INDIA WATER SYSTEMS ATLAS

WEST BENGAL

— GROUNDWATER + SURFACE WATER —

ABRIDGED VOLUME

"Rivers, delta and groundwater — a connected system."

Water outcome = Geomorphology × Soil × Lithology

- GROUNDWATER SYSTEMS
- RAINFALL & RECHARGE
- GEOLOGY & AQUIFERS
- RIVERS & BASINS
- RESERVOIRS, IRRIGATION & AGRICULTURE
- URBAN & RURAL WATER SYSTEMS
- ECOLOGY & LANDSCAPES
- DATA, INTELLIGENCE & DECISION SUPPORT



Evidence, intelligence and insights for water-secure, resilient and sustainable development of West Bengal.

OPXL Consulting • Akhsheya Group • Chennai

G.L.Sudhakar
WATER INTELLIGENCE
WATER SYSTEMS

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The cover is the West Bengal cover page for this volume. The pages after it are the abridged reading of the atlas.

The proposition

West Bengal is not one water condition. Read as a single state average, the hills, the older alluvium, the laterite, the regulated river, and the tidal delta disappear into one another. Read by how the land is lived, they are five territories. The capital is a separate reading, and it is not a sixth territory.

Kolkata is the capital. The metropolitan reading on the Hooghly stays on the capital page. It is not written onto the Kolkata district row. Howrah is the west-bank district of that system and is not a second capital. Siliguri, Asansol-Durgapur, and Haldia are urban readings on their host districts. A city figure is not a district figure.

The water is one connected thing across those readings. The rock, the rain, the river, the canal, the tide, the well, and the city do not become one number. This volume keeps the readings apart, and it marks every place where the file is empty rather than filling it.

How this volume is built

This is the abridged reading of the West Bengal atlas: the architecture already on the register, the diagnosis that the files support, and the close. A figure appears here only when the atlas file holds it.

District names are the Survey of India strings. District codes are the NWIC codes. A station is placed on a district when the file carries that code, when the published district string is the Survey of India name, when it is that name in another case, or when it is one of the published strings in the groundwater reconciliation. The published string is kept on the station. A station stays a station. A dam point is not a reservoir. Waterspread is not storage. Rainfall is the latest day in millimetres, not an annual total. Gate discharge is the sum of the gates that reported that hour, in cusec, not a canal-wide total.

The capital and the urban readings come first, because that is where a district average hides a city. The five territories come next, because membership is how the land is lived, not a basin polygon and not a rank. Each territory is read in three beats: the condition, as the register states it; the evidence, as the coded files fall on those districts; and the reading, which adds no new measurement.

Nothing in this volume is given a grade. The parameter table has no rows. A grade would be an invention.

The thirty-domain method

The state is read across thirty water-system domains. This volume does not invent a grade to justify a page. Where a file or a register sentence exists, the domain is written. Where it does not, the domain stays empty. Rain, flood, regulation, and tide differ by territory, so they are read with the territory.

1. Climate System. 113 rainfall stations, latest day in millimetres. Not an annual total and not a district climate row.

2. Glacier and snowmelt. Empty. Coded N.

3. Geology and geomorphology. Empty as a table. The territory sentences name alluvium, laterite, and tide.

4. River system. 770 river lines clipped to the district outlines.

5. Flood system. Named on the Coochbehar edge and the Medinipur West edge. No flood polygon is on file.

6. Dam and reservoir. 36 dam points and 34 reservoir polygons. A dam point is not a reservoir. They are not joined onto districts in this volume.

7. Groundwater system. The 2025 compilation gives district recharge, extractable resource, extraction, and stage in hectare-metres. Level stations stay in metres below ground. The stage percentage is not a grade.

8. Aquifer system. 13 formations clipped to the district union.

9. Borewell and tubewell. Empty as its own register. Well type is carried only on the groundwater-level station.

10. Water quality. 132 CPCB stations and 41 CWC biological stations. A sample without a river-line join is still a quality sample.

11. Soil system. Empty.

12. Agriculture system. Empty as a table. Rice on canal delivery is a territory sentence, not a crop row.

13. Irrigation system. 1,129 canal lines. Six Durgapur gate stations, cusec for the gates reporting that hour.

14. Water consumption. Empty.

15. Urbanization system. The capital page and three urban readings. Municipal limits are not on file.

16. Water body system. 11,479 waterspread polygons, phases I and II. Waterspread is not storage.

17. Forest system. Empty.

18. Ecology and biodiversity. Empty.

19. Coastal system. Tide and salinity are the C5 sentence. No coastal layer is on file.

20. Population and settlement. Empty.

21. Sanitation and health. Empty.

22. Industry and energy. Named on the Damodar reading, Asansol-Durgapur, and Haldia. No industry table.

23. Economic system. Empty.

24. Governance system. Empty.

25. Disaster system. Empty.

26. Food security system. Empty.

27. Livelihood system. Empty.

28. Ancient and traditional water. Empty.

29. Interstate water system. Three basin polygons, source spellings kept. No allocation table.

30. Future risk system. Empty.

The capital - N3 Kolkata

N3 is Kolkata. The number is the third place in the node series N1, N2, N3, N4. It is not vacant, and it is not a misprint on the urban page.

Metropolitan reading on the Hooghly. Host district Kolkata. Host district Kolkata, LGD 315.

The capital reading stays in this chapter. It is not written onto the district row. The capital map draws Kolkata, LGD 315, and Howrah, LGD 313. Howrah is the west-bank district. It is not a second capital and not a second node.

On those two codes the files hold: 2 rainfall stations; 57 groundwater-level stations; 0 waterspread polygons; 6 CPCB stations; 0 CWC stations; 0 discharge stations; 0 gate stations. Seven CPCB stations in the state file carry the district name Kolkata and no district code. They stay unlinked. They are not added here by name.

A city feeder register is not on file. Municipal limits are not on file. There is no treatment-plant count, no leakage rate, and no city water-security score in the West Bengal files. Those absences stay empty.



Plate. Kolkata in deep teal, Howrah in sand. Cyan marks are waterspread polygons on those two codes. Waterspread is not storage.

The urban readings

The node series is N1 Siliguri, N2 Asansol-Durgapur, N3 Kolkata, N4 Haldia. N3 is the capital chapter. This chapter is N1, N2 and N4. Each is kept on its host district. None of them is a second district.

N1 Siliguri. North Bengal city reading. Host district Darjeeling. The hill station is a different reading. Host district Darjeeling, LGD 309.

On this host code the files hold: 1 rainfall stations; 42 groundwater-level stations; 0 waterspread polygons; 14 CPCB stations; 5 CWC stations; 0 discharge stations; 0 gate stations.

The city map is the host district. Municipal limits are not on file, so the map is not a municipal boundary. The reading is not written onto the district row.

N2 Asansol-Durgapur. Damodar industrial city reading. Host district Paschim Bardhaman. Host district Paschim Bardhaman, LGD 704.

On this host code the files hold: 5 rainfall stations; 22 groundwater-level stations; 795 waterspread polygons; 9 CPCB stations; 0 CWC stations; 0 discharge stations; 6 gate stations.

The city map is the host district. Municipal limits are not on file, so the map is not a municipal boundary. The reading is not written onto the district row.

N4 Haldia. Port and industrial reading on the lower Hooghly. Host district Medinipur East. Host district Medinipur East, LGD 317.

On this host code the files hold: 8 rainfall stations; 160 groundwater-level stations; 0 waterspread polygons; 8 CPCB stations; 1 CWC stations; 3 discharge stations; 0 gate stations.

The city map is the host district. Municipal limits are not on file, so the map is not a municipal boundary. The reading is not written onto the district row.

Groundwater stations, reconciled

The groundwater-level file holds 1,095 stations, one latest sample at each site, in metres below ground. All 1,095 are on a register district. The five territory counts add to 1,095. The published district string is kept on the station.

Where the published string is not the Survey of India name, it is joined only by the list below. The string is not rewritten.

Purba Medinipur is kept, and 160 stations are placed on Medinipur East.

Paschim Medinipur is kept, and 100 stations are placed on Medinipur West.

S24Pgs is kept, and 70 stations are placed on 24 Paraganas South.

N24Pgs is kept, and 29 stations are placed on 24 Paraganas North.

Malda is kept, and 11 stations are placed on Maldah.

D Dinajpur is kept, and 4 stations are placed on Dinajpur Dakshin.

U dinajpur is kept, and 2 stations are placed on Dinajpur Uttar.

The groundwater-quality file holds 1,931 stations, one latest electrical-conductivity sample at each site. All 1,931 are on a register district. The published string is kept.

Quality stations whose published string is not the Survey of India name are joined by the same list. The string is kept.

Purba Medinipur is kept, and 165 stations are placed on Medinipur East.

North 24 Parganas is kept, and 110 stations are placed on 24 Paraganas North.

Paschim Medinipur is kept, and 109 stations are placed on Medinipur West.

South 24 Parganas is kept, and 94 stations are placed on 24 Paraganas South.

Malda is kept, and 56 stations are placed on Maldah.

DAKSHIN DINAJPUR is kept, and 50 stations are placed on Dinajpur Dakshin.

Uttar Dinajpur is kept, and 40 stations are placed on Dinajpur Uttar.

Dakshin Dinajpur is kept, and 2 stations are placed on Dinajpur Dakshin.

The same name in another case is the same district. Those quality strings are kept.

NADIA is kept, and 183 stations are placed on Nadia.

COOCHBEHAR is kept, and 52 stations are placed on Coochbehar.

DARJEELING is kept, and 49 stations are placed on Darjeeling.

JALPAIGURI is kept, and 36 stations are placed on Jalpaiguri.

ALIPURDUAR is kept, and 30 stations are placed on Alipurduar.

GERATER KOLKATA is the spelling in the file. It is not a register district, and it is not joined to Kolkata by that spelling. Each of those stations is placed on the district polygon that contains the point. The spelling is kept.

GERATER KOLKATA is kept, and 41 stations fall inside Kolkata.

GERATER KOLKATA is kept, and 3 stations fall inside 24 Paraganas South.

GERATER KOLKATA is kept, and 2 stations fall inside 24 Paraganas North.

Metres below ground are not the resource account. The 2025 compilation, on the next page, is that account. A 2020 compilation uses older district units and is not painted onto this register.

Groundwater resources, 2025

The national compilation prints a West Bengal district table in hectare-metres, and a state line in billion cubic metres. Recharge 25.85 bcm. Extractable resource 23.5 bcm. Extraction 10.62 bcm. Stage 45.19 percent. The same compilation counts 345 assessment units: 242 safe, 34 semi-critical, 9 critical, 60 saline, and 0 over-exploited. Those unit counts are the state line. They are not a district grade.

Each published district string below is kept, and placed on the register name. The stage percentage is the published ratio. It is not a grade awarded by this volume. The parameter table still has no rows.

Paschim Barddhaman is kept, on Paschim Bardhaman. recharge 24,168.20 hectare-metres. Extractable 21,955.99. Extraction 11,851.12. Stage 53.98 percent.

North 24 Parganas is kept, on 24 Paraganas North. recharge 151,432.08 hectare-metres. Extractable 138,984.52. Extraction 97,709.84. Stage 70.3 percent.

Paschim Medinipur is kept, on Medinipur West. recharge 240,759.01 hectare-metres. Extractable 218,332.66. Extraction 116,439.91. Stage 53.33 percent.

South 24 Parganas is kept, on 24 Paraganas South. total annual recharge printed as a dash. Extractable 0.00. Extraction 0.00. Stage 0.0 percent.

Dakshin Dinajpur is kept, on Dinajpur Dakshin. recharge 113,266.82 hectare-metres. Extractable 102,169.85. Extraction 62,222.50. Stage 60.9 percent.

Purba Barddhaman is kept, on Purba Bardhaman. recharge 202,308.00 hectare-metres. Extractable 183,612.97. Extraction 96,267.52. Stage 52.43 percent.

Purba Medinipur is kept, on Medinipur East. recharge 67,069.14 hectare-metres. Extractable 60,362.23. Extraction 22,020.83. Stage 36.48 percent.

Uttar Dinajpur is kept, on Dinajpur Uttar. recharge 121,388.68 hectare-metres. Extractable 111,027.15. Extraction 52,014.09. Stage 46.85 percent.

Murshidabad is kept, on Murshidabad. recharge 195,441.72 hectare-metres. Extractable 180,970.34. Extraction 105,680.05. Stage 58.4 percent.

Alipurduar is kept, on Alipurduar. recharge 129,084.49 hectare-metres. Extractable 116,176.02. Extraction 12,981.17. Stage 11.17 percent.

Jalpaiguri is kept, on Jalpaiguri. recharge 188,378.35 hectare-metres. Extractable 169,540.51. Extraction 20,353.68. Stage 12.01 percent.

Koch Bihar is kept, on Coochbehar. recharge 207,201.80 hectare-metres. Extractable 186,481.62. Extraction 86,164.64. Stage 46.21 percent.

Darjiling is kept, on Darjeeling. recharge 42,363.13 hectare-metres. Extractable 38,126.81. Extraction 3,323.45. Stage 8.72 percent.

Kalimpong is kept, on Kalimpong. recharge 4,004.81 hectare-metres. Extractable 3,604.32. Extraction 64.97. Stage 1.8 percent.

Jhargram is kept, on Jhargram. recharge 102,188.24 hectare-metres. Extractable 94,154.65. Extraction 23,607.35. Stage 25.07 percent.

Kolkatta is kept, on Kolkata. total annual recharge printed as a dash. Extractable 0.00. Extraction 0.00. Stage 0.0 percent.

Puruliya is kept, on Purulia. recharge 59,047.56 hectare-metres. Extractable 53,142.82. Extraction 9,458.18. Stage 17.8

percent.

Bankura is kept, on Bankura. recharge 160,694.25 hectare-metres. Extractable 147,036.71. Extraction 59,437.76. Stage 40.42 percent.

Birbhum is kept, on Birbhum. recharge 112,487.96 hectare-metres. Extractable 103,094.32. Extraction 34,464.15. Stage 33.43 percent.

Haora is kept, on Howrah. recharge 22,904.41 hectare-metres. Extractable 21,190.22. Extraction 4,358.87. Stage 20.57 percent.

Hugli is kept, on Hooghly. recharge 128,457.02 hectare-metres. Extractable 116,406.20. Extraction 62,710.62. Stage 53.87 percent.

Malda is kept, on Maldah. recharge 117,843.44 hectare-metres. Extractable 106,801.68. Extraction 36,167.96. Stage 33.86 percent.

Nadia is kept, on Nadia. recharge 194,912.04 hectare-metres. Extractable 176,494.48. Extraction 144,473.85. Stage 81.86 percent.

C1 Hills and Dooars

Condition. Water is lived as orographic rain, fast rivers, tea, and hill-town supply. Floods here are flash floods and embankment floods.

Edge. Coochbehar stays in C1 as the floodplain of the Teesta-Torsa system.

Membership, 5 districts. Alipurduar, Coochbehar, Darjeeling, Jalpaiguri, Kalimpong.

Evidence on these district codes. 10 rainfall stations; 101 groundwater-level stations; 0 waterspread polygons; 27 CPCB stations; 29 CWC stations; 0 discharge stations; 0 gate stations.

Reading. Orographic rain and fast rivers are the condition, and flash and embankment floods belong to the same territory. Coochbehar stays here as the floodplain of the Teesta-Torsa system. Siliguri is the city reading and is not a value on the Darjeeling row. The hill station is a different reading, and it is not given a second node.

Empty inside this territory, as in the state: extraction stage, the parameter table, crop by groundwater, a flood polygon, and a municipal boundary. Nothing above is averaged onto a district row.

C2 Barind and Mahananda

Condition. Water is lived from the older alluvium and from groundwater, on the plain where the Ganga enters the state.

Membership, 3 districts. Dinajpur Dakshin, Dinajpur Uttar, Maldah.

Evidence on these district codes. 4 rainfall stations; 17 groundwater-level stations; 1,430 waterspread polygons; 1 CPCB stations; 2 CWC stations; 0 discharge stations; 0 gate stations.

Reading. Older alluvium and groundwater, where the Ganga enters, are the condition. No urban reading sits on this territory. Groundwater level on file is metres below ground. The 2025 resource account is a separate table, in hectare-metres, and it is not a grade.

Empty inside this territory, as in the state: extraction stage, the parameter table, crop by groundwater, a flood polygon, and a municipal boundary. Nothing above is averaged onto a district row.

C3 Rarh laterite

Condition. Water is lived from tanks, ponds, and a short wet season on the western upland. Reservoirs sit at the edge of this territory.

Edge. Medinipur West stays in C3. Its eastern blocks also live the Rupnarayan flood; that edge is recorded on the district row.

Membership, 5 districts. Bankura, Birbhum, Jhargram, Medinipur West, Purulia.

Evidence on these district codes. 57 rainfall stations; 476 groundwater-level stations; 9,254 waterspread polygons; 25 CPCB stations; 0 CWC stations; 1 discharge stations; 0 gate stations.

Reading. Tanks, ponds, and a short wet season are the condition, with reservoirs at the edge. Medinipur West stays here. Its eastern blocks also live the Rupnarayan flood, and that edge is kept rather than moved. No urban reading sits on this territory.

Empty inside this territory, as in the state: extraction stage, the parameter table, crop by groundwater, a flood polygon, and a municipal boundary. Nothing above is averaged onto a district row.

C4 Damodar and Bhagirathi

Condition. Water is lived as regulated river and canal delivery: rice on that delivery, and industry on the Damodar.

Edge. Hooghly stays in C4 as an industrial riverbank of this canal belt.

Membership, 5 districts. Hooghly, Murshidabad, Nadia, Paschim Bardhaman, Purba Bardhaman.

Evidence on these district codes. 27 rainfall stations; 185 groundwater-level stations; 795 waterspread polygons; 37 CPCB stations; 9 CWC stations; 0 discharge stations; 6 gate stations.

Reading. A regulated river and canal delivery are the condition: rice on that delivery, industry on the Damodar. Hooghly stays as an industrial riverbank. Asansol-Durgapur is the city reading on Paschim Bardhaman. The six gate stations are Durgapur, in cusec, for the gates that reported that hour. They are not a canal-wide total and not storage.

Empty inside this territory, as in the state: extraction stage, the parameter table, crop by groundwater, a flood polygon, and a municipal boundary. Nothing above is averaged onto a district row.

C5 Kolkata and the tidal delta

Condition. Water is lived as city withdrawal from the Hooghly, as groundwater beside the city, and as tide and salinity toward the sea.

Edge. Howrah stays in C5 as the west-bank district of the Kolkata system. The city node sits on Kolkata.

Membership, 5 districts. 24 Paraganas North, 24 Paraganas South, Howrah, Kolkata, Medinipur East.

Evidence on these district codes. 15 rainfall stations; 316 groundwater-level stations; 0 waterspread polygons; 35 CPCB stations; 1 CWC stations; 3 discharge stations; 0 gate stations.

Reading. Withdrawal from the Hooghly, groundwater beside the city, and tide and salinity are the condition. Kolkata is the capital reading and is not a value on the district row. Howrah stays as the west-bank district and is not a second capital. Haldia is the port reading on Medinipur East.

Empty inside this territory, as in the state: extraction stage, the parameter table, crop by groundwater, a flood polygon, and a municipal boundary. Nothing above is averaged onto a district row.

Synthesis

Read by capital, by city, and by territory, West Bengal is not one water system experiencing one problem. It is one state carrying five conditions at once, plus a capital that must not be folded into the delta district, plus three urban readings that must not be folded into their host rows.

The hills and the Dooars live by orographic rain, fast rivers, and embankment flood. The Barind and the Mahananda live by older alluvium and groundwater where the Ganga enters. The Rarh lives by tanks, ponds, a short wet season, and reservoirs at the edge, with the Rupnarayan flood kept as an edge on Medinipur West. The Damodar and the Bhagirathi live by regulated delivery, rice on that delivery, and industry on the river, with gate discharge at Durgapur kept in cusec. The tidal delta lives by the Hooghly, groundwater beside the city, and tide and salinity.

There is no state grade, because the parameter table has no rows. There is no district grade for the same reason. The capital is Kolkata. The cities are Siliguri, Asansol-Durgapur, and Haldia. The territories are the five memberships already on the register.

Rainfall, groundwater level, waterspread, and river quality fall on district codes and can be counted. They are not summed into a territory score. Waterspread remains an area on the map, not a volume in a reservoir. A station remains a station.

The maps

The state plate colours the twenty-three Survey of India districts by the five territories. A territory is membership. It is not a basin polygon. The basin file spells three names: Brahamaputra, Ganga, Subernarekha. Those are the source strings and they are kept on the map. They are not corrected in the data layer.

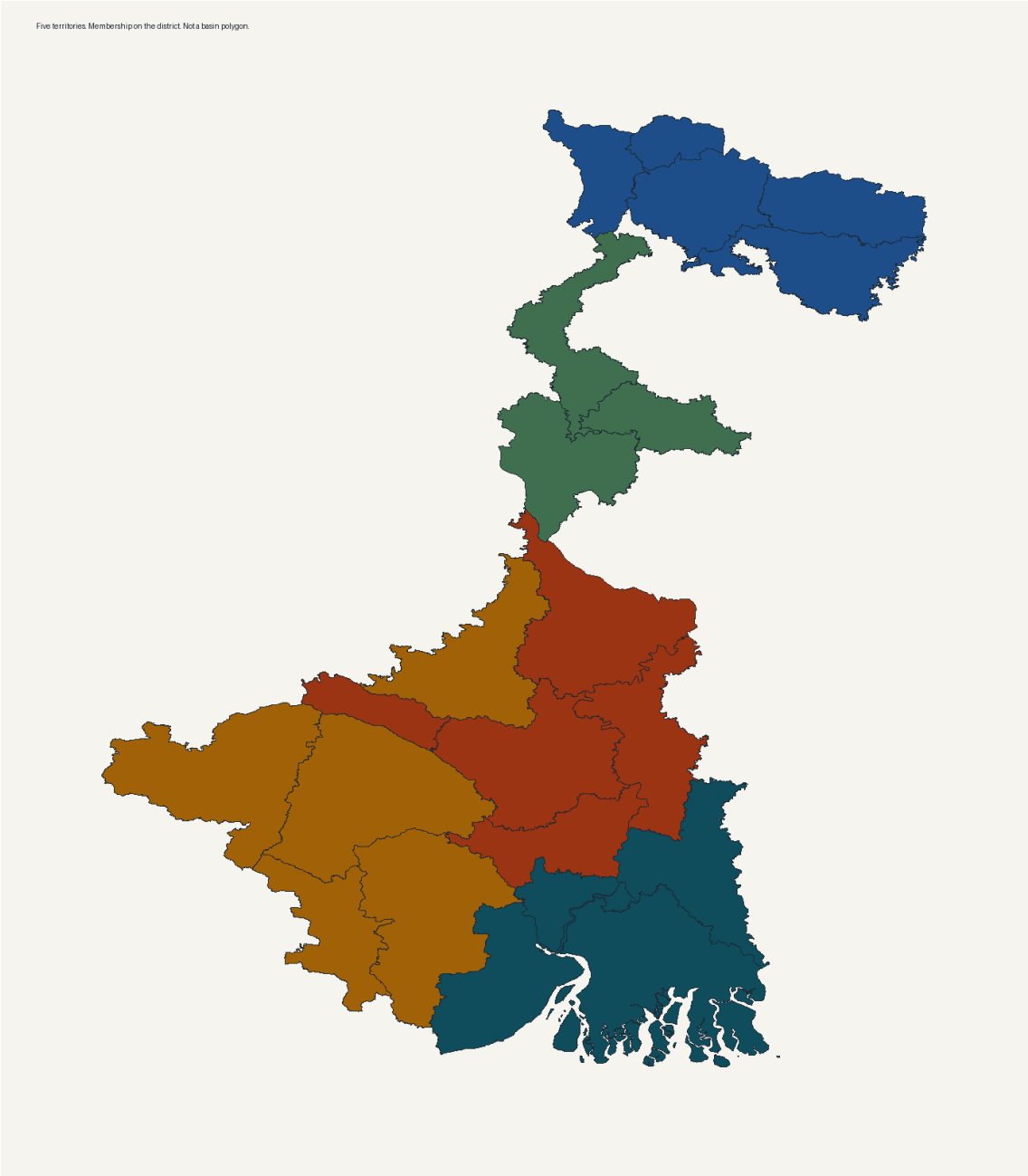

Plate. C1 deep blue, C2 green, C3 ochre, C4 rust, C5 teal.

The capital plate is in the Kolkata chapter. The atlas draws the same view, and it draws a host-district view for each urban reading. River, canal, reservoir, and dam geometries have no district code, so on the atlas they remain the state lines inside the view. They are not assigned to a district by name.

What stays open

The parameter table has no rows. The 2025 resource account is not written into it, and it is not a grade.

Kolkata and South 24 Parganas print a dash for total annual recharge in the 2025 table. The dash is kept.

Crop by groundwater stays open until a district matrix exists.

Soil, agriculture, consumption, population, sanitation, ecology, governance, and future risk stay empty. No West Bengal district table for those domains is on file.

Municipal supply, treatment, leakage, and service levels are not on file. The urban readings stay on the host district.

No flood polygon is on file. No coastal layer is on file.

Surface-water quality samples stay samples when they are not drawn as a river line. The accepted joins and the unmatched stations are listed below.

The discharge file spells Subarnarekha. The basin file spells Subernarekha. Neither string is rewritten into the other.

A feeder register for the capital is not on file.

Municipal limits for Siliguri, Asansol-Durgapur, Haldia, and Kolkata are not on file.

Glacier and snowmelt stay empty.

This book sits beside the atlas. The atlas page is the site. The PDF is not the site.

CPCB surface quality: 132 stations. Each one is a quality sample. The chemical river column is a dash. A river line is painted red only when the text before AT equals a clipped river name. That accepted join is 34 stations: Ganga River 12; Damodar River 9; Subarnarekha River 3; Rangit 2; Teesta 2; Haldi 1; Mahananda 1; Rasulpur 1; Jaldhaka 1; Raidak 1; Torsa 1.

98 stations are not painted on a river line. 98 of them have a pH reading, and 38 have dissolved oxygen. They are not stations without quality data. The title did not equal a clipped river name, so no river line is drawn from it. 7 stations have no district code. They stay unlinked. They are not joined to Kolkata by the word Kolkata.

CWC biological quality: 41 stations, 37 equal to a clipped river name. The stations not drawn as a river line still have a reading: BANPUR (local river Mathabhanga, biochemical oxygen demand 5.6); GHISH (local river Ghish, biochemical oxygen demand 1.1); NEORA (local river Naora, biochemical oxygen demand 0.7); Sagardighi Lake (local river none, biochemical oxygen demand 4.7). Naora is not rewritten as Neora. A basin spelling is not substituted for a river name.

Sources for the figures in this volume are the atlas files: Survey of India district boundaries published by the National Water Informatics Centre; the clipped river, basin, reservoir, dam, canal, and aquifer layers; groundwater level and groundwater quality stations; CPCB surface-water quality; CWC biological quality; daily rainfall; river discharge; Durgapur gate discharge; and waterspread phases I and II. Territory counts use the district codes of the register. The groundwater reconciliation counts every level station in the file.