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Tracing Ancient Pāṭaliputra: Integrating Evidence from Texts, Archaeology, and Remote Sensing

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Pāṭaliputra, one of the most celebrated cities of ancient India, reached its pinnacle as the capital of the Mauryan empire (c. 324–187 BCE). Although scholarly consensus associates it with Patna, Bihar, its precise location has been debated for over two centuries due to contradictions in the textual evidence and the complex, fragmentary nature of the archaeological record. Dense urban cover in Patna now precludes conventional excavation and exploration. However, an inter-disciplinary approach combining textual and archaeological evidence with geospatial and palaeo-hydrological analysis and field survey offers new possibilities. This paper critically analyses the entire array of textual and archaeological data and geospatially maps the palaeochannels of the Son and Ganga, traces of water bodies, wooden palisade find spots, and sub-surface features. Integrating these with declassified reconnaissance, Indian Remote Sensing (IRS) and Google Earth satellite imagery and digital elevation models (DEMs), it proposes that Mauryan Pāṭaliputra comprised a broad rectangular southern expanse that narrowed northward into a smaller rectangular extension symmetrically aligned along the city's north–south axis. The new evidence and arguments indicate that the main part of this vast city, enclosed by massive wooden fortifications and a moat, lay to the south of the area proposed in earlier studies.

Keywords: Pāṭaliputra; Palibothra/Palimbothra; Patna; Mauryan capital; river Ganga; river Son

Introduction

Pāṭaliputra, also known as Kusumapura or Puṣpapura, was one of the most celebrated cities of ancient India. The expansion of the kingdom of Magadha, located in south Bihar, began in the 6th century BCE during the reign of Bimbisāra of the Haryaṅka dynasty, with its political centre at Girivrāja or Rājagṛha (modern Rajgir). Bimbisāra's successor Ajātaśatru built a fortified stockade at Pāṭaligrāma and his successor Udāyin moved his capital to this place. Favoured with fertile soil, proximity to major rivers, and access to raw materials and elephants, the metropolis of Pāṭaliputra was well-connected with trade routes. It reached its pinnacle of eminence as the capital of the Mauryan empire (c. 324–187 BCE), but its importance continued into later centuries as well.

While Aśoka's fifth rock edict mentions Pāṭaliputra, it does not describe its location. Graeco-Roman sources, which relied heavily on the lost *Indica* of Megasthenes, ambassador of the Hellenistic king Seleucus Nicator to Candragupta Maurya, contain a brief but significant description of the Mauryan capital, which they refer to as Palibothra or Palimbothra. In 1793, William Jones identified Palibothra/Palimbothra with Pāṭaliputra of the Indian texts and suggested that the ancient city was located in Patna.[1] In the same year, James Rennell suggested that the site of ancient Pāṭaliputra lay near Patna.[2] Over time, this identification received general scholarly acceptance.

From the early 19th century onwards, several attempts were made to identify the contours of Pāṭaliputra and the location of specific structures, especially a Mauryan palace, on the basis of archaeological remains. And yet, despite over two centuries of investigations and debate, many aspects of the ancient city remain mysterious and elusive. Chief among these is where exactly its contours lay. The dense urban cover in Patna means that this puzzle cannot be solved through conventional archaeological excavations and explorations.

This paper engages with the debate on the spatial extent of ancient Pāṭaliputra by integrating the well-known body of textual and archaeological data with geospatial and palaeo-hydrological analysis. By geospatially mapping palaeochannels of the Son and Ganga, traces of water bodies, find spots of wooden palisade remains, sub-surface archaeological features, and analysing both recent and historical satellite imagery – including declassified reconnaissance satellite imagery,[3] Indian Remote Sensing (IRS) datasets, and

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Google Earth imagery – alongside digital elevation models (DEMs) and other geographical sources, this paper presents new evidence and arguments that redefine the spatial extent of the Mauryan capital, placing the main part of the city south of the area proposed in most earlier studies. Wood and water are central to our arguments.

However it must be emphasised that the geospatial and palaeo-hydrological evidence cannot be treated as an independent source for solving the problem. It is inextricably tied to the textual and archaeological evidence. The latter, in turn, is inextricably tied to the complex history of archaeological explorations and excavations in Patna from the early 19th century. Hence a detailed discussion of all these aspects is an essential part of this paper. The aim is to give a comprehensive analysis of the entire range of evidence within which we position our hypothesis, showing how it fits with the totality of the available data.

Textual References to the Location of Pāṭaliputra

The earliest datable, contemporary description of the city and its location comes from the Graeco-Roman sources based on Megasthenes.[4] It should be noted that these descriptions are not free from problems, as the original text of the *Indica* is lost and later writers who used and paraphrased from his account do not say exactly the same thing. The *Indica* has to be understood as part of a larger tradition of Greek ethnographic literature directed to a Greek audience. Further, Megasthenes got several things about India wrong. Nevertheless, as an eyewitness account of a diplomat who visited the Mauryan capital, his description has to be taken seriously. The following points emerge by putting together the references (mostly derived from Megasthenes) in the works of Arrian, Strabo, Diodorus, and Pliny: Palibothra/Palimbothra (i.e. Pāṭaliputra) was a large city located near the confluence of the Ganga and Erranoboas rivers; was parallelogram in shape, 80 stadia in length and 15 stadia in breadth; was surrounded by a wooden fortification wall pierced with holes for the discharge of arrows, with 570 towers and 64 gates; and beyond the wooden wall was a moat, 6 plethora in breadth and 30 pecheis in depth.[5] The Erranoboas can be identified with the river variously known in ancient Indian sources as Śoṇa, Hiraṇyavāha, or Hiraṇyabāhu, all of which refer to the Son.

Patañjali's *Mahābhāṣya* (2nd century BCE) places Pāṭaliputra on the Śoṇa.[6] In their list of water bodies associated with places, two Vinaya texts, the *Abhisamācārikā Dharmāḥ* and *Mahāsāṅghika-Vinaya* (dated to the 3rd century BCE–early centuries CE), link Pāṭaliputra with the Śoṇa.[7] Viśākhadatta's play *Mudrārākṣasa* (4th/5th century CE) refers to Candragupta Maurya's palace as Sugāṅga, suggesting it was near the Gaṅgā, but it also suggests a location near the Śoṇa river.[8] Among other references, the Śvetāmbara text, *Titthogālī Painnaya)* (5th–6th century CE), reports that a massive flood in the Gaṅgā and Śoṇa swept away the city.[9] There are several other, including later, references to Pāṭaliputra in ancient Indian texts and inscriptions.[10] The accounts of the Chinese monks, Faxian (*Fuguo ji*, "A Record of Buddhist Countries") and Xuanzang (*Da-Tang xiyu ji*, "The Records of the Western Regions Visited During the Great Tang Dynasty"), who visited India in the 5th and 7th centuries CE, respectively, describe the Mauryan capital.[11] Their works postdate the Mauryan period by many centuries, had a specific perspective and audience, and contain several inaccuracies and embellishments. Further, the natural and urban landscape would have undergone many changes by the time of their visits and even between their visits. Nevertheless, their statements about the location of the city (referred to by Faxian as Balianfu or Balingfu and by Xuanzang as Bozhali-zi) can be noted. Faxian describes travelling from Vaiśālī, reaching the confluence of five rivers, crossing the Ganga, and then descending south for a *yojana* before arriving at Pāṭaliputra.[12] He describes it as a flourishing city, and spent two years studying Buddhist texts there.[13] In Xuanzang's work, the city appears deserted and in decline, with ruins of its better days visible. He reports that it lay south of the Ganga and had a circumference of over 70 *li* (ca. 35 km).[14]

According to the *Tārīkh-i Dā'ūdī*, the mid-sixteenth century Afghan ruler Sher Shah Suri came to Patna while returning from Bengal to Agra. Standing on the banks of the Ganga and reflecting on the siege and the surrounding landscape, he is said to have observed that "this place was situated to the west on the banks of the Ganges, which flows from the north," and finding the place most suitable for establishing a great town, he decided to build a fort here.[15] Of course, the spread, contours, and character of ancient Pāṭaliputra would have changed over the centuries. However, taken together, these textual references present different perspectives on Pāṭaliputra's riverine setting, variously emphasising a location close to the Son, at or near the confluence of the Ganga and Son, or south of the Ganga. To evaluate these references, it is necessary to consider the geomorphology of the Ganga and Son in the vicinity of Patna – specifically, changes in the courses of these two rivers over time. However, before turning to these, it is necessary to discuss various other salient issues, starting with the results of archaeological explorations and excavations in the Patna area and

attempts to identify the location of Mauryan Pāṭaliputra through its material traces.

The earliest map of Patna consulted for this study was the *Plan of the City of Patna*, which was specially prepared for Buchanan by a local assistant during his Bengal survey and is referenced in his journal documenting his 1812 visit.[16] This map, annotated in Persian and drawn without scale, showed a walled area, roads, temples, and key landmarks. Georeferencing this plan proved exceptionally difficult due to distortions, language barriers, and the extensive changes in land use and settlement since Buchanan's time.[17]

Later maps published by Waddell[18] and Altekar[19] proved more useful, as several features could be aligned with modern Google Maps, enabling tentative georeferencing. These maps, though not planimetric and subject to distortion, nevertheless offered a framework for approximating the positions of reported palisade sites. The analysis was further refined through comparison with Survey of India maps from 1935 and 1976. Building on this cartographic work, several of the locations were visited in March 2025 for ground-truthing where access was possible, providing additional clarity on the location of archaeological sites, especially those that had reportedly yielded palisade remains, and water bodies. Although direct traces of the palisade were not expected, the visits focused on gathering insights through on the ground observation, oral history, and living memory.

Archaeological Perspectives on the Location and Extent of the Ancient City

The earliest attempt to locate the material traces of ancient Pāṭaliputra was made by Francis Buchanan-Hamilton in 1811–12 during his survey tours, but this yielded meagre results.[20] The systematic documentation of Patna's archaeological remains by the Archaeological Survey of India (hereafter, ASI) began in the 1870s with the surveys of J. D. M. Beglar and Alexander Cunningham. Megasthenes had stated that the city stood at the confluence of the Ganges and Erranoboas. Beglar initially insisted vigorously that the Erranoboas was the Gandak, but ultimately came around to Cunningham's view that it was the Son. In the course of his 1872–73 explorations in Patna, Beglar suggested that the Son, which currently flowed west of Patna, once flowed about half a mile south of Panch Pahari and ran more or less parallel to the Ganga, joining it at Fatuha. He suggested that ancient Pāṭaliputra was located on the south bank of the Ganga (before the Son changed its course), near the northeastern edge of the present city, but had been mostly swept away as the Ganga moved southward.[21]

Cunningham subsequently explored Patna and prepared a plan of the villages and mounds in the area. He identified several places mentioned in the Chinese accounts, and marked a spot as Aśoka's palace, to the north of Chhoti Pahari.[22] He discussed the old course of the Son which branched out from the present bed near Daudnagar and eventually joined the Punpun and near Nobatpur, 4 miles south of Phulwari, turned east and joined the Ganga at Phatuha (Fatuha). He records that this old course was called the Mar Son (dead Son). He suggested that only about half a mile of the ancient city had been washed away by the Ganga. He associated the "fort" area located in the north-eastern corner of the city, just south of the Ganga, with the 16th century Afghan ruler Sher Shah Sur and thought it "most probable" that this ruler had retained the lines of the old city's line of ramparts and ditches (Figure 1 (a)). All the stones of the ancient structures must have been re-used to build the medieval fort.[23] In the course of his explorations, Cunningham identified many ancient sites and remains in Patna outside the fort area largely by attempting to track down and verify on the ground the places mentioned in the accounts of the Chinese monks. He refers to Panch Pahari as located "outside the city."[24] So he seems to have thought that part of ancient Pāṭaliputra had been washed away by the Ganga, part of it was located in the fort area, and that there were many important structures, including Aśoka's palace and Buddhist stūpas and monasteries, outside the city.

In 1892, L. A. Waddell visited Patna and dramatically announced his discovery of the exact site of Aśoka's capital of Pāṭaliputra.[25] Largely correlating various spots in the area with the account of Xuanzang, he claimed to have identified almost all the main landmarks of Aśoka's palaces, monasteries, and monuments within a day. In his 'Map of the ruins of Pāṭaliputra' (Plate II), he marked various mounds, places where ancient remains had been found and those which he thought could be correlated with spots mentioned in the Chinese accounts. He marked Aśoka's palace at Kumrahar. One of the most significant aspect of Waddell's account was that he mentioned the places where mounds and wooden beams – remains of the wooden fortifications of the city mentioned in the Graeco-Roman accounts – had been found.[26]

From 1894 onwards, several excavations were made at various sites in Patna.[27] In 1896 Waddell dug some exploratory trenches at various spots, including at Kumrahar, Bulandibagh, Bahadurpur, and Rampur. The most important find at Kumrahar was unearthed by his surveyor Ahmad Hossain – a large fragment of an

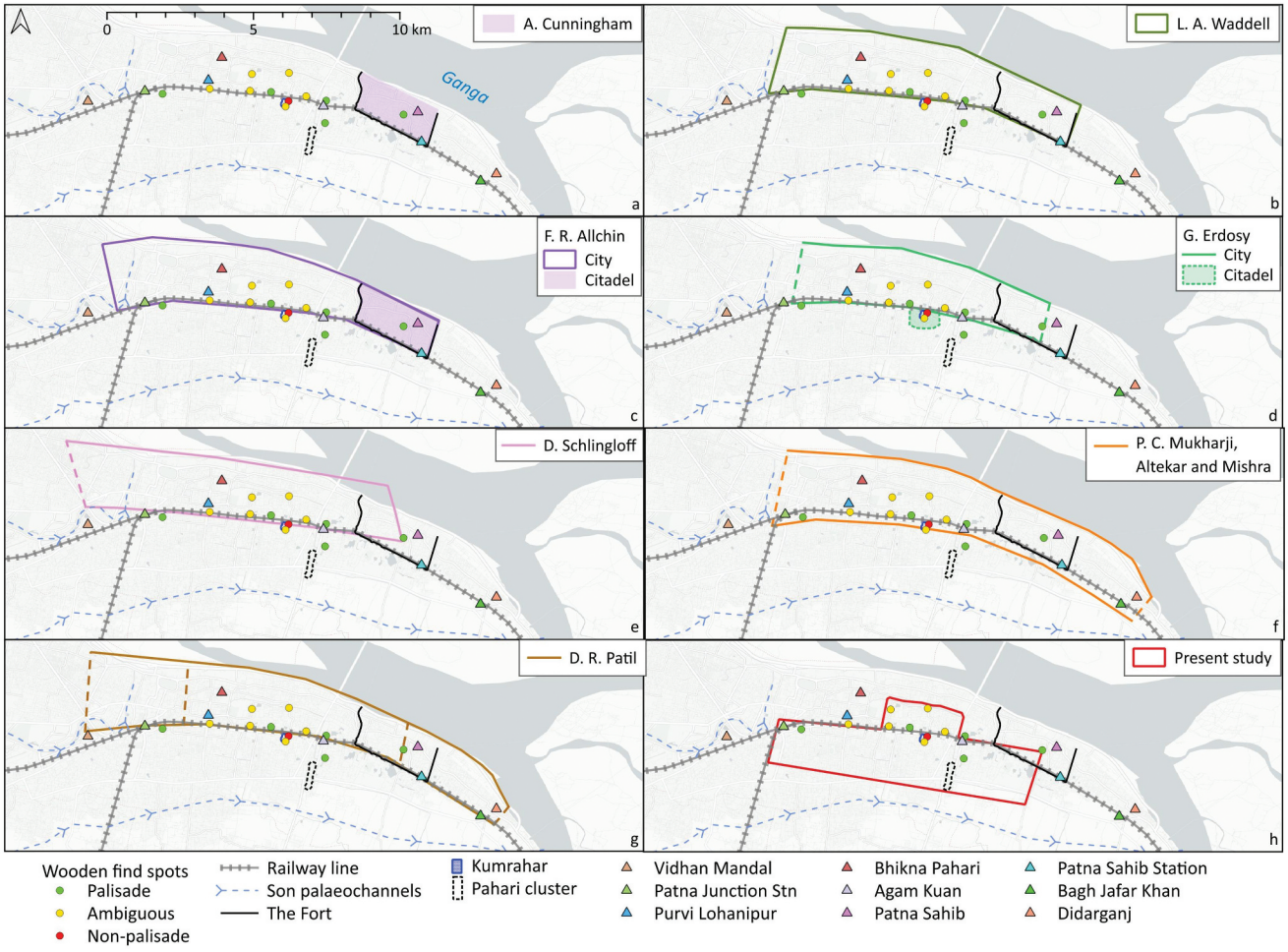


Figure 1. Location and extent of Pāṭaliputra as proposed by various scholars.

uninscribed Asoka pillar.[28] According to Waddell, ancient Pāṭaliputra must have been located on the south bank of the Ganga where it joined an old channel of the Son. Waddell's "Map of the ruins of Pāṭaliputra" extended in the east up to the eastern end of the "fort"; on the west till the old bed of the Son beyond Bankipur; in the north up to the Ganga; and to the south up to Panch Pahari. Within this area, he identified the location of the main ruins (mapped in Plan II). He suggested that all the main monuments and palaces lay to the south of the old city.[29] He highlighted the long strip of high-lying land about half a mile to the north of Kumrahar and suggested that the old city must have stretched from Bankipur on the west to beyond Patna city[30] on the east (Figure 1(b)); it was about 8 miles in length; was bounded on three sides by deep moats and on the north by the Ganga.[31] The moat on the southern side was none other than an old channel of the Son, which averaged about 200 yards in width and still retained water for most of the year. Waddell suggested that this was the same moat whose eastern portion was used many centuries later as the southern moat of the fort. In other words, Waddell located the southern moat of ancient Pāṭaliputra along the railway line that runs from Patna Junction to Patna Sahib railway stations. However, in his main text, he refrained from commenting on the precise extent of the ancient city, especially its eastern and western borders, stating that only further excavations, including a search for more remnants of the wooden fortification wall, could help answer this question.[32]

In 1896–97, P. C. Mukharji made excavations at several sites in Patna, including Kumrahar, Lohanipur, Bahadurpur, Agam Kuan, and the Arzani Dargah. These are described in a work that was apparently ready for publication, but never published.[33] The surviving copies that are accessible to us do not include the 58 Plates mentioned on the title page and list of Plates. We have located two maps that Mukharji apparently sent to V. A. Smith, along with his report, for comments.[34] However, these maps are rough and incomplete. Mukharji found remains of a wooden

palisade and drains, sculptures, ancient pottery, and other artefacts. He argued that ancient Pāṭaliputra must have been located in the long, narrow tract of land between the suburbs of Bankipur to Jafar Khan's garden (Figure 1(f)), east of Patna (this is over 3.5 km east of the eastern edge of the fort), an extent of nearly 9 miles, which roughly corresponded to the 80 stadia of Megasthenes.[35] He thought that the southern rampart of the city was located somewhere near and parallel to the railway line, which must have extended to Tulsimandi in continuation of the palisade remains he had discovered at Lohanipur, Bahadurpur, and Sandalpur.[36] What is relevant to our hypothesis is that Mukharji reported extensive remains in several locations south of the railway line, such as Lohanipur, Naoratanpur, and Nayatola.

In 1912–13, thanks to the generous financial support offered to the ASI by the philanthropist Sir Ratan Tata, D. B. Spooner conducted excavations at Kumrahar and Bulandibagh.[37] The most spectacular discoveries at the former site were pillar fragments and ash circles that seemed to represent the remains of an 80-pillared hall, which Spooner concluded was a Maurya palace, built on a Persepolitan model. He accounted for the absence of the actual pillars by proposing a theory that they had sunk in the soft alluvium. The major find at Bulandibagh was the remains of a massive wooden palisade running east–west for a distance of about 450 ft. Spooner continued to excavate at Bulandibagh in 1914–15 and 1915–16, where the discoveries included massive wooden beams and structures. The site also yielded an exceptionally rich range of artefactual finds, many assigned to the Mauryan period, including several unusual terracotta figurines (including the famous "smiling boy" and female dancing figures in swirling skirts presently on display in the Bihar Museum), metal objects (including implements, weapons, and arrowheads), a gold signet ring, pottery remains, and coins.[38] One of the unique finds was a large wooden spoked wheel with an iron rim. There was also an elaborate stone pillar capital in the Corinthian style (now considered post-Mauryan). Spooner did not give any opinion on the contours of the ancient city of Pāṭaliputra.

There is no detailed report of Manoranjan Ghosh's excavations in 1922–23, but his excavations during 1926–27 and 1927–28 concentrated on further opening up a section of the wooden palisade that Spooner had found at Bulandibagh. This made it possible to ascertain the design and the dimensions of its elements. Many antiquities belonging to different centuries of the early historic period, including terracottas and metal objects were also unearthed.[39] In 1935–36, G. C. Chandra's excavations at Gonsai Khanda, in Sandalpur village near the Arzani Dargah, yielded remains of a massive wooden platform.[40]

Kumrahar was excavated again in 1951–55 by A. S. Altekar and Vijayakanta Mishra under the aegis of the K. P. Jayaswal Institute.[41] They identified six periods of occupation, stretching from before the 2nd century BCE to the 17th century.[42] Spooner had located the sites of 72 monolithic pillars at Kumrahar. They found the sites of 12 more.[43] Altekar and Mishra refuted Spooner's theory of the sunken pillars, and suggested that the structure may have been an audience hall rather than a palace. They found the remains of several other structures at Kumrahar, but they were all post-Mauryan. As for the extent of ancient Pāṭaliputra, they suggested that the ancient city must have corresponded roughly to the modern Patna City, from Golghar to Malsalami, possibly extending further east up to Didarganj (Figure 1(f)). This view found some support from the spread of find spots of wooden palisade remains. However, they posited that the locations of the Purab-darwaja and the Pashchima-darwaja (the eastern and western gates of the fort) suggested that the ancient city did not extend significantly beyond these points. They also suggested that the old city was probably not located on the banks of the Ganga. Given Pāṭaliputra's association with the Son, they averred that the mystery of the ancient city's extent could be solved only by determining the old course of the Son down to Patna.[44]

In 1955–56, B. P. Sinha and Lala Aditya Narain sought remains of pre-Mauryan Pāṭaliputra and Maurya palace remains to the northeast of Kumrahar.[45] As the areas were heavily built up and thickly populated, very small areas could be excavated. The results included the report of pre-Maurya artefacts. As for the extent of Pāṭaliputra, Sinha and Narain suggested that the city extended to the northeast of modern Patna.[46]

Taken together, the archaeological investigations in modern Patna over two centuries have revealed traces of ancient remains at various sites including Kumrahar, Bulandibagh, Lohanipur, Sandalpur, Bhikna Pahari, Agam Kuan, Bahadurpur, Rampur, Arzani Dargah, Badi Pahari, Choti Pahari, and Panch Pahari. These include remains of mounds; wooden fortifications, platforms, and drains (some quite massive in dimensions); pillar fragments and capitals; and terracotta figurines attributed to the Maurya period.[47]

D. R. Patil's account of the antiquarian remains of Bihar includes a summary of the various explorations and excavations in the Patna area.[48] According to him, the western/southwestern limits of the ancient city seem to have extended up to the area of Kadam Kuan and Bakarganj, if not to Jamuna Dih (where the present

Secretariat buildings are located). On the east/northeast along the Ganga, the city stretched up to Mangal Talab/ Mangle Talao (later known as Gandhi Tank), if not up to Didarganj in the Malsalami area (Figure 1(g)). Patil avers that it is difficult to ascertain how much of the northern part of the city was washed away by the river, but it seems that the limits of ancient Pāṭaliputra more or less coincided with that of the modern city of Patna, although the latter was growing southwards as well as westwards.

According to Dieter Schlingloff, Bhikna Pahadi in the western part of Patna represents the approximate centre of the ancient city and the palace must have been located in the area of Patna University campus.[49] He states that Kumrahar could not have been a palace as it was 1.2 km southeast of the wooden fortification.[50] By connecting the locations where palisade remains had been found – ranging from Lohanipur in the west, through Bahadurpur, Bulandibagh, Kumrahar, Sewai Tank, to Gandhi Tank in the east – Schlingloff suggests that these form a nearly straight line, approximately 8 km long, marking the southern border of the ancient city. He also describes the eastern boundary, which runs from northwest to southeast, following the brick wall and palisade discovered in 1876 at a site called Sheik Mithia Ghari, situated between the market and the railway station in the Patna City area. He places the western boundary a few kilometres west of modern Patna, and positions the northern boundary near the southern bank of the Ganga, as it was observed at the time, adding that the northernmost part of the ancient city may have been washed away by the river (Figure 1(e)).

George Erdosy suggests that the fortified area of Mauryan Pāṭaliputra may have enclosed 1350 sq hectares (13.5 km^2).[51] He later modified his assessment, stating that in c. 250 BCE, the fortified town may have extended over 1200 acres (4.8 km^2). He based his calculation on the places where remains of the wooden palisade had been found, between Lohanipur and Bulandibagh in the west and the Gandhi Tank in the east (Figure 1(d)). He estimated the area of the possible citadel on the basis of the fragments of the palisade running north–south, south of the main palisade and enclosing Kumrahar, and various possibly religious structures.[52]

F. R. Allchin's conjectural reconstruction of Mauryan Pāṭaliputra located the city in the oblong stretch of land between the Ganga to the north and the railway line to the south.[53] (See figure 10.3 in Allchin 1995.) He estimated the fortified area at about 7 miles (11.265 km) on each side, and between 1.5 miles (2.414 km) on the west end and one mile on the east (1.609 km). He suggested that there were two moats, one larger one which enclosed the whole city, and a smaller one that he called the "city moat." He estimated that the outer city walls enclosed an area of about 2,200 hectares (22 km^2); and that the inner "city moat" (he possibly envisaged this as the citadel) enclosed an area of about 340 hectares (3.4 km^2) (Figure 1(c)).

Another view is that Mauryan Pāṭaliputra was located at the site of the "fort." This hypothesis goes back to Cunningham and has been recently reiterated by Max Deeg.[54] Allchin seems to identify this area as the citadel of the ancient city. The fort is the area marked by James Rennell and others as an irregular parallelogram in the north-eastern part of Patna.[55] Even today, this shape can be seen in the street pattern of the old city, and the area remains elevated compared to its surroundings, standing out in height maps and DEM of 10 m resolution (from Cartosat-1 also known as IRS-P5).[56] As mentioned earlier, according to the *Tārīkh-i Da'udī*, the Afghan ruler Sher Shah Sur built a fort in Patna on the banks of the Ganga.[57] However, the remains of this fort are difficult to identify. There is a "fort area" in the north-eastern part of Patna, whose walls were in dilapidated condition even in the 19th century. This medieval fortification is difficult to date as it underwent several repairs and additions during the Mughal period. In fact, the "fort" in question (and several other structures within it) have especially been connected with the time of Azim-us-Shan, Mughal governor of Bihar, during whose time Patna was known as Azimabad.[58]

According to Deeg, it is likely that the ancient Mauryan city described by Xuanzang had its centre at what is known as "Patna City" (located in the north-eastern part of Patna). He suggests that the Gupta-period Pāṭaliputra which Faxian described was more to the north and south of the old riverbed of the Ganga.[59] As the fort also presents a possible correlate to the roughly parallelogram-shaped settlement of the sort described by Megasthenes some further comment is required. Three lines of evidence challenge the identification of the site of ancient Pāṭaliputra with the fort. First, several important sites, including Kumrahar and Bulandibagh, lie outside this area. Second, almost all the wooden palisade remains have been found outside the fort area. The sole exception is a palisade segment near a talab at the centre of the fort, not along its boundary (Figure 2). Third, the location of the fort does not correspond to the confluence of the Ganga with an old channel of the Son. One reconstructed palaeochannel of the Son has been shown to meet the Ganga at Fatuha, which some scholars identify as the Mauryan-period confluence.[60] The river Punpun – parts of which may represent another palaeochannel of the Son – also joins the Ganga at this point. However,

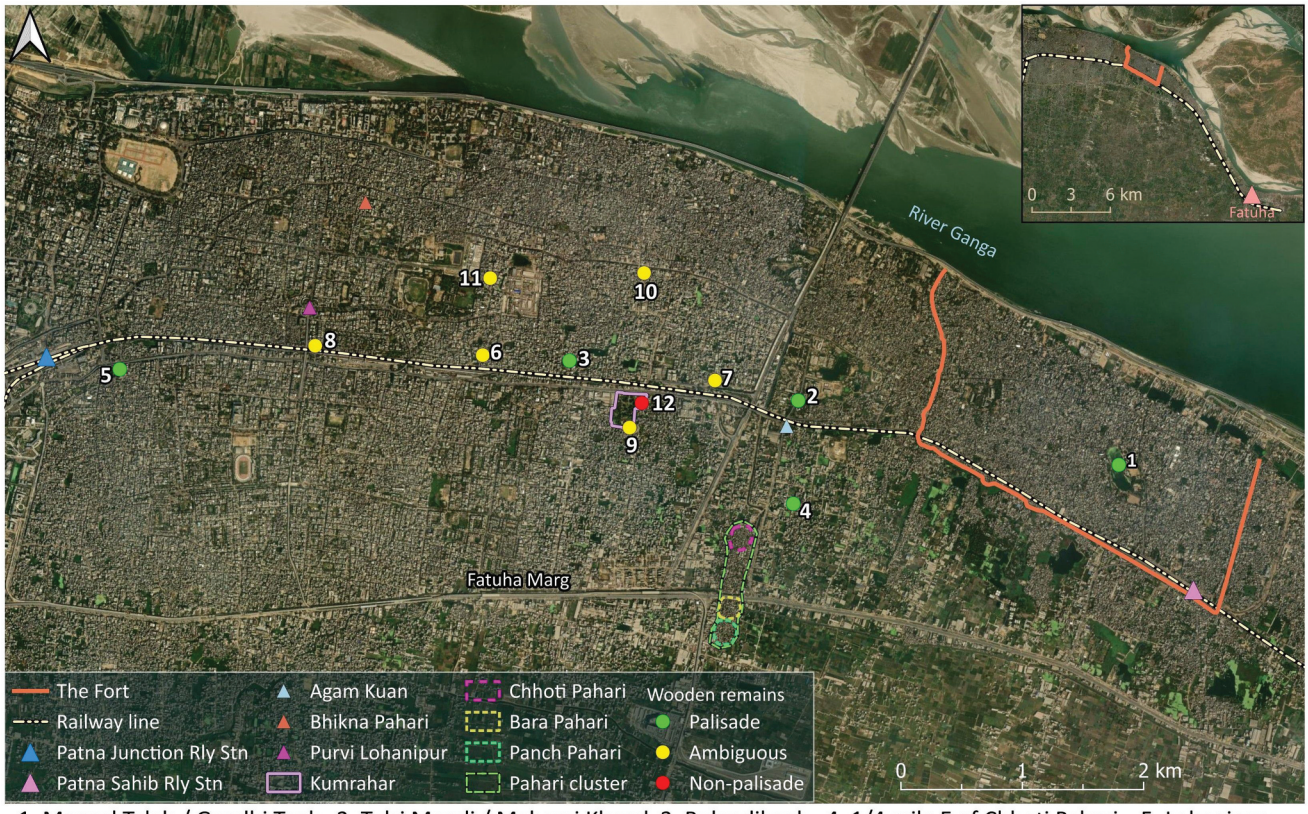


Figure 2. Locations of documented wooden findings at Patna. Background image: ESRI Satellite 3 March 2026 (accessed via QGIS).

Fatuha lies approximately 10 km southeast of the fort (Figure 2 inset).

As evident from this discussion, there are different views and a great deal of uncertainty about the location of Mauryan-period Pāṭaliputra. The use of geospatial and palaeo-hydrological techniques can facilitate a reconstruction of the ancient landscape and settlement extent of Mauryan Pāṭaliputra by offering new perspectives grounded in data, and analytical methods that have not previously been explored. Most of the identifications of the ancient city place it north of the railway line based on the locations where palisade remains were found, and suggest that the sites to its south lay outside the city limits. Our hypothesis is that the main part of the ancient city was located south of the railway line, and that it had a northern extension (Figure 1(h)). This is elaborated on below.

Remains of the Wooden Palisade

During the 19th and 20th centuries, there were several reports of the discovery of various kinds of wooden remains at several sites in Patna. These include alignments of massive wooden beams and planks. Although the stratigraphy and dates are not entirely clear, their scale and organisation point to the existence of a massive defensive wooden installation, consistent with Megasthenes' description of a Mauryan city surrounded by a timber-built fortification wall.

The earliest discovery of what were described as palisade beams was made in 1876 near Mangal Talab.[61] Significantly, this is the only palisade location recorded within the area of the medieval fort, and even here, the beams were not found along the fort's edge as one might expect of a defensive structure, but rather in its centre, during excavation of the tank (Figure 2 shows the context of the tank and Figure 3 is a photo of the northern portion of the tank taken during field survey in March 2025). In 1792, three palisade locations were reported at Bulandibagh, Tulsi Mandi (next to a water body called Maharaj Khand), and one mile east of Chhoti Pahari.[62] The bulk of the other locations – Bulandibagh, Sandalpur, Rampur, Bahadurpur, east of Kankarbagh Road, and



Figure 3. The northern portion of Mangal Talab (photograph taken in March 2025).

Lohanipur – were reported in 1896–97,[63] and several of these were excavated later.

Bulandibagh is especially important, as the wooden palisade remains here were found in the course of systematic excavations. Spooner's 1912–13 excavations had unearthed a stretch of the palisade running for about 137 metres west to east to the south of the site; its western end was marked by a slope or ramp going up to the top. In 1926–27 and 1927–28, Manoranjan Ghosh carried out excavations, primarily aimed at re-opening this section of the palisade again in order to understand its nature. These excavations unearthed an approximately 76 metre long section of the fortification running east to west. It consisted of two parallel rows of upright beams, about 3 metres high, giving the wall a total width of about 4.5 metres. The floor between the beams appears to have been paved with wooden planks and the top covered with wooden beams.[64] It is possible that some of the space between the parallel walls may have filled with earth, although it could also have been left free for the movement of troops.[65] The timber used in such constructions has been identified as sal (*Shorea robusta* Gaertn.), a durable hardwood well suited to large structural elements, with the added advantage of being more water resistant than most other woods.[66]

A radiocarbon determination carried out in 1955 on a wood sample stated to be excavated at a depth of about 16–17 feet below ground level from the site of Kumrahar yielded an age of 2115 ± 250 BP.[67] When recalibrated using OxCal v4.x with the IntCal20 calibration curve, this date corresponds to 781calBCE–405calCE at 95.4% probability and 407calBCE–210calCE at 68.3% probability with median age of 157calBCE. The uncertainty associated with this single determination is substantial, and the calibrated ranges encompass pre-Mauryan, Mauryan, and early post-Mauryan periods. Consequently, this radiocarbon determination alone cannot securely assign the timber architecture to any one of these phases, although it is consistent with the use of substantial timber architecture during the Mauryan period. Fresh AMS radiocarbon dating of securely provenanced wood samples could significantly refine the chronology and provide a firmer basis for evaluating the temporal development of timber architecture at Pāṭaliputra.

Since many of the discoveries of palisade remains were recorded, their locations can be used for geospatial mapping of Pāṭaliputra's ancient fortifications. For this study, a systematic list of the sites where palisade remains were found was compiled, along with the geographical indicators noted in excavation reports, such as "east of Kankarbagh road," "north of railway track," "northwest of Kumrahar," and "western border of the village of Tulsi Mandi." To supplement these textual sources, the available historical maps were also examined.

Although archaeological and antiquarian records from Patna document the discovery of wooden architectural remains at multiple locations, it should be noted that these are heterogeneous in both form and context, and include palisade/fortification remains, drains, platforms, and other wooden structural elements. Furthermore, except for discoveries made in the course of planned excavations, the reporting of these finds is highly inconsistent, both in terms of how their function was interpreted and how precisely their locations were recorded. Any attempt to map the fortifications of Pāṭaliputra must therefore begin by recognising that the available evidence relates broadly to *wooden remains*, of which only a subset can be confidently interpreted as part of the city palisade. For these reasons, the document of the Bulandibagh palisade segment is very important. It should also be noted that P. C. Mukharji's report of his 1896–97

Table 1. Reported locations of wooden remains associated with ancient Pāṭaliputra.

No.	Location name	Year(s)	Interpretation	Discovery context	Source(s)	Present condition
Palisade remains						
1	Mangal Talab	1876	Wooden palisade	Accidental; tank excavation	McCrindle 1877; Waddell 1903; Altekar & Mishra 1959	Active tank; exact spot unknown
2	Tulsi Mandi	c. 1867	Wooden palisade	Accidental; tank excavation	Waddell 1892, 1903; Altekar & Mishra 1959	Urbanised
3	Bulandibagh	1891, 1926-28	Wooden palisade	Well digging; later planned excavations	Waddell 1892, 1903; Page 1926–27; Altekar & Mishra 1959	Protected site, marshy
4	Near Chhoti Pahari	1892	Beams which seem to be part of a pier/tower of a palisade	Accidental; well digging	Waddell 1892, 1903	Unrecognisable
5	Lohanipur	1896–97	Wooden palisade with drain	Planned excavation	P. C. Mukharji 1898	Urbanised
Ambiguous wooden remains						
6	Bahadurpur	1896	Possible palisade/wooden drain	Planned excavation	Waddell 1903; P. C. Mukharji 1898	Urbanised
7	Sewai Tank or Sitalastan	1896–97	Possible palisade/dran	Accidental; well digging	Altekar & Mishra 1959	Urbanised
8	East of Kankarbagh Road	1896–97	Unclear	Accidental	O'Malley 1907; G. C. Chandra 1935–36	Urbanised
9	South of Kumrahar	1896–97	Unclear; listed as palisade	Planned excavation	P. C. Mukharji 1898 Altekar and Mishra 1959	Urbanised
10	Sandalpur or Gosai Khanda or near Arzani Dargah	196-97, 1935–36	Wooden platform/wharf	Accidental; Excavation	P. C. Mukharji 1898 G. C. Chandra 1935-36	Protected site, waterlogged pond
11	Rampur	1896	Wooden drains, walls, rectangular structure	Planned excavation	Waddell 1903	Urbanised
Other wooden remains						
12	Kumrahar	1912–13	Wooden platform	Planned excavation	Spooner 1912–13 Waddell 1903	Protected site

excavations contains very useful clues about the extent and alignment of the city's palisade.

Figure 2 plots all known locations where wooden remains have been reported, while Table 1 categorises these finds according to the clarity of their interpretation and the reliability of their spatial information. Only five locations (Table 1, nos. 1–5) are explicitly described in the archaeological reports as palisade remains, typically characterised by very large aligned timber posts and associated defensive features (marked as green dots in Figure 2). Among these, Bulandibagh (Table 1, no. 3) stands out as the most securely documented site, having been investigated through multiple phases of excavation and providing the clearest evidence for a 76 m long wooden defensive structure. Figure 4 presents a photograph of the site taken during the 1926–28 excavations, alongside a recent photograph (March 2025) showing the area currently protected by the Archaeological Survey of India and listed as "The grove known as Bulandibagh."

A second group of sites (Table 1, nos. 6–11; marked as yellow dots on Figure 2) comprises wooden remains whose function cannot be determined with confidence. Although some later authors list these locations as palisade sites, the original descriptions refer to features such as wooden drains or lack sufficient detail to establish a fortification role. A third group (Table 1, no. 12; red dots in Figure 2) includes wooden features that are clearly not part of the city's fortification wall , such as drains and platforms. Notably, the wooden remains at Kumrahar (Table 1, no. 12) – often cited in discussions of Pāṭaliputra – represent wooden platforms associated with a structural complex and what may have been remains of a wall around a structural complex. The Rampur wooden remains, from P. C. Mukharji's description, seem to include a rectangular structure and parallel plank walls running north to south as well as a 304 m long drain extending from near Bahadurpur to the tank in Rampur.[68]

The spatial information associated with these finds is similarly uneven. Except for Bulandibagh,



Figure 4. Above Palisade remains excavated in Bulandibagh, 1926–27 (photos courtesy ASI)); *below* Bulandibagh in March 2025.

Sandalpur, and Kumrahar, which lie within areas protected by the Archaeological Survey of India (mapped in https://bhuvan-app1.nrsc.gov.in/culture_monuments/ accessed on 25 January 2025), none of the reported locations of wooden remains can be fixed with precision. Most discoveries were accidental, occurring during the digging of tanks, wells, or drains, and were recorded using relative descriptions tied to landmarks that have since disappeared or been substantially altered. This imprecision is reflected in early cartographic reconstructions, particularly at Mangal Talab (Table 1, no. 1), where Waddell places the find within the tank while Altekar and Mishra plot it to the southeast. Such differences likely reflect interpretative choices rather than contradictory evidence, as these authors relied on secondary descriptions of discoveries made decades earlier. Consequently, the original observations cannot be translated directly into precise modern spatial coordinates. Given the limitations of the historical records and the absence of surviving indicators on the ground, it is now impossible to determine the precise find spots of most reported wooden remains. Only rough approximations are possible.

Taken together, the distribution of wooden remains highlights both the extensive use of timber in ancient Pāṭaliputra and the methodological challenges involved in isolating the fortification/palisade system within a dense and continuously occupied urban landscape.

When the reported wooden remains are examined spatially and by category, a consistent pattern emerges. Of the five confirmed palisade locations (Table 1, nos. 1–5; green dots in Figure 2), four align along a broadly linear east–west axis, with only one (no. 4) lying to the south of this alignment. Among the six sites classified as ambiguous (Table 1, nos. 6–11; yellow dots in Figure 2), three (nos. 6–8) fall along the same alignment, while out of the remaining three, one (no. 9) lies to the south, and two (nos. 10 and 11) lie to the north. The location of the latter two is of special interest about which we discuss below. The one site identified as having clearly non-palisade wooden features (Table 1, no. 12; red dot in Figure 2) lies to the south. When all reported wooden finds across the three categories are plotted geospatially (Figure 2), a subset of locations (nos. 1, 2, 3, 5, 6, 7, and 8) defines a pronounced east–west alignment that closely parallels the modern railway line traversing Patna. This alignment, extending from Mangal Talab in the east to Lohanipur in the west, has often been interpreted as marking the southern boundary of ancient Pāṭaliputra, and a linear arrangement of defensive works along this axis has been proposed by earlier scholars (see Figure 1). However, as shown in Figure 2, two wooden find spots (nos. 10 and 11, both ambiguous) lie north of the east–west alignment, while two others (nos. 4 and 9, one palisade and one ambiguous) are located to the south. Despite this, most earlier scholars have placed

the city north of the east–west alignment rather than to the south, even though several other archaeologically significant locations, such as Kumrahar and the Pahari cluster, occur south of the line. This distribution indicates that the area south of the east–west alignment has potential and provides the basis for targeted investigation using remote-sensing.

Identifying Sites South of Patna Railway Line Through Remote Sensing

The construction of railway lines in the 19th century brought significant archaeological evidence to light. The Asansol–Patna–Mughalsarai section of the Howrah–Delhi main line, completed in 1862, ran to the south of Patna's settlement, effectively marking the southern boundary of the city that Buchanan, Waddell, and Altekar had earlier mapped. By 1899–1900, the Patna–Gaya line was also operational.[69] Approaching the Patna Junction railway station from the south, this line makes a sharp ninety-degree turn to the east with an unusually tight curve for a railway line, which must have been to skirt around the archaeological remains at Lohanipur, which had been first reported by P. C. Mukharji in 1898.[70] The new alignment effectively bisected the Lohanipur area into two zones, north and south of the railway line. While Waddell and Altekar's maps place Lohanipur to the north (Figure 5 (a, b)), Survey of India maps consistently place it on the southern side (Figure 5(c, d)).

Preparations for laying the railway line in the late 1890s likely drew renewed attention to these remains. Until that point, archaeological excavations had been concentrated north of the line or further east at Kumrahar and Panch Pahari. P. C. Mukharji, reporting in 1898, described the site at Lohanipur (south of Patna Junction railway station) as the most archaeologically productive locality after Kumrahar. He also unearthed a circular structure near Naoratanpur which was a mile south of the railway station. His report included fifty-eight plates, many of them maps.[71] Unfortunately, available copies of the publication lack the plates, leaving the actual extent of the Lohanipur remains undocumented. This gap in documentation meant that, as urbanisation spread, the ancient remains were effectively lost, despite the area once being a focus of archaeological attention.

Remote sensing provides a partial corrective to the lack of detailed documentation. Analysis of declassified satellite images from 1965 reveals two circular

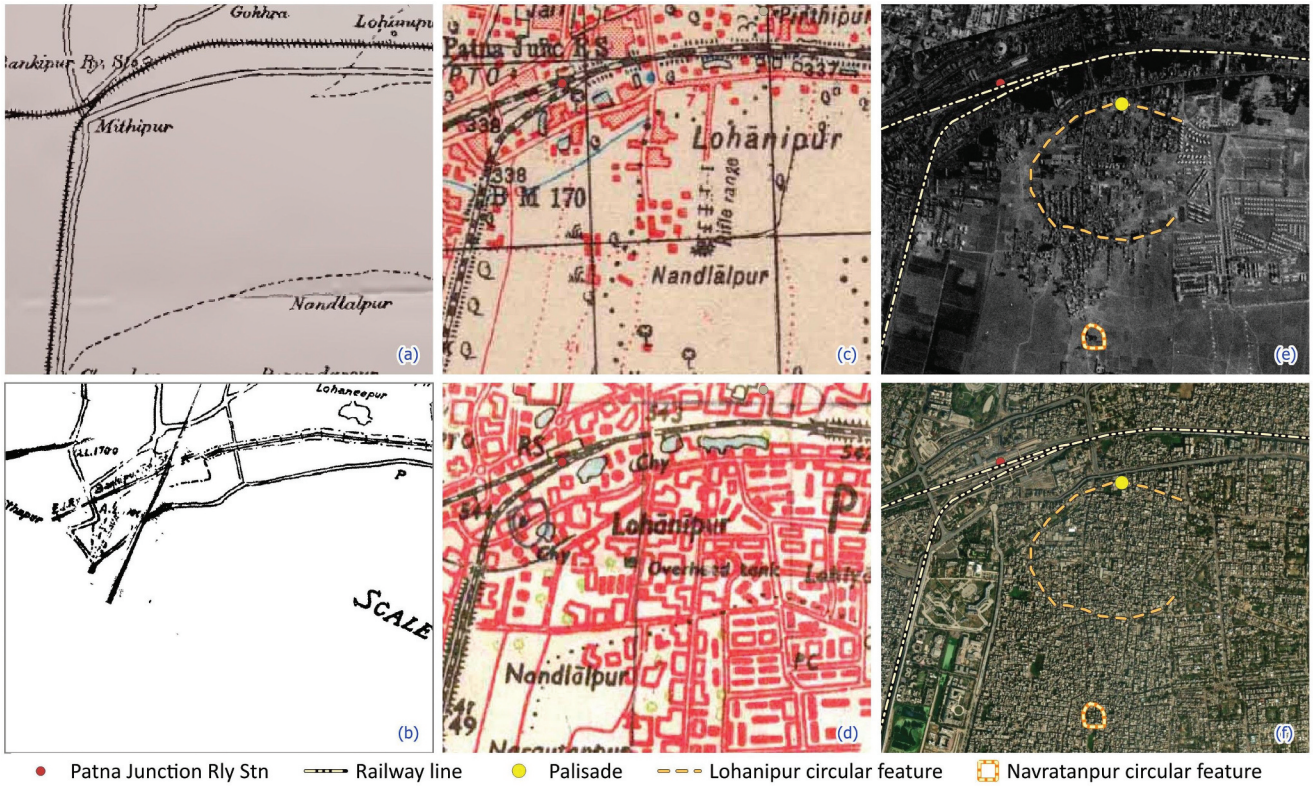


Figure 5. (a) Waddell map; (b) Altekar and Mishra map; (c) SOI 1935; (d) SOI 1976; (e) declassified 1965 above; (f) ESRI Satellite 3 March 2026 (accessed via QGIS).

enclosures south of Patna Junction railway station. The northern and larger one at Lohanipur (now Mithapur) appears as a large circular elevated area surrounded by a low-lying, dark, waterlogged boundary, which suggests that the enclosed area is a mound ringed by a moat (Figure 5(e)). Perhaps it is this feature that P. C. Mukharji refers to as *garh* when he says "The most successful place after Kumrahar was undoubtedly Lohanipur; for here on the site of the ancient *garh*, I found several important remains . . . ."[72] This feature measures approximately 650 metres in north–south diameter, and the Patna–Gaya line skirts its northwest edge, its tight curve at this point hinting that the line's alignment may have been shaped by the mound's presence.

By the time of the 1975 and 1982 imagery, rapid urbanisation had produced dense built-up cover across the area, obliterating or burying the circular feature entirely. The 1965 image appears to be the only surviving visual record of this feature; without it, its existence would likely have gone unrecognised beneath the subsequent urban sprawl (Figure 5(f)).

About 430 metres further south, at Navratanpur, lies a smaller circular feature roughly 130 metres in diameter. Much of this mound is now built over, but its western side is marked by the Navratanpur Thakurbari Mandir (Figure 5(f)). This would have been the site of Naoratanpur excavated by Mukharji. The presence of the temple may be significant, as religious structures are often established on prominent mounds and can serve as topographic markers of earlier features. Although both areas are densely urbanised today, their outlines remain faintly discernible in present-day street patterns.

The results of the inferences made on the basis of declassified imagery are confirmed by Mukharji's documentation of a variety of structural remains at Lohanipur, along with an Aśokan capital and portions of a wooden palisade associated with a drain.[73] What is also significant is that he describes one part of the wall running north-south; and above it, another wall/section running at right angles to the lower ones, i.e. east–west.[74]

It should be noted that the sites of Kumrahar, Bari Pahari and Chhoti Pahari too lie south of the railway line. The fact that most scholars placed the ancient city of Pāṭaliputra north of the railway line, may have been responsible for a greater focus on sites in that area.

Schlingloff states that the northern part of modern Patna lies on higher ground and that the area south of the habitation was unsuitable for building because it was susceptible to frequent flooding.[75] These observations, however, reflect conditions shaped by settlement patterns and fluvial processes in the recent past, when habitation was concentrated in the northern sector. The Ganga and the Son are known to have shifted their courses over time (discussed in detail in the next section), and the latter's palaeochannels in the southern area may have contributed to flooding there. The discovery of palisade remains at depths exceeding 6 metres below the present surface indicates the accumulation of occupational debris as well as extensive siltation and alluvial deposition, suggesting that fluvial activity can substantially alter local topography over time.[76] Accordingly, topography observed in recent periods, particularly in fluvially dynamic regions such as the Gangetic plains and delta, cannot be directly applied to Mauryan-period settlement patterns. Moreover, flooding is regularly experienced in the northern area also due to its proximity to the Ganga and its high water table, especially in the post-monsoon season.[77] Kumrahar, south of the railway line, is prone to water-logging due to the high water table here. However, there are water-logged unbuilt spaces in the northern part of the city too, for instance in the protected area of Bulandibagh (Figure 4(b)) and Sandalpur (Figure 6).

The evidence discussed above indicates the need for greater investigation of vestiges of ancient archaeological remains to the south of the railway line.

Tracing Old River Channels and Confluences

Today, the Son enters the Ganga plain at Rohtasgarh, but downstream of Daudnagar, its course has repeatedly shifted.[78] Previous geomorphological studies identify ten paleochannels (numbered I–X), each representing an earlier course debouching into the Ganga floodplain. Channel I, the oldest and easternmost, mouths at Fatuha, while channel X is the modern active course.[79] Figure 7 has mapped I–VII of these using Landsat-2&5 images of multiple seasons as well as DEM 10 m from Cartosat-1/IRS-P5 and 30 m from SRTM. Sahu et al. have suggested that successive avulsions of the Son have been driven by the continuous northwestward tilting of the block between the West Patna and East Patna faults. The easternmost channel is thus the oldest, with younger channels progressively displaced westward.[80]

Two of these palaeochannels pass close to the extent of Pāṭaliputra proposed in the present study: channel V to the west and channels III/IV to the south (Figure 7). One of these would likely have been the active channel referenced in early literary accounts. Channel V in particular was navigable into the 19th century and served as a major conduit for transport and



Figure 6. Sandalpur (photograph taken in March 2025).

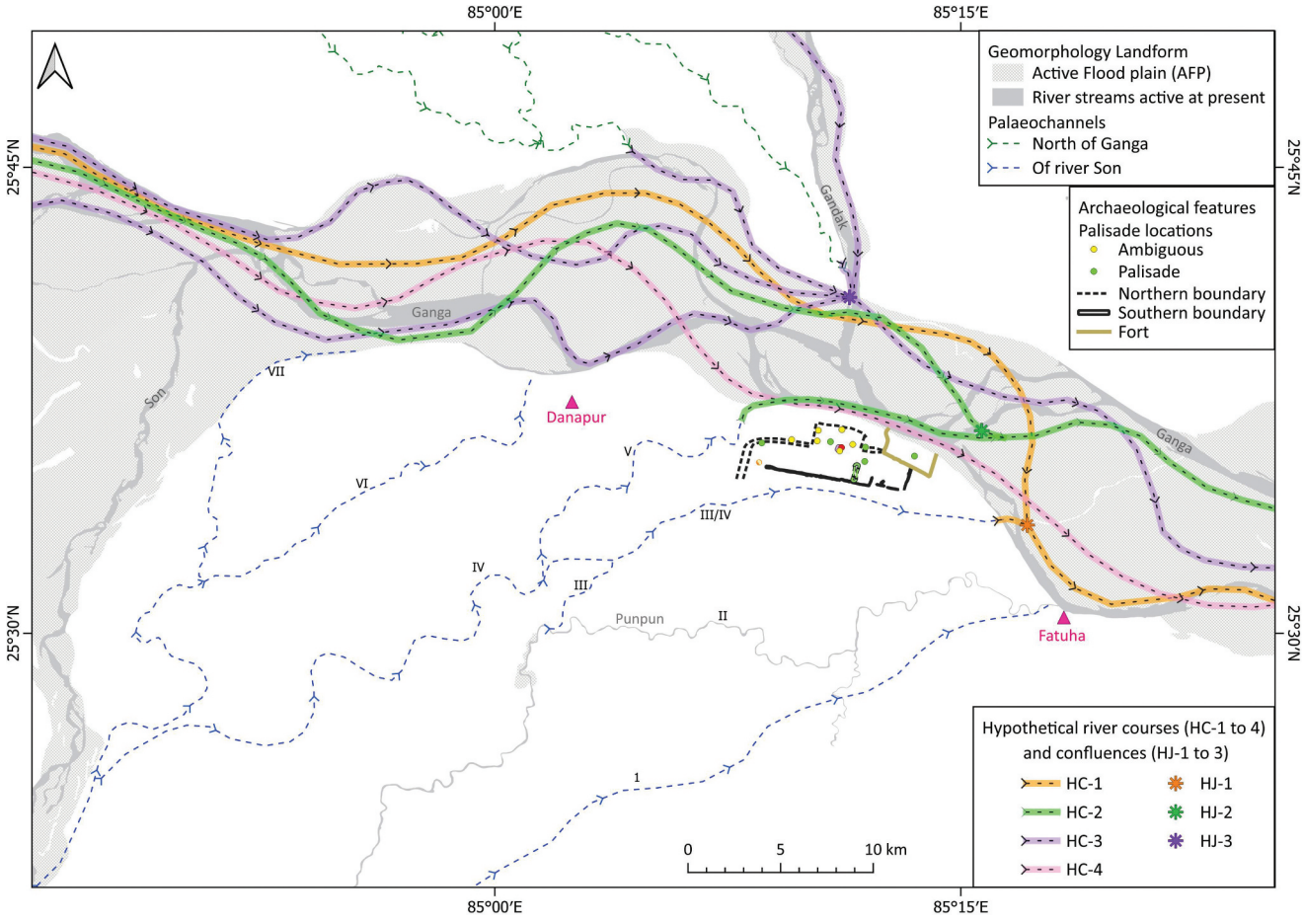


Figure 7. Proposed extent of Pāṭaliputra in the context of the active flood plain of river Ganga and palaeo-channels of river Son.

connectivity.[81] Channel(s) III/IV that passes south of Patna is the one referred to earlier by Cunningham as Mar Son.

The Ganga, meanwhile, occupies a broad active floodplain (AFP) in this region. Adjacent to the fort, the AFP spans 7 km; 20 km to the west near Danapur it widens to about 15 km, and near Fatuha to roughly 12 km. Declassified imagery from 1965 shows the main stream of the Ganga flowing along the northern edge of the AFP near both Danapur and Fatuha (Figure 8). By contrast, 2021 Google Earth imagery shows the main stream near the southern edge. This demonstrates how drastically the Ganga has shifted within its floodplain, even within six decades, and underscores the likelihood of comparable changes in antiquity.

A schematic reconstruction (Figure 7) shows the Ganga AFP, its current course, and the entry points of the Gandak and Son, together with palaeochannels from both rivers. Based primarily on geomorphic evidence, including mapped palaeochannels, floodplain morphology, and river alignments within the AFP, four hypothetical Ganga courses (HC-1 to HC-4) and three possible confluence locations (HJ-1 to HJ-3) are proposed within the AFP. These are presented as hypothetical reconstructions intended to evaluate alternative configurations that may correspond to the different textual descriptions. Each model helps reconcile different textual descriptions:

- **HC-1/HJ-1**: The Ganga follows the northern extreme of the AFP before bending southwards, while the Son flows to the south of the city along palaeochannel III/IV. The two rivers meet at HJ-1, located to the east of the city. This matches Megasthenes' account of Pāṭaliputra at the Ganga–Son confluence and supports other references linking the city with the Son. This HC1 trajectory of Ganga also supports the mid-16th century reference in *Tārīkh-i Da'udī* that states Patna was to the west of the Ganga which was flowing from the north.
- **HC-2/HJ-2**: The Son flows along channel V and meets the Ganga at a confluence point HJ-2, which is northeast of the city. This too aligns with the sources, since Megasthenes does not specify whether the city stood between the rivers or beside one of them.
- **HC-3/HJ-3**: Five streams converge at the northern edge of the AFP, at a distance of about 7.5 km from the northern limits of our proposed city extent. This configuration accords with Faxian's description that mentions one yojana between the confluence and the city, if 1 yojana is taken to be equivalent to ~7 km.
- **HC-4**: The city lies simply south of the Ganga, without reference to a confluence, consistent with Xuanzang's report.

Thus, the geomorphological evidence, combined with literary testimony, suggests multiple plausible riverine contexts for Pāṭaliputra. However, as will become apparent, the proposed settlement extent identified in the present study intersects directly with two Son palaeochannels, providing a strong geographical basis for correlating the archaeological footprint with historical accounts.

Identifying the Moat and the City

When examined through declassified satellite imagery from 1965, the landscape south of the railway line appears predominantly agricultural, with very few buildings. At this time, construction of the highway

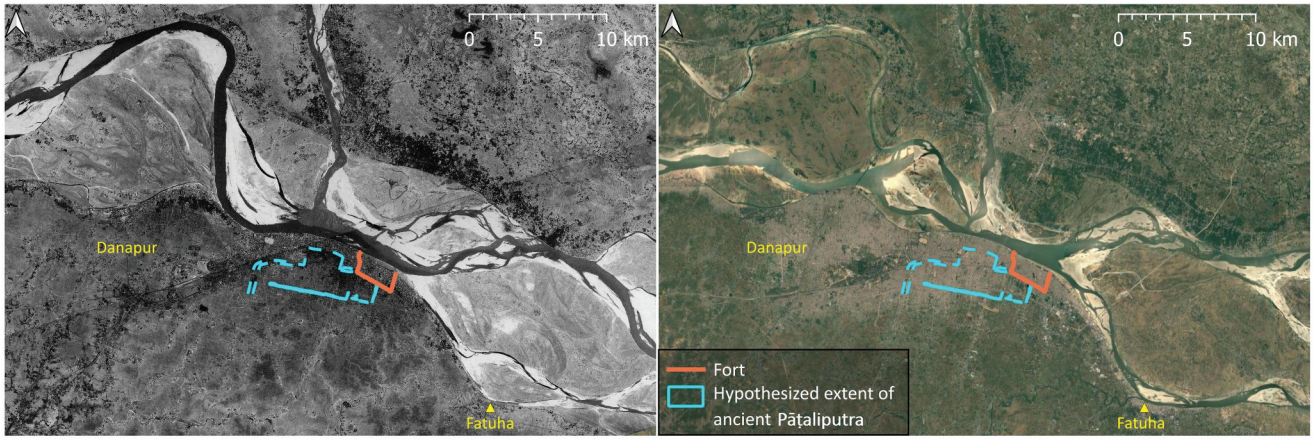


Figure 8. The shifting courses of the Ganga, visible by comparing the 1965 (left) and 2021 (right) images.

Fatuha Marg – more than 2 km south of the railway line – had not yet begun. The most conspicuous feature in the imagery is a dark linear patch, about 400 metres wide, immediately east of the Gaya–Patna railway line (Figure 9). This feature runs north along the railway line for roughly 1.5 km, narrows to 200 metres at the railway bend (likely reflecting the alignment), and then extends eastward along the northern edge of the present day Kankarbagh for over 2.5 km, paralleling the railway line running eastward up to Bahadurpur (Figure 9). The regular shape of the feature suggests anthropogenic origins. Its dark tone indicates a positive crop or soil mark, consistent with buried moats that retain moisture. (This is the same feature that S. P. Gupta, in 1980, states as "the long depression along the railway line may represent an old course of that river or of one of its branches"[82]). Comparable moat signatures on declassified images have been identified at sites such as Bihar Sharif and Bodhgaya also using declassified imagery.[83] As in those sites, in Patna too, such features are no longer visible in more recent imagery due to urbanisation (Figure 9(b)). This dark linear patch, interpreted as a moat, is not conspicuous east of Bahadurpur for a stretch of approximately 2.5 km – a gap that includes the areas of Bulandibagh and Kumrahar – after which it becomes visible again north of the railway line for about 1.3 km, a stretch that includes Tulsi Mandi, before terminating at the western edge of the fort. Waddell's description of the location where palisade remains were found in this area is noteworthy, as he states that it lay near the western boundary of the village of Tulsi Mandi and beside a water body known to village elders as Maharaj Khand ("Emperor's Moat").[84]

The 1965 declassified imagery also highlights another linear feature created by field boundaries, evocative of a former moat or canal. This feature runs parallel to the railway line about 1.9 km to its south, extending for some 7.5 km east–west (Figure 9(a)). Though narrower – about 80–100 metres wide – than the earlier mentioned moat features, it is strikingly straight, tilted about 15 degrees off the Fatuha Marg,

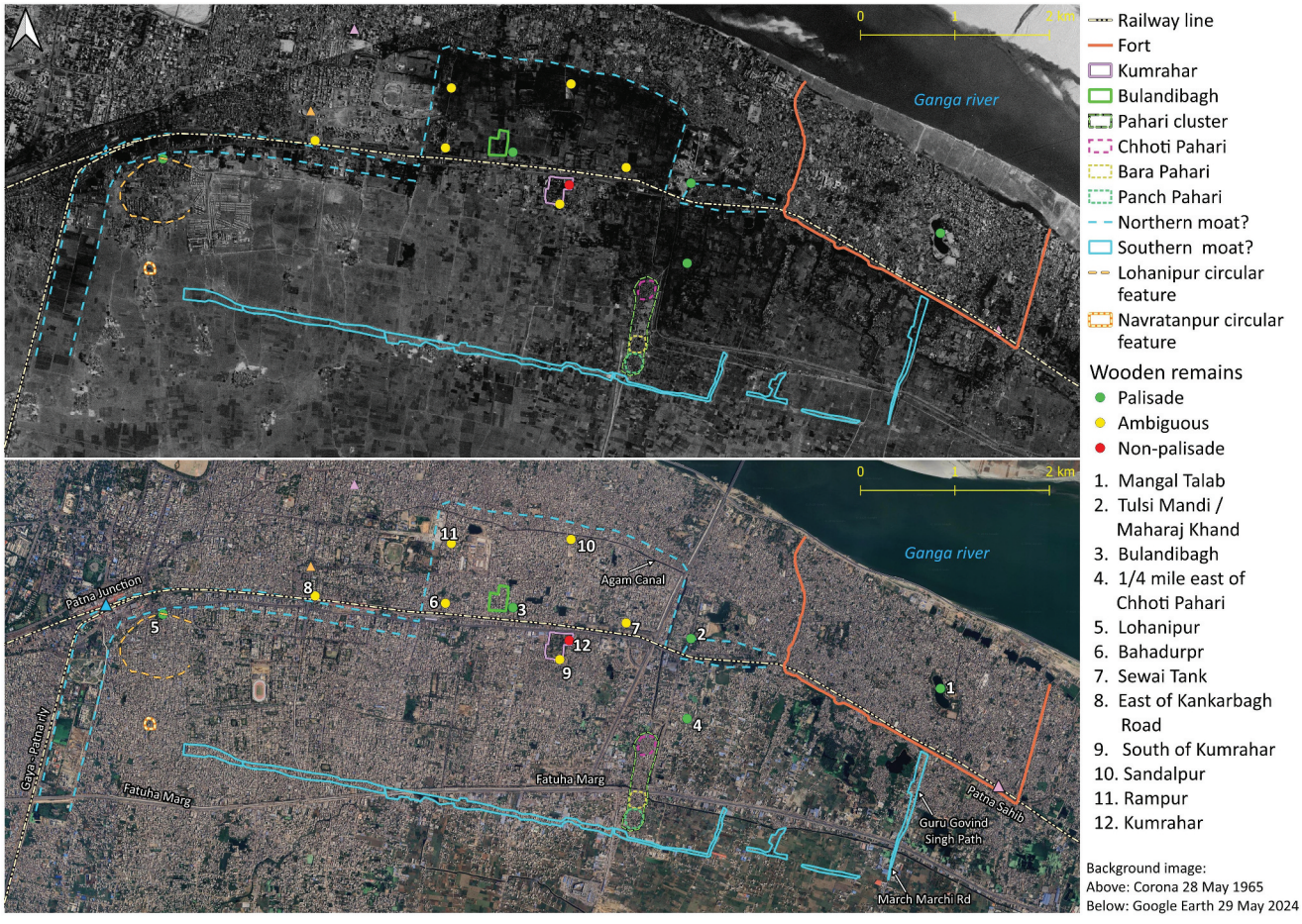


Figure 9. Moat features detectable in (a) 1965 declassified image, and (b) corresponding area in a 2024 GE image.

and intersecting it at the junction where the Vijay Nagar Road heads north. Most of this feature is now built over, though traces survive in street patterns. A short surviving stretch of canal close to the junction was identified on Google Earth imagery (Figure 10) and visited for ground truthing in March 2025 (Figure 11), where it seemed more than 5 metres deep and 15 metres wide. Locally, it is known as the *Badshahi Pyne* ("Emperor's Canal").

The Ahar–Pyne system, a traditional flood-harvesting and irrigation network in South Bihar, typically combines earthen diversion channels (*pynes*) with embanked ponds (*ahars*).[85] While the surviving feature is locally called a *pyne*, its shape and length (straight for 7.5 km rather than following topographical contours) and absence of associated *ahar*s make it difficult to reconcile with traditional irrigation canals. Instead, the evidence (its east-west orientation as well as locations being south of and parallel to the northern moat) suggests that this linear feature represents the remnant of a southern moat, which gradually silted but remained deep enough to function later as a canal. Its alignment – straight, long, parallel to the moat and positioned to the south of the historical settlement – makes it a strong candidate for a defensive boundary. (Note: the cluster of Paharis – Badi, Chhoti, and Panch Pahari – that form a row of mounds running north-south is at a right angle to the southern moat; see Figure 10, which also indicates that the moat may have influenced the alignment of the Pahadi cluster or vice versa). Similar traces of moat can also be observed on the east along the present March Marchi road and Guru Govind Singh Path, extending from the centre of the south of the fort (Figure 9).[86] If the eastern and northern boundaries are extended into the fort, the two lines will meet at the Mangal Talab, which probably marks the northeastern corner of this large rectangle. This would account for the solitary wooden palisade find inside the medieval fort.

Together, these linear traces form a large rectangle – approximately 9 km east–west and 2 km north–south – lying south of the railway line between Patna Junction in the west and Patna Sahib in the east, covering the present localities of Mithapur, Kankarbagh, Kumrahar, and Ranipur. The pronounced linearity of these water bodies, their alignment with the cardinal directions, and

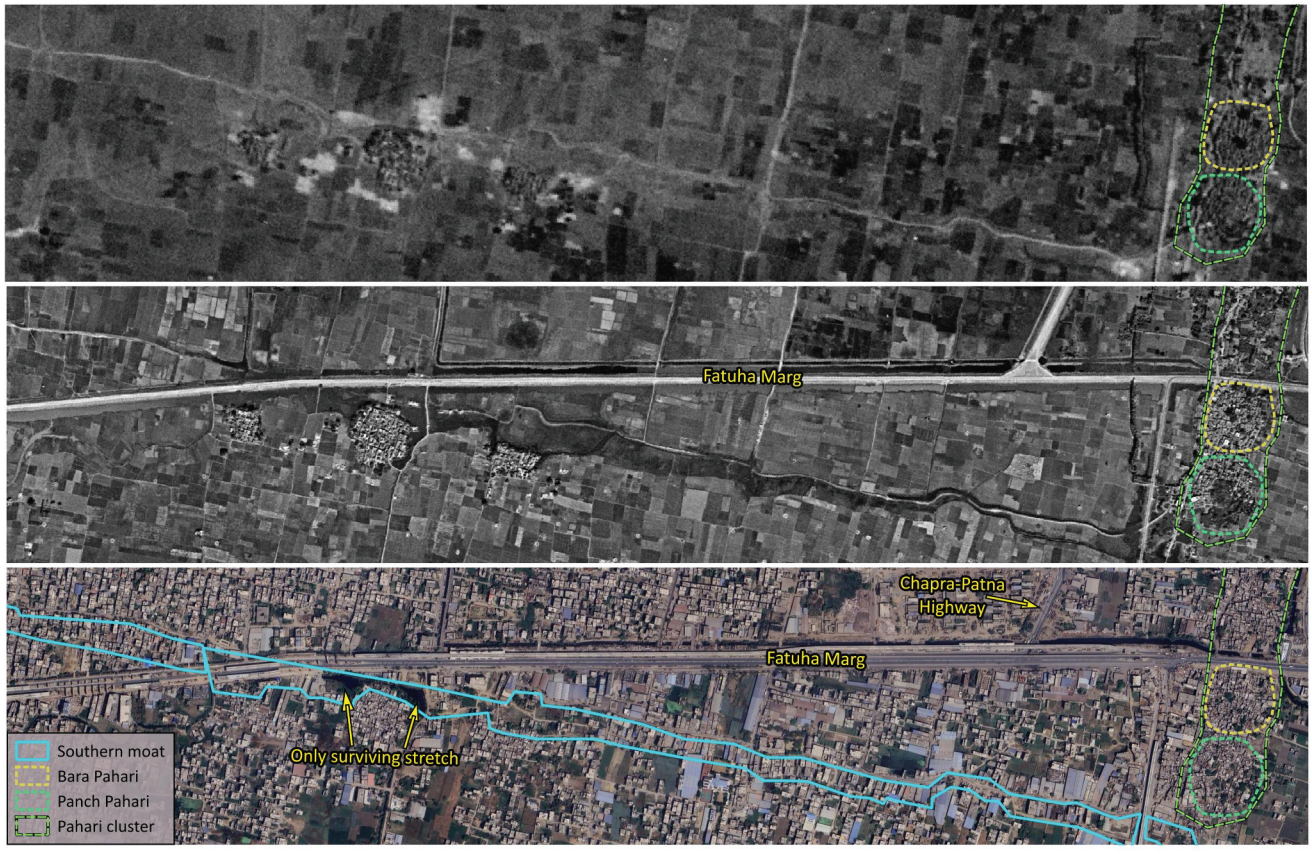


Figure 10. Proposed southern moat (Badshahi Pyne). Above: declassified 28 May 1965; middle: declassified 23 December 1975; below: GE 29 May 2024.



Figure 11. The only surviving section of the southern moat at its intersection with Fatuha Marg (photos taken in March 2025). *Above*: a short stretch immediately north of Fatuha Marg. *Below*: a wider, longer stretch to the south of Fatuha Marg.

their rectilinear spatial distribution strongly indicate that they are not of natural origin but were deliberately constructed. This interpretation is further supported by oral histories and local memory recorded from two locations within this layout.

Of particular significance is the fact that a stretch near Tulsi Mandi along the northern moat was called Maharaj Khand ("Emperor's Moat") in the early 20th century (as documented by Waddell), while the surviving stretch of the southern moat is still known as Badshahi Pyne ("Emperor's Canal"). These features must have been distinct and substantial bodies of water to have acquired such toponyms, which persisted in local memory while the features were still clearly visible on the ground. These additional inputs from two independent sources corroborate our hypothesis

regarding the locations of the northern and southern moats of the ancient city.

The absence of reported palisade finds along the proposed southern, eastern, or western moat is best understood as a consequence of changing discovery and reporting conditions rather than as evidence for the absence of archaeological remains. As shown in Table 1, almost all confirmed palisade finds were accidental discoveries during public works such as the digging of wells, tanks, or drains, with the last reported instances dating to 1896–97. Given the large quantities of wood documented during these early discoveries – many of which are preserved in the Patna Museum – it is unlikely that later ground disturbance, whether along the southern or eastern stretches or within gaps along the northern extent of the moat, failed to encounter comparable material. Instead, the pattern suggests that accidental archaeological finds were no longer being systematically reported in the 20th century. This shift coincides with the urbanisation history of the area south of the railway line: Waddell's 1903 map depicts the region as largely undeveloped, while Survey of India maps (1935) show only limited early settlement. Declassified satellite imagery indicates that substantial and planned urban expansion occurred primarily after the mid-20th century, intensifying between the 1960s and 1980s and resulting in dense urban cover by 2015. Consequently, public works in this area began largely after the period when incidental archaeological reporting appears to have ceased. This explains the absence of documented palisade finds in south Patna and, more generally, across the city.

To the north of the large rectangle described above, traces of a smaller rectangular area of dark-toned soil (indicating high moisture and waterlogging) are detectable. The regular shape suggests an artificially created space. This smaller rectangle extends northward from Bahadurpur in the west and Agam Kuan and Tulsi Mandi in the east. Its western boundary measures approximately 1.2 km; the northern boundary is about 2.6 km and runs parallel to the Agam Kuan canal, which lies roughly 100 metres to its south; and the eastern boundary measures about 900 metres. The western boundary coincides with the locations of Bahadurpur and Rampur, between which a 304 m long wooden drain was discovered and documented by Mukharji in 1898. The correspondence between the linear moat-like feature visible in declassified imagery and the excavated wooden drain is significant. This alignment strengthens the possibility that a linear wooden drain, a palisade, or both, extended along the remainder of the moat feature detected in the declassified imagery. In addition, the presence of Sandalpur along the northern boundary further supports this interpretation.

We are thus proposing a city layout consisting of two sections: the city plan consisted of two rectangles joined along a north–south axis, with the smaller rectangle centred on the northern side of the larger one. The northern section is approximately 2 km wide and covers about 3 km^2, whereas the southern rectangle is about 9 km wide and encompasses roughly 22 km^2. An artificial moat that surrounded the wooden palisade fortification ran outside the outer perimeter of the adjoined sections, as evidenced by palisade or possible palisade remains found at locations nos. 1, 2, 5, 6, 8, 10 and 11 (refer to Fig.9). It is likely that an internal palisade separated the two rectangles (nos. 3 and 7) and that wooden walls also enclosed other distinct parts of the city, such as Kumrahar (no. 9) or additional city segments (no. 4). The northern section may represent a suburb or extension of the main city. Megasthenes' reference to a parallelogram or rectangular shape suggests clearly demarcated artificially created boundaries, namely a wooden fortification wall and a moat. He may have been referring to the main city. Or he may have referred to both of the sections taken together. Although this would have formed the shape of an irregular polygon, he may have got the impression of a rectangle while travelling across the city. The much greater length than breadth, the visible straight lines of the imposing fortification walls and moat, and their perpendicular corners would have reinforced this impression.

The combined configuration of the larger southern rectangle with symmetrically placed northern extension encloses all known Mauryan/early historic-period archaeological sites: the palisade locations, Kumrahar, Badi/Chhoti/Panch Pahari, Bulandibagh, as well as Lohanipur and Navratanpur. Within this layout, Kumrahar and Bulandibagh – two sites which have revealed significant Mauryan period structural/artefactual remains discovered in the context of archaeological excavations – occupy a central position (see Figure 9). Based on this, we propose that the moat identified in the declassified imagery marks the extent of the Mauryan capital.

Conclusions

The textual evidence is remarkably consistent in associating Pāṭaliputra with the Son and the Ganga. There are explicit references to the city's situation "along the Son" (*Mahābhāṣya*, Vinaya texts, *Mudrārākṣasa*), at the confluence of Son and Ganga (Megasthenes), or close to both the Son and Ganga (*Titthogālī*

Painnaya). Faxian's, Xuanzang's and later, medieval testimonies situate the city within a landscape defined by the Ganga, river confluences, and broad river plains.

The spread, contours, and character of ancient Pāṭaliputra would have changed to some degree over the centuries. We are focusing mainly on the Mauryan capital described by Megasthenes and revealed through material remains of the early historic period found in the Patna area. In our investigation, remains of the wooden palisade, traces of the old moat, and the palaeochannels of the rivers are of crucial importance. While Megasthenes' account of India can be critiqued on several grounds, as we have seen above, certain aspects of his description of ancient Pāṭaliputra – namely location near the confluence of the Ganga and Son, parallelogram/rectilinear shape, wooden fortifications, and moat are reinforced by the archaeological and hydrological evidence.

The present study has documented several archaeologically significant features south of the railway line, including the large circular feature at erstwhile Lohanipur (present-day Mithapur), the Navratanpur mound, and a system of moats enclosing the ancient city's rectilinear footprint. This settlement comprised a broader southern expanse that narrowed northward into a smaller section symmetrically aligned along the city's north–south axis. The study has further compiled and mapped all reported wooden finds from the Patna region, assessed their functional attribution and spatial distribution, and examined historical factors that may explain the absence of reports of accidental/chance wooden discoveries from the 20th century onward.

The palaeochannels of the Son show that at least two (III/IV and V) pass directly adjacent to the extended settlement outline proposed in this study, while the Ganga's shifting courses within its active floodplain create multiple potential junction points. These hypothetical confluences (HJ-1, HJ-2, HJ-3) correspond closely to the scenarios described by various eyewitness accounts belonging to different periods, suggesting that the literary variations probably reflect hydrological shifts through time. The larger settlement footprint we have traced – bounded by moats, canals, and rectilinear features visible in declassified imagery – fits well within this dynamic riverine framework.

While attempting to delineate the boundaries of ancient Pāṭaliputra, there are, of course, larger questions such as how to define a city and its different parts and how to distinguish between a city, citadel, core area, suburb, and hinterland. In the past, several scholars have suggested a smaller city or citadel area enclosed by a fortification wall and moat, with many important structures lying outside this area; or a larger, undefined urban space. However, by combining archaeological evidence with geomorphological reconstruction, we are able to hypothesise a very large settlement boundary marked by fortification walls and a moat, which includes and encloses major sites such as Kumrahar, Lohanipur, Navratanpur, and Bulandibagh, with Kumrahar and Bulandibagh occupying a central position. This settlement included a larger southern section and a smaller northern extension. This rectangular configuration (about 25 km^2), although still smaller than Megasthenes's dimensions for the Mauryan capital (about 39.42 km^2), accords more closely than most other estimations proposed so far, while its placement adjacent to probable palaeo-confluences of the Ganga and Son satisfies the geographical contexts described in diverse literary traditions.

Thus, this geospatial and palaeo-hydrological analysis, synthesised with the entire range of textual and archaeological evidence, supports a vision of Mauryan Pāṭaliputra as an extensive, carefully planned, urban settlement surrounded by a massive wooden fortification, integrated with major hydraulic features, bounded by a moat, and strategically sited within the fluctuating but advantageous confluence zone of two great rivers, the Ganga and the Son. This synthesis provides a framework for understanding the Mauryan capital's extent and unique features and underscores the value of geospatial and palaeo-hydrological methods in resolving a long-standing historical debate.

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NOTES

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2. James Rennell, *Memoir of a Map of Hindoostan, or the Mogul Empire*, 3rd ed. (1793): 51–55, Internet Archive (https://archive.org/details/dli.pahar.0025).
3. Declassified U.S. reconnaissance satellite imagery from the 1960s–1980s was sourced from the USGS Earth Explorer archive, which hosts imagery from several reconnaissance programmes, including CORONA, ARGON, LANYARD, GAMBIT, and HEXAGON. In this study, these datasets are collectively referred to as *declassified imagery* and are identified by their acquisition dates where relevant. These images are of special importance as they record the landscape before rampant and dense urban development obliterated traces of many archaeological remains.
4. Duane W. Roller, 'Megasthenes (715).' In *Brill's New Jacoby*, Editor in chief, Ian Worthington (Brill Online, (2012) www.brillonline.nl).
5. It should be noted that the term parallelogram could also apply to a rectangle. The approximate equivalents of the measures are as follows: 1 stad/stadion = c. 182.88 m; 1 plethora = 30.48 m; 1 pechys = 462–476 mm. This would give the city a length of 14.6 km, breadth of 2.7 km and area of about 39.42 km^2. It would make the moat about 182.8 m wide and 13.8–14.2 m deep.
6. *Mahābhāṣya* 2.1.16.
7. Max Deeg, *Records of the Western Regions, Eighth Fascicle (One Kingdom), By Imperial Order Explained by the Tripiṭaka-Dharma-Master Xuanzang Compiled by the Śramaṇa Bianji of the Great Congchi-si [Monastery]* (unpublished), p. 4.
8. *Mudrārākṣasa*, Act 3, after verse 1; Act 4, verse 16.
9. A.S.Altekar and Vijayakanta Mishra, *Report on Kumrahar Excavations 1951–1955* (K. P. Jayaswal Res Inst 1959, rpn 2005): 3–13.
10. See Altekar and Mishra, *Report on Kumrahar Excavations 1951–1955*, 9–13.
11. Max Deeg, *Records of the Western Regions*, (unpublished), 7. According to Deeg, p. 13, Xuanzang's account is less reliable than that of Faxian and was in various places, based on the latter. The Chinese monks, focused especially on the Buddhist religious structures, including those attributed to Aśoka.
12. According to Max Deeg (personal communication), it is possible that 1 Yojana = 16 *li* and 1 *li* = 420 m. However, he also highlights the difficulties in establishing firm equivalences for the distance measures used in the Chinese accounts.)
13. Deeg, *Records of the Western Regions*, p. 5.
14. Deeg, *Records of the Western Regions*, p. 10.
15. Sarwani, ʿA. K., *Tarikh-i-Sher Shahi* (B. P. Ambashthya, Trans.) (K. P. Jayaswal Research Institute, 1974): 571–572 (https://archive.org/details/tarikh-i-sher-shahi-of-abbas-khan-sarwani-persian-to-english-k-p-jayaswal-resear/page/571/mode/2up).
16. British Library: MSS.Eur.D.97-1: printed as 'Map of Patna and Bankipur' in Buchanan, F. (1939). *An account of the districts of Bihar and Patna in 1811–1812*. Patna, India: Bihar & Orissa Research Society.
17. Sonia Das and M.B. Rajani, 'Palimbothra to Patna: reconstructing the ancient landscape using geospatial analysis'. In: Rao N (ed.) *Facets of Indian culture* (Aditya Prakashan, New Delhi and S R Rao Memorial Foundation for Indian Archaeology, Art And Culture, 2020).
18. 1903
19. 1959
20. V.H. Jackson, ed. *Journal of Francis Buchanan (afterwards Hamilton) kept during the survey of the districts of Patna and Gaya in 1811–1812* (Patna, Superintendent, Government Printing, Bihar and Orissa, 1925): 173–87.
21. J.D. Beglar, *Report of a Tour Through the Bengal Provinces in 1872–73*, 8 (Calcutta: Office of the Superintendent of Government Printing, 1878): 1–34. Beglar observed that some old stones seem to have been built into more recent buildings, for instance, in the lane leading to the Patan Devi temple and at the door to the temple itself. He also pointed out that near the northeastern end of Patna there were various stone boulders on the river banks and built into its revetment, indicating that the old city was probably located on this side. "Besides these, no other traces of old Pāṭaliputra exist in modern Patna" (p. 28). He also expressed the view that modern Patna did not stand on the site of old Pāṭaliputra but very close to it. The latter occupied what was now part of the Ganga bed and perhaps part of the island between Patna and Hajipur on the opposite side of the river (p. 24).
22. Alexander Cunningham, *Report of a tour in Bihar and Bengal, in 1879–80, from Patna to*

Sunargaon, Archaeological Survey of India, 11 (1871): 151–62. (https://archive.org/details/in.ernet.dli.2015.358908).

23. Cunningham, 11 (1871): 157.
24. Cunningham, 11 (1871): 157. Cunningham added a few more details in his account of Patna in his report for 1879–80: Alexander Cunningham, *Report of a tour in Bihar and Bengal, in 1879–80, from Patna to Sunargaon*, Archaeological Survey of India, 15 (1871): 1–3.
25. L.A. Waddell, *Discovery of the Exact Site of Asoka's Classic Capital of Pāṭaliputra, the Palibothra of the Greeks and Description of the Superficial Remains* (Calcutta, Bengal Secretariat Press, 1892).
26. The first notice of wooden beams in Patna was by J. W. McCrindle, *Ancient India as Described by Megasthenes and Arrian* (Bombay, Education Society's Press, Byculla, 1877) 207 https://archive.org/details/AncientIndiaAsDescribedByMegasthenesAndArrian-1877/page/n215/mode/2up?q=Palisades&view=theater
27. L.A. Waddell, *Report on the Excavations at Pāṭaliputra (Patna), the Palibothra of the Greeks* (Calcutta, Bengal Secretariat Press, 1903). As Waddell was unwell, these excavations were mostly supervised by C. A. Mills of the CPWD.
28. It was a vertical section of the shaft, 3½ ft long and almost 2½ ft in diameter; the pillar circumference was calculated to be about 7 ft 7 inches.
29. Waddell, *Report*, 12.
30. The size and boundaries of Patna have expanded over time. Survey of India maps (1935 and 1976) specifically label the eastern area around Patna Sahib as "Patna City," a term that is still used today for one of the tehsils in Patna district. Although its exact boundaries have shifted, the area centred on the Patna Sahib Gurudwara and the Patna Sahib (Patna City) railway station remains the core of what is known as Patna City.
31. Waddell, *Report*, 19–23.
32. Waddell, *Report*, 21.
33. P.C. Mukharji, *A Report on the Excavations on the Ancient Sites of Pāṭaliputra (Patna-Bankipur) in 1896–97* (Calcutta, Bengal Secretariat Press, 1898). Although the publication details are given, the report was never actually published.
34. V. A. Smith served as Curator of the Indian Institute, Oxford, from 1910 until his death in 1920. These maps, together with a few letters addressed to Smith and several pages of an unpublished 1898 report bearing pencil annotations, were tied to a volume, (IND) 81 F 3/1, that was likely part of the Indian Institute collection transferred to the Bodleian Library in the 1960s. Based on the contents of the two maps and the captions in the list of plates, we infer that these are draft versions of the intended Plates I and II, although they are not themselves numbered. We are grateful to Dr Robert Harding, UCL Institute of Archaeology, who helped in locating these materials in the Bodleian Library and Ms Marwa Ahmed, a researcher in Oxford who examined these and provided us with photographs.
35. Mukharji, *A Report*, 11–13.
36. Mukharji, *A Report*, 17, 31–32.
37. D.B. Spooner, *Annual Report of the Archaeological Survey, Eastern Circle for 1912–13*, Calcutta (The Bengal Secretariat Book Depot, 1913). J.F. Blakiston, *Annual Report of the Archaeological Survey, Eastern Circle, for 1913–14* (Calcutta: The Bengal Secretariat Book Depot, 1914). D.B. Spooner, Mr. Ratan Tata's excavations at Pāṭaliputra. In *Annual Report of the Archaeological Survey of India, 1912–13* (Superintendent Government Printing. 1913): 53–86. For a discussion of this and other issues, see Sraman Mukherjee, New province, old capital: Making Patna Pāṭaliputra, *Indian Economic and Social History Review*, 46, 2 (2009): 241–79.
38. Archaeological Survey of India, Eastern Circle, *Annual Report of the Archaeological Survey of India, Eastern Circle, for 1914–15*, Part II (Calcutta: The Bengal Secretariat Book Depot, 1915): 48–49, and Archaeological Survey of India, Eastern Circle, *Annual Report of the Archaeological Survey of India, Eastern Circle, for 1915–16* (Calcutta: The Bengal Secretariat Book Depot, 1916): 27–30.
39. Reported by J. A. Page 'Bulandibagh.' In *Annual Report of the Archaeological Survey of India, 1926–27.* By John Marshall (Calcutta: Government of India, 1930), 135–140.
40. Annual Rep, ASI for 1935–36 (Delhi, Manager of Publns, 1938), pp. 54–55. G.C. Chandra 'Excavations at Pāṭaliputra.' In *Annual Report of the Archaeological Survey of India, 1935–36*, edited by J. F. Blakiston (Delhi Manager of Publications, 1938), 54–55.
41. Altekar, and Mishra, *Report*, 1959.
42. Altekar, and Mishra, *Report*, 19–20. Period I, before c. 150 BCE; Period II, c. 150 BCE to 100 CE; Period III, c. 100–300 CE; Period IV, c. 300–

450 CE; Period V, 450–600 CE; Period VI, c. 17th century.

43. They also reported remains of a canal going back to the Mauryan period to the south of the pillared hall, and suggested that it was initially connected with a branch of the Son (Altekar and Mishra, *Report*, 25, 30).
44. Altekar and Mishra, *Report*, 6–7.
45. B.P. Sinha, and L.A. Narain, *Pāṭaliputra Excavation, 1955–56* (Patna, The Directorate of Archaeology and Museums, Bihar, Patna, 1970).
46. Sinha and Narain, *Pāṭaliputra*, 57.
47. The dates of the stone male torsos found at Lohanipur and the Didarganj yakṣi are debated. Once thought to belong to the Maurya period on account of their highly polished surface, they are now usually assigned to the late Mauryan or post-Mauryan period.
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49. Dieter Schlingloff, *Fortified Cities of Ancient India: A Comparative Study* (London: Anthem Press, 2013): 40.
50. Schlingloff, *Fortified*, 42.
51. George Erdosy, *Urbanisation in Early Historic India* (BAR International Series 430. Oxford: BAR International, 1988), 110 and 134.
52. George Erdosy, Early Historic Cities of Northern India. *South Asian Studies*, 3, 1–23 (1987): 18.
53. F.R. Allchin and George Erdosy, *The Archaeology of Early Historic South Asia: The Emergence of Cities and States* (Cambridge University Press, 1995), 201–02 and Figure 10.3.
54. Deeg, *Records of the Western Regions*, p. 10.
55. Rennell, *Bengal Atlas*, sheet N.XV.
56. M.B. Rajani, *Patterns in Past Settlements: Geospatial Analysis of Imprints of Cultural Heritage on Landscapes* (Springer Remote Sensing/Photogrammetry, 2021), 100, https://doi.org/10.1007/978-981-15-7466-5
57. This is also cited in D. R. Patil, *The Antiquarian Remains in Bihar*, 410–11.
58. Patil, *The Antiquarian Remains in Bihar*, 411, 416–17.
59. Deeg, *Records of the Western Regions*, 10
60. Beglar, 8 (1878) 23; Cunningham, 11 (1871), 155.
61. McCrindle, *Ancient India*, 207, https://archive.org/details/AncientIndiaAsDescribedByMegasthenesAndArrian-1877/page/n215/mode/2up?q=Palisades&view=theater
62. L.A. Waddell, Discovery of wooden palisades of the ancient city of Pāṭaliputra. *Journal of the Asiatic Society of Bengal*, 65, no. 1 (1986): 1–7.
63. P.C. Mukharji, *A Report*, 1898.
64. Page, 'Bulandibagh', 137.
65. The dimensions of the elements of the palisade vary in different publications. A distinction needs to be made between the large wooden beams that were part of a palisade and those that represent remains of wooden drains, some of which were quite massive. Although both followed a similar design, the drains were much smaller than the palisade; they were up to 3.8 m high with a distance of 50–70 cm between the two lines. See S.P. Gupta, *The Roots of Indian Art* (B. R. Publishing Co. 1980), 234–35. Remains of wooden platforms associated with structures were also found at Kumrahar. Also see Altekar and Mishra, *Report*, 7–9.
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69. P. Chanda, *The Fast and The Furious*. 12 Aug 2018, *Medium*. https://medium.com/@pchanda/the-fast-and-the-furious-e19386fb3f9a
70. Mukharji, *A Report*, 1898.
71. Mukharji, *A Report*, 1898. https://archive.org/details/dli.ministry.20560/page/n7/mode/2up?view=theater&q=XXXIII
72. Mukharji, *A Report*, 25.
73. At Lohanipur, Mukharji records a palisade above a drain, which may suggest that palisades could also have originally existed at other sites where drains were documented but may not have survived.
74. Mukharji, *A Report*, 25–26.
75. Schlingloff, *Fortified*, 37.
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86. It is possible that the eastern extent stretched further east and its traces are not visible due to flooding and erosion caused by the Ganga.