BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI
O.A. NO. 515 OF 2023

IN THE MATTER OF: -

GANGA POLLUTION **...APPLICANT**

VERSUS

STATE OF U.P & ORS. **...RESPONDENTS**

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FILED BY
BHANWAR PAL SINGH JADON
STANDING COUNSEL FOR
THE STATE OF UTTAR PRADESH
EMAIL- bhanwar09jadon@gmail.com

DATE: 09.11.2024
PLACE: NOIDA

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

O.A. NO. 515 OF 2023

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PROGRESS REPORT ON BEHALF OF PRINCIPAL SECRETARY, IRRIGATION DEPARTMENT, STATE OF UTTAR PRADESH IN COMPLIANCE WITH THE ORDER DATED 19.09.2024 ALONGWITH THE AFFIDAVIT

1. That in the present Original Application 515/2023 Ganga Pollution vs. State of U.P the core issue involve is defining the flood plain zone of river Ganga and its tributaries in the State of UP and actions taken by the concerned authorities to protect the flood plain zone.

2. That the matter was listed on 19.09.2024 and the Hon'ble Tribunal was pleased to pass the following order:

> *"...7. Learned Counsel for the State has submitted that the draft of the final report will be submitted by NIH to the State by 15.10.2024 and the report will be finalized by the State by 30.10.2024.*
>
> *8. Hence, we require the State to file the progress report by 07.11.2024..."*

3. It is humbly submitted that the memorandum of agreement was signed between the National Institute of Hydrology (hereinafter referred as NIH) and Superintending Engineer, Flood Management Information Centre System on 22.12.2023 after the approval of Chief Engineer for the demarcation of the flood plain zone as per (Rejuvenation, Protection and Management) Authorities order, 2016.

4. It is submitted that the State of U.P. filed a report on 24.05.2024 with respect to the demarcation of the floodplain zone and the relevant portion of the Report is reproduced herein:

> ***Conclusion:***
>
> *5. This comprehensive approach, combining flood frequency analysis, satellite data, and hydraulic modelling, will ensure accurate delineation and demarcation of the Flood Plain Zones for Segment B, Phase II (Unnao to Ballia) of the River Ganga, in compliance with the Hon'ble Tribunal's directives.* ***It is submitted that the entire process for the earmarking of the flood plain zone would be completed by the December, 2024 by NIH as per the MOA which is executed between the State Govt. and the National Institute of Hydrology.***

5. That the matter was listed for hearing on 27.05.2024, during the hearing the Counsel appearing for the State submitted that the NIH will be able to submit **the Interim Report by October, 2024** and completion of work defined in the agreement dated 22.12.2023 will be completed by **December, 2024**

6. It is important to highlight that all the necessary data, as requested, was duly submitted to the NIH for the precise demarcation of the floodplain

zone. **In accordance with the commitments outlined in their previous report, the NIH has completed the task and sent the draft of the final report to the concerned authorities on 16.10.2024.** This submission was made in full compliance with the directions issued by this Hon'ble Tribunal in its prior order, ensuring that all procedural requirements were met within the stipulated timeline.

True copy of **the report** sent through mail dated 16.10.2024 is attached herein as **ANNEXURE R1.**

7. It is also important to mention that **a Review Meeting** was organized by the Flood Management Information System Centre **on 18.10.2024**, via video conferencing, following the submission of the NIH report. During this meeting, irrigation officers deliberated on additional data and information, addressing specific concerns raised regarding the contents of the report.

   The points of concern discussed and resolved in the meeting are outlined below:

   1. Required a Descriptive Report with the Location map of Study Area.

   2. On page no-4, the 2nd point of 3.1 Data mentioned that "30m grid spacing FABDEM Is this data used in the project?

   3. On page no-4, Fig-2-Location of GAD sites and their Catchment area, kindly mention the catchment area in tabular form and show the Catchment boundary on the map with the Legend.

   4. Provide the width of the flood plain delineation at each gauge and cross-section, as well as the area at the upstream and downstream gauges cross-sections.

   5. Provide information about the average width, Water Level and total area of the flood plain.

6. Explain the process with Flowchart diagram, snapshots at different stages of analysis which is used in Hec-Hms & Hec RAS in ID and 2D modelling. Also provide their outputs in kml/GIS format.

7. Compare the results obtained in the present sidy (Le delineation of FPZ from Unnao to Ballia) with the results of FPZ phase I segment-B (Le. Haridwar to Unnao) done by CWC.

8. Explain the role of GIS software's in the project.

9. Provide detail of HFL at gauge sites/cross sections.

10. Share data of JRC committee for review purpose.

11. Describe the methods used for flood frequency analysis and also explain their results.

12. Full form of abbreviations used in this report.

13. After plotting the result on ARCGIS it is found that outer boundary of 100 years delineation coincides with the embankment at locations. Details of embankments should not be considered in analysis. Flood and flood plain are different things, flood plains should not be restricted by embankments.

It is submitted that CWC conducted the Phase I flood plain zone demarcation in which embankment was not included, however, in Phase II the NIH has included the embankment, therefore, an uniformity in both the Phases i.e. Phase I (Haridwar to Unnao) and Phase II (Unnao to Ballia) in the demarcation of the flood plain zone was needed. Hence, it has been requested to the NIH to give the final draft report after considering the objections raised in the meeting.

8. It is important to mention here that the above stated points have been formally communicated to Dr. A.K. Lohani, Scientist-G, Division Head at the NIH, by the Executive Engineer, Flood Management Information System Centre, Irrigation and Water Resources Department, Uttar Pradesh, through letter No. 333/ADMN./FMISC/Lucknow, dated 21.10.2024. **This was done for conducting a comparative study to minimize the errors in the work of the Flood Plain Zone.**

   True copy of letter no. 333/admn./FMISC/Lucknow, dated 21.10.2024 is attached herein as **ANNEXURE R2.**

9. It is important to note that, pursuant to letter no. 217/ADMN./FMISC/Lucknow, dated 4.11.2024, from the Office of the Superintending Engineer, Flood Management and Information System Centre (FMISC), addressed to Dr. A.K. Lohani, Scientist-G, Division Head, NIH, the matter regarding the inclusion of an additional floodplain delineation scenario, which excludes the consideration of embankments, was discussed.

   True copy of vide letter no 217/admn./FMISC/Lucknow, dated 4.11.2024 is attached herein as **ANNEXURE R3.**

10. It is submitted that, in response to the above letter, NIH sent an Email to the Superintending Engineer on 04.11.2024 stating that NIH has submitted the draft report on 16 October 2024 having delineated flood plain corresponding to 100 year return period flood based on the Survey of India DEM. Both shape file & KML files along with coordinates in tabular form (Excel file) are also submitted for review by the Irrigation Department, UP. In response (dated 21 October 2024) has provided comments to NIH on the draft report, During online meetings and telephonic discussions with the

officers of Irrigation Dept, it was requested to include another scenario of floodplain delineation without consideration of embankments.

The modelling exercises for this additional scenario is being carried out. Since this requires necessary modification of SOI DEM (removal of embankment) and subsequently HEC-RAS simulation and GIS processing of results, this will take some time. It is expected that the modified draft report addressing all observations of the Irrigation Department (dated 21 October 2024) will be submitted by 29 November 2024, It is also requested to provide the results (shape files) and report of Phase-I for comparison as mentioned at observation no7.

True copy of mail dated 04.11.2024 is attached herein as **ANNEXURE R4.**

11. It is respectfully submitted that at the ground level, the staff / officers of Irrigation department, State of UP has started the process of ground truth verification **for the entire stretch except the embankment stretch.** This crucial verification is being conducted to ensure the accuracy and reliability of the data related to the project. The department is actively engaged in this task.

True copy of Photographs of Ground truth verification is annexed herein as ANNEXURE R5

12. That the Irrigation Department of the State of Uttar Pradesh is fully committed to adhering to the directives of the Hon'ble Tribunal and ensuring compliance with the statutory orders outlined in the Ganga Rejuvenation Order, 2016 and **again reaffirm the commitment to complete the work i.e. the delineation of flood Plain zone of second Phase II { Unnao to Ballia } by Decemebr 2024.**

4

Hence the present progress report is submitted for the kind perusal and further direction of this Hon'ble Tribunal.

FILED BY

BHANWAR PAL SINGH JADON
STANDING COUNSEL FOR
THE STATE OF UTTAR PRADESH
EMAIL- bhanwar09jadon@gmail.com

DATE: 09.11.2024
PLACE: NOIDA

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
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O.A. NO. 515 OF 2023

IN THE MATTER OF: -

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VERSUS

STATE OF U.P & ORS. ...RESPONDENTS

AFFIDAVIT

I, Anil Garg, S/o Shri Ratan Lal Garg, aged about 54 years presently posted as Principal Secretary, Irrigation do hereby solemnly affirm and state as under:

1. That I, in the abovementioned capacity, am fully and well conversant with the facts and circumstances of the case and competent to swear the present Affidavit.

2. That I have gone through the contents of the accompanying reply/progress report and the contents of the same are true and correct as per my knowledge based on record and legal knowledge obtained.

3. That the contents of the accompanying reply may also be read as part and parcel of this affidavit which are not repealed herein for the sake of brevity.

DEPONENT

VERIFICATION

Verified at 03:00 P.M. on this 9th day of NOVEMBER, 2024, that the contents of the above affidavit are believed to be true and correct to the best of my knowledge and belief. No part of it is false and nothing material has been concealed therefrom.

DEPONENT

Oath Commissioner
Civil Secretariate
03:00 P.M.

कूपन सं0 0262001
द्वारा शपथ की गई अनिल गर्ग, प्रमुख सचिव, सिंचाई एवं जलसंसाधन विभाग उ०प्र० शासन।
जिनका परिचय श्री सूर्य नाथ उपाध्याय, अनु० अधि० " " " " "
दिनांक 09.11.24 समय 03:00 P.M.
वाद संख्या O.A. No. 515 of 2023
पक्षकार गंगा प्रदूषण कुंभ नाम उ० प्र० राज्य व अन्य।
न्यायालय मा० राष्ट्रीय हरित न्यायाधिकरण, नई दिल्ली।
की फीस वसूली गई.....

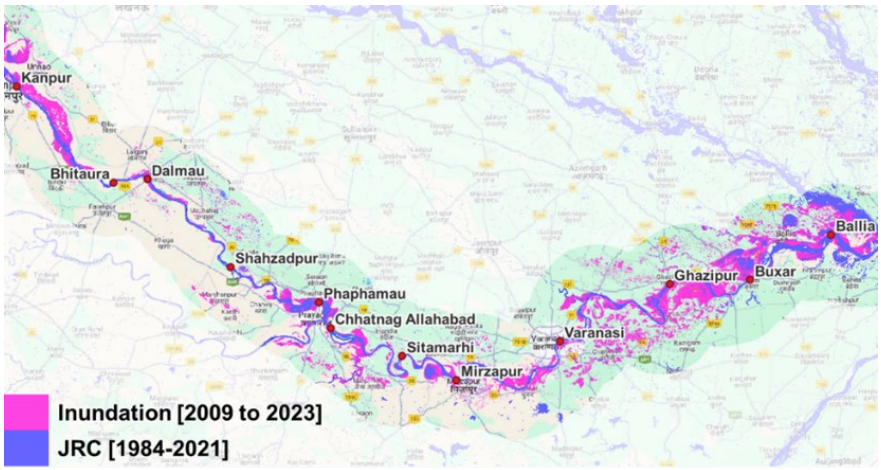
09.11.24
ब्रह्मानन्द मिश्र
शपथ आयुक्त एवं अनुभाग अधिकारी
न्याय अनुभाग-2
उ०प्र० शासन।

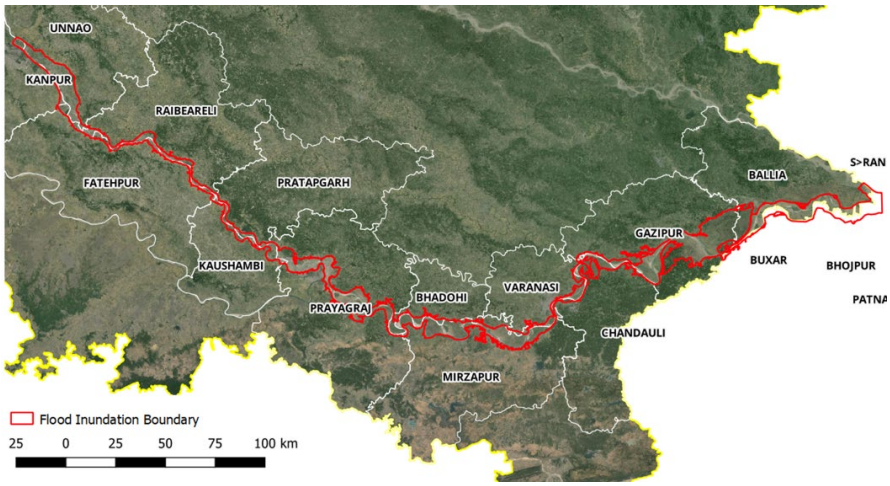
सूर्य नाथ उपाध्याय
9/11/2024
सूर्यनाथ अनुभाग अधिकारी
सिंचाई एवं जल संसाधन अनुभाग

1-IDENTIFY THE DEPONENT
WHO HAS SIGNED BEFORE ME

ANNEXURE R1

FLOOD PLAIN ZONE DELINEATION FROM UNNAO TO BALIA





National Institute of Hydrology

Jal Vigyan Bhawan, Roorkee (Uttarakhand) – 247667

October, 2024

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1 INTRODUCTION

Floods constitute one of the major national calamities faced by India almost every year resulting in substantial loss of life, large scale damage to property, disruption of community lifelines besides entailing untold misery to the millions. Concerted efforts have been made over the years to reduce the damage due to floods and mitigate the sufferings of the people. Various structural flood control measures were taken up in the past including construction of reservoirs, embankments, drainage channels, etc. It is, however, now realised that absolute and permanent protection to all flood prone areas and for all magnitudes of floods by structural measures alone is not only impossible but also not economically viable. The emphasis has therefore been rightly shifted to non-structural measures like Flood Plain Zoning and Regulation, Flood Forecasting, etc., to effectively supplement the structural measures for providing sustainable protection to flood affected areas. The broad concept in flood plain zoning is to regulate the land use in order to mitigate the damage potential. The role of flood plains and need for flood plain zoning was recognized by the Central Water Commission (CWC) as early as 1975. This bill envisages zoning of flood plain of a river according to flood frequencies and defines the type of use of flood plain. The States of Manipur, Rajasthan, Uttarakhand, and erstwhile State of Jammu & Kashmir had enacted the legislation.

In pursuance to the directions contained in the judgment passed by Hon'ble NGT a Report on identification and demarcation of the flood plains of river Ganga in segment B of Phase- I (Haridwar to Unnao) was prepared by CWC in 2019. Subsequently, the Irrigation and Water Resources Department, Govt. of UP has approached NIH Roorkee to carry out the study "Flood plain zone delineation from Unnao to Balia" as per direction given by Hon'ble NGT. This study was originally envisaged with similar methodologies as used by CWC in the earlier study for the Ganga River in the stretch of Haridwar to Unnao. However, as per direction given by Hon'ble NGT it was decided to first **demarcate the flood plain corresponding to once in hundred years return period flood**. Moreover, Chief Engineer (Ramganga) Irrigation and Water Resources Department, Kanpur requested to include the river stretch up to Ganga barrage,

2 OBJECTIVES AND SCOPE OF WORK

The original scope of the proposed work includes:

a. Identify and demarcate the flood plains of river Ganga in segment B of Phase-II on one in twenty-five year's cycle or appropriately.

b. Identify no development / construction zone, regulatory zone and the activities that can be/ cannot be carried on in the regulator y zone of the flood plain

However, as per direction given by Hon'ble NGT it was decided to first demarcate the flood plain corresponding to once in hundred years return period flood. Based on this the study has been carried out with following specific objectives.

- Estimation of floods of various return periods viz. 2 year, 3 year, 10 year, 25 year, 50 year and **100 year** at different gauging sites based on flood frequency analysis.
- Flood Plain Demarcation based on Satellite Data/Images.
- Flood Plain Demarcation based on hydraulic modelling.
- Demarcation of flood plain by combining results of Satellite Data/Images and hydraulic modelling.

3 STUDY AREA AND DATA

The study reach of Ganga river from Unnao to Balia is shown in Figure 1. The length of river stretch is about 700 km and 30 km buffer zone is also demarcated for analysis. Various data and information are collected from the Survey of India (SOI), Central Water Commission (CWC), Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP) and field survey by the Irrigation and Water Resources Department Govt. of U.P. and provided to NIH for this study.

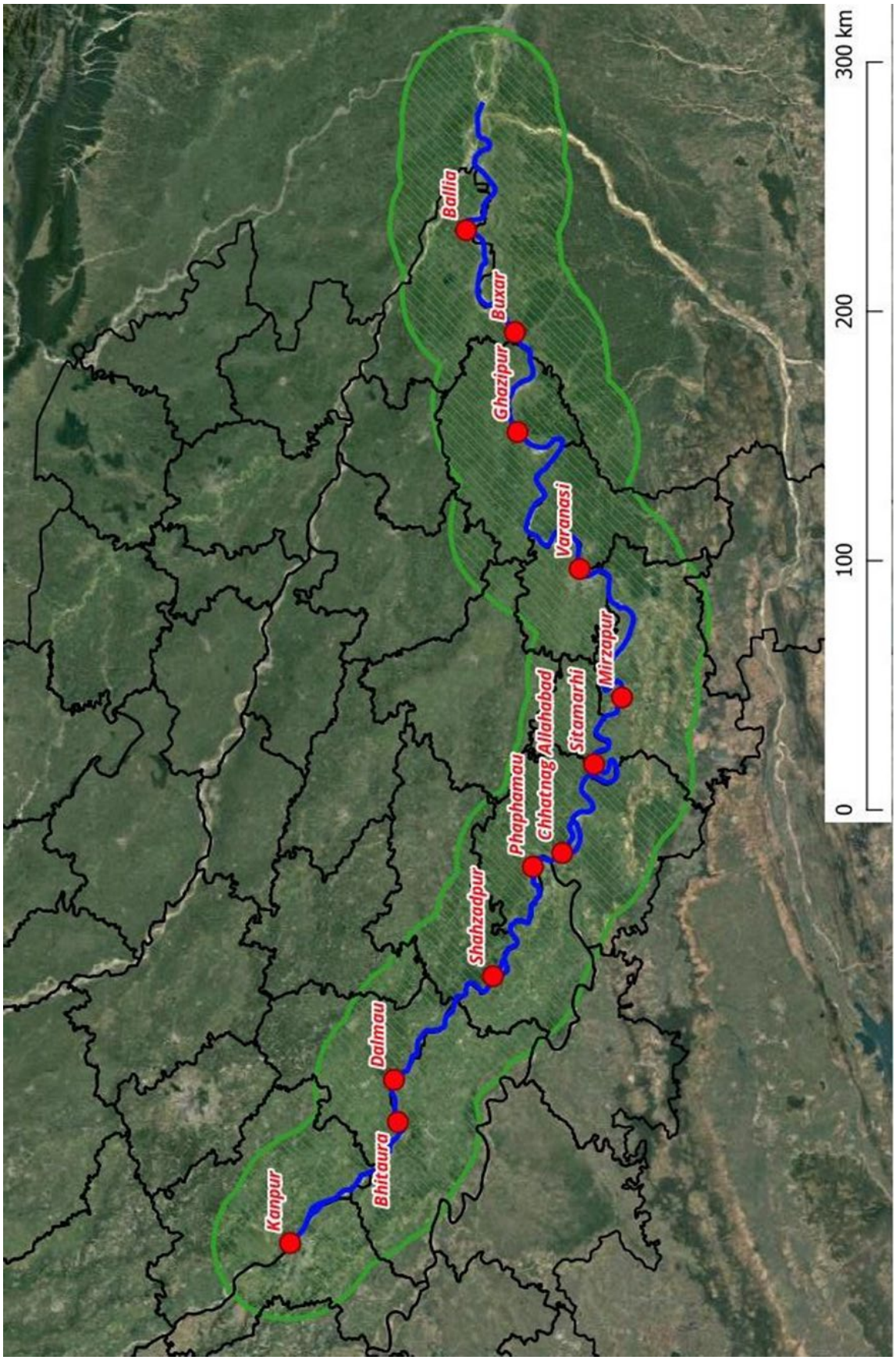


Figure 1: Index Map of the Study Area

3.1 Data

Following data/ information are used in this study

- 1 m grid spacing Digital Elevation Model (DEM) from the Survey of India.
- 30 m grid spacing FABDEM (Forest And Buildings removed Copernicus DEM).
- Historical Annual peak flood data of six CWC sites.
- Analyzed satellite datasets of Joint Research Commission- European commission for the period 1984-2021.
- Annual/ event wise flood extent layer extracted from remote sensing data for the period 2009 to 2023.
- Surveyed river cross-section and embankment data provided by Irrigation and Water Resources Department Govt. of U.P.

The locations of G&D sites (CWC) and contributing catchment area is shown in Figure 2. The long term annual maximum data and water level are available at six G&D sites. Details are given in Table 1.

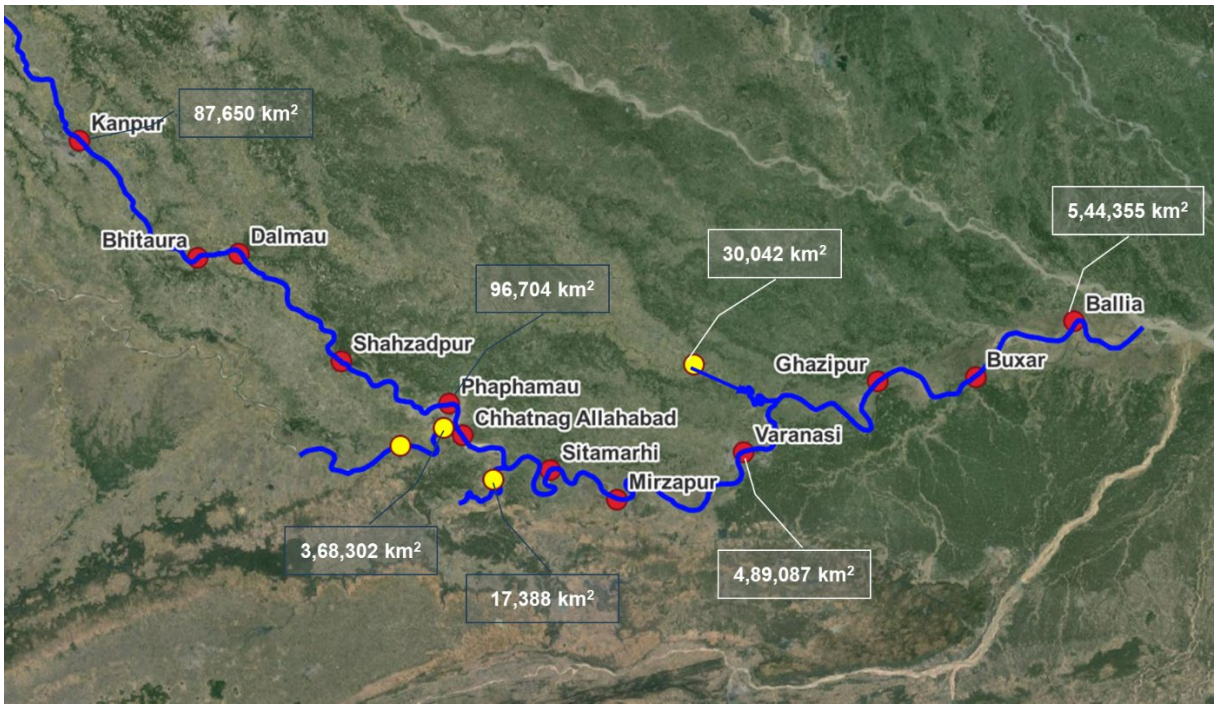


Figure 2: Location of G&D sites and their catchment area

Table 1: Summary of data availability at various G&D sites.

SN	HO Site	Data available
1	Kanpur	01/01/1974 to 28/02/2023
2	Bhitaura	01/01/1974 to 31/07/2023
3	Chhatang Allahabad	03/07/1970 to 20/07/2023
4	Mirzapur	01/06/1976 to 04/07/2023
5	Varanasi	01/01/1968 to 30/06/2023
6	Buxar	01/01/1974 to 15/08/2023

River cross-sections at these CWC's HO locations are provided to NIH. Further, river cross-sections at 43 locations surveyed by AECOM and Irrigation Dept. are also made available. The extent of DEM and location of surveyed Cross-sections are shown in Figure 3.

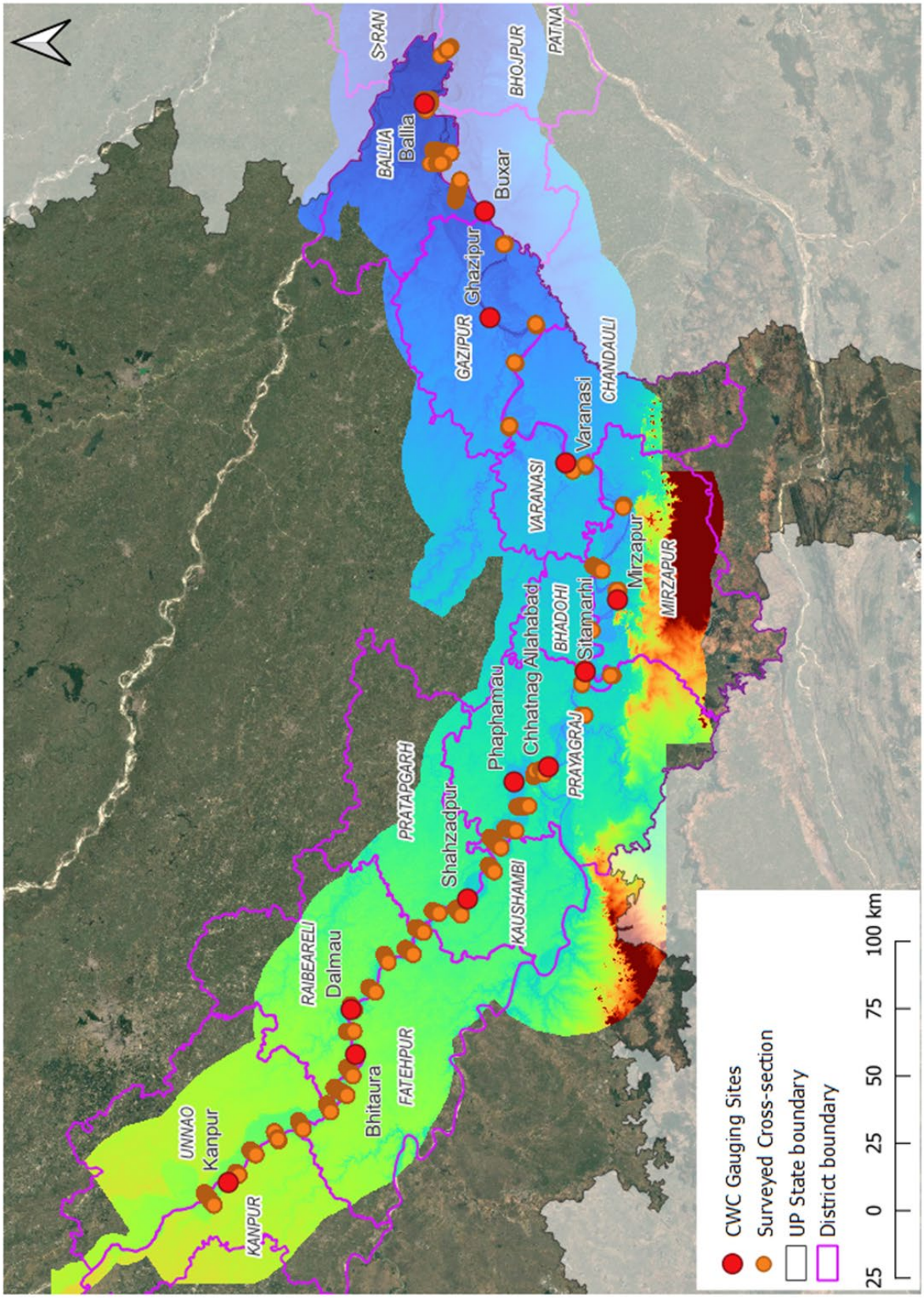


Figure 3: Extent of DEM and location of surveyed Cross-section

4 SOFTWARE USED

4.1 Hydraulic Model

HEC-RAS, a hydraulic model developed by the USACE, is extensively applied in calculating the hydraulic characteristics of rivers. It is an integrated program and uses the following energy equation for calculating water surface profiles:

$$Y_2 + Z_2 + \frac{\alpha_2 V_2^{\,2}}{2g} = Y_1 + Z_1 + \frac{\alpha_1 V_1^{2}}{2g} + h_e$$

Where Y, Z, V, α, $h\ e$, and g represent water depth, channel elevation, average velocity, velocity weighting coefficient, energy head loss, and gravitational acceleration; and subscripts 1 and 2, respectively, show cross sections 1 and 2. This program provides user to input data, data correction, to receive output display and analysis. HEC-RAS model needs details of river cross sections and upstream flow rate. The water depth and mean velocity are calculated for a given cross section using the energy conservation equation HEC-RAS calculates the water levels' variation along the channel and the water level values are overlaid on a digital elevation model (DEM) of the area to get the extent and flood depth using GIS. Spatial data like cross section, river reach, stream network, flow paths, and others have been obtained using RAS mapper of HEC-RAS.

The U. S. Army Corps of Engineers (USACE) developed HEC-RAS, and it is the latest product of 90 years of hydraulic modelling experience in the United States. Hydraulic modelling development began in the United States after a major flood event on the Mississippi River in 1927 prompting the USACE to begin exploring options to prevent flooding. The Hydrologic Engineering Centre (HEC) is a branch of the USACE that was established for the purpose of researching and developing new techniques to deal with the effects of floods (US Army Corps of Engineers). HEC originally began developing physical models to simulate river flow, but as technology progressed, computer programs that could simulate floods were developed. The computer models were then used to predict water surface profiles in response to potential future flood events and better prepare. The latest update on the program, HEC-RAS 6.5 includes capabilities to model the hydraulics of a river both one and two dimensionally. The three governing equations of hydraulics are the energy equation, the momentum equation, and the

continuity equation. One-dimensional HEC-RAS uses a variation of the energy equation in a procedure called the standard step method to calculate the water surface elevation corresponding to different discharges flowing through the hydraulic system being modelled.

The stand outputs of HEC RAS model is water surface elevation, depth and velocity. With use of DEM the inundation boundary and other maps can be generated in RAS mapper. These maps can be exported to as vector file (.shape) and raster file (.tif) for mapping and further analysis by GIS software.

4.2 Geographic Information System (GIS)

A Geographic Information System (GIS) is required for working with geographical data (both vector and raster) and preparation of maps. Built by Esri, ArcGIS is a comprehensive geospatial platform that integrates and connects data through the context of geography. It provides world-leading capabilities for creating, managing, analyzing, mapping, and sharing all types of data. In this study ArcGIS and QGIS an open-source software are used as GIS platform.

5 METHODOLOGY

All relevant data, information collected from various agency are analysed in the following manner:

5.1 Flood Frequency Analysis

The annual maximum discharge series of available six G&D sites are shown in Figure 4. The G&D site wise observed annual maximum discharge data are shown in Figure 5. Flood frequency analysis of annual maximum discharge series of available period has been carried out using the L-moments approach as described elsewhere (Hosking and Wallis, 1997; Kumar and Chatterjee, 2005). Twelve frequency distributions viz. extreme value (EV1), general extreme value (GEV), logistic (LOS), generalized logistic (GLO), normal (NOR), generalized pareto (GPA), generalized normal (GNO), uniform (UNF), exponential (EXP), pearson Type-III (PT3), kappa (KAP) and wakeby (WAK) have been used to identify robust distribution based on the L-moment ratio diagrams and the Z_i^{dist}–statistic criteria. The Estimated floods of

various return periods at six G&D sites are shown in Table 2. The best fitted frequency distribution for each site is also given in the bracket.

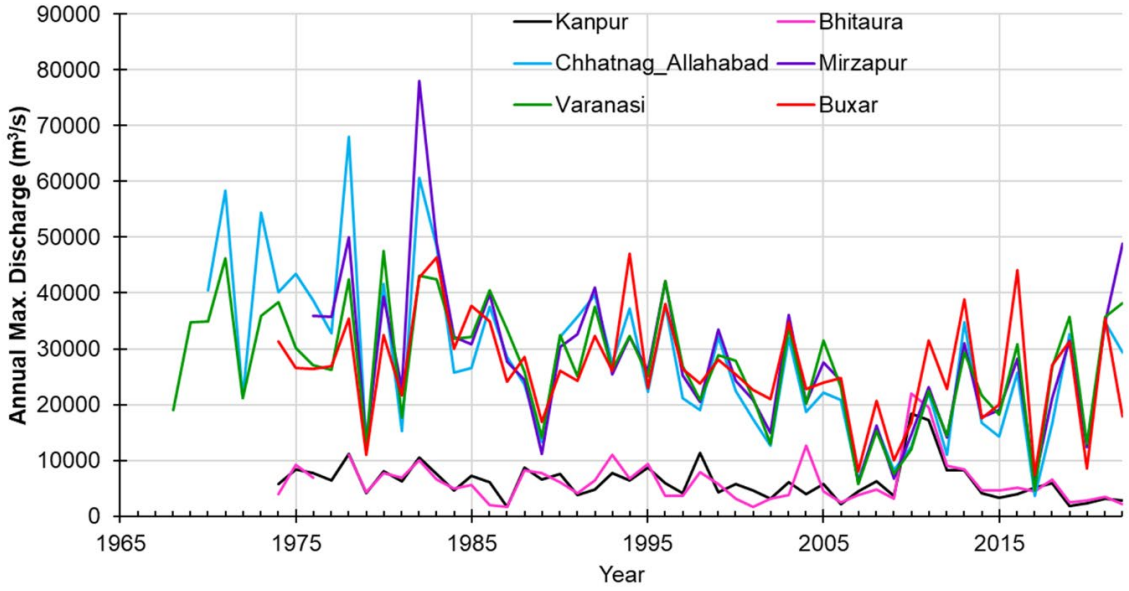
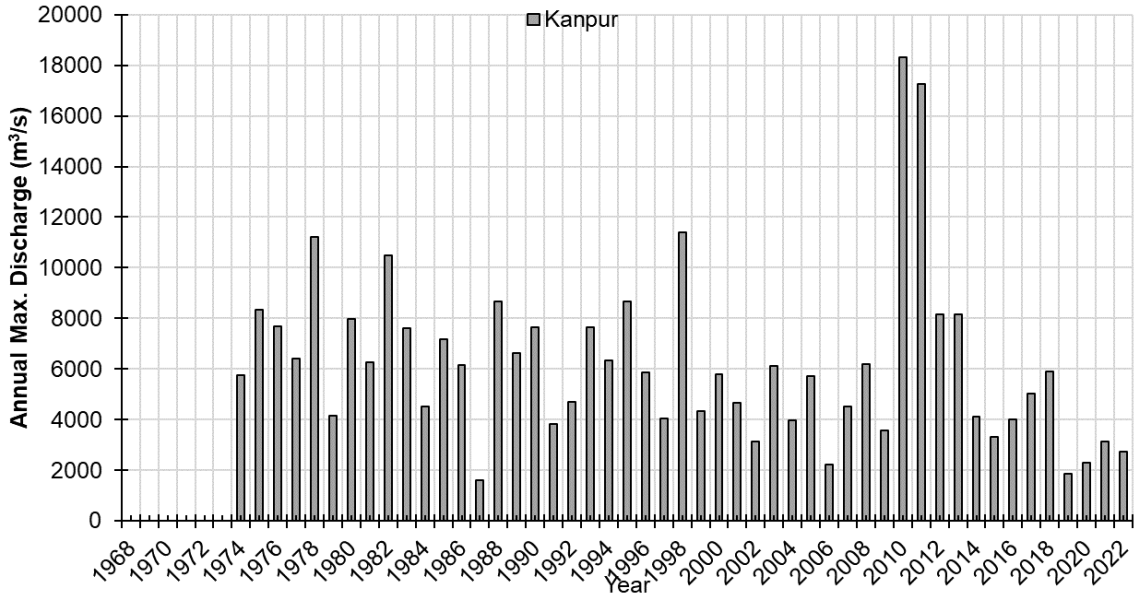
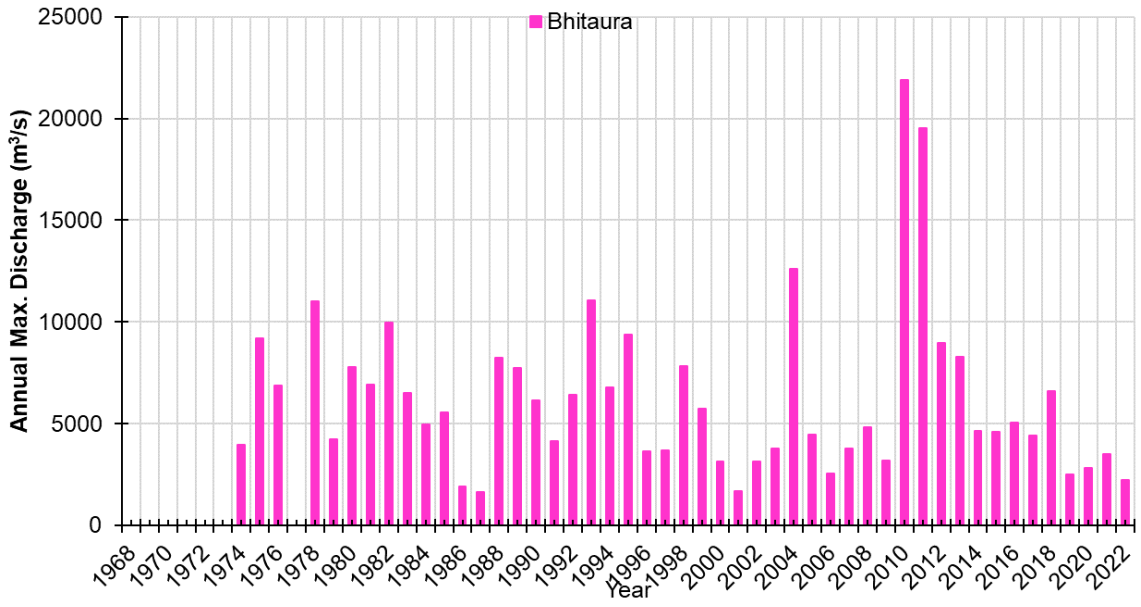
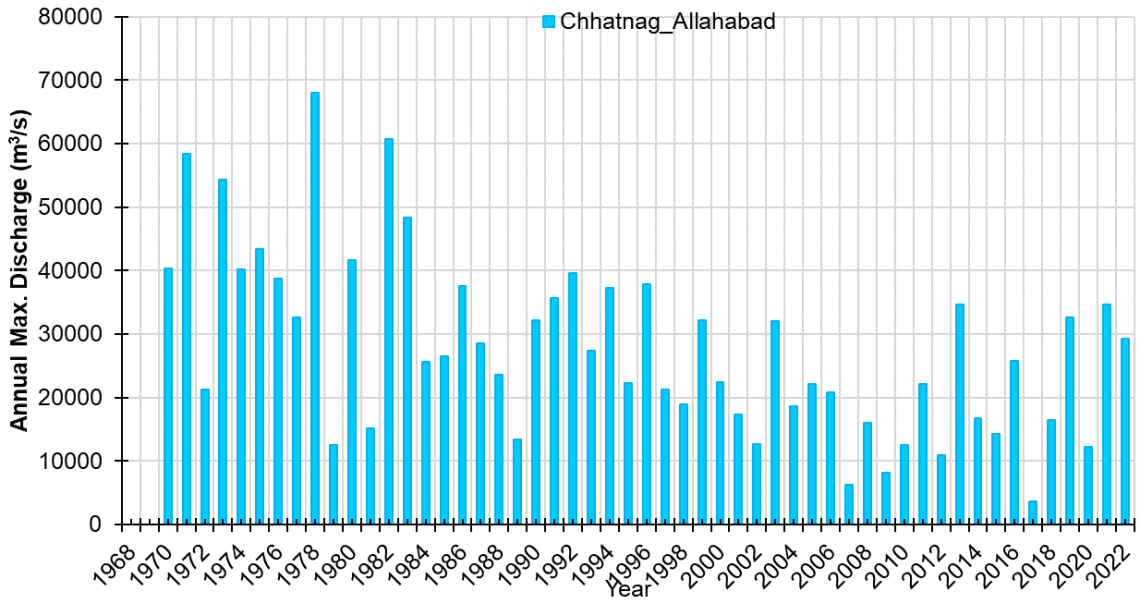


Figure 4: Annual maximum discharge series




Bhitaura
Annual Max. Discharge (m³/s)
25000
20000
15000
10000
5000
0
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year


Chhatnag_Allahabad
Annual Max. Discharge (m³/s)
80000
70000
60000
50000
40000
30000
20000
10000
0
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
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2016
2018
2020
2022
Year

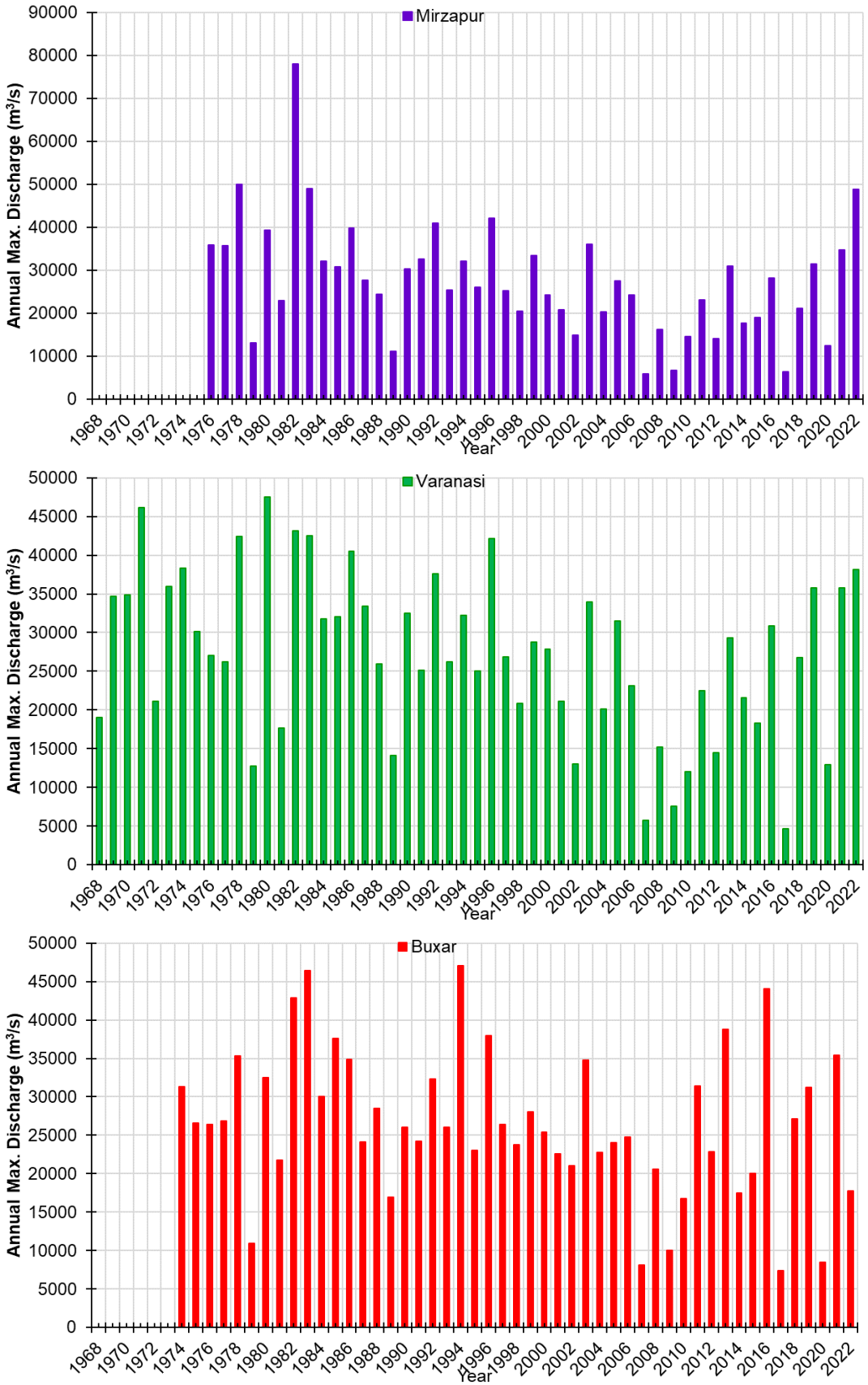


Figure 5: G&D site wise observed annual maximum discharge data.

Table 2: Estimated floods of various return periods

Return Period (Year)	Discharge (cumec)					
	Kanpur (GLO)	Bhitaura (GEV)	Chhatnag_Allahabad (PE3)	Mirzapur (GLO)	Varanasi (GEV)	Buxar (GLO)
2	5595.2	5216.7	25926.1	26291.2	27659.0	26364.9
5	8174.7	8434.2	39098.5	36907.2	36697.2	33931.8
10	10112.4	11002.0	47163.7	43956.8	40944.0	38445.5
20	12243.3	13850.9	54475.5	51061.8	44047.5	42693.6
25	12991.0	14838.0	56708.1	53411.7	44864.2	44021.1
50	15539.3	18192.9	63405.9	60986.7	47042.0	48163.0
100	**18492.7**	**22010.2**	**69824.7**	**69086.9**	**48702.7**	**52278.4**

5.2 Satellite Based Approach

The flood inundation Extent of recent years from 2009 to 2023 was provided by the RSAC, UP. This dataset includes recent flood events of 2010, 2016, 2021 and 2022 etc. The Joint Research Centre-European Commission has analyzed Landsat multispectral satellite images of the past 37 years (1984-2021) for deriving the frequency with which water returns from year to year i.e. recurrence interval and maximum flood extent. The overlay of JRC inundation extent and NRSC data set is shown in Figure 6. It is observed that the inundation extent is higer in the dataset obtained from RSAC, UP. This may be sue to the fact the Landsat satellites collect images of the Earth's surface on a 16-day repeat cycle, whereas daily inundation layer was provided by the RSAC, UP. Hence for further analysis the inundation extent provided by the RSAC, UP is used.

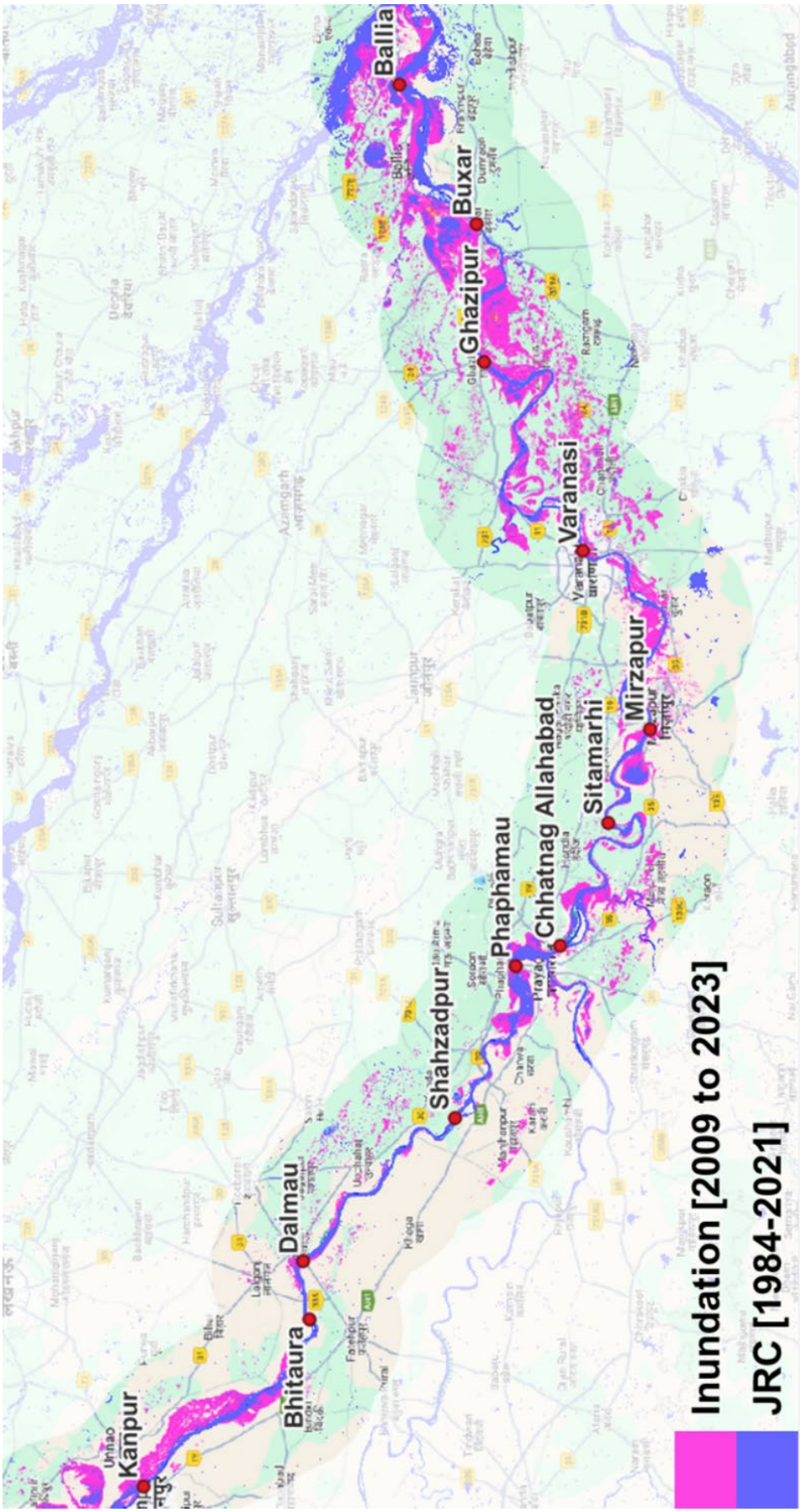


Figure 6: Overlay of maximum flood inundation extent of JRC and RSAC,UP

5.3 Hydraulic Modelling Approach

HEC-RAS, a hydraulic model developed by the USACE, is extensively applied in calculating the hydraulic characteristics of rivers. HEC-RAS model needs details of river cross sections (for 1-D modelling) and DEM (for 2-D modelling and flood inundation mapping) apart from boundary conditions (discharge, water level etc.).The latest update on the program, HEC-RAS 6.5 includes capabilities to model the hydraulics both one and two dimensionally is used for this study. The HEC-RAS model is setup (Figure 6) using following data:

- Upstream branch to provide constant flood magnitude equal to 100 year return period at upstream boundary (Kanpur barrage).
- Downstream boundary as normal depth at downstream of Balia extended beyond state boundary.
- Flood plain bathymetry (DEM), River cross-section for routing the flows between Unnao and Balia.
- Different locations (G&D sites) flow is added to match the estimated flood of corresponding return period at the intermediate gauging sites (Kanpur, Bhitaura, Chhatnag_Allahabad, Mirzapur, Varanasi, Buxar).

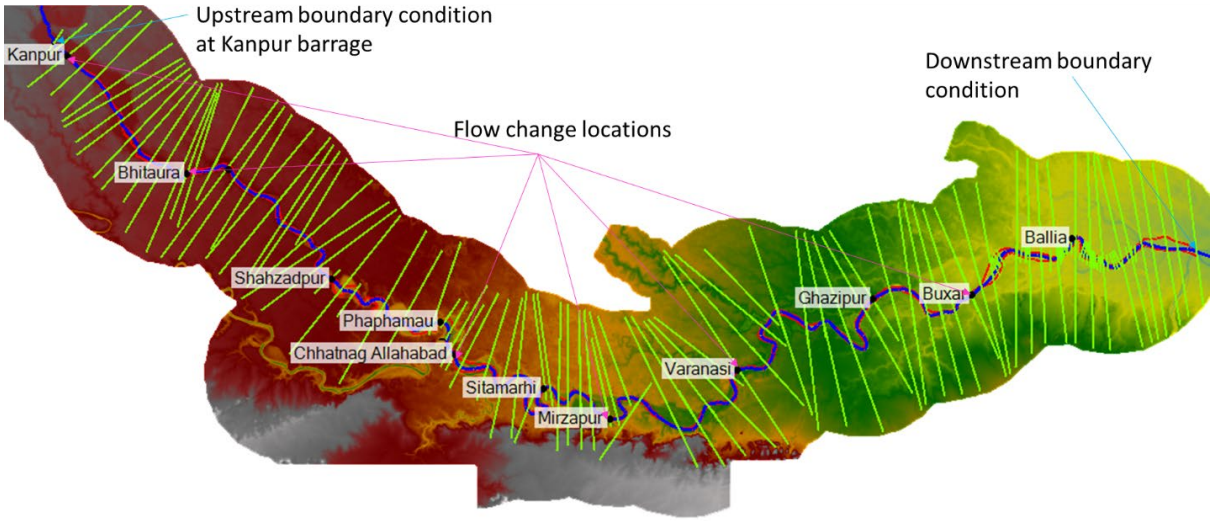


Figure 7: HEC RAS model setup

Comparisons of longitudinal simulated water surface profile for 100-year return period flood and historical flood event are shown in Figure 8. The inundation extent for 100-year return period flood is shown in Figure 9. The discharge at Kanpur and Bhitaura in the year 2010 is maximum and near to 100 year return period.

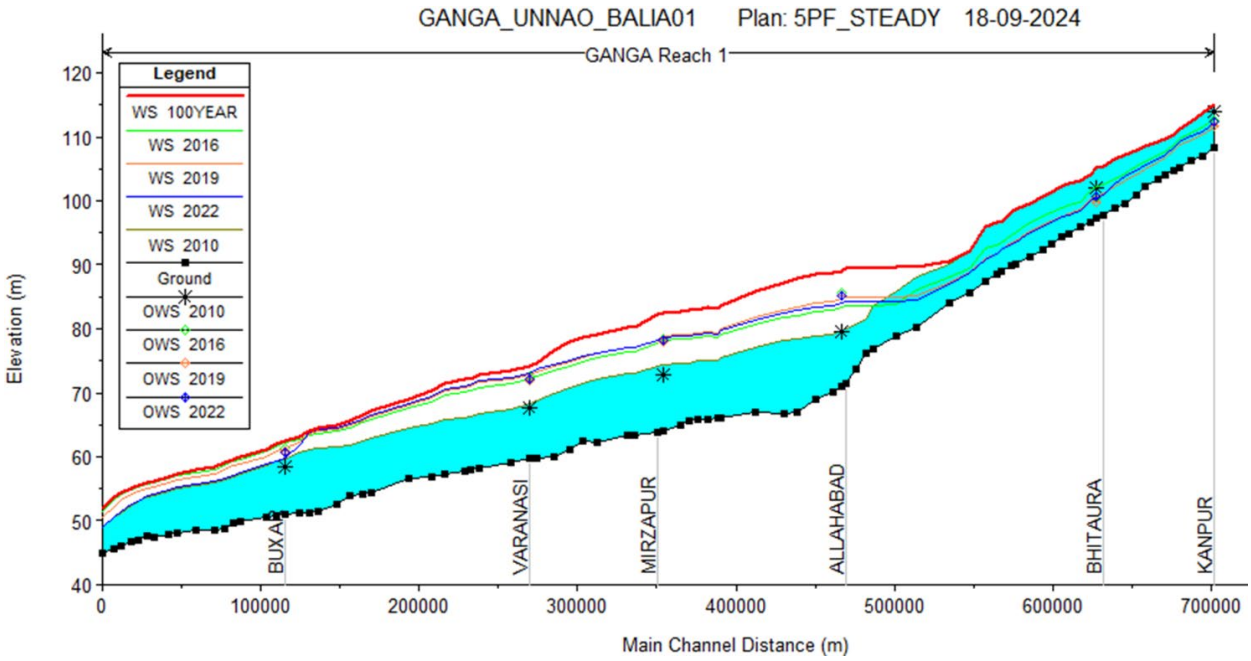


Figure 8: Longitudinal simulated water surface profile

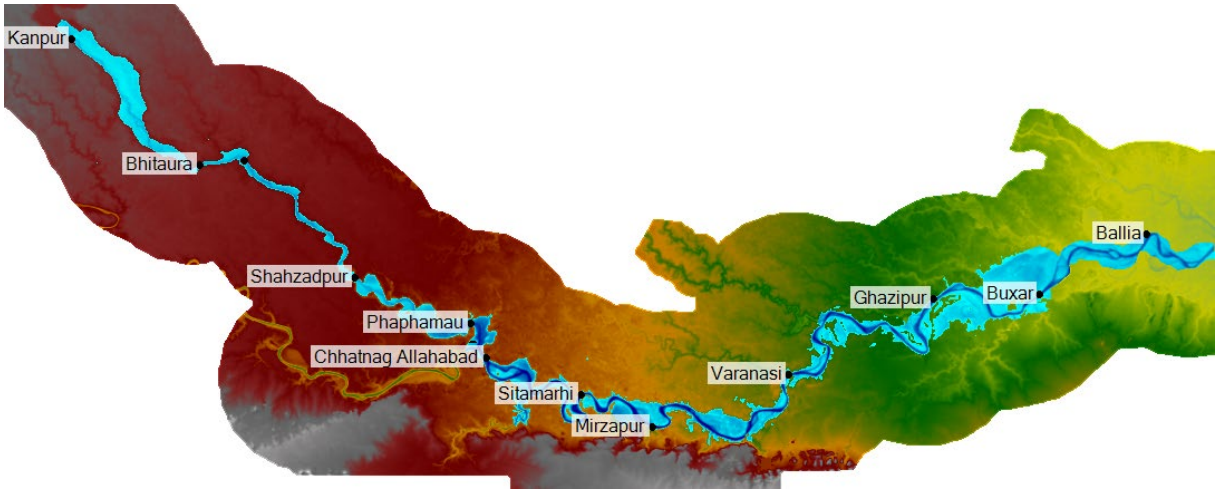


Figure 9: Flood Inundation extent for 100-year return period flood

6 FLOOD PLAIN DELINEATION

The final hydraulic model result shows may small islands within the flood extent causing inundation gaps. These gaps have been filled to get final inundation area as shown in Figure 10. Furthe the inundation extent provided by the RSAC, UP (satellite-based approach) are compared with gap filled inundation area. The overlayed map is shown in Figure 11. It is observed that the gap filled inundation extent from hydraulic model is mostly encompass the inundation extent of satellite-based approach. The draft delineated flood plain for 100 year return period flood is shown in Figure 12. Further the KML file (can be opened in Google Earth) and tabular value of coordinate (Longitude, Latitude) are also provided for ground truth verification.

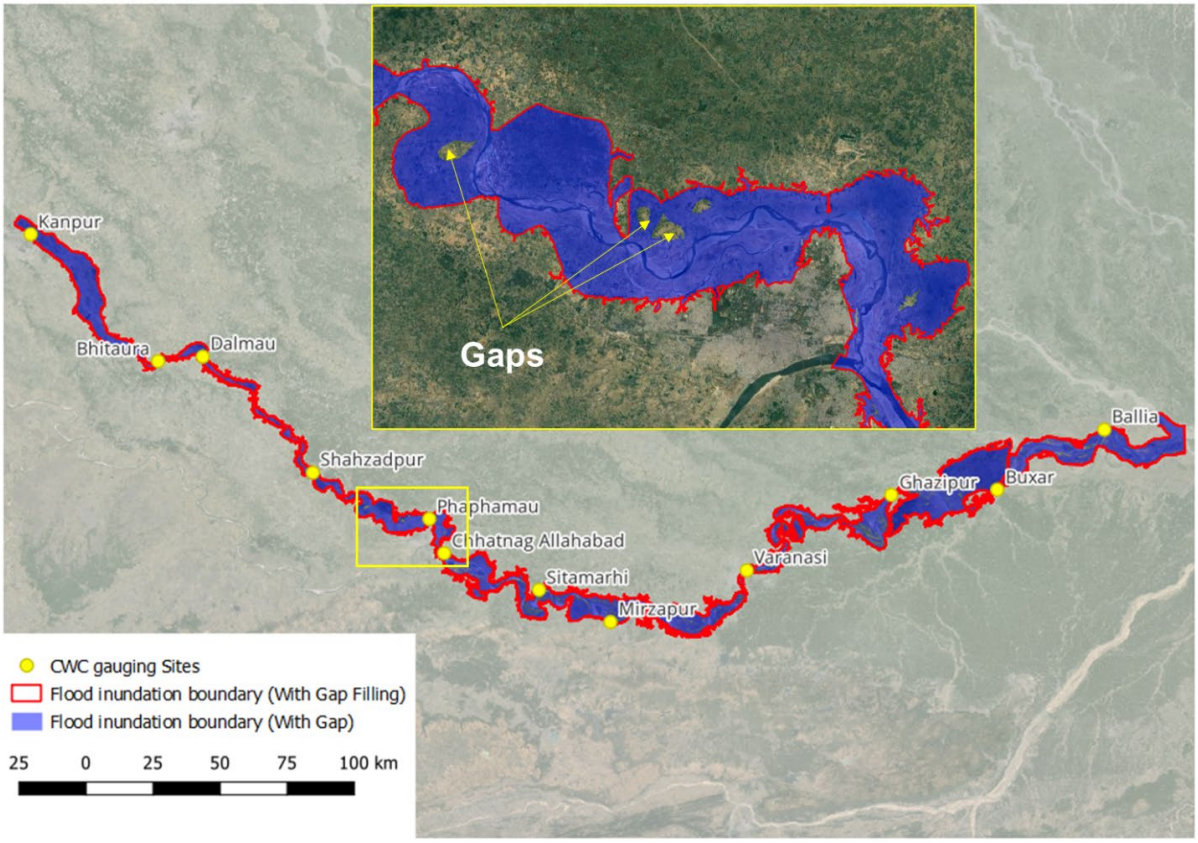


Figure 10: Model based flood plain delineation with gap filling.

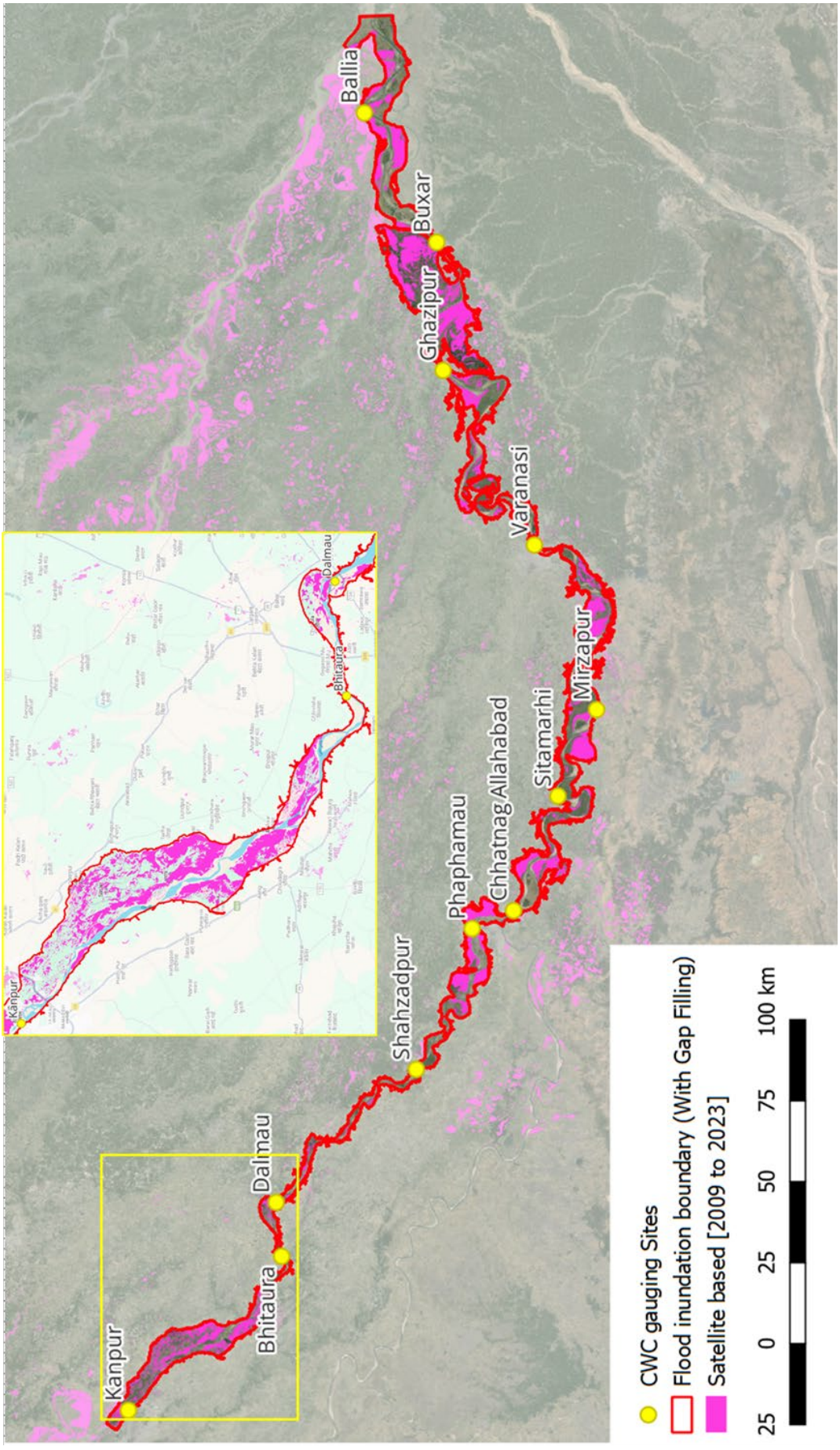


Figure 11: Overlay of maximum flood inundation extent of hydraulic model and satellite data (RSAC,UP)

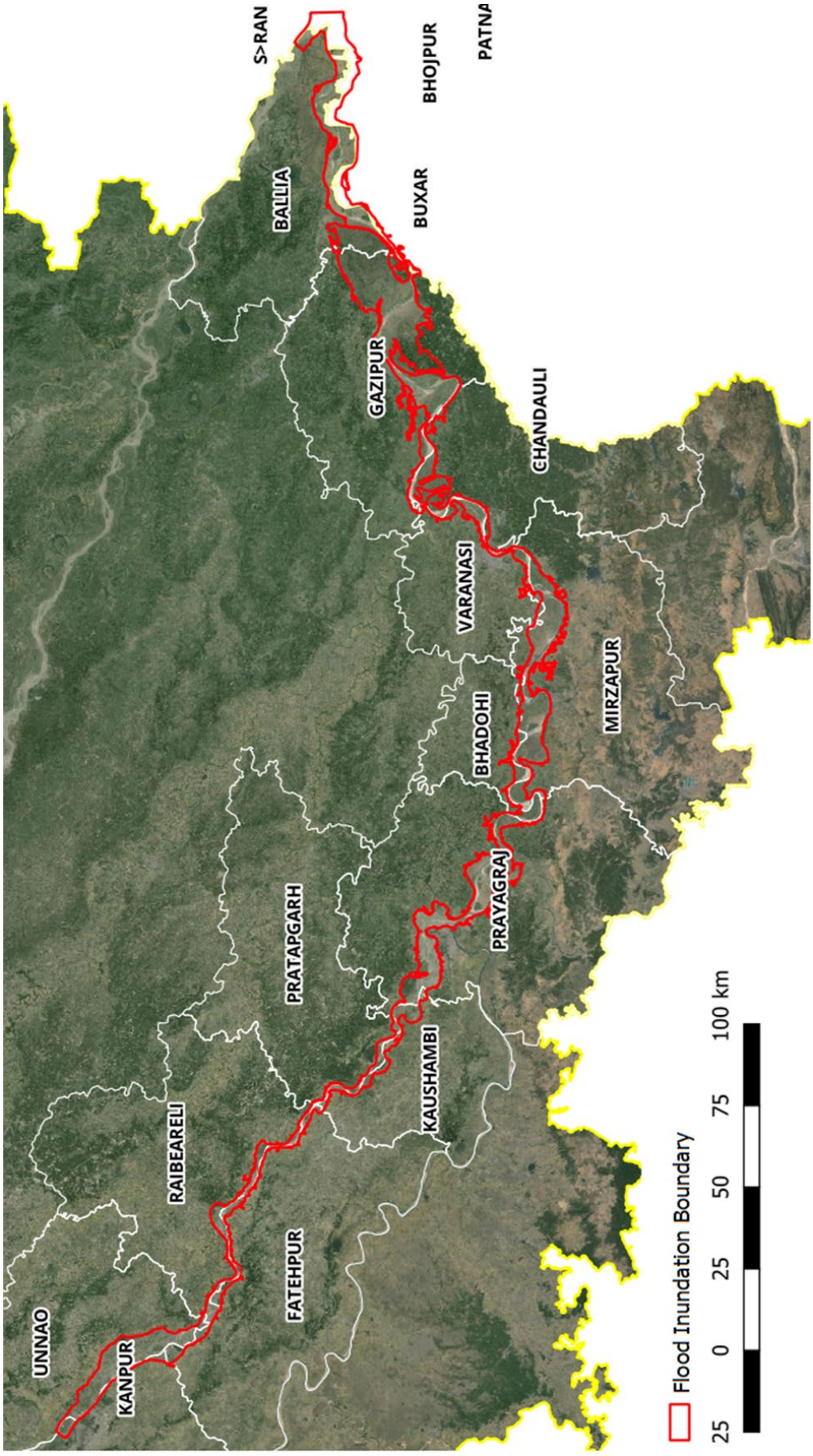


Figure 12: Flood plain delineation for 100 year return period flood

7 ASSUMPTIONS AND LIMITATIONS

For Satellite

- Flood extent covered by satellite depends upon revisit period. cloud cover. River turbidity. river seasonality etc. and classification algorithm used.
- Embankment breach scenarios are not accounted.
- Cannot segregate reverine flooding from other types of flooding.

For Mode

- Manning's value of 0.015 to 0.025 was adopted for the river and 0.02 to 0.035 for the flood plain.
- Limitation of river bathymetry below the water spread area in the SOI DEM and accounted using available cross-sections only.
- Effects of major embankments are considered based on the DEM. However, effects of other small roads, buildings, hydraulic structures. bridges etc. were not considered.
- River morphological changes is not considered.
- Flooding due to drainage congestion. water clogging etc. are not accounted.
- Evaporation, infiltration/ groundwater interaction and diversion losses neglected.

Bibliography

Hosking, J.R.M., and Wallis, J.R. (1997). *Regional frequency analysis: an approach based on L-moments*. Cambridge University Press, Cambridge.

Kumar, R., and Chatterjee, C. (2005). Regional flood frequency analysis using L-moments for North Brahmaputra Region of India. *Journal of Hydrologic Engineering*, *American Society of Civil Engineers, 10(1)*, 1–7.

NEW DELHI, FRIDAY, OCTOBER 7, 2016/ASVINA 15, 1938: https://nmcg.nic.in/writereaddata/fileupload/47_AuthorityNotification.pdf

ANNEXURE R2

प्रेषक,

अधिशासी अभियंता,
बाढ़ प्रबन्धन सूचना प्रणाली केन्द्र,
सिंचाई एवं जल संसाधन विभाग,
उ0प्र0, लखनऊ।

प्रेषित,

डा0 एके0 लोहानी,
साइंटिस्ट–G एवं प्रभागाध्यक्ष, सतही जल प्रभाग,
राष्ट्रीय जल विज्ञान केन्द्र,
रूड़की, उत्तराखण्ड।

पत्रांक:–333 /अधिoअभि0/FMISC/NGT Draft Report/ दिनांक– 21 अक्टूबर, 2024

विषय:– गंगा नदी के Segment-B, Phase-II (उन्नाव से बलिया) की Flood Plain Zone (FPZ) के निर्धारण एवं सीमांकन (Delineation & Demarcation) के कार्यों की प्रगति/समीक्षा के संबंध में।

महोदय,

उपरोक्त विषयक के संबंध में अवगत कराना है कि आपके द्वारा FPZ की Draft report दिनांक 16.10.2024 को ई–मेल के माध्यम से प्राप्त हुयी थी जिसके क्रम में बाढ़ प्रबन्धन सूचना प्रणाली केन्द्र द्वारा दिनांक 18.10.2024 को एक समीक्षा बैठक विडियो कॉन्फ्रेंसिंग के माध्यम से आयोजित की गयी। इस बैठक में Draft report पर आपके साथ की गयी वार्ता/चर्चा के मुख्य बिन्दु निम्न प्रकार है:–

1. Required a Descriptive Report with the Location map of Study Area.
2. On page no-4, the 2nd point of 3.1 Data mentioned that "30m grid spacing FABDEM. Is this data used in the project?
3. On page no-4, Fig-2-Location of G&D sites and their Catchment area, kindly mention the catchment area in tabular form and show the Catchment boundary on the map with the Legend.
4. Provide the width of the flood plain delineation at each gauge and cross-section, as well as the area at the upstream and downstream gauges/cross-sections.
5. Provide information about the average width, Water Level and total area of the flood plain.
6. Explain the process with Flowchart diagram, snapshots at different stages of analysis which is used in Hec-Hms & Hec RAS in 1D and 2D modelling. Also provide their outputs in kml/GIS format.
7. Compare the results obtained in the present study (i.e. delineation of FPZ from Unnao to Ballia) with the results of FPZ phase-I segment -B (i.e. Haridwar to Unnao) done by CWC.
8. Explain the role of GIS software's in the project.
9. Provide detail of HFL at gauge sites / cross sections.
10. Share data of JRC committee for review purpose.
11. Describe the methods used for flood frequency analysis and also explain their results.
12. Full form of abbreviations used in this report.

13. After plotting the result on ARCGIS it is found that outer boundary of 100 years delineation coincides with the embankment at locations. Details of embankments should not be considered in analysis. Flood and flood plain are different things, flood plains should not be restricted by embankments.

14. Comparison of flood discharge:

Station Name	Observed Peak Discharge (in cumec.)	Duration Data	Estimated Floods Discharge by NIH (100 years return period) (in cumec.)
Kanpur	18324 (29-09-2010)	1974-2023 (49 yrs.)	18492.70
Bhitaura	21913 (01-10-2010)	1974-2023 (49 yrs.)	22010.20
Chhatnag (Allahabad)	68000 (08-09-1978)	1970-2023 (53 yrs.)	69824.70
Mirzapur	78071.(31-08-1982)	1976-2023 (47 yrs.)	69086.90
Varanasi	47524 (02-09-1980)	1968-2023 (55 yrs.)	48702.70
Buxar	47100 (12-08-1994)	1974-2023 (49 yrs.)	52278.40

अतः कृपया उपरोक्त बिन्दुओं के दृष्टिगत आवश्यक एवं उचित कार्यवाही करने का कष्ट करें।

21/10/2024

(हरेंद्र कुमार)
अधिशासी अभियन्ता

पत्रांक:— /अधि0अभि0/FMISC/NGT Draft Report/तदिनांक:

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित है:—

1. मुख्य अभियन्ता, सूचना प्रणाली संगठन, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
2. अधीक्षण अभियंता, बाढ़ प्रबन्धन सूचना प्रणाली केन्द्र, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।

(हरेंद्र कुमार)
अधिशासी अभियन्ता

ANNEXURE R3

प्रेषक,

अतिमहत्वपूर्ण

अधीक्षण अभियन्ता,
बाढ़ प्रबन्धन एवं सूचना प्रणाली केन्द्र (FMISC),
सिंचाई एवं जल संसाधन विभाग,
परिकल्प भवन, उ0प्र0।

सेवा में,

डा0 ए0के0 लोहानी,
साइंटिस्ट–G एवं प्रभागाध्यक्ष,
सतही जल विज्ञान प्रभाग,
राष्ट्रीय जल विज्ञान केन्द्र,
रूड़की, उत्तराखण्ड।

पत्रांकः–217/अधी0अभि0/एफएमआईएससी/ लखनऊ, दिनांकः 04 नवम्बर, 2024

विषयः– मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में विचाराधीन गंगा नदी के Segment B, Phase II (उन्नाव से बलिया) की फ्लड प्लेन जोन (FPZ) के निर्धारण एवं सीमांकन (Delineation & Demarcation) से संबंधित संशोधित Final Draft Report एवं राष्ट्रीय हरित अधिकरण, नई दिल्ली में दिनांक 12.11.2024 को सुनवाई में उपस्थित होने के संबंध में।

संदर्भः– अधिशासी अभियन्ता, एफएमआईएससी का पत्रांक 333/अधि0अभि0/FMISC/NGT Draft Report दिनांक 21.10.2024

महोदय,

उपरोक्त संदर्भित पत्र के क्रम में मुख्य अभियन्ता, सूचना प्रणाली संगठन, लखनऊ से दिनांक 25.10.2024 को आपके संगठन के श्री जगदीश पात्रा, साइंटिस्ट–E से दूरभाष पर हुई वार्ता के उपरान्त यह आश्वासन दिया गया था कि संदर्भित पत्र में उल्लिखित संशोधनों को समाहित करते हुए विषयांकित से संबंधित Final Draft Report जल्द से जल्द उपलब्ध करा दी जायेगी। किन्तु अभी तक संशोधित Final Draft Report अप्राप्त है।

उक्त के संबंध में अवगत कराना है कि मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली द्वारा इस वाद की सुनवाई की अग्रिम तिथि 12.11.2024 निर्धारित की गई है, जिसके संबंध में आपसे अपेक्षा है कि आपके स्तर से Final Report कब तक उपलब्ध कराया जायेगा, के संबंध में लौटती डाक से अवगत कराते हुए उक्त दिनांक 12.11.2024 को मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में व्यक्तिगत रूप से उपस्थित होकर अपना पक्ष रखने का कष्ट करें।

04/11/2024

(प्रवीण कुमार)
अधीक्षण अभियन्ता

पत्रांकः– /अधि0अभि0/एफएमआईएससी/तदिनांकः

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित हैः–

1. मुख्य अभियन्ता, सूचना प्रणाली संगठन, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
2. मुख्य अभियन्ता (शारदा सहायक), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
3. मुख्य अभियन्ता (सोन), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, वाराणसी।
4. मुख्य अभियन्ता (जल संसाधन), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
5. अधिशासी अभियन्ता, एफएमआईएससी, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।

(प्रवीण कुमार)
अधीक्षण अभियन्ता

ANNEXURE R4

Gmail

Superintending Engineer <sefmisiduplu@gmail.com>

मा0 राष्ट्रीय हरित अधिकरण नई दिल्ली में विचाराधीन गंगा नदी के Segment B, Phase II (उन्नाव से बलिया) की फ्लड प्लेन जोन (FPZ) के निर्धारण एवं सीमांकन (Delineation & Demarcation) से संबंधित Final Draft Report एवं राष्ट्रीय हरित अधिकरण, नई दिल्ली में दिनांक 12-11-2024 को सुनवाई में उपस्थित होने के संबंध में।

Anil Kumar Lohani <akinih@gmail.com>
To: Superintending Engineer <sefmisiduplu@gmail.com>
Cc: "Krishna Mohan Kansal Chief Engineer (ISO)" <ceisoiduplu-up@nic.in>, Chief Engineer Lucknow <cessiduplu-up@nic.in>, cesonevaranasi@gmail.com, cewriduplu-up <cewriduplu-up@nic.in>, Executive Engineer FMISC <eefmisiduplu@gmail.com>, Jagadish Patra <patra.nih@gmail.com>
Mon, Nov 4, 2024 at 5:47 PM

Dear Sir,

NIH has submitted the draft report on 16 October 2024 having delineated flood plain corresponding to 100 year return period flood based on the Survey of India DEM. Both shape file & KML files along with coordinates in tabular form (Excel file) are also submitted for review by the Irrigation Department, UP. In response (dated 21 October 2024) has provided comments to NIH on the draft report. During online meetings and telephonic discussions with the officers of Irrigation Dept, it was requested to include another scenario of floodplain delineation without consideration of embankments.

The modelling exercises for this additional scenario is being carried out. Since this requires necessary modification of SOI DEM (removal of embankment) and subsequently HEC-RAS simulation and GIS processing of results, this will take some time. It is expected that the modified draft report addressing all observations of the Irrigation Department (dated 21 October 2024) will be submitted by 29 November 2024. It is also requested to provide the results (shape files) and report of Phase-I for comparison as mentioned at observation no.7.

Dr. Anil Kumar Lohani
Scientist G
Head Surface Water Hydrology Division
Coordinator, Centre for Flood Management Studies NIH, Guwahati
Coordinator, Central India Hydrology, Regional Centre, Bhopal
Training Coordinator National Hydrology Project
National Institute of Hydrology (Ministry of Jal Shakti, Dept of Water Resources, RD & GR, Govt of India)
Roorkee-247667 (Uttarakhand)
India
Phone: +91 1332 249214
Mobile: +919412928676
Fax +91 1332 272123

Home Page

Author Page

Information

(Click here for Scholar Profile)

[Quoted text hidden]

ANNEXURE R5

Ground truth verification in O.A. No. 515/2023

5405

5406

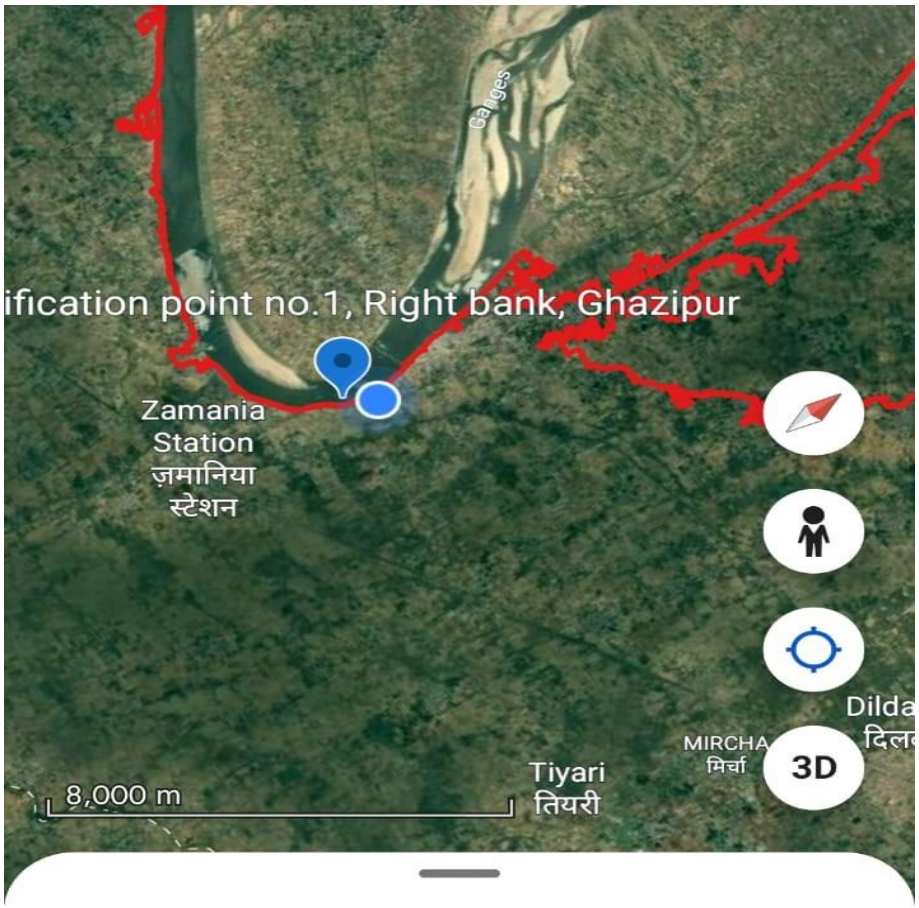
point 1

Location
25°23'57"N 83°33'12"E


5407
Latitude: 25°23'58"N
Longitude: 83°33'13"E
Altitude: -3.8±9 m
Accuracy: 1.9 m
Time: 09-11-2024 11:05
Note: zamania ground truth verification
Powered by NoteCam


5408
Latitude: 25°23'58"N
Longitude: 83°33'13"E
Elevation: 61.45±5 m
Accuracy: 78.3 m
Time: 09-11-2024 11:05
Note: zamania ground truth verification
Powered by NoteCam

5409


ification point no.1, Right bank, Ghazipur
Ganges
Zamania
Station
ज़मानिया
स्टेशन
Tiyari
तियरी
8,000 m
MIRCHA
मिर्चा
3D
Dilda
Edit
Saved on this device
Title
ver. pt.2, zamania, Ghazipur