

Environmental Screening Tool — Methodology Companion

A short guide to how the tool produces the results you see.

Print-ready A4 · Read-through: ~10 minutes · Depth reference: METHODOLOGY.md (~1,600 lines).

Pilot layer built by **Resilicity** as a decision-support instrument for the relevant Authority of Ghana. Not an EPA product; not a determination.

1 · What the tool does

The Environmental Screening Tool answers two questions the Authority faces every day:

1. **For a specific project at a specific coordinate** — what does the L.I. 2504 pathway look like, what environmental features sit on or near this parcel, and is the proponent's declared scale plausible? This is the **single-site screening** workflow.
2. **Across the whole country** — where should verification and enforcement resources be concentrated for galamsey (illegal small-scale mining)? This is the **Galamsey Monitor**.

The tool produces a determination in **minutes** where the L.I. 2504 statutory clock allows the Authority up to **25 days for screening** and **25 days for scoping**. It does not replace officer judgement; it prepares every finding, citation and spatial fact the officer needs to sign a defensible Reg 29 letter.

2 · What the tool does NOT do

- **It does not issue permits.** Every output is decision-support only. The banner on every page and the footer of every PDF say so.
- **It does not attribute activity to any individual or company.** Corporate operator names are stripped from the site register (2026-08-24 sanitisation, six-hat review).
- **It does not replace field verification.** Every determination carries a *"field or high-resolution verification is required"* clause.
- **It is not an official Government of Ghana instrument** until the Authority formally adopts it.

3 · The single-site workflow — step by step

An officer completes the same four steps a proponent's consultant would:

Step	What happens	Data used
1. Locate	Officer drops a pin, pastes a coordinate, resolves a Ghana Post GPS digital-address, or uploads a polygon. Coordinates are validated against the Ghana jurisdiction outline (rectangle acceptance is deliberately rejected — projects off Ghanaian soil should not be screened).	GADM Ghana level-0, Ghana Post GPS resolver, Google Places autocomplete.
2. Project	Officer picks a sector (from the Act 1080 nine-sector canonical taxonomy) + a sub-type + scale fields (rooms · MW · ha · km · etc., sector-aware). Tier-1 plausibility runs immediately: e.g. a 500 MW solar array on 20 ha is flagged before submission.	Act 1080 taxonomy (intake-config.js), plausibility thresholds (METHODOLOGY.md §5).

Step	What happens	Data used
3. Screen	The orchestrator fires 20 spatial indicators in parallel against the site (or polygon), then evaluates the L.I. 2504 First Schedule / Third Schedule ruleset in order, plus the Act 1080 Impact Scale advisory. The strictest applicable rule wins .	See §5 below for the indicator table.
4. Determine	A single JSON verdict is assembled with decision (refused / requires_eia / requires_registration / no_permit_required / insufficient_information), rule_hits (every fired rule with statute citation), indicators (every one of the 20 with red / amber / green + measurement), and plausibility_flags. The determination PDF is rendered from this JSON on demand.	Determination logic in services/orchestrator.py.

The reasoning is transparent at every step. A proponent or officer can reproduce every finding from the coordinates + inputs + the ruleset version, and the machine-readable verdict JSON is preserved permanently.

4 · The regulatory engine — how a rule fires

The tool's binding decision comes from the **L.I. 2504 First Schedule (undertakings requiring registration) + Third Schedule (undertakings requiring full EIA)**, cross-referenced with the Act 1080 Impact Scale advisory. Every rule the tool fires cites the exact schedule, item and (where applicable) sub-clause.

For example, when a proposed hotel exceeds **40 rooms** on peri-urban land, the tool fires:

- LI2504_S3_ITEM_TOURISM_40ROOMS — full EIA required (L.I. 2504, Third Schedule, Item on tourism developments ≥ 40 rooms; original threshold traced to L.I. 1652 Schedule 2, retained in L.I. 2504)
- If the site sits within a Ramsar wetland buffer or on a designated inland water body, the wetland / IWB rule fires and **the strictest applicable outcome is bound** to the verdict.
- If the Impact Scale computes an *EIA-equivalent* score, the Impact Scale advisory is attached; the tool does NOT allow the Act 1080 fee band (a revenue instrument) to override an L.I. 2504 assessment tier (six-hat review 2026-07-18 fix).

The fee estimate (Act 1080 revenue-side taxonomy) is calculated separately and rendered in PDF §13, with a confidence rollup — a rule that could match multiple fee lines is flagged for officer confirmation, never silently priced.

5 · The 20 spatial indicators

Every screening runs all twenty in parallel. Each returns a red / amber / green verdict plus its raw measurement, its statute reference (where one exists), and its data source.

#	Indicator	Data source	Statute / driver
1	Wetlands (Ramsar)	Ramsar SIS + curated Ghana Ramsar polygons	Wetlands Management Act 923 (2016), Ramsar Convention
2	Protected areas	Ghana Forestry Commission reserves + WDPA	Wildlife Conservation Act 43 (1961), Forests Act 1041
3	Rivers & buffers	HydroSHEDS Level-8 + OSM waterways + curated Ghana rivers	Water Resources Commission Act 522 §13 (25 m riparian)
4	Water bodies (dams / lakes / lagoons)	Curated ghana_water_bodies_display.geojson	WRC Act, EPA Sensitive Areas guidance

#	Indicator	Data source	Statute / driver
5	Coastal / lagoon zone	500 m coastal buffer + coastal lagoons layer	Ghana Maritime Authority Act 630, Act 490 §17
6	Flood zones (JRC Global Flood Hazard, 100-yr RP)	JRC Global Flood Hazard Maps	NADMO Act 927; L.I. 2504 flood-plain restriction
7	Recent flood events (2015–2026)	Curated NADMO + HSD + Copernicus EMS	Duty of care under Act 923
8	Urban drainage corridors	Curated Accra Tier-1 + OSM Tier-2 + Sentinel-1 Tier-3	Local Governance Act 936
9	REGSEC predictive flood-risk (2026)	REGSEC Minister-signed statement, 10 June 2026	Regional Security Council mandate
10	Dam-spillage envelopes (6 dams)	VRA + GWCL + BWMA + UWR spillage rules	Volta River Development Act 46, VRA Act 692
11	Inland water bodies (designated)	Curated ghana_inland_water_bodies.geojson (Volta, Bosumtwi, Songor, etc.)	Water Resources Commission Act 522, Songor Lagoon Act 286
12	Cultural heritage	Curated GMMB heritage register	National Museums Act 387
13	Government / institutional lands	Curated CSIR + universities + military + prisons + hospitals + MoFA + CRIG	State Property and Contracts Act 6, Universities Act 806
14	Galamsey hotspots (proximity)	Sanitised ghana_galamsey_sites.geojson (97 features, corporate names redacted)	Minerals & Mining Act 703
15	Galamsey-affected rivers	HydroSHEDS + OSM + Northern-belt site-proximity union	Same
16	Slope / terrain	Copernicus GLO-30 DEM	L.I. 2504 slope-instability provisions
17	Seismic zones	Ghana Geological Survey seismic hazard map	Ghana Building Code
18	HAND / flood-adjacent terrain	Copernicus GLO-30 + JRC layers	Duty of care
19	High-tension power lines (161 / 330 kV)	GRIDCo network + 30 m ROW band	L.I. 542, L.I. 1737 (statutory right-of-way)
20	Road corridors (statutory ROW)	Ghana Highway Authority network with class-specific ROW	Streets and Buildings Regulations

How they compose. For each indicator the tool records the raw measurement (e.g. "450 m from a *Priority-1* protected area"), the threshold (e.g. "*red* < 1 000 m for a *mining project*"), the sector adjustment (e.g. "*mining tightens the buffer to 2 000 m*"), the resolved verdict (red), and the source-file SHA-256. The rule engine reads these and fires only the applicable statutory rules. The 20 indicators are also served as JSON at /screen so a third party can independently reproduce the verdict.

6 · The Galamsey Monitor — national district ranking

The Monitor ranks all **260 Ghana MMDAs** by a **galamsey-pressure score (0–100)**. It is deliberately a **triage / targeting layer, not enforcement evidence**.

Score formula

$$\text{score} = 100 \cdot (0.50 \cdot F_{\blacksquare} + 0.30 \cdot R_{\blacksquare} + 0.20 \cdot \blacksquare)$$

Each component is min–max normalised across all 260 districts using a **low-tail-only** (0–95 pct) clamp so top-of-ranking discrimination is preserved:

Component	Weight	Definition	Data source
F — forest-loss intensity	0.50	Hansen GFC tree-cover loss in the galamsey era (lossyear $\geq$ 2015, treecover2000 $\geq$ 10 %) as a share of the district's wooded area, with built-up land excluded (ESA WorldCover 2021 unioned with Google Dynamic World 2023–24 built mode).	UMD/Google/USGS/NASA Global Forest Change v1.13 (2025 release, loss through 2024)
R — riverine concentration	0.30	Share of that loss falling within 300 m of a river (HydroSHEDS Level-8 unioned with OSM `waterway=river`)	stream`; 17 000+ Ghana streams). Galamsey is alluvial.
S — documented-site density	0.20	Curated register sites per 1 000 km ² (sites at district-centroid precision excluded to remove self-referential contamination; sites in Northern regions with 0 documented sites floored to the national median so under-documented dredging fronts are not silently zeroed).	Sanitised ghana_galamsey_sites.geojson (97 features)

Tier bands (renamed from severity words to action priorities)

Tier	Score	Meaning
P1 — Verify first	≥ 70	Satellite evidence strongest; top of the verification queue.
P2 — Investigate	≥ 50	Schedule verification within the current planning cycle.
P3 — Monitor	≥ 30	Track through the next imagery release.
P4 — Watch	≥ 15	Low satellite signal; watch on next update.
Baseline	< 15	No detectable galamsey signal (not evidence of absence).

Informational signals (not in the primary score)

To give officers a fuller picture without silently re-weighting the score, the producer also emits per district:

- **W — turbidity uplift** (Sentinel-2 SR red-band, 2024–26 median vs 2020–22, summed over the river buffer). Coarse water-quality proxy: sediment-laden water reflects red more strongly than clear water.
- **D — degradation** (JRC Tropical Moist Forest degraded area, class == 2). Catches hard-rock and sub-canopy galamsey that Hansen under-detects.
- **rank_ci_95** — deterministic 500-run weight-jitter bootstrap (± 5 %). Reports the 2.5th / 50th / 97.5th-pct rank per district + an unstable flag when spread > 20 .
- **annual_loss_ha** — per-year loss (2015–2024) so the drill panel shows a bar chart (grey pre-2020, orange 2020+ — the post-COVID surge is visible per district).
- **data_quality** — confidence (low / medium / high) + explanatory flags.

Currency

The Monitor is a **dated snapshot** (meta.generated, meta.snapshot_id = gm-<10-char sha256 of the ranking file>). It is rebuilt on the annual Hansen release cadence — the natural refresh window is once a year in Q2. Officers cite the snapshot_id in decision letters; a memo written today remains anchored even after the next re-run reshuffles ranks.

Known limits — declared on the tool itself

- **The score does not yet subtract Minerals Commission licensed concessions.** Districts hosting large legally-licensed mines (Tarkwa-Nsuaem, Prestea Huni-Valley, Obuasi Municipal / East, Bekwai, Asutifi North / South, Ellembele) rank high driven by regulated mining, not galamsey. Every affected district carries a "*licensed LSM*" chip in the ranking table + a full disclosure box in the drill panel. Full fix is queued — needs the Minerals Commission concessions register, which is not currently open data.
- **Weights (0.50 / 0.30 / 0.20) are expert-elicited priors, not empirically calibrated** against a held-out validation set. Disclosed on the tool itself (Knowledge Centre §6). Weight-jitter bootstrap gives per-district uncertainty.
- **Hansen has a ~1-year lag.** Activity after the loss window is not detected until the next release.

7 • Data lineage & audit trail

Every screening writes a **hash-chained audit-log entry** — a SHA-256 chain where each entry incorporates the previous entry's hash, so tampering with any historic record breaks the chain and every downstream entry. The chain is verified on every officer login; a broken chain fails closed. Officers can export the audit trail to CSV for internal review or a Right-to-Information request.

Every source dataset carries a **SHA-256 fingerprint** stamped into the verdict's dataset_lineage field, so a verdict signed today can be replayed against the same dataset version six months from now.

Every galamsey site feature now carries a per-source **licence** field (CC BY 4.0 / Pure Earth FCDO / Ghana government bulletin / journal terms / open-source) so a reader can trace re-use rights per source.

8 • Where to see the detail

Deliverable	Path	Purpose
This companion (5 pages)	demo/METHODOLOGY-COMPANION.md	Demo-day walkthrough
Full methodology (~1,600 lines)	METHODOLOGY.md and /methodology.html	Every rule, every citation, every threshold, every change-log entry
Officer Manual	docs/USER_MANUAL.md and /manual.html	How an officer uses the tool day-to-day
Right of Reply	/galamsey-rightofreply.html	SLA + contact for any concern about the Monitor
Determination PDF (per screening)	Generated on demand	The reader-facing scoping determination — cover, reason, rules, indicators, obligations, methodology, disclaimer
CEO 1-pager	demo/CEO-PITCH-1PAGER.pdf	Executive summary

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