 09:00	163.48	1891.46	2088.00	-196.54	-10.39
	Tawa_dam	2310.00	355.40	31/08/24 09:00	29.09	336.57	315.00	21.57	6.41
01.09.2024	Bargi_dam	3920.00	422.00	45331.38	65.11	753.32	65.11	688.21	91.36
	Barna	539.00	348.55	45331.38	11.19	129.47	11.19	118.28	91.36
	Indira_sagar_da	12200.00	263.13	45331.38	409.88	4742.31	409.88	4332.43	91.36
	Omkareshwar	1500.00	201.20	45331.38	291.70	3374.97	291.70	3083.27	91.36
	Tawa_dam	2310.00	355.40	45331.38	92.76	1073.23	92.76	980.47	91.36
02.09.2024	Bargi_dam	3920.00	422.00	45360.38	56.95	658.91	633.00	25.91	3.93
	Barna	539.00	348.55	45360.38	7.36	129.47	111.72	17.75	13.71

	Indira_sagar_da	12200.00	263.13	45360.38	278.91	4742.31	3407.00	1335.31	28.16
	Omkareshwar	1500.00	201.20	45360.38	447.48	3374.97	1978.00	1396.97	41.39
	Tawa_dam	2310.00	355.40	45360.38	72.30	1073.23	433.00	640.23	59.65
03.09.2024	Bargi_dam	3920.00	422.00	45391.38	45.41	525.39	633.00	-107.61	-20.48
	Barna	539.00	348.55	45391.38	10.75	124.38	111.72	12.66	10.18
	Indira_sagar_da	12200.00	263.13	45391.38	333.97	3864.03	3407.00	457.03	11.83
	Omkareshwar	1500.00	201.20	45391.38	489.60	5664.67	1978.00	3686.67	65.08
	Tawa_dam	2310.00	355.40	45391.38	96.48	1116.27	433.00	683.27	61.21
04.09.2024	Bargi_dam	3920.00	422.00	45421.38					
	Barna	539.00	348.55	45421.38	225.32	2606.95	111.72	2495.23	95.71
	Indira_sagar_da	12200.00	263.13	45421.38	3.21	37.14	3314.00	-3276.86	-8823.07
	Omkareshwar	1500.00	201.20	45421.38	243.72	2819.84	4155.00	-1335.16	-47.35
	Tawa_dam	2310.00	355.40	45421.38	18.30	211.73	112.00	99.73	47.10
05.09.2024	Bargi_dam	3920.00	422.00	45452.38	25.06	289.94	634.00	-344.06	-118.66
	Barna	539.00	348.55	45452.38	1.88	21.75	0.00	21.75	100.00
	Indira_sagar_da	12200.00	263.13	45452.38	193.63	2240.30	1926.00	314.30	14.03
	Omkareshwar	1500.00	201.20	45452.38	176.91	2046.85	2435.00	-388.15	-18.96
	Tawa_dam	2310.00	355.40	45452.38	9.00	211.73	180.00	31.73	14.99
06.09.2024	Bargi_dam	3920.00	422.00	45482.38	24.13	289.94	1199.00	-909.06	-313.53
	Barna	539.00	348.55	45482.38	1.60	21.75	0.00	21.75	100.00
	Indira_sagar_da	12200.00	263.13	45482.38	196.44	2240.30	1733.00	507.30	22.64
	Omkareshwar	1500.00	201.20	45482.38	5.77	2046.85	2071.00	-24.15	-1.18
	Tawa_dam	2310.00	355.40	45482.38	159.38	104.13	112.00	-7.87	-7.56
07.09.2024	Bargi_dam	3920.00	422.00	45513.38	49.81	279.18	1115.00	-835.82	-299.38
	Barna	539.00	348.55	45513.38	1.96	18.51	8.07	10.44	56.41
	Indira_sagar_da	12200.00	263.13	45513.38	205.66	2272.81	1825.00	447.81	19.70
	Omkareshwar	1500.00	201.20	45513.38	8.07	66.76	2214.00	-2147.24	-3216.41
	Tawa_dam	2310.00	355.40	45513.38	172.19	1844.03	180.00	1664.03	90.24
08.09.2024	Bargi_dam	3920.00	422.00	45513.38	49.81	576.30	843.00	-266.70	-46.28
	Barna	539.00	348.55	45513.38	1.96	22.68	0.00	22.68	100.00
	Indira_sagar_da	12200.00	263.13	45513.38	205.66	2379.49	1805.00	574.49	24.14
	Omkareshwar	1500.00	201.20	45513.38	8.07	93.37	2214.00	-2120.63	-2271.21
	Tawa_dam	2310.00	355.40	45513.38	172.19	1992.24	112.00	1880.24	94.38
10.09.2024	Bargi_dam	3920.00	422.00	45605.38	70.52	815.92	5579.00	-4763.08	-583.77
	Barna	539.00	348.55	45605.38	3.65	42.23	198.84	-156.61	-370.84
	Indira_sagar_da	12200.00	263.13	45605.38	139.83	1617.83	2523.00	-905.17	-55.95
	Omkareshwar	1500.00	201.20	45605.38	33.97	393.03	2109.00	-1715.97	-436.60
	Tawa_dam	2310.00	355.40	45605.38	172.64	1997.44	1596.00	401.44	20.10
11.09.2024	Bargi_dam	3920.00	422.00	45635.38	1098.01	12703.98	7545.00	5158.98	40.61
	Barna	539.00	348.55	45635.38	47.20	546.10	257.29	288.81	52.89

	Indira_sagar_da	12200.00	263.13	45635.38	495.05	5727.73	6360.00	-632.27	-11.04
	Omkareshwar	1500.00	201.20	45635.38	92.67	1072.19	4414.00	-3341.81	-311.68
	Tawa_dam	2310.00	355.40	45635.38	1007.17	11652.96	1523.00	10129.96	86.93
13.09.2024	Bargi_dam	3920.00	422.00	14/09/24 09:00	325.06	3760.94	1438.00	2322.94	61.76
	Barna	539.00	348.55	14/09/24 09:00	10.59	122.53	115.31	7.22	5.89
	Indira_sagar_da	12200.00	263.13	14/09/24 09:00	548.65	6347.88	11650.00	-5302.12	-83.53
	Omkareshwar	1500.00	201.20	14/09/24 09:00	49.38	571.33	1262.00	-690.67	-120.89
	Tawa_dam	2310.00	355.40	14/09/24 09:00	569.78	6592.35	249.00	6343.35	96.22
14.09.2024	Bargi_dam	3920.00	422.00	15/09/24 09:00	202.25	2340.03	967.00	1373.03	58.68
	Barna	539.00	348.55	15/09/24 09:00	3.48	40.26	63.20	-22.94	-56.97
	Indira_sagar_da	12200.00	263.13	15/09/24 09:00	609.83	7055.73	9800.00	-2744.27	-38.89
	Omkareshwar	1500.00	201.20	15/09/24 09:00	408.50	4726.35	10979.00	-6252.66	-132.29
	Tawa_dam	2310.00	355.40	15/09/24 09:00	17.68	204.56	151.00	53.56	26.18
15.09.2024	Bargi_dam	3920.00	422.00	16/09/24 09:00	74.26	859.19	841.00	18.19	2.12
	Barna	539.00	348.55	16/09/24 09:00	2.37	27.42	63.32	-35.90	-130.92
	Indira_sagar_da	12200.00	263.13	16/09/24 09:00	630.61	7296.16	4209.00	3087.16	42.31
	Omkareshwar	1500.00	201.20	16/09/24 09:00	279.47	3233.47	3858.00	-624.53	-19.31
	Tawa_dam	2310.00	355.40	16/09/24 09:00	10.13	117.20	180.00	-62.80	-53.58
16.09.2024	Bargi_dam	3920.00	422.00	17/09/24 09:00	54.24	627.56	844.00	-216.44	-34.49
	Barna	539.00	348.55	17/09/24 09:00	1.91	22.10	40.72	-18.62	-84.26
	Indira_sagar_da	12200.00	263.13	17/09/24 09:00	502.20	5810.45	3506.00	2304.45	39.66
	Omkareshwar	1500.00	201.20	17/09/24 09:00	201.88	2335.75	4214.00	-1878.25	-80.41
	Tawa_dam	2310.00	355.40	17/09/24 09:00	12.09	139.88	112.00	27.88	19.93
17.09.2024	Bargi_dam	3920.00	422.00	18/09/24 09:00	59.89	692.93	1794.00	-1101.07	-158.90
	Barna	539.00	348.55	18/09/24 09:00	1.73	20.02	113.92	-93.90	-469.14
	Indira_sagar_da	12200.00	263.13	18/09/24 09:00	270.54	3130.15	2399.00	731.15	23.36
	Omkareshwar	1500.00	201.20	18/09/24 09:00	156.50	1810.71	3216.00	-1405.30	-77.61
	Tawa_dam	2310.00	355.40	18/09/24 09:00	4.80	55.54	182.00	-126.46	-227.72

18.09.2024	Bargi_dam	3920.00	422.00	19/09/24 09:00	114.62	1326.15	1484.00	-157.85	-11.90
	Barna	539.00	348.55	19/09/24 09:00	1.66	19.21	26.36	-7.15	-37.25
	Indira_sagar_da	12200.00	263.13	19/09/24 09:00	212.25	2455.73	1954.00	501.73	20.43
	Omkareshwar	1500.00	201.20	19/09/24 09:00	137.02	1585.32	2405.00	-819.68	-51.70
	Tawa_dam	2310.00	355.40	19/09/24 09:00	8.93	103.32	114.00	-10.68	-10.34
19.09.2024	Bargi_dam	3920.00	422.00	20/09/24 09:00	138.81	1606.03	645.00	961.03	59.84
	Barna	539.00	348.55	20/09/24 09:00	1.62	18.74	21.38	-2.64	-14.07
	Indira_sagar_da	12200.00	263.13	20/09/24 09:00	226.00	2614.82	2651.00	-36.18	-1.38
	Omkareshwar	1500.00	201.20	20/09/24 09:00	148.61	1719.42	2075.00	-355.58	-20.68
	Tawa_dam	2310.00	355.40	20/09/24 09:00	8.50	98.35	114.00	-15.66	-15.92
20.09.2024	Bargi_dam	3920.00	422.00	21/09/24 09:00	46.83	541.82	500.00	41.82	7.72
	Barna	539.00	348.55	21/09/24 09:00	3.09	35.75	0.00	35.75	100.00
	Indira_sagar_da	12200.00	263.13	21/09/24 09:00	260.26	3011.21	2586.00	425.21	14.12
	Omkareshwar	1500.00	201.20	21/09/24 09:00	5.85	67.68	2392.00	-2324.32	-3434.04
	Tawa_dam	2310.00	355.40	21/09/24 09:00	184.03	2129.23	114.00	2015.23	94.65
21.09.2024	Bargi_dam	3920.00	422.00	22/09/24 09:00	39.83	460.83	369.00	91.83	19.93
	Barna	539.00	348.55	22/09/24 09:00	2.40	27.77	0.00	27.77	100.00
	Indira_sagar_da	12200.00	263.13	22/09/24 09:00	211.22	2443.82	2397.00	46.82	1.92
	Omkareshwar	1500.00	201.20	22/09/24 09:00	167.52	1938.21	2499.00	-560.79	-28.93
	Tawa_dam	2310.00	355.40	22/09/24 09:00	8.36	96.73	144.00	-47.27	-48.88
22.09.2024	Bargi_dam	3920.00	422.00	23/09/24 09:00	31.28	361.91	397.00	-35.09	-9.70
	Barna	539.00	348.55	23/09/24 09:00	3.28	37.95	0.00	37.95	100.00
	Indira_sagar_da	12200.00	263.13	23/09/24 09:00	194.08	2245.51	2250.00	-4.49	-0.20
	Omkareshwar	1500.00	201.20	23/09/24 09:00	155.41	1798.09	2669.00	-870.91	-48.43
	Tawa_dam	2310.00	355.40	23/09/24 09:00	18.96	219.37	114.00	105.37	48.03
23.09.2024	Bargi_dam	3920.00	422.00	24/09/24 09:00	27.56	318.87	267.00	51.87	16.27
	Barna	539.00	348.55	24/09/24 09:00	1.77	20.48	0.00	20.48	100.00

	Indira_sagar_da	12200.00	263.13	24/09/24 09:00	186.51	2157.92	2167.00	-9.08	-0.42
	Omkareshwar	1500.00	201.20	24/09/24 09:00	5.98	69.19	2153.00	-2083.81	-3011.78
	Tawa_dam	2310.00	355.40	24/09/24 09:00	150.06	1736.19	114.00	1622.19	93.43
24.09.2024	Bargi_dam	3920.00	422.00	25/09/24 09:00	23.05	266.69	802.00	-535.31	-200.73
	Barna	539.00	348.55	25/09/24 09:00	1.63	18.86	0.00	18.86	100.00
	Indira_sagar_da	12200.00	263.13	25/09/24 09:00	184.63	2136.17	1147.00	989.17	46.31
	Omkareshwar	1500.00	201.20	25/09/24 09:00	121.62	1407.14	1945.00	-537.86	-38.22
	Tawa_dam	2310.00	355.40	25/09/24 09:00	9.93	114.89	114.00	0.89	0.77
25.09.2024	Bargi_dam	3920.00	422.00	26/09/24 09:00	23.45	271.32	1169.00	-897.68	-330.86
	Barna	539.00	348.55	26/09/24 09:00	1.62	18.74	0.00	18.74	100.00
	Indira_sagar_da	12200.00	263.13	26/09/24 09:00	138.11	1597.93	1514.00	83.93	5.25
	Omkareshwar	1500.00	201.20	26/09/24 09:00	115.16	1332.40	1943.00	-610.60	-45.83
	Tawa_dam	2310.00	355.40	26/09/24 09:00	12.22	141.39	182.00	-40.61	-28.73
26.09.2024	Bargi_dam	3920.00	422.00	27/09/24 09:00	41.29	477.73	1368.00	-890.27	-186.36
	Barna	539.00	348.55	27/09/24 09:00	3.76	43.50	26.50	17.00	39.08
	Indira_sagar_da	12200.00	263.13	27/09/24 09:00	184.88	2139.06	1200.00	939.06	43.90
	Omkareshwar	1500.00	201.20	27/09/24 09:00	183.46	2122.63	1945.00	177.63	8.37
	Tawa_dam	2310.00	355.40	27/09/24 09:00	31.46	363.99	366.00	-2.01	-0.55
27.09.2024	Bargi_dam	3920.00	422.00	28/09/24 09:00	229.70	2657.63	1252.00	1405.63	52.89
	Barna	539.00	348.55	28/09/24 09:00	1.97	22.79	198.84	-176.05	-772.38
	Indira_sagar_da	12200.00	263.13	28/09/24 09:00	173.19	2003.81	1853.00	150.81	7.53
	Omkareshwar	1500.00	201.20	28/09/24 09:00	21.21	245.40	1540.00	-1294.60	-527.55
	Tawa_dam	2310.00	355.40	28/09/24 09:00	196.68	2275.59	228.00	2047.59	89.98
28.09.2024	Bargi_dam	3920.00	422.00	29/09/24 09:00	81.11	938.44	939.00	-0.56	-0.06
	Barna	539.00	348.55	29/09/24 09:00	12.41	143.58	36.70	106.88	74.44
	Indira_sagar_da	12200.00	263.13	29/09/24 09:00	145.74	1686.21	1877.00	-190.79	-11.31
	Omkareshwar	1500.00	201.20	29/09/24 09:00	23.82	275.60	1627.00	-1351.40	-490.35

	Tawa_dam	2310.00	355.40	29/09/24 09:00	239.85	2775.06	114.00	2661.06	95.89
29.09.2024	Bargi_dam	3920.00	422.00	30/09/24 09:00	86.91	1005.55	997.00	8.55	0.85
	Barna	539.00	348.55	30/09/24 09:00	2.04	23.60	22.34	1.26	5.35
	Indira_sagar_da	12200.00	263.13	30/09/24 09:00	145.61	1684.71	1704.00	-19.29	-1.15
	Omkareshwar	1500.00	201.20	30/09/24 09:00	12.29	142.20	1637.00	-1494.80	-1051.23
	Tawa_dam	2310.00	355.40	30/09/24 09:00	202.08	2338.07	114.00	2224.07	95.12
30.09.2024	Bargi_dam	3920.00	422.00	45301.38	52.99	613.09	338.00	275.09	44.87
	Barna	539.00	348.55	45301.38	2.65	30.66	0.00	30.66	100.00
	Indira_sagar_da	12200.00	263.13	45301.38	143.79	1663.65	1710.00	-46.35	-2.79
	Omkareshwar	1500.00	201.20	45301.38	176.03	2036.67	1562.00	474.67	23.31
	Tawa_dam	2310.00	355.40	45301.38	7.94	91.87	45.00	46.87	51.02
01.10.2024	Bargi_dam	3920.00	422.00	45332.38	48.89	565.66	463.00	102.66	18.15
	Barna	539.00	348.55	45332.38	2.04	23.60	0.00	23.60	100.00
	Indira_sagar_da	12200.00	263.13	45332.38	131.76	1524.46	1642.00	-117.54	-7.71
	Omkareshwar	1500.00	201.20	45332.38	6.87	79.49	1631.00	-1551.51	-1951.94
	Tawa_dam	2310.00	355.40	45332.38	153.66	1777.85	114.00	1663.85	93.59
02.10.2024	Bargi_dam	3920.00	422.00	45361.38	1.72	19.90	255.00	-235.10	-1181.38
	Barna	539.00	348.55	45361.38	51.98	601.41	0.00	601.41	100.00
	Indira_sagar_da	12200.00	263.13	45361.38	124.84	1444.40	1933.00	-488.60	-33.83
	Omkareshwar	1500.00	201.20	45361.38	132.48	1532.79	1451.00	81.79	5.34
	Tawa_dam	2310.00	355.40	45361.38	4.34	50.21	94.00	-43.79	-87.20
03.10.2024	Bargi_dam	3920.00	422.00	45392.38	1.58	18.28	255.00	-236.72	-1294.92
	Barna	539.00	348.55	45392.38	45.62	527.82	0.00	527.82	100.00
	Indira_sagar_da	12200.00	263.13	45392.38	110.06	1273.39	1667.00	-393.61	-30.91
	Omkareshwar	1500.00	201.20	45392.38	118.03	1365.61	1398.00	-32.39	-2.37
	Tawa_dam	2310.00	355.40	45392.38	3.80	43.97	30.00	13.97	31.77
04.10.2024	Bargi_dam	3920.00	422.00	45422.38	20.24	234.18	262.00	-27.82	-11.88
	Barna	539.00	348.55	45422.38	1.51	17.47	0.00	17.47	100.00
	Indira_sagar_da	12200.00	263.13	45422.38	150.35	1739.55	1454.00	285.55	16.42
	Omkareshwar	1500.00	201.20	45422.38	3.57	41.30	1474.00	-1432.70	-3468.58
	Tawa_dam	2310.00	355.40	45422.38	103.71	1199.92	35.00	1164.92	97.08
05.10.2024	Bargi_dam	3920.00	422.00	45453.38	19.48	225.38	256.00	-30.62	-13.58
	Barna	539.00	348.55	45453.38	1.48	17.12	0.00	17.12	100.00
	Indira_sagar_da	12200.00	263.13	45453.38	138.95	1607.65	1075.00	532.65	33.13
	Omkareshwar	1500.00	201.20	45453.38	3.46	40.03	1347.00	-1306.97	-3264.79
	Tawa_dam	2310.00	355.40	45453.38	96.94	1121.60	35.00	1086.60	96.88
06.10.2024	Bargi_dam	3920.00	422.00	45483.38	19.04	220.29	102.00	118.29	53.70

	Barna	539.00	348.55	45483.38	1.46	16.89	0.00	16.89	100.00
	Indira_sagar_da	12200.00	263.13	45483.38	111.64	1291.67	797.00	494.67	38.30
	Omkareshwar	1500.00	201.20	45483.38	91.12	1054.26	1037.00	17.26	1.64
	Tawa_dam	2310.00	355.40	45483.38	3.40	39.34	35.00	4.34	11.03
07.10.2024	Bargi_dam	3920.00	422.00	45514.38	18.77	217.17	90.00	127.17	58.56
	Barna	539.00	348.55	45514.38	1.44	16.66	0.00	16.66	100.00
	Indira_sagar_da	12200.00	263.13	45514.38	93.72	1084.34	860.00	224.34	20.69
	Omkareshwar	1500.00	201.20	45514.38	88.07	1018.97	1168.00	-149.03	-14.63
	Tawa_dam	2310.00	355.40	45514.38	3.36	38.88	40.00	-1.12	-2.89
08.10.2024	Bargi_dam	3920.00	422.00	45545.38	18.58	214.97	252.00	-37.03	-17.23
	Barna	539.00	348.55	45545.38	1.42	16.43	0.00	16.43	100.00
	Indira_sagar_da	12200.00	263.13	45545.38	93.39	1080.52	652.00	428.52	39.66
	Omkareshwar	1500.00	201.20	45545.38	3.32	38.41	834.00	-795.59	-2071.17
	Tawa_dam	2310.00	355.40	45545.38	86.05	995.60	35.00	960.60	96.48
09.10.2024	Bargi_dam	3920.00	422.00	45575.38	18.89	218.56	71.00	147.56	67.51
	Barna	539.00	348.55	45575.38	1.41	16.31	0.00	16.31	100.00
	Indira_sagar_da	12200.00	263.13	45575.38	84.72	980.21	599.00	381.21	38.89
	Omkareshwar	1500.00	201.20	45575.38	84.67	979.63	445.00	534.63	54.57
	Tawa_dam	2310.00	355.40	45575.38	3.30	38.18	35.00	3.18	8.33
10.10.2024	Bargi_dam	3920.00	422.00	45606.38	24.49	283.35	230.00	53.35	18.83
	Barna	539.00	348.55	45606.38	1.40	16.20		16.20	100.00
	Indira_sagar_da	12200.00	263.13	45606.38	84.10	973.04	704.00	269.04	27.65
	Omkareshwar	1500.00	201.20	45606.38	84.24	974.66	180.00	794.66	81.53
	Tawa_dam	2310.00	355.40	45606.38	3.27	37.83	35.00	2.83	7.49
12.10.2024	Bargi_dam	3920.00	422.00	13/10/24 09:00	20.05	231.98	241.00	-9.02	-3.89
	Barna	539.00	348.55	13/10/24 09:00	1.39	16.08		16.08	100.00
	Indira_sagar_da	12200.00	263.13	13/10/24 09:00	82.87	958.81	1253.00	-294.19	-30.68
	Omkareshwar	1500.00	201.20	13/10/24 09:00	7.64	88.39	913.00	-824.61	-932.87
	Tawa_dam	2310.00	355.40	13/10/24 09:00	130.69	1512.08	212.00	1300.08	85.98
13.10.2024	Bargi_dam	3920.00	422.00	14/10/24 09:00	18.23	210.92	222.00	-11.08	-5.25
	Barna	539.00	348.55	14/10/24 09:00	1.36	15.74		15.74	100.00
	Indira_sagar_da	12200.00	263.13	14/10/24 09:00	104.99	1214.73	614.00	600.73	49.45
	Omkareshwar	1500.00	201.20	14/10/24 09:00	16.29	188.48	533.00	-344.52	-182.80
	Tawa_dam	2310.00	355.40	14/10/24 09:00	106.44	1231.51	182.00	1049.51	85.22
14.10.2024	Bargi_dam	3920.00	422.00	15/10/24 09:00	17.96	207.80	219.00	-11.20	-5.39

	Barna	539.00	348.55	15/10/24 09:00	2.20	25.45		25.45	100.00
	Indira_sagar_da	12200.00	263.13	15/10/24 09:00	110.92	1283.34	993.00	290.34	22.62
	Omkareshwar	1500.00	201.20	15/10/24 09:00	20.27	234.52	697.00	-462.48	-197.20
	Tawa_dam	2310.00	355.40	15/10/24 09:00	115.89	1340.85	182.00	1158.85	86.43
15.10.2024	Bargi_dam	3920.00	422.00	16/10/24 09:00	17.63	203.98	203.00	0.98	0.48
	Barna	539.00	348.55	16/10/24 09:00	3.74	43.27		43.27	100.00
	Indira_sagar_da	12200.00	263.13	16/10/24 09:00	118.75	1373.94	1186.00	187.94	13.68
	Omkareshwar	1500.00	201.20	16/10/24 09:00	10.72	124.03	1198.00	-1073.97	-865.89
	Tawa_dam	2310.00	355.40	16/10/24 09:00	117.57	1360.28	114.00	1246.28	91.62

CHAPTER-10

COORDINATION WITH STATE AGENCIES

The success of flood forecasting activities depends on the proper utilisation of information by state agencies. To counter the flood havoc and reducing the flood damages, various state agencies contribute their part. The list of various state agencies informed during flood season 2024 is as follows:

Table 10.1 List of User Agencies

S. No	Name of Agency
1	Director FFM, CWC, New Delhi
2	Director IMD, Bhopal
3	Director IMD, Ahmedabad
4	State Data Centre Bhopal (Flood Cell)
5	Relief Commissioner, Mantralay, Bhopal
6	Deputy Commissioner (Relief), Mantralay, Bhopal
7	Chief Secretary, Govt. of MP, Mantralay, Bhopal
8	Deputy Commissioner, SDMA, Bhopal
9	Collector, Mandla
10	SP, Mandla
11	Dist. Commandant, Home Guard, Mandla
12	EE, Irrigation Division, Mandla
13	CMO, Flood Control Room, Mandla
14	Officer In-charge, Flood Control Room, Mandla
15	Flood Relief Officer, Narsinghpur
16	Collector, Narmadapuram
17	SP, Narmadapuram
18	SE, Tawa Circle, Narmadapuram
19	In-charge, Flood Control Room, NVDA, Bhopal
20	In-charge, Flood Control Room, Narmadapuram
21	Chief Engineer, Rani Avanti Bai Dam (Bargi), NVDA, Jabalpur
22	EE, Rani Avanti Bai Dam (Bargi), Jabalpur
23	Member, NVDA, Bhopal
24	Member (Engineering), NVDA, Bhopal
25	Executive Engineer, NVDA, Barwani
26	EE, NVDA for Collector Barwani
27	EE(M&E), NVDA, Indore
28	EE, Design, NVDA, Bhopal
29	Water Resource Department, Bhopal
30	EE, Indirasagar Dam, Punasa, Khandwa
31	EE, Omkareshwar Dam, Khandwa
32	EE, Barna Dam, Raisen

Address of CWC Authorities			
Name	**Designation**	**E-Mail ID**	**Mobile Number**
FFM Directorate, New Delhi	FMDTE	fmdte@nic.in	
FFM Directorate, New Delhi	FFM CWC	ffmcwc@gmail.com	
Cini Menos	D.D.(HM)	ffmcwc@gmail.com	9205953500
Aditya Sharma	CE. NBO	cenbo-cwc@nic.in	9717200563
Neelam Naroliya	SE Cord	secobhopal-cwc@nic.in	9990808371
MK Gupta	DD	gupta_mkg@yahoo.com	9424708607
Karan Saini	EE	karansaini-cwc@gov.in	9111999613
Manish Sharma	AD II	manishsharma-cwc@gov.in	7898723484
Dr. Rajesh Kumar Dube	EAD(HM)	rkdube65@gmail.com	7067990490
Santosh Kumar	SDE (HQ)	santoshkumar-cwc@gov.in	9752388559
Giriraj Singh Dangi	SDE Jabalpur	sde_cwcjabalpur@rediffmail.com	8982497286
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Akash Mardane	JE Mandleshwar	akashmardane123@gmail.com	7987488581
Adarsh Shukla	JE Sub Div Bhopal	adarshshukla-cwc@gov.in	9311055105
Jyoti Kushwaha	Senior Computer (NDB)	jyoti.kushwaha-cwc@gov.in	8989856208
R.S.Bachhav	W/I	rsbachhav65@gmail.com	9893693105
Anurag Pratap Singh	JE Manot	anuragpsingh-cwc@gov.in	7748820828
Prashant Shankar Pandey	JE Narmadapuram	prashantpandey-cwc@gov.in	9999070240
Shubham Dwivedi	JE Narmadapuram	shubhamcwc@gmail.com	8770432295
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ISP Control Room	ISP Control Room		9630701352
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Mr. Shishir Kushwaha	Member Power. NVDA, CE WRD, Kolar and Tawa Dam	ceomwrd@rediffmail.com	9425019042
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Abhay Kandpal	JE Tapi Division	ee.tapi-cwc@gov.in	7668594541
Naresh Podwal	EE Mahi Division Surat Gandhinagar		8160495513
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Sanjiv Yadav	NHDC Bhopal		9425756613
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Incharge Tashildar Mandla	Incharge tashildar Mandla		9893414794
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CHAPTER-11

PROBLEMS FACED AND DIFFICULTIES NOTICED DURING MONSOON - 2024

The catchments area between Dindori to Mandla and Barmanghat to Narmadapuram are very large and also rain fed. Gauge to Gauge co-relation for this reach is not giving desired results and thus discharge method is being used for flood forecasting of Mandla and Narmadapuram. Due to above problem, performance for these sites is affected. Communication system at Barna Dam for release may be made to improve the performance of forecast for Narmadapuram. For this purpose, one gauge site opened at Barna dam under DWRIS plan Scheme.

The performance of Network was excellent and Telephones at vital sites has provided valuable information during this Monsoon and every official engaged in FF work has performed his duties excellently with full sincerity. A TV set (LCD/LED) have been installed in the office of Executive Engineer and Narmadapuram FF Control room for live news coverage of FF related events to take necessary steps for smooth functioning of FF related works.

Though Narmada Division is entrusted with the various types of works like flood forecasting, conducting hydrological observations, carrying out various deposit works undertaken by Narmada Basin Organisation etc. and has a wide jurisdiction in state of Madhya Pradesh yet the staff strength provided is inadequate, even the sanctioned posts are not filled. The deficiencies observed which are required to be dealt with are as follows:

1. The vacant post of Senior Computor in Division office is required to be filled as this post is very essential for proper assessment of floods, formulation of forecasts and its dissemination as well as updation during monsoon season and for preparation of Flood Appraisal Report.
2. In order to make the staff involved in flood forecast work well conversant with meteorological aspects and its applications in flood forecasting, it is suggested that the staff should imparted training at regular intervals in meteorology and other aspects of flood forecast.
3. For round the clock monitoring of telemetry data and its installations the vacant post of J.E (Communication) should be filled immediately for smooth functioning of flood forecasting activities as in future only telemetry data will be used in formulation of flood forecasts.
4. Absence of adequate staff at sites.
5. During monsoon period hourly data entry of all 68 sites has been done in WIMS by the respective Sub Divisions. Like DFCR all three Sub Divisions needed sufficient number of outsource staff to receive and to make hourly data entry in WIMS as well as in Google sheet to facilitate the user agencies round the clock.
6. During non-monsoon period at least one no. of Data Entry operators are required in division as well as in sub-divisions for timely entry of three hourly data in WIMS portal.

CHAPTER-12
SPECIFIC MODERNISATION EFFORTS

Presently, conventional methods of flood level forecast are being used for both the sites for flood forecast. Most of the work is being done manually and performance is satisfactory. Satellite images and weather reports available at website of Indian Meteorological Department also helped a lot in monitoring the movement of storm/ depression zone over basin during monsoon.

Various steps are taken and further required to be taken to modernise the existing network so that the deficiencies can be sorted out, are listed as follows;

1. A mathematical model for flood forecasting by using software like MIKE-11 etc. shall be attempted and be revalidated by actual hydrological condition during floods at site.
2. Efforts for providing and using communication facilities like Telephone/ mobile phone to all sites are on.
3. Internet facility at all Sub division has been installed to download Weather reports and Satellite images available at different Web sites proved more helpful to formulate accurate forecast.
4. The facility at Mandla site is also required to be modernised for better communication.
5. The Flood Forecast has been uploaded on WIMS portal for beneficiaries and general public use.
6. 13 Nos. of Telemtry stations performed successfully during the Monsoon 2024 and provided great help in Flood Forecasting activities.

Modernization through Advancement of New Technology

Now a days Central Water Commission have adopted new technologies i.e., Automatic Real time data acquisition and communication system i.e., Telemetry Data and MIKE-11 Software for the development of basin specific forecast models. Most of these models are in its calibration stage and are giving good results. With the help of this software CWC has started issuing 7-days advisory forecast based on rainfall runoff modelling (using 7-days QPF of IMD). This advisory can be viewed on CWC AFF (Beta) website for providing real-time mapping and delivery of forecast and flood inundation extent on the internet in advance. These technologies use accurate ground-elevation data, robust flood plain hydraulic models and new spatial information technology and internet map-serving software. Adoption of the technologies has significantly enhanced the qualitative value of flood forecasts issued by CWC in India. For the enhancement of forecast qualitatively and providing Inundation forecast CWC has started Google Cap alerts in collaboration with Google

CHAPTER-13
CONCLUSION

Flood forecasting plays a vital role in minimizing flood damages. Existing methods are giving fairly good results. The coordination between Bargi and Tawa Project Authorities to release water can be even more helpful in reducing severity of flood at Narmadapuram.

This year, monsoon spells started in fourth week of June and showered up to the first week of October. The rainfall pattern was uneven having less number of rainy days in June and August. The rainfall was slightly higher to the Normal rainfall in some parts and below normal in other parts in the Narmada Basin. The distribution of rainfall was not even, causing lesser number of rainy days at some stations whereas a greater number of rainy days at other stations. Most of the rain took place in the months of July and September with moderate to high intensity. All the reservoirs situated in Narmada Basin touched their FRL in September itself and the Dam authorities were compelled to release the excess water cautiously to prevent flooding in downstream areas. During entire monsoon period river Narmada experienced two flood waves at Mandla and Narmadapuram. During the season 04 Nos. of sites recorded New HFL details of which are given below in table. In this season 27 Nos. of level forecasts were issued for Mandla and Narmadapuram with 100% accuracy. Apart from these 105 Nos. of Advisory Inflow forecasts for five Reservoirs were issued with 100% accuracy.

During entire monsoon season the whole communication was done through Telephone and Mobiles without any interruption.

The vacant posts of J. E. (Comm.) and Senior Computor at Bhopal Division may be filled immediately to avoid any chance of error in flood forecast and to upgrade flood forecast formulation.

In order to modernize the flood forecasting system at least two/ three officials from division should be imparted proper training in Basin/ Flood simulation using computers.

The official Mobile Phone facility should be made available to all the staff of sites, Sub Division and Division office who are involved in FF activity for timely dissemination of flood warnings.

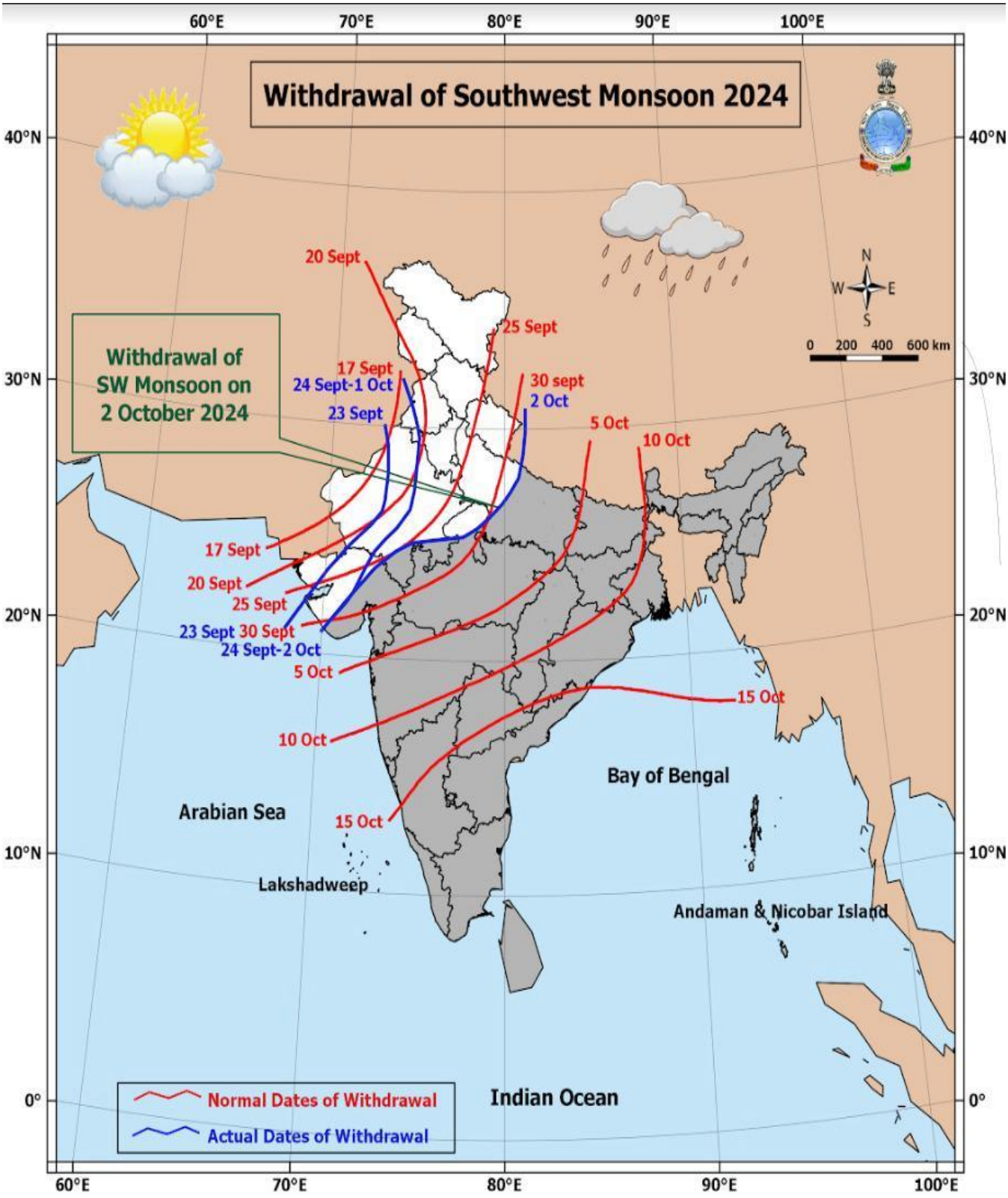
Withdrawal of Southwest Monsoon 2024
Withdrawal of SW Monsoon on 2 October 2024
60°E
70°E
80°E
90°E
100°E
40°N
30°N
20°N
10°N
0°
N
W
E
S
0 200 400 600 km
20 Sept
25 Sept
17 Sept
24 Sept-1 Oct
23 Sept
30 sept
2 Oct
5 Oct
10 Oct
17 Sept
20 Sept
25 Sept
23 Sept 30 Sept
24 Sept-2 Oct
5 Oct
15 Oct
10 Oct
15 Oct
Bay of Bengal
Arabian Sea
Lakshadweep
Andaman & Nicobar Island
Indian Ocean
Normal Dates of Withdrawal
Actual Dates of Withdrawal

Figure- 13.1