Catchment Degradation from Mining in the Dikhow Basin and Its Role in the Upper Assam Flood Disaster of July 2026

A geomorphological and hydrological assessment based on multi-temporal satellite imagery (2010-2026), official flood and rainfall records, and headwater rainfall climatology

Study area: Naginimora sector, Dikhow (Dikhu) river
Mon District (Nagaland) - Charaideo / Sivasagar Districts (Assam)
Event: 19 July 2026 onward

14 satellite image plates, headwater and downstream rainfall analysis, graded attribution finding

This assessment states its conclusions at explicit confidence levels and sets out, in Section 12, the further evidence required to raise them. Counter-arguments are addressed in Section 10.

Contents

1. Purpose, Scope and Statement of Evidentiary Limits

This report examines whether, and to what degree, the expansion of coal mining, riverbed extraction and associated land-use change in the Dikhow (Dikhu) basin contributed to the flood disaster that struck Upper Assam from 19 July 2026 onward.

It is necessary to state at the outset what this evidence base can and cannot establish.

The material comprises: two official daily reports (one flood, one rainfall) for 19 July 2026; six matched pairs of high-resolution satellite images from 2010 and 2026; headwater rainfall figures and July climatology for Mon district; and contemporaneous official and press reporting on the event and on mining activity in the basin. This is sufficient to establish land-surface change with very high confidence, and sufficient to establish a physically well-founded amplification pathway. It is **not** sufficient to establish a counterfactual, that is, to demonstrate that the flood would not have occurred in the absence of mining.

Three facts specifically prohibit that stronger claim:

- **Rainfall on the Assam plain was independently sufficient to cause flooding.** Sonari recorded 161.5 mm and 197.5 mm at its two gauges in the 24 hours to 08:30 on 19 July. Both fall in IMD's "Very Heavy Rainfall" band, approaching the "Extremely Heavy" threshold, and both are higher than any figure reported for any Nagaland district on the same day.
- **The headwater event was described by the responsible authority as cloudburst-like.** The NSDMA characterised Mon's rainfall on 19 July as an amount that would ordinarily fall over several days, arriving within a very short period. Sub-daily intensity of that kind produces flash floods and landslides in steep terrain irrespective of catchment condition.
- **No hydrological model, discharge record or channel survey has been run or examined.** Without these, the mining contribution to peak discharge cannot be quantified, only reasoned about.

Accordingly, this report advances a **graded attribution finding** (Section 11): that catchment degradation is a significant amplifying factor operating through documented physical mechanisms. Section 10 sets out the principal counter-arguments and assesses each on its merits. Section 12 specifies what further data would be required to test the stronger causal proposition. This is the conservative position, and it is the one that will withstand technical and legal challenge.

2. Study Area and Hydrological Context

The Dikhow, known as the Dikhu in Nagaland, rises near the Zunheboto-Kiphire divide in the Naga Hills and flows through Zunheboto, Mokokchung, Longleng and Mon districts before entering Assam near Naginimora and joining the Brahmaputra. Downstream it traverses Charaideo and Sivasagar districts, passing Sonari, Nazira and Sivasagar town.

This drainage geometry is important for the rainfall analysis in Section 4. The catchment spans four Nagaland districts; rainfall recorded at Mon headquarters is therefore representative of only part of it, and figures for Mokokchung, which is also within the basin, are equally relevant.

The basin contains Nagaland's principal coalfield, around Borjan and Kongan-Tiru, where coal has been extracted since 1907. Rat-hole mining continues at Borjan; open-cast mining dominates parts of Upper Tiru. Naginimora, at the mountain front on the interstate boundary, is the main trading and stockpiling centre for Nagaland coal.

The interstate boundary in this sector runs along and across the active river corridor; the imagery shows the "NAGALAND" and "ASSAM" labels on opposite banks and, at several locations, on opposite sides of the same meander. This is jurisdictionally significant: the extraction footprint straddles two states. It is compounded by Article 371A of the Constitution, under which land in Nagaland belongs to its people and is governed by customary tribal law, a constraint on state regulatory intervention that Nagaland's own Chief Minister has acknowledged in the State Assembly.

The imagery records two distinct extraction regimes in the same catchment:

- **Hard-rock and open-cast mining** in the hill terrain south-east of Naginimora (the large pale scar in the overview plates), consistent with the Borjan / Kongan-Tiru coalfield.
- **Alluvial extraction** (sand, gravel and boulder removal) within the active channel, on point bars, and across the meander cores of the Dikhow itself.

2.1 Catchment overview: 2010 compared with 2026

Figure 1 shows the study reach in both epochs with the six assessment locations marked. Read it for three things: the extent of the pale mining scar in the south-east quadrant; the density of the haul-road network penetrating the hill forest; and the width, colour and braiding pattern of the Dikhow channel.

Figure 1. Study reach, Naginimora sector, Dikhow river: catchment overview

Figure 1a, 2010. Continuous hill forest; a single confined open-cast working at lower right; narrow, well-defined channel with limited exposed bar surface.

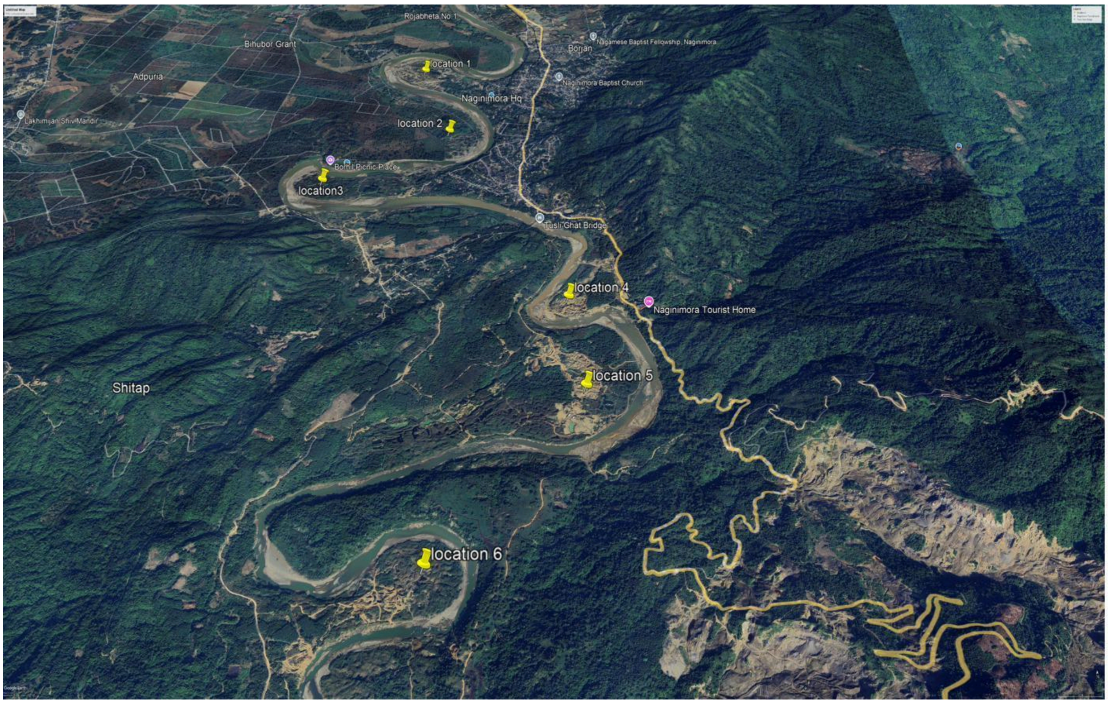

Figure 1b, 2026. Open-cast complex expanded by a large multiple with an extensive new haul-road network; hillslope forest fragmented; channel conspicuously wider, paler and more braided along its full mapped length.

Comparing the two epochs at catchment scale:

- The open-cast complex in the south-east has **expanded by a large multiple**, with an extensive new haul-road network radiating into previously forested hill terrain.
- Hillslope forest cover between Naginimora and the mine complex has been substantially fragmented by new access tracks and clearings.
- The Dikhow channel is **visibly wider, paler and more braided** along its entire mapped length in 2026, with much larger exposed sediment surfaces, the surface expression of a large increase in coarse sediment supply.
- Extraction is present on **both banks**, that is, on both sides of the interstate boundary.

3. Event Chronology and Scale

An important correction to any analysis resting on the 19 July daily reports alone: **19 July was the opening day of a multi-week disaster, not the event itself.** The official reports reproduced in Section 6 are a snapshot taken on day one. The event that followed was of an entirely different order.

19 July 2026, Nagaland. Torrential, cloudburst-like rainfall struck Mon district in the early morning. A major landslide below the Assam Rifles camp in Mon town buried a civilian settlement at approximately 06:00. Flash flooding affected Tizit town and the Lapalampong area. More than fifty landslides were reported across the district. The eventual toll in Mon district was 11 dead, around 20 injured, approximately 850 houses destroyed and some 5,000 people displaced. Mokokchung, Longleng, Tuensang, Kiphire, Shamator and Wokha also reported significant damage. Across Nagaland, the NSDMA subsequently reported 28,264 families affected across 280 villages and wards, 1,746 houses damaged, and 1,593 acres of cultivated land destroyed, with all 17 districts affected.

19 July 2026, Assam. The DRIMS daily report for that date records 8 districts, 22 revenue circles, 298 villages, 57,199 persons affected and one death. At 08:00 the CWC bulletin showed only the Burhidihing at Chenimari above danger level; the Dikhow was not listed.

Subsequent days. The Dikhow rose rapidly under continuing rainfall in Nagaland and the upper catchment and **passed its extreme flood level**, inundating Sivasagar, Charaideo, Jorhat and Golaghat. The Assam death toll rose through 47-50, to 62, and ultimately to at least 89. Reported persons affected rose past six lakh and subsequently past ten lakh. Charaideo alone recorded 10 deaths and Jorhat 8.

Characterisation by the State. Assam's Parliamentary Affairs Minister described this as the worst flood in six decades, on the specific ground that it inundated Sivasagar, Charaideo and Jorhat, districts with **no prior experience of flooding on this scale**. Local residents in the Nazira-Bihubor reach described the Dikhow flood as the worst in living memory.

This chronology materially changes two conclusions. First, the observation that the Dikhow was below its danger level applies only to the 08:00 bulletin on day one; over the event the river exceeded its extreme flood level, and the earlier caveat should not be carried forward as though it described the event. Second, the fact that the worst-hit districts had no prior experience of inundation at this scale is, on its own, the most significant piece of impact evidence in this report, because it is precisely the signature expected where a catchment's hydrological behaviour has changed rather than merely its weather.

4. Meteorological Forcing

4.1 Downstream rainfall in Assam, 18-19 July 2026

Totals for the 24 hours ending 08:30 IST on 19 July 2026, from IMD AWS and ARG stations:

District	Station	Rainfall (mm)	IMD Category
Charaideo	SONARI_AEGCL	197.5	Very Heavy
Charaideo	SONARI	161.5	Very Heavy
Kamrup (M)	SARUSAJAI	135.5	Very Heavy
Jorhat	MARIYANI_AEGCL	102.5	Heavy
Sivasagar	SIVSAGAR_AEGCL	90.5	Heavy
Tinsukia	MARGHERITA	62.0	Moderate
Tinsukia	NTPS_APDCL	59.5	Moderate
Nagaon	SAMAGURI_AEGCL	56.0	Moderate
Chirang	CHIRANG	54.5	Moderate
Golaghat	BOKAKHAT	49.5	Moderate
Barpeta	BARPETA_ARG	44.0	Moderate
Udalguri	ROWTA_AEGCL	44.0	Moderate
Lakhimpur	CHOULDHUAGHAT	32.5	Moderate
Dhemaji	SILAPATHAR	29.5	Moderate
Dibrugarh	LAHOWAL	25.0	Moderate
Jorhat	TEOK	4.0	Light

The field was strongly concentrated, not uniform. Sonari’s two gauges are the wettest in the entire state network for this window, and they sit at the outlet of the degraded Dikhow reach. The Jorhat contrast is instructive: Mariani received 102.5 mm and reported flash flooding, while Teok, in the same district, received 4.0 mm. This is convective, spatially concentrated rainfall, the regime in which catchment surface condition exerts its greatest influence on peak discharge, because runoff generation is dominated by infiltration-excess processes on short timescales.

4.2 Headwater rainfall in Nagaland

No single official Nagaland-wide total for 19 July 2026 is available in open sources. IMD’s bulletin for that date placed Nagaland in the very heavy rainfall band (12-20 cm), but issued no statewide millimetre figure. The available district-level figures are as follows, and **they are not interchangeable**, because they come from different stations, agencies and time windows:

Figure	Source	Basis	Value
Mon HQ, 19 July	Nagaland DIPR (official)	AWS, Mon headquarters, daily	83.95 mm
Mon district, 19 July	Meteorological Centre, Kohima (via Down To Earth)	District figure	137 mm
Mon district, 19 July	NSDMA (via press)	District figure, “short period”	~130 mm
Mokokchung, 19 July	NSDMA (via press)	District figure	126 mm
Mon HQ, 19-31 July	Nagaland DIPR (official)	AWS, cumulative 13 days	341 mm

Three observations follow.

First, the official daily figure is lower than the downstream figure. 83.95 mm at Mon HQ falls in IMD's "Heavy" band (64.5-115.5 mm), not "Very Heavy". Even the higher district figures of 130-137 mm are "Very Heavy" but well short of "Extremely Heavy" (≥204.5 mm). Sonari, on the Assam plain, recorded 197.5 mm, more than any reported Nagaland district. On daily totals alone, the heaviest rain fell on the plain, not on the mined headwaters.

Second, daily totals are the wrong metric for this event. The NSDMA's Joint Chief Executive Officer characterised Mon's ~130 mm as falling within a very short period, an amount that would ordinarily be spread over several days. Multiple sources describe the trigger as a cloudburst. The hydrologically relevant variable is therefore sub-daily intensity, which is not published for any Nagaland station. **This is a genuine and material gap, and it cuts against the argument advanced in this report as much as for it:** an extreme sub-daily burst can produce landslides and flash floods in steep terrain regardless of land cover.

Third, Mon HQ is not the catchment. Mon town lies well away from the Dikhow's main stem, and the basin extends across Zunheboto, Mokokchung, Longleng and Mon. The Mokokchung figure of 126 mm is at least as relevant to Dikhow runoff as the Mon HQ figure. No gauge figure specific to the Dikhow catchment above Naginimora has been located.

4.3 Mon July rainfall climatology

Reported July rainfall at Mon, for context:

Period	Total (mm)	Days	Mean rate (mm/day)
July 1985 (record)	534	31	17.2
July 2017	517	31	16.7
July 2019	491	31	15.8
July 2024	457	31	14.7
July 2018	446	31	14.4
July 2025	351	31	11.3
July average	322	31	10.4
19-31 July 2026 (Mon HQ)	341	13	26.2

A caution that must be stated plainly. It is tempting to read the first column and conclude that July 2026 was unremarkable: 341 mm against Julys of 446, 457, 491, 517 and 534 mm. **That reading is not defensible, and it should not be advanced.** The 341 mm figure covers 19-31 July, a 13-day window; the comparison figures are full 31-day months. Normalised to a daily rate, the 2026 window delivered approximately 26 mm per day against 17.2 mm per day in the wettest July on record, roughly 50 per cent more intense. The 341 mm figure also excludes 1-18 July entirely, so the full-month total for July 2026 is unknown and is necessarily higher than 341 mm.

Presented as evidence that rainfall was "not unusual", this comparison inverts under the most cursory scrutiny and would discredit the argument it was offered to support. It is set out here explicitly so that it is not repeated.

What the climatology **does** legitimately establish is narrower: that Mon has repeatedly received July monthly totals substantially in excess of 341 mm, and that heavy monsoon rainfall in this catchment is a recurrent rather than an exceptional condition. Whether any earlier single day matched the 130-137 mm range could not be confirmed from open archives, and that question remains open.

5. Rainfall-Normalised Assessment: Was the Forcing Exceptional?

The central analytical question is not whether it rained heavily, which it plainly did, but whether the rainfall was sufficiently extreme to account for the impact on its own. Setting out both sides:

Evidence that the forcing was NOT exceptional enough to account for the impact

- The official headwater daily figure (83.95 mm, Mon HQ) is in IMD's "Heavy" band, not "Very Heavy", a category this catchment experiences in most monsoon seasons.
- Even the higher district figures (126-137 mm) fall well short of "Extremely Heavy" (≥204.5 mm).
- Mon's July monthly totals have repeatedly exceeded 440 mm, and reached 534 mm in 1985, without producing a comparable downstream disaster.
- The worst-affected Assam districts (Sivasagar, Charaideo and Jorhat) are described by the State as having no prior experience of inundation at this scale, despite the basin's long history of heavy monsoon rainfall.
- The Dikhow ultimately exceeded its extreme flood level, a threshold that presumably was not exceeded in earlier, wetter Julys.

Evidence that the forcing WAS exceptional

- The event is consistently described as a cloudburst; the responsible State authority characterised the rainfall as several days' worth arriving in a very short period. Sub-daily intensity, not daily total, governs landslide and flash-flood generation in steep terrain.
- Normalised to a daily rate, the 19-31 July 2026 window at Mon HQ (26.2 mm/day) exceeded the wettest full July on record (17.2 mm/day) by roughly half.
- Downstream rainfall on the Assam plain (197.5 mm at Sonari) was itself in the upper part of the "Very Heavy" band and independently capable of causing severe local flooding.
- The rainfall was regionally widespread: all 17 Nagaland districts and, at peak, more than a dozen Assam districts were affected, which is not consistent with a purely catchment-specific explanation.

Assessment. The forcing was severe but not unprecedented in daily-total terms; it may have been unprecedented in sub-daily intensity terms, which cannot be tested because the data is not published. The mismatch that requires explanation is therefore this: **rainfall totals within historical experience produced flooding without historical precedent in the receiving districts.** Catchment change is the leading candidate explanation for that mismatch, but the unmeasured sub-daily intensity is a genuine competing explanation and must be acknowledged as such.

6. Recorded Flood Impact

From the DRIMS Assam Daily Flood Report for 19 July 2026, day one of the event:

Parameter	Value
Districts affected	8
Revenue circles affected	22
Villages affected	298
Total population affected	57,199
Crop area submerged	3,874.84 ha
Human lives lost	1 (Amguri, Sivasagar)
Relief camps / distribution centres	15
Animals affected	37,558

Districts affected on that date: Dhemaji, Dibrugarh, Charaideo, Tinsukia, Lakhimpur, Sivasagar, Udalguri and Jorhat. Distribution within the Dikhow corridor districts:

District	Villages	Population affected	Crop area (ha)
Charaideo	57	23,891	741.68
Sivasagar	61	1,502	117.26
Jorhat	34	2,378	51.27

Within Charaideo, **Sonari revenue circle alone accounts for 16,750 of the 23,891 affected persons**, the largest circle-level impact in the state on that date. Sonari lies immediately downstream of the study reach.

Infrastructure damage in the corridor on day one included submergence of the Tiokhabi road (ch. 0.00-1885.00 m) at Sonari, damage to the Bekadolong irrigation scheme, submergence of fisheries, and five PWSS schemes damaged at Amguri. In Jorhat, the district report attributes the Mariani impacts to incessant rainfall causing flash floods.

As set out in Section 3, these day-one figures were exceeded by more than an order of magnitude as the event developed, to at least 89 deaths and more than ten lakh persons affected in Assam. The day-one report is retained here because it is the primary official document available in full, not because it describes the event.

7. Land-Cover and Geomorphic Change, 2010 to 2026

The following is a location-by-location reading of the matched image pairs. Descriptions are of observable surface features; interpretations are labelled as such. Locations are keyed to the markers in Figure 1.

7.1 Location 1: Meander core at the Assam boundary, downstream Naginimora

2010. The meander core is largely vegetated: mature tree cover in the interior, small cultivated plots, and a settlement and track along the eastern margin. Extraction is present but confined, a terraced working and vehicle standings on the outer point bar. The active channel is well defined, with a single dominant thread and a moderate exposed bar.

2026. The vegetated core has been **effectively eliminated.** The entire meander interior is stripped to bare substrate and reworked into a mosaic of excavation pits, spoil ridges, benched faces and haul tracks, with standing water in the deeper cuts. The floodplain surface has been lowered and disaggregated. Riparian vegetation on the channel margin is gone. A distinct orange-red staining is visible along parts of the channel margin.

Interpretation: wholesale removal of a floodplain block: the loss here is not only of vegetation but of the floodplain sediment body itself, together with its roughness, storage and cohesion.

Figure 2. Location 1, meander core at the Assam boundary

Figure 2a, 2010. Vegetated meander core with mature tree cover, small cultivated plots and a settlement along the eastern margin. Extraction confined to a terraced working on the outer point bar. Single dominant channel thread.

Figure 2b, 2026. Vegetated core effectively eliminated; the interior is stripped to bare substrate and reworked into excavation pits, spoil ridges, benched faces and haul tracks, with standing water in the deeper cuts. Orange-red staining visible on parts of the channel margin.

7.2 Location 2: Right-bank corridor opposite Naginimora HQ

2010. A continuous, dense forested strip occupies the inner bank between the town and the river, an intact riparian buffer several hundred metres wide, with a clean bar-and-channel geometry.

2026. The buffer has been replaced by a **pit-and-pond mosaic**: dozens of discrete water-filled excavations set directly into the former forest floor, immediately adjacent to the bank line, connected by an access-track network. Remnant vegetation survives only between pits.

Interpretation: floodplain aggregate extraction. Pits sited this close to the bank are hydraulically connected to the river at high stage and are the principal mechanism of avulsion and pit capture (see 9.4). Note that this configuration is also the physical basis of the allegation, made publicly by several Assam organisations, that water-filled abandoned pits collapsed into the Dikhow during the event, a claim assessed at Section 10.3.

Figure 3. Location 2, right-bank corridor opposite Naginimora HQ

Figure 3a, 2010. Continuous dense forested strip between the town and the river forming an intact riparian buffer several hundred metres wide; clean bar-and-channel geometry.

Figure 3b, 2026. Buffer replaced by a pit-and-pond mosaic, dozens of discrete water-filled excavations set directly into the former forest floor, immediately adjacent to the bank line and linked by an access-track network.

7.3 Location 3: Meander loop at Borhil / interstate boundary

2010. The loop interior carries continuous closed-canopy forest. Extraction is present but peripheral, confined to a working on the upstream limb.

2026. The loop interior shows the **same pit-mosaic conversion** as Location 2, extending across the full width of the loop and onto the Assam bank. Bar surfaces have widened substantially and the channel is visibly more braided. Extraction has crossed the interstate line.

Figure 4. Location 3, meander loop at Borhil, interstate boundary

Figure 4a, 2010. Loop interior under continuous closed-canopy forest; extraction peripheral, confined to a working on the upstream limb.

Figure 4b, 2026. Pit-mosaic conversion across the full width of the loop and onto the Assam bank; bar surfaces substantially widened and the channel visibly more braided. Extraction has crossed the interstate line.

7.4 Location 4: Meander below Tusli Ghat Bridge

2010. The meander core is fully forested. The channel carries clear blue-green water. The point bar is a natural, unworked gravel surface.

2026. The core is **completely excavated**: terraced benches, spoil heaps, a dense haul-road network, and working faces cut into the former floodplain terrace. The water in the upstream limb is **heavily turbid brown**, in sharp contrast to the 2010 condition. Bar surfaces are markedly enlarged and the low-flow channel is narrowed and displaced.

Note: this frame carries a scale bar (800 ft) and an imagery credit (© 2026 Airbus), making it the best candidate for quantified digitisation.

Figure 5. Location 4, meander below Tusli Ghat Bridge

Figure 5a, 2010. Meander core fully forested; channel carrying clear blue-green water; point bar a natural, unworked gravel surface.

Figure 5b, 2026. Core completely excavated into terraced benches, spoil heaps, a dense haul-road network and working faces cut into the former floodplain terrace. Water in the upstream limb is heavily turbid brown. Bar surfaces markedly enlarged; low-flow channel narrowed and displaced. This frame carries a scale bar (800 ft) and imagery credit (© 2026 Airbus).

7.5 Location 5: Meander loop below Naginimora Tourist Home

2010. Continuous dense forest across the entire loop interior, extending up the valley side. The MECK Tea Estate (Dikhu Division) label sits within unbroken canopy. The channel is clear-water with clean lateral bars.

2026. The most severe change in the sequence. The loop interior has been opened into a **large excavation complex** (working faces, spoil, settling ponds, haul roads and structures) extending from the bank up onto the hillslope. Forest loss extends well beyond the floodplain into the valley sides. Bars are greatly enlarged and the channel is choked with sediment. **Pronounced orange-ochre staining** is visible on bar surfaces and along the channel margin downstream of the workings.

Interpretation: the ochre staining is the characteristic signature of iron-oxide precipitation from acid or ferruginous mine drainage, that is, from sulphide-bearing, coal-associated material in contact with water. This is a water-quality finding of independent regulatory significance and warrants direct sampling (pH, Fe, SO_4, conductivity, total suspended solids).

Figure 6. Location 5, meander loop below Naginimora Tourist Home

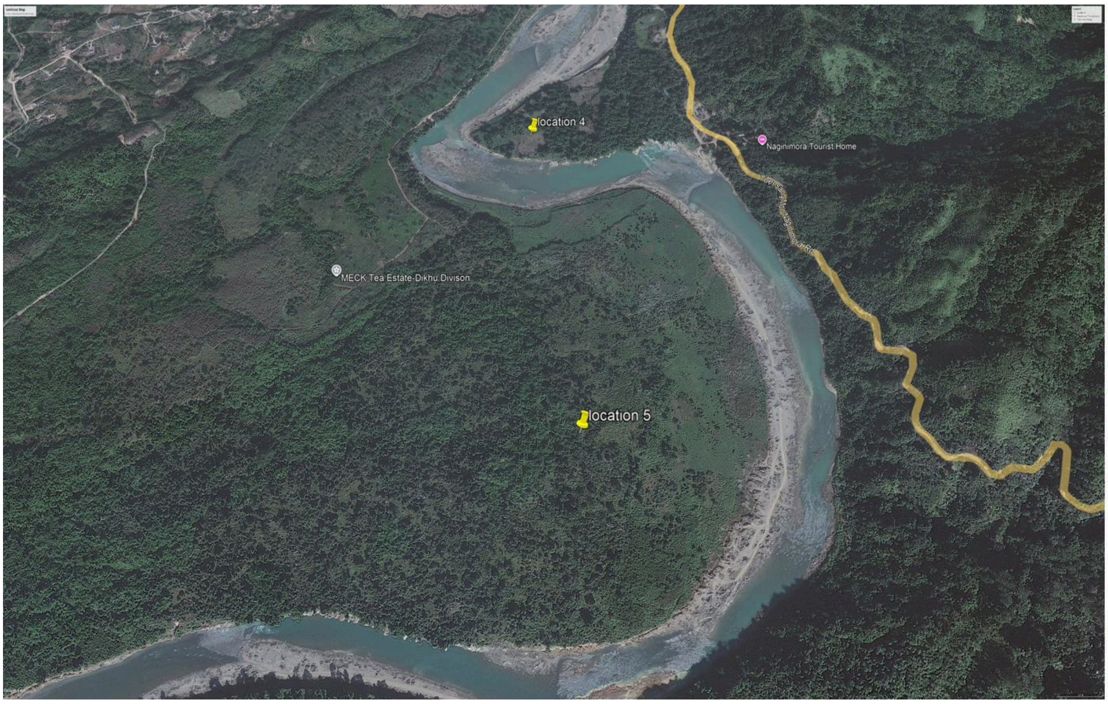

Figure 6a, 2010. Continuous dense forest across the entire loop interior and up the valley side; the MECK Tea Estate (Dikhu Division) label sits within unbroken canopy. Clear-water channel with clean lateral bars.

Figure 6b, 2026. The most severe change in the sequence: a large excavation complex with working faces, spoil, settling ponds, haul roads and structures, extending from the bank up onto the hillslope. Bars greatly enlarged; channel choked with sediment; pronounced orange-ochre staining on bar surfaces and along the channel margin downstream of the workings.

7.6 Location 6: Downstream meander pair

2010. Both meander loops are fully forested with clean, well-defined bars. This reach is essentially pristine.

2026. The southern loop core has been **stripped and dissected** by an extraction and track network. New access roads penetrate the surrounding hill forest. Bar surfaces throughout the reach are conspicuously widened and pale, and the channel shows increased braiding.

Figure 7. Location 6, downstream meander pair

Figure 7a, 2010. Both meander loops fully forested with clean, well-defined bars. This reach is essentially pristine.

Figure 7b, 2026. Southern loop core stripped and dissected by an extraction and track network; new access roads penetrating the surrounding hill forest; bar surfaces throughout the reach conspicuously widened and pale, with increased braiding.

8. Documentary Corroboration of Mining Activity in the Basin

The satellite interpretation in Section 7 does not stand alone. Independent documentary sources describe the same activity, several of them official.

8.1 Official Nagaland State documentation

The Annual Administrative Report 2024-25 of the **Nagaland Department of Soil & Water Conservation** identifies the environmental impact of uncontrolled rat-hole and open-cast mining in Wokha, Mon, Mokokchung, Longleng and Tuensang districts. Four of these five districts lie within or adjoin the Dikhow catchment. This is the State's own department recording the problem in its own annual report, and it is the strongest single documentary corroboration available.

8.2 Field study of the border mining belt

A study covering Tiru and Naginimora in Mon district, Yonglok in Longleng and Bhandari in Wokha, all of them close to the Assam border, documented widespread rat-hole mining together with serious occupational risks and ecological damage. Its findings, as reported, are directly relevant to every mechanism set out in Section 9: that mining processes necessitate extensive deforestation and removal of topsoil to reach coal; that both rat-hole and open-cast methods have caused severe land degradation, soil erosion, landslides, destruction of agricultural land and loss of forest cover; and that mining waste dumped in adjacent areas has altered natural landforms and reduced soil fertility.

8.3 Basin coalfield characteristics

The Dikhow basin contains Nagaland's principal coalfield, at Borjan and Kongan-Tiru, worked since 1907. Rat-hole mining continues at Borjan; open-cast dominates parts of Upper Tiru. Overburden from open-cast workings is reported to be dumped along nearby slopes rather than scientifically managed, the specific practice that supplies sediment directly to the drainage network (Section 9.3). Large-scale extraction of boulders and gravel continues from the Dikhow riverbed itself, which is what Figures 2b through 7b depict.

8.4 Scale and trend of extraction

Reported coal traffic through Naginimora has **declined** over the study period: a local trader cited approximately 100 trucks per day entering Assam during the 2010-11 peak season, against roughly six to ten per day now. This is recorded here because it runs counter to the argument of this report and must not be omitted. Two qualifications apply. First, coal truck movements are a measure of coal trade throughput, not of total earth moved. Stone and gravel extraction is separately reported to involve some 300 trucks per day of river stones and coal through the town. Second, and more importantly, **the hydrological effect of mining is cumulative and largely irreversible**: a hillslope stripped in 2015 continues to shed runoff and sediment whether or not trucks are still running in 2026. Declining current throughput is not evidence of declining hydrological impact.

8.5 Expert comment

Professor Arup Kumar Sarma, hydrologist at IIT Guwahati, has commented publicly on the role of developmental activity in hill areas in the July 2026 floods. Environmental researchers have argued over an extended period that activity of this kind reduces catchment absorption capacity while increasing sediment delivery to downstream rivers, which is the mechanism set out at Section 9.

8.6 Regulatory context

Regulation in the Nagaland portion of the basin is constrained by Article 371A, under which land belongs to the people of Nagaland and is governed by customary tribal law. Nagaland's Chief Minister has acknowledged in the State Assembly that the state's landholding system does not permit effective government intervention. Security sources have separately alleged insurgent financial interest in the coal trade, which is reported to complicate regulation and enforcement further. These are structural obstacles to enforcement and are noted for that reason; no finding is made here on the legality of any specific working (see Section 12.7).

9. Mechanisms Linking the Observed Change to Flood Response

Each mechanism below is stated with its physical basis and an explicit note on the strength of evidence.

9.1 Loss of infiltration capacity and increased runoff coefficient

Removal of forest canopy, litter layer and soil structure over the mining area and haul-road network converts an infiltrating surface into a compacted or near-impervious one. Runoff coefficients for compacted mine surfaces and haul roads typically exceed 0.7-0.9, against 0.1-0.3 for intact hill forest on permeable soil. A larger fraction of any given rainfall depth is converted into direct storm runoff.

The field study referenced at 8.2 documents exactly this precondition: extensive deforestation and topsoil removal as a necessary part of the extraction process.

Evidence status: mechanism standard and uncontested; **magnitude for this catchment unquantified** without runoff modelling and sub-daily headwater rainfall.

9.2 Reduction in time of concentration

Compacted surfaces and the dense engineered drainage of haul-road networks route water to the channel faster than the diffuse subsurface pathways they replace. The result is shorter lag time, a steeper rising limb and a higher, earlier peak for the same rainfall volume, the defining signature of a flash-flood-prone catchment.

Evidence status: consistent with the flash-flood character reported at Mariani, in Tizit, and in the sudden onset described by residents in the Nazira-Bihubor reach; **not independently verified** without gauge hydrographs.

9.3 Elevated sediment supply and downstream channel aggradation

Mine spoil, disturbed hillslope and disaggregated floodplain material supply large volumes of fine and coarse sediment to the channel. The 2026 imagery shows this directly: turbid brown water at Location 4 (Figure 5b) against clear water in 2010, and greatly enlarged pale bar surfaces throughout. The reported practice of dumping open-cast overburden on adjacent slopes (8.3) is the direct supply mechanism.

This is the mechanism with the most direct bearing on downstream flooding. Sediment mobilised at Naginimora is deposited on the low-gradient reach downstream, where the Dikhow enters the Assam plain, that is, the Sonari, Nazira and Sivasagar reaches. Bed aggradation reduces conveyance capacity: an aggraded channel overtops at a lower discharge than it did before. This provides a coherent physical explanation for the two most striking features of the event: severe flooding in districts with no prior experience of it, and a river that passed its extreme flood level on rainfall totals within historical experience.

Evidence status: sediment mobilisation **directly observed**; the practice supplying it **documented**. Downstream aggradation **strongly inferred but not measured**; requires cross-section survey (12.1).

9.4 Floodplain pit capture and avulsion risk

The pit mosaics at Locations 2 and 3 (Figures 3b, 4b), sited within metres of the bank line, are a recognised avulsion hazard. At high stage the river breaches into the pit field, which then captures the flow, producing abrupt channel relocation, accelerated bank retreat and headward erosion, damage disproportionate to the flood magnitude that triggered it.

Evidence status: the hazard configuration is **directly observed**. No capture event is confirmed for this specific flood.

9.5 Loss of floodplain storage and hydraulic roughness

A vegetated floodplain attenuates a flood wave: it stores water temporarily and dissipates energy through vegetative drag. The meander cores at Locations 1, 4, 5 and 6 performed this function in 2010 and are bare by 2026. Removal of roughness increases flood-wave celerity and reduces peak attenuation, delivering a sharper peak downstream.

Excavation lowers the floodplain surface, which locally increases storage volume, but this storage is disconnected and pit-bound, and does not attenuate a passing wave as a vegetated surface does. The net effect on wave propagation is adverse.

Evidence status: land-cover change **directly observed**; hydraulic effect requires 1D/2D modelling to quantify.

9.6 Slope destabilisation and landslide generation

Excavation into hillslope toes, spoil loading on slopes, and haul-road cut-and-fill all reduce slope stability. Under intense rainfall the result is mass movement. Over fifty landslides were reported in Mon district on 19 July, and the field study at 8.2 lists landslides among the documented consequences of rat-hole and open-cast mining in this belt.

Landslides matter hydrologically as well as directly: they deliver very large sediment pulses to channels in a single event, can dam and then abruptly release drainage lines, and are the proximate cause of most of the human casualties in Mon.

Evidence status: landslide occurrence **documented**; the contribution of mining to any specific landslide **not established** and requiring site-specific geotechnical investigation.

9.7 Water quality degradation

The ochre staining at Location 5 (Figure 6b) indicates ferruginous or acid mine drainage entering the river. During floods this material is remobilised and carried downstream onto agricultural land and into water supply intakes, including the five PWSS schemes reported damaged at Amguri. A compounding harm distinct from the flood hydraulics.

Evidence status: **visual indication only**; requires water sampling to confirm.

10. Counter-Arguments and Alternative Explanations

The mining-flood linkage is publicly contested. Each substantive counter-argument is set out below and assessed. Fair treatment of these is not a concession; a report that ignores them is worth less, not more.

10.1 "The flooding originated in exceptionally heavy rainfall in the higher hills, not in mining"

This is the position of the Konyak Union, which stated following a field assessment that it found no evidence supporting a mining link, and that the flooding originated in the higher hill ranges of Mon district following exceptionally heavy rainfall and cloudburst-like downpours which triggered widespread landslides, flash floods and overflowing streams before reaching Naginimora and Tizit.

Assessment: partly correct, and the correct part must be accepted. The rainfall was the trigger; nothing in this report disputes that. The argument does not, however, address the amplification question. Rainfall determines how much water arrives; catchment condition determines how fast it arrives, how much sediment it carries, and what channel capacity remains to convey it. That the flood originated in rainfall in the higher hills and that catchment degradation amplified its consequences are not mutually exclusive propositions. This counter-argument constrains the claim that may be made; it does not defeat it.

10.2 "Water was released from a dam on the Dikhu"

This claim has been made publicly by Assam political figures, one of whom has stated that construction on Phase 3 of the Dikhu Hydroelectric Project has been under way since February 2025 and that accumulated water must have been released during construction. The Konyak Union has rejected this, stating that the Dikhu Hydro Electric Project remains only a proposed project listed by the Central Electricity Authority and has neither been constructed nor commissioned.

Assessment: this report places no reliance on the dam-release claim, and recommends that no reliance be placed on it. The existence of an operational dam capable of such a release is disputed at the most basic factual level, and the claim is readily falsifiable. Advancing a contested and possibly false claim alongside a well-founded one is the surest way to discredit both. Separately, releases from NEEPCO's Doyang project were reported during the event, but Doyang is on the Dhansiri, not the Dikhow, and cannot explain flooding in the Dikhow corridor.

10.3 "Abandoned mine pits filled with water and collapsed into the river"

Alleged by the Assam Sammilita Mahasangha and, in a related form, by the Sivasagar MLA, who described illegal miners hollowing out the bases of hills, artificial lakes forming underground over years, and that stored water rushing down together when the hills began to collapse.

Assessment: physically plausible and partly visible in the imagery, but not established for this event. Figures 3b and 4b show water-filled pit fields immediately adjacent to the bank line, so the configuration described does exist. Whether any specific pit or void discharged into the Dikhow during the event is a site-specific question requiring ground investigation. It should be presented as an allegation supported by a documented hazard configuration, not as an established fact.

10.4 "Coal extraction has declined since 2010, so it cannot explain a 2026 flood"

Truck movements through Naginimora are reported to have fallen from around 100 per day at the 2010-11 peak to roughly six to ten per day.

Assessment: does not rebut the argument, for the reasons at 8.4. Hydrological damage from land-surface change is cumulative and persistent. A catchment stripped between 2010 and 2020 behaves as a stripped catchment in 2026 regardless of current throughput. The 2026 imagery shows the damage in its present state; the trend in coal traffic does not bear on it. Stone and gravel extraction, moreover, is reported to continue at a substantially higher traffic volume than coal.

10.5 “The heaviest rain fell on the Assam plain, not on the mined catchment”

This is the strongest technical counter-argument available, and it comes from this report’s own data. Sonari recorded 197.5 mm on 19 July; the official Mon HQ figure was 83.95 mm.

Assessment: it materially limits the claim that can be made about day one. Flooding at Sonari on 19 July is substantially explained by rainfall falling directly on Sonari. The mining argument does not rest on that day, however: it rests on the subsequent behaviour of the Dikhow, which rose past its extreme flood level under continuing upper-catchment rainfall, in a channel whose conveyance capacity is at issue. The argument should be framed around the river’s response over the event, not around day-one pluvial flooding on the plain.

10.6 “This was a regional event across two states, so it cannot be catchment-specific”

All 17 Nagaland districts and more than a dozen Assam districts were affected.

Assessment: valid, and it limits the scope of any attribution. Catchment degradation in the Dikhow basin cannot explain flooding in Dhemaji, Lakhimpur or Barpeta. Any attribution claim must be confined to the Dikhow corridor (Charaideo, Sivasagar and adjoining Jorhat), where the degraded catchment and the impact footprint coincide. Claims extending beyond that corridor are not supported.

11. Attribution Finding

Finding 1: Land-surface change is established beyond dispute. Between 2010 and 2026 the Dikhow corridor at Naginimora underwent severe and extensive conversion from forested floodplain and hillslope to active extraction surface. Directly observable at all six locations and at catchment scale (Figures 1-7), and independently documented by Nagaland's own Department of Soil & Water Conservation and by field study of the border mining belt. Confidence: **very high**.

Finding 2: The change is of a type and location that increases flood hazard downstream. Every mechanism in Section 9 is established hydrological and geomorphological science, and the observed configuration (bare compacted hillslopes, spoil dumped on slopes, floodplain excavation, riparian buffer loss, near-bank pits and elevated sediment supply) is the configuration that produces higher, faster, more sediment-laden flood peaks and reduced downstream conveyance. Confidence: **high**.

Finding 3: The event was triggered by severe rainfall, and would have produced flooding in some form regardless of catchment condition. Cloudburst-like rainfall in the Mon hills and 197.5 mm at Sonari are each independently sufficient causes of flooding. Confidence: **high**.

Finding 4: Rainfall totals were within historical experience; the flood impact was not. Mon's July totals have repeatedly exceeded 440 mm and reached 534 mm in 1985; the daily headwater figures for 19 July fall in the "Heavy" to "Very Heavy" bands, not "Extremely Heavy". Yet the outcome was the worst flood in six decades, inundating districts with no prior experience of inundation at this scale, and driving the Dikhow past its extreme flood level. Confidence in the mismatch: **high**. Confidence that the mismatch is attributable to catchment change rather than to unmeasured sub-daily rainfall intensity: **moderate**.

Finding 5: Catchment degradation is assessed to have materially amplified the event within the Dikhow corridor. The coincidence of the degraded reach with the districts of most severe and most unprecedented impact, the flash character of the response, and the exceedance of extreme flood level on rainfall totals within historical range, are together consistent with an amplified flood response in an aggraded, conveyance-reduced channel. Confidence: **moderate**. Consistency is not proof; the unmeasured sub-daily intensity of the 19 July burst remains a genuine competing explanation.

Finding 6: The proposition that the flood would not have occurred but for mining is not supported by the present evidence. It is not disproved; it is untested. Section 12 sets out what testing it requires.

Finding 7: Attribution is confined to the Dikhow corridor. Nothing in this report supports extending the claim to flooding in Dhemaji, Lakhimpur, Barpeta or other districts outside the basin.

The defensible position, therefore, is this: the mining did not create the rain, but it degraded the catchment's capacity to absorb the rain and the channel's capacity to carry it away. On the evidence available, catchment degradation is a significant aggravating factor in the July 2026 Dikhow flood and, whatever is concluded about this particular event, an ongoing and worsening determinant of flood risk in the corridor for every future rainfall event.

12. Data Required to Test the Stronger Causal Claim

Listed in order of evidentiary value per unit of effort.

12.1 Channel cross-section comparison (highest priority). Water Resources Department survey cross-sections for the Dikhow at Sonari, Nazira and Sivasagar, compared between the earliest available epoch and the present. Demonstrated bed aggradation would establish reduced conveyance directly, converting Section 9.3 from inference to measurement, and explaining why a river passed its extreme flood level on rainfall within historical range. This is the single most valuable outstanding item.

12.2 Sub-daily rainfall intensity for the headwaters. Fifteen-minute or hourly data from Nagaland's 16 weather stations for 18-20 July 2026, or satellite-derived estimates (GPM IMERG). This is the pivotal missing variable: it determines whether the 19 July burst was meteorologically unprecedented or merely severe, and therefore how much of the impact requires a catchment explanation. Section 5 cannot be closed without it.

12.3 Stage-discharge rating curve shift. CWC/WRD gauge records for the Dikhow. If the stage produced by a given discharge has risen over the period, this is quantitative proof of lost capacity, and demonstrates that the danger and extreme flood level thresholds have become non-conservative.

12.4 Quantified land-cover change mapping. Supervised classification of Landsat/Sentinel-2 imagery for the full Dikhow catchment upstream of Sonari at 3-5 year intervals from 2010, yielding mined and bare area in hectares, forest loss in hectares, and percentage of catchment disturbed. The plates in this report are the qualitative version; the quantified version is what a tribunal or technical committee will require. Figure 5b, carrying a scale bar and imagery credit, is the appropriate starting point for georeferenced digitisation.

12.5 Paired hydrological modelling. An HEC-HMS or SWAT model of the Dikhow catchment run under 2010 and 2026 land-cover scenarios, forced with observed July 2026 rainfall. The difference in simulated peak discharge at Sonari is the direct quantitative measure of the mining contribution, and is the analysis that would settle the question. Requires 12.2 and 12.4 as inputs.

12.6 Water quality sampling. Grab samples upstream and downstream of the Location 5 workings: pH, total suspended solids, iron, sulphate, conductivity, heavy metals. Tests the acid mine drainage indication independently of the flood question.

12.7 Legal and regulatory status of the workings. Mining lease records, environmental clearances and consent-to-operate for the Nagaland side; sand and gravel permits and District Survey Reports for the Assam side. The characterisation of any activity as illegal is a legal determination resting on this record, not on satellite imagery. Imagery establishes that extraction occurred; it cannot establish that it was unauthorised. This report makes no such finding.

12.8 Historical flood series for the corridor. Flood records for Sonari and Nazira circles over 1960-2026 with corresponding rainfall. If flood impact per unit rainfall has increased over the period, this is powerful support for progressive loss of channel capacity, and it directly tests the “worst in six decades” characterisation.

12.9 Geotechnical investigation of the Mon landslides. Site-specific assessment of the 19 July landslide scars, in particular their relationship to mine workings, spoil dumps and haul-road cut slopes. This is the only way to establish whether mining contributed to the failures that caused the loss of life in Mon.

13. Recommendations

Immediate

1. Halt further extraction within the active channel and the meander cores at Locations 1-6 pending assessment, on both sides of the interstate boundary.
2. Undertake the cross-section survey (12.1) before the next monsoon.
3. Obtain and publish sub-daily rainfall data from Nagaland’s 16 weather stations for 18-20 July 2026 (12.2).
4. Sample water quality at Location 5 (12.6) to confirm or exclude acid mine drainage.
5. Commission geotechnical assessment of the Mon landslide scars (12.9).

Short term

6. Formalise the Assam-Nagaland technical coordination already established between ASDMA and NSDMA into a standing joint committee for the Dikhow catchment with a data-sharing mandate covering rainfall, gauge and sediment records.
7. Commission the quantified land-cover mapping and paired modelling (12.4, 12.5).

8. Re-derive danger and extreme flood levels for the Dikhow at Sonari, Nazira and Sivasagar against current bed levels rather than the historical rating.
9. Extend flood early warning to the Charaideo-Sivasagar-Jorhat corridor, which the event demonstrated to be exposed and unprepared.

Longer term

10. Enforce a statutory no-extraction riparian buffer, and require backfilling and re-profiling of near-bank pits at Locations 2 and 3 to reduce avulsion risk.
11. Require scientific overburden management and sediment retention structures at active workings, in place of slope dumping.
12. Institute progressive revegetation of worked-out surfaces.
13. Address the regulatory gap created by the interstate boundary and by Article 371A through a negotiated framework rather than unilateral enforcement, which the constitutional position makes unlikely to succeed.

14. Limitations

This assessment rests on one day's official flood and rainfall records, headwater figures drawn from secondary and press reporting of official sources, and visual interpretation of two imagery epochs. It involves no ground survey, no discharge measurement, no water sampling and no hydrological modelling.

Areal changes are described qualitatively, not quantified: only one frame carries a scale reference and none is georeferenced in the material supplied. Imagery acquisition dates within 2010 and 2026 are not stated, so some apparent channel-width difference may reflect seasonal stage rather than permanent change, though this cannot account for the excavation, spoil, haul-road and vegetation-loss signatures, which are stage-independent.

The Nagaland rainfall figures at 4.2 come from different stations, agencies and time windows and are not directly comparable with one another. No figure specific to the Dikhow catchment above Naginimora has been located. Sub-daily intensity, the variable that most directly governs this event, is not available at all.

The Mon July climatology at 4.3 is drawn from secondary compilation and has not been verified against primary IMD station records; it should be so verified before publication.

Event-scale impact figures in Section 3 are drawn from contemporaneous press reporting of official statements and evolved during the event; they should be replaced with final ASDMA and NSDMA figures when published.

The characterisation of any observed extraction as illegal is not made here and cannot be made from imagery. It requires the record identified at 12.7.

The findings on land-surface change are robust to all of these limitations. The findings on flood attribution are not, and are stated at correspondingly lower confidence.

Sources

Primary documents

- DRIMS Assam, Assam Flood Report as on 19-07-2026, Assam State Disaster Management Authority (generated 27-07-2026).
- India Meteorological Department, Daily Rainfall Report - Assam, AWS and ARG station data, 18/07/2026 08:30 IST to 19/07/2026 08:30 IST.
- Satellite imagery, Naginimora sector, Dikhow river: 2010 and 2026 epochs, six matched location pairs plus catchment overviews (Google Earth; 2026 imagery © Airbus).

- Nagaland Directorate of Information and Public Relations, rainfall figures for Mon HQ AWS, 19 July and 19-31 July 2026.
- Nagaland Department of Soil & Water Conservation, Annual Administrative Report 2024-25.

Reported official statements and press sources

- Nagaland State Disaster Management Authority statements on district rainfall, casualties and damage, July 2026 (via Northeast Live, Morung Express, Nagaland Tribune).
- Meteorological Centre, Kohima, district rainfall figure for Mon, 19 July 2026 (via Down To Earth).
- Assam State Disaster Management Authority daily bulletins and Chief Minister’s statements, July-August 2026 (via Assam Tribune, Northeast Live).
- Assam Tribune, reporting on coal mining and stone quarrying along the Dikhow and the Borjan / Kongan-Tiru coalfield, August 2026.
- Konyak Union statement rejecting dam-release and coal-mining attributions, 31 July 2026 (via EastMojo).
- Assam Sammilita Mahasangha statement on illegal mining and the Sivasagar-Charaideo floods, 28 July 2026 (via Assam Times).
- Reporting on the Dikhow river’s course, basin coalfield and expert comment including Prof. Arup Kumar Sarma, IIT Guwahati (via NE Now).
- Reporting on flood scale, casualties and characterisation as worst in six decades (via India Development Review, Northeast Live, Assam Tribune).

Figures reported through press sources have been attributed to their originating agency wherever that agency is identified. Where figures from different agencies conflict, all are reported (Section 4.2) rather than a single value selected.