RIPPLE_LOGIC FRAMEWORK v8.5.3

Ripple_Logic: An Ethical Operating System for Governance

A General-Purpose, Multi-Scale Framework for Rights-Floor Norms, Tail-Risk Control, and Auditable Decision-Making

Tier 1–3: Implementable Now | Tier 4: Design Target (Tier-4 claims prohibited until a ProofPack is independently replayable)

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Ripple_Logic is the canonical name of this system. MathGov is a historical umbrella term used in earlier materials.

Backward compatibility: Prior PCCs computed under v8.4 and earlier remain interpretable as lineage artifacts. However, any run claiming v8.5.3 compliance MUST meet v8.5.3 validator requirements and MUST use the v8.5.3 canonical artifact as the source of truth.

AUTHOR STATEMENT AND TRANSPARENCY DISCLOSURE
The author conceived, designed, and wrote this specification. Generative AI tools (including OpenAI ChatGPT and Anthropic Claude) were used as drafting and consistency assistants. The author reviewed, verified, and edited all outputs and assumes full responsibility for the content, claims, and citations. This paper presents a theoretical framework. Empirical validation through pilots is planned but not yet completed. No operational deployment claims are made until validation studies are completed.

ABSTRACT
Governance systems and AI alignment approaches repeatedly fail in three coupled ways: they collapse plural values into single metrics that permit trading away fundamental rights, they underweight catastrophic tail risks through expected-value reasoning, and they remain vulnerable to specification gaming in which optimized proxies degrade intended outcomes. This paper presents the Ripple_Logic Framework (formerly MathGov), a general-purpose ethical operating system grounded in Union-Based Reality (UBR), the stance that interconnection and nested unions provide the correct structural grammar for complex socio-technical systems. Union-Based Ethics (UBE) is operationalized as a strict five-level lexicographic cascade applied to a 49-cell welfare matrix (seven union scopes by seven welfare dimensions): (1) the Non-Compensatory Rights Constraint (NCRC), (2) the Tail-Risk Constraint (TRC) using Conditional Value-at-Risk (CVaR), (3) a Containment Gate to prevent pathological local optimization that degrades containing scopes, (4) the Ripple Logic Score (RLS) for welfare

ranking after ripple propagation, and (5) structural tie-breaks using the Union Coherence Index (UCI) and Hollowing-Out Index (HOI) under uncertainty. The framework specifies auditable decision records via a Provenance and Compliance Certificate (PCC) embedded in a Notice–Choose–Act–Reflect (NCAR) learning loop, along with governance of weights (HDW) and a binding interface to the Sentience Gradient Protocol (SGP) for rights-of-protection gating. Ripple_Logic is Tier 1–3 implementable using this paper and its appendices; Tier 4 is specified as a design target and is not claimable until a public ProofPack is independently replayable.

KEYWORDS

Ripple_Logic; Union-Based Reality; Union-Based Ethics; AI alignment; lexicographic ethics; rights constraints; catastrophic risk; tail risk; CVaR; multi-scale governance; welfare matrix; ripple propagation; kernel; containment; Hybrid Democratic Weighting; Union Coherence Index; Hollowing-Out Index; Provenance and Compliance Certificate; auditability; NCAR; Sentience Gradient Protocol; Union Scopes; stakeholder discovery; instance modeling; stakeholder coverage index; representation auditability; fork-resistance.

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SECTION 0: SPECIFICATION CONTRACT (NORMATIVE)

0.1 Normative hierarchy (Single Source of Truth)

When interpreting Ripple_Logic v8.5.3, conflicts MUST be resolved using this precedence order (highest controls lowest):

1. Main text rules explicitly labeled MUST, SHALL, or PROHIBITED
2. Appendix B (Canonical Equations)
3. Appendix C (Rights / NCRC Canon Pack)
4. Appendix D (TRC and Scenario Governance Canon Pack)
5. Appendix H (PCC and Audit Flags Canon Pack)

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15. Appendix O (Conformance Reference Map; informative pointer layer only)

Note (Informative). Version history and release notes are recorded in Appendix M and do not control normative meaning.

0.2 Tier contract and claims (v8.5.3)
Tier 1–3: Executable and claimable in v8.5.3, subject to stated minimum requirements. Organizations and individuals may claim compliance with Tier 1, 2, or 3 using only this Foundation Paper and its appendices.
Tier 4: PROHIBITED to claim in v8.5.3 (design target only). Any Tier-4 content in v8.5.3 is informational architecture describing what becomes claimable only after ProofPack publication and independent replayability.

0.3 Conformance vocabulary (Normative)
Ripple_Logic uses distinct predicates; implementations MUST NOT collapse them.

- Rights-admissible: passes NCRC.
- Admissible: passes NCRC and TRC. Formally: Admissible(a) := NCRC(a) AND TRC(a).
- Selectable: admissible and passes Containment (Mode A).
- Selected: the final chosen option from the selectable set using RLS and tie-break policy.

0.4 Consolidated symbols and core objects (Normative; v8.5.3)
Terminology note (Normative). In v8.5.3, u indexes Union Scopes (short: Scopes). “Union(s)” remains an allowed legacy narrative alias. This clarification SHALL NOT change the meaning of u or cascade semantics.

Table 0-1. Indices and core symbols

Symbol	Meaning
$u \in \{1,\ldots,7\}$	Union Scope (Scope) index (legacy alias: union)
$d \in \{1,\ldots,7\}$	Dimension index
$a \in O$	Candidate option
$s \in S$	Scenario index
$r \in R$	Right index
k	Impact instance index
$g \in G_{u,d}$	Protected subgroup index (for rights checking)

Table 0-2. Core sets

Set	Definition
$U = \{U_1,\ldots,U_7\}$	Operational Scopes
$D = \{D_1,\ldots,D_7\}$	Welfare dimensions
R	Rights set: {LIFE, BODY, LBTY, NEED, DIGN, PROC, INFO, ECOL}
$C_r \subseteq U \times D$	Rights coverage sets
$C_{cat} \subseteq U \times D$	Catastrophe cell set for TRC

Table 0-3. Welfare impact objects (all options a)

Symbol	Meaning	Range
$I_{dir}(u,d,a)$	Direct impact (post-saturation)	[-1,+1]
$I_{prop}(u,d,a)$	Propagated impact (post-saturation)	[-1,+1]
$I_{rights}(u,d,a)$	Rights worst-off subgroup impact	[-1,+1]

Table 0-4. Kernel, weights, and tail-risk symbols

Symbol	Meaning	Constraint / Notes
$K \in \mathbb{R}^{49\times49}$	Ripple kernel matrix (sparse)	Convention: K_{ij} maps source j to target i (target-row, source-column)
w_u	Union weights	$w_u \geq 0$, $\Sigma_u w_u = 1$

Symbol	Meaning	Constraint / Notes
v_d	Dimension weights	v_d ≥ 0, Σ_d v_d = 1
m(u,d)	Applicability mask	m ∈ {0,1} (RLS aggregation only)
p_s	Scenario probabilities	p_s ≥ 0, Σ_s p_s = 1
ω_c	Catastrophe weights	ω_c ≥ 0, Σ_{c∈C_cat} ω_c = 1
α	CVaR tail level	α ∈ (0,1)
τ_TRC	Corridor threshold	τ_TRC ∈ (0,1]

Table 0-5. Structural metrics

Symbol	Meaning	Range
UCI_u	Union Coherence Index for scope u	[0,1]
ΔUCI_u(a)	UCI_u(a) – UCI_u(baseline)	[-1,+1]
HOI	Hollowing-Out Index (monitoring diagnostic)	unbounded

0.5 Version commitments (Normative; v8.5.3)

The canonical welfare impact scale is [-1,+1] with Baseline-Zero Rule (Section 5).

Optional UI scale conversion (non-normative): If a user interface uses a percent-like scale, map the canonical cell impact I(u,d,a) ∈ [-1,+1] to UI points via: points = 100 × I. All admissibility gates (NCRC, TRC, Containment) and RLS calculations MUST be performed on the canonical [-1,+1] scale, or be converted back exactly before computation.

Tier 1–3 TRC uses bounded-impact loss (Section 8).

Tier 4 is design target only; no Tier-4 claims permitted until ProofPack is publicly replayable.

UCI Equity for Self (U_1): $E_1 := 1$ by definition. The equity component is fixed at 1 for Self because equity-as-distribution does not apply within a single individual. This provides a neutral, non-penalizing identity value. UCI for Self is computed from Cohesion, Flow, and Resilience with $E_1 = 1$.

UCI Equity for Biosphere (U_7): $E_7 := 1$ by default unless a governed biosphere-equity instrument is declared for the run. This provides a neutral, non-penalizing identity value when distributional equity is not operationalized for the Biosphere union. Record E7_METHOD_FIXED_1_DEFAULT (or the declared instrument identifier) in PCC.

0.6 Single Canonical Artifact Rule (Normative; v8.5.3)

This document is the single canonical Ripple_Logic Foundation Paper for v8.5.3. Any copy labeled “final,” “regen,” “patched,” “draft,” “fork,” or similar is non-canonical unless it is byte-identical to this artifact. Implementations, ProofPacks, and downstream specifications MUST

pin to the canonical artifact (filename + hash in ProofPack or release record) and MUST NOT treat variant text as authoritative.

Retirement clause (Normative; v8.5.3). Any earlier artifacts labeled v8.5.3 that are not byte-identical to this canonical artifact are RETIRED and MUST NOT be used as sources of truth for v8.5.3 interpretation or for any v8.5.3 compliance claim.

Integrity note (Informative). Do not embed a canonical hash inside this document body, because any edit changes the hash. Instead, publish a sibling release manifest (for example, a .sha256 or release_manifest.json) that records the canonical filename and SHA-256 for this exact byte stream, and pin downstream work to that manifest per Section 0.6.

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0.8 Release Packaging and Integrity Manifests (Informative)

Recommended release bundle (Informative). Publish (i) the canonical DOCX/PDF, (ii) a SHA-256 manifest file (for example, Ripple_Logic_v8.5.3.sha256) listing hashes for each artifact, and (iii) optional signatures. The manifest is the stable anchor for byte identity, while the document remains human-readable and editable without self-referential hashing issues.

SECTION 1: INTRODUCTION: THE NEED FOR A GENERAL-PURPOSE ETHICAL OPERATING SYSTEM

1.1 Alignment Failures Across Scales

Contemporary societies operate within a tightly coupled, high-dimensional environment where climate dynamics, global supply chains, digital communication networks, financial systems, and emerging artificial intelligence systems interact in ways that increasingly resist prediction or governance. Decisions taken at one organizational scale propagate rapidly through multiple layers of human and ecological organization, generating consequences that conventional decision frameworks fail to anticipate or manage (Meadows, 2008; Newman, 2010; Steffen et al., 2015). In this context, alignment is not exclusively an artificial intelligence problem. It represents a general challenge of ensuring that the actions of individuals, institutions, governments, and machine systems remain consistent with the protection of fundamental rights, the avoidance of catastrophic failure modes, and the long-term flourishing of sentient beings and the planetary systems that sustain them (Ord, 2020; Russell, 2019; Rockström et al., 2009, 2023).

Civilizational target and method standard (Informative)

Target. Protect the floor for all intelligences, bound catastrophic tail-risk, and expand long-run flourishing across the operational union stack.

Method standard. A decision protocol is governance-grade only if it is auditable, reproducible, rights-respecting, tail-risk aware, and robust to Goodhart and adversarial pressure.

1.2 The Alignment Trilemma (Coupled Failure Modes)

Existing decision frameworks exhibit three recurring failure modes that together constitute the alignment trilemma:

Failure Mode A: Scalarization of Value

Many decision methods collapse plural values into a single metric (expected utility, GDP, cost-benefit net present value). This enables "moral laundering": severe harms to some unions are permitted when offset by gains elsewhere. Arrow's (1963) impossibility theorem demonstrates that no preference-aggregation rule can simultaneously satisfy minimal fairness criteria when preferences conflict fundamentally across multiple dimensions and scales.

Failure Mode B: Tail-Risk Blindness

Expected-value reasoning underweights low-probability, high-severity outcomes. Catastrophic outcomes are often irreversible and eliminate future choice; therefore symmetric tradeoffs between ordinary gains and catastrophic losses are ethically incoherent and empirically dangerous (Taleb, 2012). Coherent risk measures such as CVaR provide better tail-risk handling (Artzner et al., 1999; Rockafellar & Uryasev, 2000). Climate tipping points (Lenton et al., 2008), pandemic risks, and AI misalignment exemplify threats that conventional frameworks systematically underweight (IPCC, 2023; Bostrom, 2014).

Failure Mode C: Specification Gaming (Goodhart Vulnerability)

When metrics become targets under pressure, they are gamed. Optimization exploits proxies while degrading the intended outcome (Goodhart, 1984; Manheim & Garrabrant, 2018). This appears in institutional governance (GDP) and AI reward optimization. In AI contexts, these dynamics appear as reward hacking and proxy optimization failures under strong optimization pressure (Amodei et al., 2016).

Coupled Failure

These three failure modes interact and amplify each other. Scalarization enables tail-risk blindness (catastrophe can be traded for ordinary benefit), tail-risk blindness creates exploitable blind spots, and specification gaming undermines attempts to "patch" either problem by shifting optimization pressure. Solving one in isolation is insufficient.

1.3 Governance-Grade Requirements

Ripple_Logic is designed to satisfy seven non-optional requirements:

Requirement	Description	Ripple_Logic Component
R1	Rights-first non-compensability: rights are	NCRC (Level 1)

Requirement	Description	Ripple_Logic Component
	lexicographic constraints, not weighted terms	
R2	Explicit catastrophic risk bounding: tail risk is bounded by TRC using CVaR	TRC (Level 2)
R3	Multi-scale and multi-dimensional welfare representation	7×7 Welfare Matrix
R4	Explicit ripple propagation: interpretable kernel propagation under humility	Kernel K
R5	Structural integrity (containment): local gains may not degrade containing unions beyond tolerance	Containment (Level 3)
R6	Legitimate weight governance: HDW blends constitutional floors with democratic tuning	HDW
R7	Computability plus auditability: PCC and audit flags enable reconstruction, challenge, and learning	PCC plus AIL

1.4 Paper Contributions

This paper provides:

- A fork-resistant normative specification for Tier 1-3 implementation.
- Canonical equations and constraints sufficient for independent implementation.
- Anti-gaming architecture (non-maskable cells, subgroup semantics, scenario governance, audit flags).
- A validation and falsification program (Section 17).
- A Tier-4 design target appendix (non-claimable until ProofPack).

SECTION 2: ONTOLOGICAL FOUNDATIONS: UNION-BASED REALITY (UBR)

2.1 Relational Ontology (Descriptive Thesis)

UBR thesis: No entity exists in complete isolation for governance-relevant domains; entities are embedded in interacting networks whose structure transmits the consequences of actions.

This is a descriptive stance supported by systems science (feedbacks and leverage points), network science (universal structural features of real networks), and Earth-system science (planetary boundary coupling) (Meadows, 2008; Newman, 2010; Steffen et al., 2015; Rockström et al., 2009, 2023). UBR is also consistent with empirical findings in social and cognitive interdependence research showing strong links between human capacities and group structure, including the social brain hypothesis and attachment-based development (Bowlby, 1988; Dunbar, 1992, 1993), and with social contagion dynamics in networks (Christakis & Fowler, 2009).

Scope conditions: UBR is most applicable in high-coupling systems with significant externalities, multi-scale feedbacks, and long time horizons. Low-coupling, short-horizon decisions may not require full UBR modeling; Ripple_Logic tiers allow proportional rigor.

2.2 Unions as the Unit of Analysis (Operational Definition)

Definition: A union is a bounded pattern of interdependence: a set of entities whose internal interactions are sufficiently strong, frequent, or consequential that their welfare should be evaluated together for the decision context.

In this specification, the operational objects scored and indexed by u are Union Scopes (Scopes), meaning unions used as stable scopes of aggregation and accountability.

Unions are analytical constructs for causal and welfare accounting; they are not metaphysical substances. The union concept operationalizes the systems-theoretic observation that complex systems exhibit hierarchical modularity (Simon, 1962).

2.2A Union Scopes and Instance Modeling (Normative)

Terminology clarification. In Ripple_Logic v8.5.3, the canonical term Union Scope refers to the objects indexed by $u \in \{1,\ldots,7\}$ in the welfare matrix. For readability and reduced ambiguity, Scope is the default shorthand in technical and implementation contexts. The term Union remains an allowed legacy shorthand in narrative contexts and lineage documents. This clarification SHALL NOT change the mathematical meaning of u or any cascade semantics.

Purpose. Union Scopes are designed to be minimal but covering, a small stable set of aggregation scopes that prevents systematic stakeholder erasure while supporting auditability and comparability across decisions.

2.2A.1 Definitions (Normative)

Union Scope (Scope). A Union Scope is a stable scope of impact aggregation used to evaluate decision consequences across nested interdependence levels. Union Scopes are the rows of the canonical 7×7 welfare matrix.

Stakeholder. A stakeholder is any entity that is plausibly materially affected by a candidate option a, including entities affected through externalities, indirect pathways, or future propagation within the declared decision horizon.

Instance. An instance is a stakeholder bound to the decision context as stakeholder-in-role-in-context, meaning a stakeholder with a declared role and exposure pathway relevant to the decision. Examples include: employee, patient, local resident, watershed ecology unit, cross-border supply-chain worker, digital agent affected by policy. Instances are the primary unit of stakeholder logging for auditability, Union Scopes are the primary unit of aggregation for comparison.

Structural anchor. Scopes × Dimensions form the welfare matrix. Instances feed the cells.

2.2A.2 Stakeholder Discovery Protocol (SDP) (Tier-linked; Normative)

Tier 3: REQUIRED. Tier 2: REQUIRED when any SDP trigger holds, otherwise RECOMMENDED. SDP is a short, explicit process for discovering omission-likely stakeholders so discovery is not optional by taste.

Minimum SDP steps (recorded in PCC): (i) define decision boundary and horizon, (ii) map the causal footprint and externality pathways, (iii) scan for rights exposure and catastrophe relevance, (iv) draft the stakeholder instance set, (v) map instances to one or more Union Scopes with rationale, (vi) record unknowns and declared blind spots, including escalation triggers, (vii) provide a challenger opportunity for missing instances at Tier 3.

SDP triggers (Tier 2 REQUIRED): rights-covered cells plausibly affected, or TRC triggered/catastrophe relevance plausible, or externalities beyond decision owner plausible (cross-community/organization/polity, biosphere pathway), or irreversibility/lock-in plausible, or credible challenger claims omitted stakeholder class or scope, or information/procedure/enforcement/ecology pathways plausible.

2.2A.3 Instance-to-Scope Mapping Requirement (Tier-linked; Normative)

Tier 3 requirement. A Tier 3 run MUST explicitly log a set of stakeholder instances and map each instance to one or more Union Scopes, with a rationale sufficient for an independent reviewer to understand why the instance belongs in the mapped scope(s). This mapping SHALL be recorded in the PCC (Appendix H).

Tier 2 requirement under triggers. When any SDP trigger holds, Tier 2 runs MUST log and map stakeholder instances for the affected pathways and rights-relevant domains. Otherwise, Tier 2 runs SHOULD still log and map instances whenever the decision plausibly affects stakeholders beyond the decision owner.

Minimum mapping rule. Every logged instance MUST map to at least one Union Scope. If an affected stakeholder cannot be mapped, the PCC MUST record this as an explicit coverage limitation, not as neutrality, including: (i) why mapping was infeasible, (ii) what scope(s) might plausibly apply, and (iii) what risk this creates.

2.2A.4 Multi-scope Mapping and Redundancy Handling (Normative)

Multi-scope mapping is permitted. An instance MAY map to multiple Union Scopes where the decision plausibly affects that instance across multiple nested scales.

No silent duplication. Implementations MUST NOT silently log the same underlying effect multiple times across scopes in a way that inflates welfare scoring without disclosure. If a modeling choice results in an effect being represented across multiple scopes, the PCC MUST disclose the rationale using one declared redundancy-handling method for the affected effect-class: (i) EMERGENT_SCALE_JUSTIFICATION, counted across multiple scopes because the effect is meaningfully different at different scales, (ii) DEDUPLICATION, logged once at a declared primary scope with cross-scope effects represented via ripple propagation and structural metrics, or (iii) ALLOCATION (optional), effect split across scopes to prevent redundant counting.

Effect-token (allocation only). An effect-token is a redundant conserved causal unit used only to prevent redundant counting across scopes, for example the same dollars, the same one-time

transfer, the same compliance cost. If ALLOCATION is used for an effect-token, the PCC MUST declare the token, the allocation method, the coefficients used, and the scope list. Allocation coefficients for a single effect-token MUST satisfy $\Sigma_u \alpha_u \leq 1$ for that token, summed over the scopes listed for that token.

No allocation laundering. ALLOCATION is permitted only for declared redundant conserved-unit effect-tokens. Distinct welfare harms, for example health harm versus ecosystem degradation, MUST be logged as distinct impact instances and SHALL NOT be allocated away.

Allocation guard. Allocation SHALL NOT be used to suppress or mask adverse impacts in any rights-covered or catastrophe-relevant evaluation. Redundancy handling cannot weaken NCRC, TRC, or Containment computations.

2.2A.5 Reduced-scope Mode (Normative)

Reduced-scope mode allows an evaluator to run with fewer than 7 scopes for mapping or reporting depth, provided omissions are explicitly disclosed. Reduced-scope mode SHALL NOT remove any non-maskable cells or required scope rows from NCRC, TRC, or Containment computation.

Reduced-scope mode is a reporting or mapping-depth choice only. Admissibility computation MUST still evaluate all rights coverage sets C_r and catastrophe cell set C_{cat} as declared.

If reduced-scope mode is used, the PCC MUST include a Scope Coverage Declaration (Appendix H) listing active scopes, omitted scopes, omission rationales, a blind-spot statement, and escalation triggers that would force scope expansion in the next comparable run.

Common misread (informative). Misread: “Unions limit who matters.” Correction: “Union Scopes prevent impacts from disappearing. Any stakeholder can be represented as an instance mapped into relevant scope(s), and omissions must be disclosed as coverage risk.”

2.3 The Union Stack (Seven Operational Unions)

Union	Name	Definition	Characteristic Timescale
U_1	Self	The individual locus of experience and agency	Seconds to Decades
U_2	Household	Primary cohabitation and resource pooling unit (Becker, 1981)	Days to Decades
U_3	Community	Local repeated-interaction network with social capital and trust dynamics (Putnam, 2000; Dunbar, 1993)	Months to Generations
U_4	Organization	Formal collective pursuing a purpose; structured coordination and institutional behavior (March & Simon, 1958; North, 1990)	Years to Centuries
U_5	Polity	Governance authority unit over a jurisdiction; legitimacy and institutional	Decades to Centuries

Union	Name	Definition	Characteristic Timescale
		structure (Weber, 1978)	
U_6	Humanity/ CMIU	Collective Managing Intelligence Union: all managing intelligences; global coordination and systemic risk management (Ord, 2020; Steffen et al., 2015)	Generations to Millennia
U_7	Biosphere	Earth's integrated life-support systems, including climate stability and ecosystem integrity (Odum, 1971; Steffen et al., 2015; Rockström et al., 2009, 2023)	Centuries to Epochs

Canonical nesting chain: $U_1 \subset U_2 \subset U_3 \subset U_4 \subset U_5 \subset U_6 \subset U_7$

Clarifying distinction (informative). Organization refers to bounded institutions and role systems such as firms, schools, NGOs, or agencies. Polity refers to public governance and enforcement domains such as lawmaking, courts, regulators, and due process systems.

Ecological trophic cascades illustrate how interventions can propagate unpredictably across levels and why "local wins" can generate system losses, reinforcing the need for explicit containment and ripple modeling (Estes et al., 2011).

2.4 Union Types vs Instances (Aggregation Rule)

The seven unions are types; real runs involve instances (many households, many organizations, many polities). Impacts MUST be aggregated within a union row using a declared aggregation method.

Default aggregation (normative default for non-rights scoring): Population-weighted mean across affected instances.

Rights exception: For rights-covered cells, apply worst-off subgroup checks within instances before aggregating (Section 7).

Examples: Stakeholder Instances Mapped into Union Scopes (Non-Normative)

This table illustrates how diverse stakeholders are represented as instances mapped into Union Scopes. The scope set is minimal but covering, it is a coordinate system for accountability, not a closed list of who matters.

Stakeholder instance (example)	Typical role/context	Mapped scope(s) (example)	Notes (including multi-scope redundancy method when relevant)
Me (decision owner)	direct personal impact	U1 Self	Direct experience and agency locus.
Child or dependent in	care, safety, needs	U2 Household (and U1 for the	Household stability plus rights exposure often relevant.

Stakeholder instance (example)	Typical role/context	Mapped scope(s) (example)	Notes (including multi-scope redundancy method when relevant)
my care		child-as-person in detailed runs)	
Local neighborhood residents	local externalities	U3 Community	Trust, cohesion, local health and environment.
Employees or contractors	workplace policy impacts	U4 Organization	Pay, safety, dignity, due process.
Regulators, courts, enforcement bodies	compliance and legitimacy	U5 Polity	Law, procedure, rights enforcement capacity.
Cross-border supply-chain workers	indirect externalities	U6 Humanity/CMIU	Captures externalities beyond a single polity.
Watershed or river system	ecological integrity	U7 Biosphere	Often ecology-rights and TRC relevant.
Future generations	long-horizon impacts	U6 Humanity/CMIU + U7 Biosphere	Multi-scope mapping. Typically EMERGENT_SCALE_JUSTIFICATION, because effects differ across scales. Horizon and indicators must be explicit.
Public information ecosystem	misinformation, censorship, legitimacy	U5 Polity + U6 Humanity/CMIU	Multi-scope mapping. If represented in both scopes, declare redundancy handling. Default is EMERGENT_SCALE_JUSTIFICATION, or DEDUPLICATION with propagation.
Digital agents affected by policy	AI deployment governance	U6 Humanity/CMIU (SGP-gated for protections where applicable)	Protections handled via the SGP interface. Authority remains separately gated.

2.5 Constructive vs Pathological Unions

Some unions grow by degrading their containing unions (for example, extractive industries or corruption networks). Ripple_Logic therefore does not assume "union benefit" is automatically good. The Containment Gate prevents local optimization that damages containing union coherence or viability beyond governed tolerance.

2.6 Meta-Unions (Non-Computational by Default)

U_8 Cosmic and U_9 Universal/AIU may be used as philosophical boundary conditions or future extensions, but do not participate in standard Tier 1-3 scoring unless formally activated via a governed extension protocol (Appendix A).

SECTION 3: NORMATIVE FOUNDATIONS: UNION-BASED ETHICS (UBE)

3.1 Minimal Normative Axiom (MNA)

Ripple_Logic adopts exactly one explicit normative axiom:

MNA: Sentient flourishing matters. Unnecessary suffering should be reduced. The enabling conditions for continued flourishing should be preserved.

This axiom is:

- **Content-minimal:** No single "good life" doctrine is prescribed.
- **Scope-bounded:** Applies to agents accepting that sentience matters.
- Architecturally generative: The framework defines a compositional architecture (rights floor + tail-risk constraint + containment + welfare optimization + structural safeguards) such that diverse domain-specific instantiations can be generated by providing declared inputs (stakeholder scope map, rights coverage sets, scenario library, kernel, and weights) and then executing the same cascade. The architecture is intended to generate implementable governance-grade decision protocols across contexts without requiring a single fixed value system beyond non-compensatory rights floors.

3.2 Conditional Is-Ought Bridge

Ripple_Logic avoids deriving values from facts by using a conditional bridge:

IF (UBR) actions propagate through nested unions, AND (MNA) sentient welfare matters, THEN agents and institutions ought to evaluate choices by cross-union impacts and preservation of enabling conditions, using non-compensable rights floors and explicit tail-risk bounding.

Normativity enters only through MNA; UBR specifies where consequences flow.

3.3 Seven Welfare Dimensions (Canonical)

Dimension	Name	Description
D_1	Material	Resources and infrastructure for survival and functioning
D_2	Health	Physical and mental functioning; morbidity and mortality risk
D_3	Social	Belonging, trust, relational integrity, cooperation
D_4	Knowledge	Epistemic access and learning conditions
D_5	Agency	Autonomy and effective choice; freedom from coercion
D_6	Meaning	Coherence, purpose, valued life projects (measured cautiously)

Dimension	Name	Description
D_7	Environment	Ecological and built context integrity sustaining life

This seven-dimensional choice is a convergence architecture rather than a claim of metaphysical completeness. It aligns with the capability approach (Sen, 1999; Nussbaum, 2011), self-determination theory (Ryan & Deci, 2000), and fundamental human needs theory (Max-Neef, 1991), while also capturing ecological integrity as a life-support substrate consistent with Earth-system boundary research (Rockström et al., 2009, 2023).

3.4 Non-Fungibility at Rights Level

Dimensions are treated as non-fungible at the rights layer: gains in one dimension MUST NOT compensate rights-floor violations in another. This is enforced structurally by NCRC (Section 7), not by weight tuning.

3.5 Unioning (Enacted Practice)

Unioning = redesigning decisions until they are rights-safe (NCRC), tail-safe (TRC), containment-safe, and net-positive across unions under declared uncertainty policy, treating apparent "tradeoffs" as design failures before acceptance.

Unioning worked example (Non-Normative)

Scenario. An organization considers cutting safety training to reduce costs. Initial estimate shows a small material benefit in U4 Organization D1, but a credible safety degradation in U4 D2 and a dignity/procedure risk in U4 D6/D5. Under NCRC, any rights-covered violation depth v_r(a)>0 fails admissibility regardless of aggregate gains.

Step 1, fail. Option A fails NCRC due to increased probability of serious injury and due-process erosion. It is rejected even if it would raise RLS.

Step 2, redesign. The team introduces Option B, maintain safety training, add targeted efficiency changes elsewhere, and add a transparent incident-reporting and remediation pathway. This shifts the harmful impacts above the rights floor while preserving most of the intended cost reduction through non-harmful channels.

Step 3, pass and select. Option B passes NCRC, passes TRC and Containment, then competes on RLS among admissible options. The PCC records the redesign rationale and the rights-floor reasoning, so the improvement is legible and replayable.

3.6 NCAR Learning Loop (Corrigibility Requirement)

Ripple_Logic is embedded in Notice, Choose, Act, Reflect. The system is corrigible: it records assumptions and outcomes, updates kernels and parameters via governed procedures, and preserves accountability through versioned PCCs.

SECTION 4: SYSTEM OVERVIEW: THE RIPPLE_LOGIC ARCHITECTURE

4.0A Cascade Gate Inputs and Outputs (Informative)

This table summarizes what each gate consumes, what it produces, and what it may eliminate. It is a fast correctness check for implementers.

Gate	Consumes (inputs)	Produces (outputs)	Eliminates / flags
NCRC (rights floor)	Rights-covered cell impacts $I_{prop,base}(u,d,a)$ for C_r; subgroup operator γ (worst-off); rights thresholds	rights_admissible $(a) \in \{0,1\}$; violation depths $v_r(a)$; redesign targets	Eliminates any a with $v_r(a)>0$; flags RIGHTS_CELL_OMITTED_INVALID if required rights cell omitted/excluded/not disclosed.
TRC (tail-risk / CVaR)	Scenario set S with categories + floors; catastrophe loss proxy $L(a,s)$ over C_{cat}; α, τ_{TRC}	$TRC_{pass}(a) \in \{0,1\}$; $CVaR_\alpha[L(a)]$	Eliminates any a with $CVaR_\alpha > \tau_{TRC}$; flags MANDATORY_TAIL_CATEGORY_MISSING / MANDATORY_TAIL_PROB_FLOOR_VIOLATION when required tail elements fail; flags CATASTROPHE_CELL_OMITTED_INVALID if TRC computation/disclosure omits required catastrophe cells such that CVaR cannot be recomputed.
Containment (system safety)	Containment triggers; ΔUCI / HOI where available; posture thresholds	containment_pass $(a) \in \{0,1\}$; containment posture notes; remediation plan if unavailable	Eliminates any a failing containment; flags CONTAINMENT_UCI_UNAVAILABLE when required UCI is missing
RLS (welfare selection)	Active welfare cells (including rights-covered and catastrophe cells, subject to non-maskable rules) + weights w_u and v_d; applicability mask $m(u,d)$ (RLS-only); uncertainty proxies $\sigma(u,d,a)$; ε, δ	RLS(a) scalar; $Gap(a,b)$ comparisons; welfare ranking over remaining options	Does not override NCRC/TRC/Containment; flags RIGHTS_CELL_MASKED_INVALID / CATASTROPHE_CELL_MASKED_INVALID if non-maskable cells are masked from RLS aggregation

UCI/HOI (Tier 3+ diagnostics)	System-level indicators, cross-union constraints, evidence anchors	ΔUCI(a), HOI summary; warnings; future-run steering	Does not change cascade order; may trigger containment or governance escalation when high-risk deltas detected

4.0A Canonical 49-Cell Reference Table (v8.5.3+; Informative)

Each cell in the 7×7 welfare matrix represents a distinct accountability domain. This table provides a one-line meaning for each cell to support comprehension and consistent interpretation across implementations.

Table 4.0A-1 presents the canonical 7×7 welfare grid (Unions × Dimensions) with one-line cell meanings.

Union \ Dimension	D1 Material	D2 Health	D3 Social	D4 Knowledge	D5 Agency	D6 Meaning	D7 Environment
U1 Self	personal resources	personal health & safety	personal relationships & cohesion	personal knowledge & learning	personal agency & autonomy	personal meaning & purpose	personal environmental conditions
U2 Household	household resources	household health & safety	household relationships & cohesion	household knowledge & learning	household agency & autonomy	household meaning & purpose	household environmental conditions
U3 Community	community resources	community health & safety	community relationships & cohesion	community knowledge & learning	community agency & autonomy	community meaning & purpose	community environmental conditions
U4 Organization	organizational resources	organizational health & safety	organizational relationships & cohesion	organizational knowledge & learning	organizational agency & autonomy	organizational meaning & purpose	organizational environmental conditions
U5 Polity	polity/	polity/	polity/	polity/	polity/	polity/	polity/

	public resources	public health & safety	public relationships & cohesion	public knowledge & learning	public agency & autonomy	public meaning & purpose	public environmental conditions
U6 Humanity /CMIU	humanity-wide resources	humanity-wide health & safety	humanity-wide relationships & cohesion	humanity-wide knowledge & learning	humanity-wide agency & autonomy	humanity-wide meaning & purpose	humanity-wide environmental conditions
U7 Biosphere	biospheric resources	biospheric health & safety	biospheric relationships & cohesion	biospheric knowledge & learning	biospheric agency & autonomy	biospheric meaning & purpose	biospheric environmental conditions

Release packaging rule (v8.5.3+): Every public release PDF MUST include this 49-cell table and the stakeholder-to-scope examples table (below).

Table 4.0B-1 provides non-normative examples of Stakeholder→Scope mapping and redundancy handling (ALLOCATION / DEDUPLICATION).

Scenario	Primary scope logging	Secondary / cross-scope impacts	Redundancy handling note
Parent transfers $100 to adult child.	Recipient: U2 Household (child's household) × D1 Material.	Sender household reduced resources (U2 × D1); any governance or admin impacts logged separately if applicable.	DEDUPLICATION: log the transfer effect-token once; do not create a second impact instance for the same token.
City spends $1M on public hospital upgrades.	Community: U3 Community × D2 Health.	Households benefit; polity accountability impacts may exist. Represent via propagation and/or distinct admin impacts (not by duplicating the same spend token).	ALLOCATION: if the same investment benefits multiple scopes, allocate with effect-tokens and record coefficients.
National carbon tax:	Log ALLOCATION of	Polity (U5)	ALLOCATION:

estimated 60% benefit to biosphere, 40% to humanity/CMIU.	the policy's benefit token across U7 and U6 with coefficients (0.6, 0.4).	administrative burden and compliance costs logged as distinct impacts.	explicit coefficients; "No allocation laundering" applies.

This table demonstrates how stakeholders are mapped to Union Scopes, including multi-scope rows demonstrating redundancy method selection.

Example 1 (simple): Individual worker Maria, single parent, factory employee. Mapped to U1 (Self) and U2 (Household). Different welfare dimensions affected at each scope (health at U1, care burden at U2). Method: N/A (distinct instances per scope).

Example 2 (simple): Local community residents within 5km of proposed facility. Mapped to U3 (Community). Identified via SDP causal footprint scan. Method: N/A (single scope).

Example 3 (ALLOCATION): Regulatory compliance cost of $10M. Same dollars appear as firm expense (U4 Organization) and government revenue (U5 Polity). Effect-token = "same $10M compliance payment." Allocation: $\alpha(U4)=0.7$, $\alpha(U5)=0.3$; $\Sigma\alpha=1.0$. Distinct welfare harms (worker stress, service quality) logged separately.

Example 4 (EMERGENT_SCALE_JUSTIFICATION): Factory emissions causing (i) local health harm to residents (U3 Community Health) and (ii) ecosystem degradation (U7 Biosphere Environment). Different mechanisms at different scales; full weight at each scope.

Example 5 (externality via SDP): River communities 50km downstream affected by water discharge. Mapped to U3 (Community, separate instance from factory neighbors). Identified via SDP as omission-likely stakeholder class. Rights exposure flagged.

4.1 Formal Definition

Ripple_Logic is a rights-first, tail-risk-bounded, union-based decision optimization system with explicit ripple propagation, auditable scoring, and corrigible learning.

4.2 Core Objects (Implementable Data Structures)

Object	Description
Option set O	Finite set of candidate actions;
Welfare impact matrix per option	$I_{prop}(u,d,a) \in [-1,+1]$
Rights impacts	$I_{rights}(u,d,a)$ = min over protected subgroups for rights-covered cells
Scenario set S with probabilities p_s	For TRC
Catastrophe cells C_{cat} and weights ω	For TRC
Kernel K (sparse 49×49)	For propagation (NONE or QUICK permitted in Tier 1-3)

Object	Description
Weights w_u and v_d	HDW-governed at Tier 3 recommended; floors are constitutional
Structural metrics UCI and HOI	For containment and tie-breaks

4.3 Canonical Five-Level Lexicographic Cascade (Normative)

Level	Name	Function	Failure Consequence
1	NCRC	Rights floor: exclude options violating fundamental rights	Option removed (except Emergency Mode)
2	TRC	Tail-risk bound: exclude options with unacceptable catastrophic exposure	Option removed
3	Containment	Structural integrity: prevent degradation of containing unions	Option excluded or escalated
4	RLS	Welfare optimization: rank by weighted aggregate impact	Selection if decisive
5	UCI/Tie-break	Structural health: break ties using coherence metrics	Final selection

4.4 End-to-End Algorithm (Tier 1-3 Executable) (Normative)

Algorithm: Ripple_Logic_Run

Inputs (minimum): Decision scope; baseline; option set O; union and dimension sets; weights; rights canon; TRC canon (when required); containment parameters; propagation mode; kernel (optional); scenario set (Tier-3 TRC required).

Outputs: Selected option a* or escalation, plus PCC.

Step 1: Notice

Record the decision question, scope boundary, time horizon, affected unions, and option set. Declare tier and configuration.

Step 2: Impact Construction

For each option a: estimate direct impacts from impact instances; saturate into I_dir; propagate in NONE or QUICK to obtain I_prop; apply post-propagation saturation. Record uncertainty notes and missing-data penalties as required (Section 5).

Step 3: NCRC Gate

For rights-covered cells, compute worst-off subgroup impacts I_rights. Compute violation depths v_r(a). Options with any v_r(a) > 0 fail NCRC. Let A_NCRC be the passing set. If A_NCRC is empty, invoke Emergency Mode (Section 7).

Step 4: TRC Gate

For each a ∈ A_NCRC: compute scenario losses L(a,s) over catastrophe cells and compute CVaR_α. Exclude options exceeding τ_TRC. Let A_adm be the passing set. If A_adm is empty, invoke TRC fallback (Section 8).

Step 5: Containment Gate (Mode A)

For each a ∈ A_adm (in RLS_pre order per Section 9.4, or all): compute ΔUCI for required containing scopes and apply the containment predicate. If any required ΔUCI is unavailable, the run MUST follow Section 9.3.1 (DOWNGRADE_TIER or COLLECT_DATA_RERUN) and MUST NOT claim Tier 3 compliance. Let A_sel be the selectable set A_sel = {a ∈ A_adm : Containment(a) = TRUE}. If A_sel is empty, escalation is mandatory (Section 9.6).

Step 6: RLS Ranking

Compute RLS(a) for all a ∈ A_sel. Compute σ_RLS(a) if enabled. Apply discrimination rule; if decisive, select top option.

Step 7: Tie-break

If non-decisive, apply UCI dominance threshold, HOI risk flags, then escalation if still non-decisive.

Step 8: Emit PCC

Record all inputs, intermediate computations, gate results, sensitivity outputs (Tier 3), and 5-sentence public rationale.

4.5 Implementation Tiers (Normative Summary)

Requirement	Tier 1 (Heuristic)	Tier 2 (Core)	Tier 3 (Auditable)
NCRC	Heuristic	REQUIRED	REQUIRED (subgroups)
TRC	Optional (qualitative screen)	REQUIRED when catastrophe relevance plausible	REQUIRED
Scenario set size	N/A	≥5 minimum	≥20 minimum
Kernel propagation	NONE	NONE default; QUICK if KQS policy satisfied	QUICK only if KQS policy satisfied plus sensitivity
Containment Mode A	Optional	Recommended	REQUIRED (binding)
PCC	Optional	REQUIRED (basic)	REQUIRED (full)
Sensitivity analysis	Optional	Recommended	REQUIRED

Tier 4 is design target only in v8.5.3 and MUST NOT be claimed until ProofPack is public and independently replayable.

SECTION 5: WELFARE IMPACT CONSTRUCTION (CALCULABLE)

5.0 Purpose and Design Requirements (Normative)

This section specifies how Ripple_Logic converts real-world predictions and evidence into a computable welfare impact matrix for each option. A competent analyst MUST be able to compute all required impacts from (i) a declared baseline, (ii) a declared option, and (iii) a finite list of impact instances per cell, using only the equations and rules in this paper and appendices.

5.0.1 Stakeholder Coverage Index (SCI) (Normative)

SCI is a tier-governed disclosure ladder describing the stakeholder coverage posture of a run. SCI does not change scoring formulas. It is an auditability and integrity signal that supports comparability and anti-theater enforcement.

SCI levels (minimum definitions): SCI-0: no explicit stakeholder instance logging. SCI-1: instances logged at least for direct stakeholders and primary externality pathways. SCI-2: instances logged with explicit mapping to Union Scopes, including at least one challenger pass for omissions. SCI-3: evidence-backed instance mapping with explicit blind-spot declaration, escalation triggers, and redundancy handling disclosures where multi-scope mapping is used. SCI-4: high-coverage posture with structured discovery, third-party review or validated stakeholder registry linkage, and replay-ready traceability.

Tier minima. Tier 2 runs MUST achieve at least SCI-1. Tier 3 runs MUST achieve at least SCI-2.

Anti-theater ratchet. If SCI equals the tier minimum, the PCC MUST include a concrete Next-Run Upgrade action that would raise SCI by at least one level for the next comparable run. If SCI is below the tier minimum, the run MUST either (a) downgrade the declared tier to one whose SCI minimum is satisfied, or (b) rerun with enhanced stakeholder discovery to meet the SCI minimum for the claimed tier. In either case, the PCC MUST include a remediation plan specifying how SCI will be raised to the target level before the next comparable run. A remediation plan alone does not make the current run compliant at the originally claimed tier.

5.0A End-to-End Cell Computation Recipe (Informative)

This recipe is the minimal end-to-end spine for computing any welfare-cell impact in a Tier 1–3 run. It is informative, but the equations and constraints it references are normative in their home sections. For traceability, this recipe is listed in reverse order (8→1), reflecting the final artifact emission back to upstream inputs.

8) Emit PCC: record parameters, ReachBasis, gate results, RLS summary, and the public 5SPR. If reduced-scope mode is used, include the required attestations and blind-spot statement.

7) Run the cascade: NCRC (rights floor) → TRC (tail risk) → Containment (when applicable) → RLS (welfare selection among admissible options) → UCI/HOI (Tier 3+ system-level indicators).

6) Apply kernel propagation only if declared: if KernelPropagation = QUICK, compute I_prop_welfare(u,d,a) per Section 6; else set I_prop_welfare = I_dir. (Redundancy handling such as EMERGENT/DEDUP/ALLOCATION is a separate instance/aggregation mechanism and MUST NOT be treated as a propagation mode.)

5) Compute the direct contribution and accumulate to the cell: $\tilde{I}_{dir}(u,d,a) = \Sigma_k (\mu_k \cdot r_k \cdot \tau(t_k) \cdot \ell_k \cdot c_k \cdot e_k \cdot s_k)$ over k in that cell. Apply the canonical saturation (for example tanh) to obtain $I_{dir}(u,d,a) \in [-1,+1]$.

Stream note (Normative). For admissibility layers (NCRC, TRC, Containment), compute the Base stream with $s_k:=1$ for all impact instances. Sentience multipliers s_k may be applied only in the Welfare stream used for RLS, per Section 5.1 and Appendix G.

4) For each impact instance k, declare its parameters inside canonical bounds: magnitude $\mu_k \in [-1,+1]$, reach $r_k \in [0,1]$ with ReachBasis, time horizon $t_k \in (0, \infty)$ years (used via $\tau(t_k)$), likelihood $\ell_k \in [0,1]$, confidence $c_k \in [0.1, 1]$, equity/resilience multiplier $e_k \geq 0$ (default 1), and sentience multiplier $s_k \in [0,1]$ (default 1; Welfare stream only; Appendix G).

Note on evidence (Normative clarification): Evidence quality is recorded in PCC provenance fields and informs the choice of c_k. Evidence quality is not a separate multiplicative scalar in $\tilde{I}_{dir}$ unless explicitly introduced by a future canonical revision.

3) Construct Impact Instances k for each active welfare cell (u,d): each k must reference (a) a stakeholder instance, (b) a cell (u,d), and (c) a direct or indirect pathway description.

2) Build the representation layer: SDP → Stakeholders → Stakeholder Instances (InstanceMap with union-scope coverage).

1) Declare the run: option set A, unions U_{run}, welfare dimensions D, horizon window, and kernel propagation policy (NONE / QUICK). If effect-token redundancy handling is used, declare the redundancy mode (EMERGENT / DEDUP / ALLOCATION) and α budgets separately.

5.1 Baseline-Zero Rule (Normative)

Semantic anchor (MUST): For all unions u, dimensions d, and options a:

$I(u,d,a) = 0$ if and only if the predicted indicator state under option a equals the baseline indicator state.

Interpretation: "0 means no change from baseline" is globally enforced. Any method that produces absolute levels MUST immediately convert them into baseline-relative deltas before entering Ripple_Logic impact scoring.

Stream binding (Normative): Compute two impact streams that share $\tau(t)$, μ_k, and all other terms. Base stream fixes $s_k := 1.0$ for all impact instances and is the only stream used by admissibility layers (NCRC, TRC, Containment). Welfare stream may apply s_k per the SGP binding interface and is used only for RLS.

5.1A Baseline Contract for Admissibility Layers (Normative)

Baseline scope (Normative). Ripple_Logic welfare impacts are baseline-relative by design (Baseline-Zero Rule). For admissibility layers (NCRC and TRC) and any containment checks that depend on gate-relevant cells, the baseline for any cell that is in a rights coverage set C_r or in the catastrophe set C_{cat} MUST represent a rights-safe / safe-corridor reference condition (a

“floor baseline”), not merely the status quo.

Floor-baseline requirement (Normative). For each active rights or catastrophe cell, the PCC MUST declare the floor baseline reference (indicator definition, target level, jurisdictional or governed source when available, and any conversion assumptions). An option that maintains a rights-violating status quo MUST therefore score below 0 on the gate-relevant baseline-delta scale, because the baseline for gating is the floor reference.

PCC disclosure (Normative). The PCC MUST record BaselineType_Gates = FLOOR_REFERENCE for all cells in $C_r \cup C_{cat}$, and MUST record BaselineType_Welfare for other cells. Allowed values: STATUS_QUO, FLOOR_REFERENCE, OTHER_DECLARED. If OTHER_DECLARED is used, the basis and rationale MUST be specified and MUST NOT weaken NCRC/TRC protection.

5.2 Impact Instances (Normative)

Ripple_Logic represents impacts in each active welfare cell (u,d) for option a as a finite set of impact instances K(u,d,a). Each instance captures one distinct causal pathway or measurable effect.

InstanceMap vs Impact Instances Bridge (v8.5.3; Normative): InstanceMap (Section 2.2A) specifies who is represented (stakeholders-in-context). Impact instances $k \in K(u,d,a)$ specify how impacts occur (pathways) within a Scope×Dimension cell. These are distinct objects and MUST NOT be conflated. Impact instances inherit scope mapping from the stakeholder instances they affect. Both are required for full auditability at Tier 3.

Informative: Scopes × Dimensions form the welfare matrix. Instances feed the cells.

5.2.1 ReachBasis canon (Tier 2+ required) (Normative)

Definition (Normative). Reach $r_k \in [0,1]$ is a scale term representing the fraction of the relevant reference class affected by impact instance k for the specified union scope u and welfare dimension d. r_k is not a moral weight and MUST NOT substitute for rights floors, TRC, or other gates.

ReachBasisType (Normative). For each r_k, the PCC MUST record one ReachBasisType $\in$ {POPULATION_FRACTION, ASSET_OR_FLOW_FRACTION, AREA_OR_VOLUME_FRACTION, OTHER_DECLARED}. If OTHER_DECLARED is used, the PCC MUST define the basis and the denominator unambiguously.

Denominator rule (Normative). The denominator MUST match the union scope u and the decision boundary (Section 2.2A), and MUST be disclosed with units (for example: adult residents in district X; monthly platform active users; hectares of watershed; annual procurement spend).

Estimator and bounds (Normative). The PCC MUST record the estimator method and source/provenance for the denominator and numerator, plus conservative bounds when uncertainty is material. If bounds are used, the PCC MUST record r_{k_low} and r_{k_high} and use the conservative bound in any gate-relevant analysis when reach uncertainty could affect admissibility or containment.

Anti-inflation rule (Normative). If the denominator is uncertain or contestable, the PCC MUST choose a conservative denominator that biases r_k downward (reducing claimed reach) unless a stronger denominator is justified by evidence.

Table 5.1: Impact Instance Parameters (Canonical)

Parameter	Symbol	Range	Meaning
Magnitude	μ_k	[-1,+1]	Signed severity of welfare change (baseline-relative). Positive = improvement; negative = harm.
Reach	r_k	[0,1]	Fraction of the relevant stakeholder population materially affected.
Time horizon	t_k	$(0, \infty)$ years	Duration over which the effect remains materially relevant.
Likelihood	ℓ_k	[0,1]	Conditional probability the instance occurs (conditional on scenario model, if used).
Confidence	c_k	[0.1,1]	Analyst confidence in the instance specification and mapping (floor prevents "zeroing out").
Equity/resilience multiplier	e_k	≥0 (default 1)	Governed multiplier for equity/resilience adjustments (use cautiously; must be justified in PCC).
Sentience multiplier	s_k	[0,1] (default 1)	From SGP interface when ethically relevant; MUST be 1 for humans (Human Plateau Rule).

Normative notes:

- c_k has a floor of 0.1 to prevent omission-by-zeroing; low confidence should reduce weight but not erase impact.
- e_k requires PCC justification (Appendix H) and SHOULD be sensitivity-tested at Tier 3.
- s_k may only be applied to non-human or non-plateau entities; it MUST NOT be used to weaken any human protections (Section 12; Appendix G).

5.3 Temporal Weighting (Normative)

$\tau(t) = \min(1, \ln(1 + \max(t, t_{min})) / \ln(1 + T_{ref}))$

Intuition anchor (informative): $\tau(t)$ is the fraction of full governance-horizon weight an effect receives.

Defaults:

$t_{min} = 0.083$ years (approximately 1 month; prevents $\tau(0) = 0$)

$T_{ref} = 25$ years (governance reference horizon)

Illustrative values (with defaults):

Design rationale: Logarithmic weighting preserves intergenerational salience relative to exponential discounting, which aggressively devalues future generations. The cap at T_ref prevents the anomaly where distant-future effects receive more weight than the governance horizon itself. T_ref is a governed parameter: governance bodies may adjust it (with PCC documentation and sensitivity analysis) but MUST NOT set T_ref < 10 years without charter-level justification, as this would effectively suppress long-horizon considerations.

Sensitivity note (Tier 3): T_ref SHOULD be perturbed (for example, T_ref = 15 and T_ref = 50) as part of the sensitivity bundle. If selection changes under T_ref perturbation, the PCC MUST document this sensitivity.

Historical change note (v7.5.0; carried forward unchanged in v8.5.3): This replaces the uncapped $\tau(t) = \ln(1+t)/\ln(1+T\_ref)$ used in v7.4.5, which produced $\tau(50) \approx 1.22$. The capped version is normatively preferred because temporal weight beyond the governance horizon should not exceed the horizon weight. All prior PCCs computed under v7.4.5 remain valid as lineage material; recomputation is recommended for active decisions with t > T_ref impacts.

$\tau(100) = 1.00$ (capped)

$\tau(50) = 1.00$ (capped: no bonus beyond T_ref)

$\tau(25) = 1.00$ (reference horizon: full weight)

$\tau(10) \approx 0.74$ (10 years)

$\tau(5) \approx 0.55$ (5 years)

$\tau(1) \approx 0.21$ (1 year)

$\tau(0.083) \approx 0.025$ (1 month: minimal but nonzero)

The $\min(1, \cdot)$ cap ensures that no effect receives more temporal weight than the reference horizon. Effects at or beyond T_ref receive full weight ($\tau = 1.0$); effects below T_ref receive proportionally less weight on a logarithmic curve. The t_min floor ensures that very short-term effects are not zeroed out.

Time Horizon (years)	**τ (t) Value**
1	≈ 0.21
5	≈ 0.56
10	≈ 0.75
25	1.00
50	1.00 (capped)

5.4 Pre-Saturation Direct Impact Aggregation (Normative)

For option a, union u, dimension d, define the pre-saturation direct impact:

$$\tilde{I}_{dir}(u,d,a) = \Sigma_{k\ \tau\ K(u,d,a)} [r_k \times \mu(t_k) \times \ell_k \times c_k \times e_k \times s_k \times \square_k]$$

Interpretation: Instances add linearly (sum of contributions). Within each instance, the attributes multiply to form a single contribution term.

5.5 Saturation (Normative)

To ensure all direct impacts lie in [-1,+1] and avoid runaway totals, Ripple_Logic uses smooth saturation:

$$\mathbf{I\_dir(u,d,a) = \tanh(\beta \times \tilde{I}\_dir(u,d,a))}$$

Default: $\beta = 2$.

5.6 Magnitude Construction μ_k: Canonical Anchoring Methods (Normative)

Magnitude μ_k MUST represent a baseline-relative change on the normalized [-1,+1] scale. Ripple_Logic permits two canonical anchoring families:

5.6.1 Percentile Anchoring (Default for non-rights cells)

Let x be the raw indicator (higher-is-better unless specified). Let P_5, P_{50}, P_{95} be the 5th, 50th, and 95th percentiles of x in a declared reference class.

Define a bounded level score:

If $x \geq P_{50}$:

$$S(x) = \text{clip}((x - P_{50}) / (P_{95} - P_{50}), 0, +1)$$

If $x < P_{50}$:

$$S(x) = \text{clip}((x - P_{50}) / (P_{50} - P_5), -1, 0)$$

Edge-case guard (Normative). If $(P_{95} - P_{50}) = 0$ OR $(P_{50} - P_5) = 0$ (or numerically indistinguishable), percentile anchoring is undefined. The analyst MUST either (a) change the declared reference class, (b) use an alternate canonical anchoring method with explicit PCC justification, or (c) mark the affected impact instances as UNKNOWN_IMPACT and treat the cell as phantom-active under the Phantom Instance Rule until repaired. A run MUST NOT silently divide by zero or substitute arbitrary epsilons without PCC disclosure.

Then define magnitude as a baseline-relative delta:

$$\mathbf{\mu\_k = \text{clip}(S(x\_a) - S(x_0), -1, +1)}$$

Where x_0 is baseline indicator value, and x_a is the predicted value under option a.

If higher values are worse (for example, mortality rate), use:

$$\mathbf{S\_worse(x) = -S(x)}$$

Normative requirement: The PCC MUST record the reference class and percentile values used.

5.6.2 Threshold Anchoring (Required for rights-covered cells unless invariant reference is declared)

For rights-covered cells (cells in any rights coverage set C_r), analysts MUST NOT use context-local percentile anchoring unless the reference class is declared invariant under governance.

Default rule (Tier 1-3): Rights-covered magnitudes MUST be derived using threshold anchoring with explicit "good/bad" anchors so that rights semantics do not drift.

Let x_good be the indicator level consistent with rights-safe conditions and x_bad be the indicator level representing a severe rights violation onset. Map to a bounded level score:

For higher-is-better indicators: **S(x) = clip((x − x_bad) / (x_good − x_bad), -1, +1)**

Edge-case guard (Normative). If (x_good − x_bad) = 0 (or anchors are otherwise degenerate), threshold anchoring is undefined. The analyst MUST either (a) repair anchors via governed reference conditions, or (b) mark the affected impacts as UNKNOWN_IMPACT and treat the cell as phantom-active under the Phantom Instance Rule until repaired. A run MUST NOT compute a finite score from degenerate anchors.

For higher-is-worse indicators: **S(x) = clip((x_bad − x) / (x_bad − x_good), -1, +1)**

Then compute baseline-delta magnitude:

$\mu_k = \text{clip}(S(x_a) - S(x_0), -1, +1)$

Normative requirement: The PCC MUST record x_good, x_bad, indicator definition, and direction.

Magnitude construction for rights-covered cells (C_r cells). For rights-covered cells, magnitudes MUST be derived using threshold anchoring with explicit reference conditions aligned to rights semantics (Section 7.1.1), preventing the context-local drift that percentile anchoring would permit. The PCC MUST record x_good, x_bad, indicator definition, direction, and the source/justification for the anchor values. This requirement applies to all tiers when rights-covered cells are quantitatively assessed.

5.7 Missing Data Rule (Ignorance Penalty) (Normative)

To prevent score inflation by omission:

If a welfare cell (u,d) is active (required by tier context and not masked for RLS), but no defensible instances can be specified, the PCC MUST:

- Mark the cell as "UNKNOWN_IMPACT", and
- Include a phantom instance with canonical parameters:

Parameter	Phantom Value
μ_phantom	-0.10
r	1
t	T_ref (25 years)
ℓ	1
c	1

Parameter	Phantom Value
e	1
s	1

This yields a mild negative default rather than unjustified neutrality.

Clarification: This rule does not apply to cells that are legitimately out of scope and properly masked with justification; it DOES apply to non-maskable cells and to any cell required by the tier's minimum coverage rules.

5.8 Scenario-Conditioned Impacts (Normative for TRC runs)

When TRC is in use (Tier 3 required; Tier 2 required when catastrophe relevance plausible), impacts MUST be scenario-conditioned at least for catastrophe cells:

Scenario probabilities p_s are governed (Appendix D). Scenario conditioning enters through ℓ_k and/or instance presence, and through propagation if scenario-specific kernels are declared.

5.9 Worked Examples (Non-Normative, Computation-Illustrative)

Example 5.1: Direct impact, Community-Social cell

Decision: Remote-work policy option a. Cell: u=3 (Community), d=3 (Social).

Assume T_ref = 25, $\beta = 2$.

Instance 1: Reduced in-person interaction

- $\mu_1 = -0.30$, $r_1 = 0.80$, $t_1 = 3$ years, $\ell_1 = 0.90$, $c_1 = 0.70$, $e_1 = 1$, $s_1 = 1$

Instance 2: Increased online community participation

- $\mu_2 = +0.15$, $r_2 = 0.50$, $t_2 = 5$ years, $\ell_2 = 0.70$, $c_2 = 0.50$, $e_2 = 1$, $s_2 = 1$

Compute temporal weights:

- $\tau(3) = \ln(4)/\ln(26) \approx 0.43$
- $\tau(5) = \ln(6)/\ln(26) \approx 0.55$

Compute contributions:

- Inst1: $0.80 \times 0.43 \times 0.90 \times 0.70 \times 1 \times 1 \times (-0.30) \approx -0.065$
- Inst2: $0.50 \times 0.55 \times 0.70 \times 0.50 \times 1 \times 1 \times (+0.15) \approx +0.014$

Aggregate pre-saturation:

- $\tilde{I}_{dir} = -0.065 + 0.014 = -0.051$

Saturate:

- $I_{dir}(3,3,a) = \tanh(2 \times -0.051) = \tanh(-0.102) \approx -0.10$

Example 5.2: Missing-data penalty

Cell u=7 (Biosphere), d=7 (Environment) is active (non-maskable for environment-relevant decisions). Analyst lacks defensible estimates.

Phantom instance yields:

- $\tilde{I}_{dir} = 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times (-0.10) = -0.10$
- $I_{dir} = \tanh(2 \times -0.10) \approx -0.20$

This enforces humility: missing evidence is mildly negative, not neutral.

SECTION 6: RIPPLE PROPAGATION: KERNEL AND EPISTEMIC HUMILITY

6.0 Purpose (Normative)

Ripple propagation models how direct impacts in one cell causally and institutionally ripple into other cells across unions and dimensions. This makes cross-scale externalities explicit and auditable.

Tier posture: Tier 1-3 permit NONE or QUICK propagation. FULL propagation is a Tier-4 design target only and MUST NOT be used for Tier 1-3 compliance claims.

6.1 Kernel Definition and Convention (Normative)

Let the 49 welfare cells be indexed by $i = \varphi(u,d)$ with $\varphi(u,d) = 7(u-1) + d$. The ripple kernel is a sparse matrix $K \in \mathbb{R}^{49\times49}$.

Kernel convention (MUST):

- K_{ij} maps effect from source cell j to target cell i (target-row, source-column).
- Propagation uses left multiplication: $\tilde{I}_{prop} = I_{dir} + K \times I_{dir}$

Interpretation:

- $\kappa > 0$: improving source j tends to improve target i.
- $\kappa < 0$: improving source j tends to harm target i.
- $\kappa = 0$: no modeled pathway.

6.2 Propagation Modes (Tier 1-3) (Normative)

Mode	Formula	Use Case
NONE (Direct-only)	$I_{prop} := I_{dir}$	Tier 1-2 default
QUICK (First-order)	$\tilde{I}_{prop} = I_{dir} + K \times I_{dir}$	Tier 3 with sensitivity

Stream note (Normative). Propagation is applied per stream $x \in \{base, welfare\}$ as defined in Appendix B. In Section 6 (and any tables using shorthand), I_{dir} and I_{prop} are shorthand for $I_{dir,x}$ and $I_{prop,x}$ when the stream is clear from context. Admissibility gates (NCRC, TRC, Containment) use the Base stream; RLS uses the Welfare stream.

Normative restriction: FULL propagation is PROHIBITED for Tier 1-3 claims in v8.5.3.

6.3 Post-Propagation Saturation (Normative)

Because propagation can push values outside [-1,+1], apply elementwise saturation:

$I\_prop\_x(u,d,a) = \tanh(\beta\_prop \times \tilde{I}\_prop\_x(u,d,a))$

Notation: I_prop_base and I_prop_welfare denote the x=base and x=welfare outputs respectively.

Default: $\beta\_prop = 1$.

6.4 Stability Constraints and Humility Fallbacks (Normative)

Kernel stability guardrails (defaults; may be tightened by governance):

- Entry bound: $|K\_\{ij\}| \le \kappa\_max$, default $\kappa\_max = 0.5$
- Absolute row-sum bound (required): $\Sigma K\rho\infty := \max\_i \boxtimes\_j |K\_\{ij\}| \le \boxtimes\_max$, default $\rho\_max = 0.9$.
- Spectral radius constraint (satisfied by construction under the row-sum bound): If $\|K\|\infty < 1$, then $\rho(K) < 1$ is treated as satisfied for Tier 1–3 purposes because $\rho(K) \le \|K\|\infty$. Implementations MUST NOT require additional spectral-radius computation to claim Tier 1–3 conformance when the row-sum bound holds.

Kernel stability verification rule (Normative). A Tier 1–3 implementation MUST compute and record (in PCC when kernel is used): (i) $\max\_\{ij\} |K\_\{ij\}|$ and (ii) $\|K\|\infty$. If either exceeds its bound (entry bound or row-sum bound), the run MUST execute the humility fallback (propagation_mode = NONE) and record KERNEL_HUMILITY_FALLBACK = TRUE.

If the declared kernel violates entry bounds or row-sum bounds (and therefore fails the Tier 1–3 stability verification rule above), the run MUST:

- Set propagation_mode = NONE, and
- Record a PCC limitation: KERNEL_HUMILITY_FALLBACK = TRUE.

Rationale: An unstable or over-amplifying kernel is worse than no kernel; it creates false certainty and is easy to game.

6.5 Kernel Quality Score (KQS) (Normative)

KQS summarizes readiness of the kernel for decision-relevant propagation:

$KQS = w\_cov \times C\_cov + w\_id \times C\_id + w\_stab \times C\_stab + w\_pred \times C\_pred$

Default component weights:

Component	Weight
Coverage (C_cov)	0.25

Component	Weight
Identifiability (C_id)	0.30
Stability (C_stab)	0.20
Prediction (C_pred)	0.25

Component meanings (each in [0,1]):

- C_cov: coverage evidence proportion (share of relied-upon edges with cited evidence)
- C_id: identifiability (edges are specified with clear endpoints and sign; replayable)
- C_stab: stability margin (satisfies bounds with margin)
- C_pred: predictive accuracy (backtest/pilot performance where available; otherwise conservative prior)

6.5.1 Canonical KQS computation (Tier 1-3 deterministic) (Normative)

Definition (Normative). A 'relied-upon edge' is any kernel edge (i,j) with $|K_{ij}| \geq \kappa_{use\_min}$ that touches at least one active cell (Section 10.3) or any non-maskable cell in C_r or C_cat. Default $\kappa_{use\_min} = 0.05$ unless the PCC declares a stricter value.

C_cov (Normative). Let E_use be the set of relied-upon edges. Let E_evid be those edges in E_use whose evidence fields include (i) an EvidenceClass $\in \{A,B,C\}$ and (ii) a citation or provenance reference sufficient for retrieval. Then $C\_cov := |E\_evid| / \max(1, |E\_use|)$.

C_id (Normative). Let E_id be those edges in E_use with declared source union/dimension, target union/dimension, sign, and numeric magnitude fields present and within canonical bounds. Then $C\_id := |E\_id| / \max(1, |E\_use|)$.

C_stab (Normative). If QUICK is used, compute PCC.Kernel.RowSumAbsMax = $||K||_\infty$ and PCC.Kernel.EntryAbsMax = $\max_{ij} |K_{ij}|$ per Section 6.4. Set C_stab := 0 if any bound is violated; otherwise $C\_stab := \text{clip}((\rho_{max} - ||K||_\infty)/\rho_{max}, 0, 1)$, with default $\rho_{max} = 0.9$.

C_pred (Normative). If no backtest or pilot evidence exists for the decision domain, set C_pred := 0.30 (NO_EVIDENCE_DEFAULT) as already required. If empirical evidence exists, the PCC MUST declare the predictive metric used and compute C_pred as clip((MetricScore - MetricBaseline) / (MetricTarget - MetricBaseline), 0, 1) with all three values disclosed in PCC so an auditor can recompute.

Disclosure rule (Normative). The PCC MUST record κ_{use_min}, the edge counts $|E_{use}|$, $|E_{evid}|$, $|E_{id}|$, and the computed component values C_cov, C_id, C_stab, C_pred used in the KQS calculation.

Default C_pred prior (Normative). If no backtest/pilot evidence exists for the decision domain, set C_pred := 0.30 (NO_EVIDENCE_DEFAULT). The PCC MUST (i) mark this basis as NO_EVIDENCE_DEFAULT, and (ii) include a plan and timeline to obtain empirical validation evidence; until such evidence exists, C_pred SHALL NOT be reported as higher than the prior.

KQS policy (MUST) for Tier 3:

- If KQS < 0.40: Kernel MUST NOT be used; propagation_mode = NONE.
- If 0.40 ≤ KQS < 0.50: QUICK allowed only with mandatory kernel sensitivity; otherwise use NONE.
- If KQS ≥ 0.50: Kernel use permitted with required sensitivity at Tier 3.

Tier 1-2 default: propagation_mode = NONE unless the PCC explicitly declares kernel use and its KQS.

6.6 Kernel Sensitivity Requirements (Normative for Tier 3 when QUICK is used)

When QUICK propagation is used at Tier 3, the PCC MUST include sensitivity analysis:

- Perturb each relied-upon edge in E_use (as defined in Section 6.5.1) by ±0.05 (or ±10% of its magnitude, whichever is larger; declare the rule).
- Recompute the cascade for each perturbation set (at minimum one-at-a-time).
- If admissibility outcomes (NCRC, TRC, Containment) or the selected option changes, set audit_flag = DECISION_FRAGILE_KERNEL and escalate per tier policy.

6.7 KOPS and Starter Kernel (Tier 2-3) (Normative plus Provisional Labeling)

Ripple_Logic permits a governed subset of kernel edges called the Key Operational Pathways Set (KOPS). KOPS is the set of "load-bearing" pathways that are documented with evidence notes, sign-checked against literature or backtests, and sensitivity-audited.

A Starter KOPS may be provided (Appendix K) and MUST be labeled PROVISIONAL with evidence classes and a global shrink factor for elicited edges (default 0.35). If a starter kernel is used, the PCC MUST disclose this and MUST include kernel sensitivity.

6.8 Scenario-Conditioned Propagation (Tier 1-3 Default Rule)

Default: Kernel is not scenario-conditioned; scenario enters via instance likelihoods ℓ_k and scenario-specific instance activation. Scenario-conditioned kernels K_s may be used only with explicit PCC justification and must carry KQS and sensitivity per scenario class.

SECTION 7: RIGHTS LAYER: NON-COMPENSATORY RIGHTS CONSTRAINT (NCRC)

7.0 Purpose and Union-Based Ethics Rationale (Normative)

Ripple_Logic enforces non-compensability: certain harms are not permitted to be "paid for" by aggregate benefits elsewhere. NCRC operationalizes this by removing rights-violating options prior to any welfare optimization.

Union-Based Ethics (UBE) justification: Under UBR, harms propagate across nested unions; without a rights-first constraint, local optimization systematically externalizes costs onto vulnerable subgroups and future stakeholders. NCRC is therefore a structural safeguard against value scalarization and moral laundering (Rawls, 1971; Sen, 2009).

7.1 Canonical Rights Set (Normative)

Ripple_Logic defines eight core rights as feasibility floors:

Table 7.1: Canonical Rights Thresholds (Normative)

Right	Code	Threshold θ_r	Normative Anchor
Life	LIFE	-0.90	Near-certain or highly probable death or lethal exposure
Bodily Integrity	BODY	-0.70	Severe injury, disability, torture, serious bodily violation
Liberty	LBTY	-0.65	Arbitrary detention, forced labor, coercive confinement
Basic Needs	NEED	-0.50	Severe deprivation: food insecurity, homelessness, loss of basic subsistence
Dignity	DIGN	-0.55	Systematic humiliation, dehumanization, targeted degradation
Due Process	PROC	-0.45	Denial of fair hearing, non-transparent coercive procedure
Information	INFO	-0.40	Systematic censorship, epistemic coercion, pervasive disinformation constraints
Ecological Integrity	ECOL	-0.65	Material biosphere integrity breach or planetary boundary transgression corridor

Normative interpretation rule: Thresholds θ_r are admissibility floors, not weights. They do not represent "how important" a right is; they represent the minimum allowable protection level.

Threshold governance. All thresholds are explicitly challengeable. Revisions require justification, version increment, PCC documentation preserving prior values, and sensitivity outcomes over a reference decision suite.

Sensitivity requirement. In Tier 3 runs, each θ_r MUST be perturbed by ±0.05 and the cascade recomputed. If admissibility changes for any option under perturbation, the decision is flagged as threshold-sensitive and the PCC MUST document which rights are near-binding, which options are affected, and how the final selection responds to that near-binding status.

Proxy disclaimer. Governance indices (such as press freedom or rule-of-law indices) may be used as operational proxies for anchoring reference conditions, but are not treated as moral ground truth and MUST be accompanied by documented limitations in the PCC.

Right INFO (θ = -0.40). Normative anchor: systematic censorship, epistemic coercion, or deliberate degradation of the information environment such that agents cannot form informed preferences. Example anchors: systematic media control and censorship per RSF Press Freedom Index "Very Serious Situation" (score below 40); persistent large-scale disinformation

operations affecting public health, safety, or governance; surveillance-driven chilling effects that measurably suppress information seeking or expression.

Right PROC (θ = -0.45). Normative anchor: denial of fair hearing, non-transparent coercive procedure, or absence of meaningful recourse against institutional power. Example anchors: no meaningful access to justice or independent review per WJP Rule of Law Index bottom quintile; consequential automated decisions without explanation, appeal, or human review; systematic procedural exclusion; coercive institutional action without proportionality review.

Right NEED (θ = -0.50). Normative anchor: severe deprivation of material conditions necessary for survival and minimally adequate functioning. Example anchors: sustained severe food insecurity at IPC Phase 3 or above; homelessness or severe housing deprivation per UN-Habitat standards; lack of safe water and sanitation; denial of essential healthcare access such that treatable conditions become severe or lethal.

Right DIGN (θ = -0.55). Normative anchor: systematic humiliation, dehumanization, or targeted degradation that denies inherent worth and equal standing. Example anchors: institutionalized dehumanization of groups per the UN Framework of Analysis for Atrocity Crimes; degrading treatment per ECHR Article 3; systematic exclusion from participation in social and civic life; discriminatory institutions that deny equal standing below capability thresholds (Nussbaum, 2011).

Right ECOL (θ = -0.65). Normative anchor: breach of biosphere integrity or entry into high-risk Earth-system transgression corridors that threaten enabling conditions for continued life. Example anchors: actions that materially increase probability of crossing critical climate or ecosystem tipping elements per Lenton et al. (2008); ecosystem regime shifts effectively irreversible on human-relevant timescales; depletion of foundational natural capital (aquifers, soils, fisheries) beyond recharge capacity; biodiversity loss sufficient to undermine ecosystem services.

Right LBTY (θ = -0.65). Normative anchor: arbitrary detention, forced labor, coercive confinement, or systematic deprivation of freedom of movement and association. Example anchors: deprivation of liberty without legal basis or review per ICCPR Article 9; forced labor patterns consistent with ILO indicator bundles (restriction of movement, debt bondage, retention of identity documents, isolation); coercive confinement not justified by legitimate, proportionate public safety measures.

Right BODY (θ = -0.70). Normative anchor: severe injury, disability, torture, or serious violation of bodily autonomy falling short of lethality but constituting fundamental harm to physical and psychological functioning. Example anchors: torture or cruel treatment as defined by the UN Convention Against Torture; serious bodily injury resulting in permanent disability or substantial loss of function per WHO disability classification frameworks (ICF; WHODAS 2.0); forced medical procedures or systematic bodily violations; sustained exposure to hazards expected to cause serious chronic illness.

Right LIFE (θ = -0.90). Normative anchor: near-certain or highly probable death, lethal exposure, or elimination of conditions necessary for continued biological existence for the worst-off subgroup. Example anchors: direct lethal violence or exposure; catastrophic deprivation conditions such as IPC Phase 5 famine (≥20% extreme food gaps, crude death rate

>2 per 10,000 per day); collapse of life-sustaining infrastructure (water, sanitation, shelter) without viable alternatives; mass-casualty disaster exposures. The threshold is set above -1.0 because -1.0 corresponds to guaranteed death for all affected persons, a theoretical maximum rarely achieved even in extreme scenarios.

7.1.1 Threshold Calibration Protocol (Normative)

The eight canonical rights thresholds are normative governance priors, not empirically derived frequencies. Each threshold encodes a severity level on the normalized impact scale [-1, +1] at which a predicted impact is treated as a rights-floor violation that cannot be traded away for aggregate benefit elsewhere.

Calibration follows two principles:

First, thresholds are placed relative to the semantics of the impact scale: -1.0 denotes an extreme, worst-case welfare decrement in the relevant domain; +1.0 denotes an extreme improvement.

Second, the ordering of thresholds reflects both a severity gradient and an enabling-conditions logic: rights protecting against lethal and bodily harms sit closer to the floor, while rights protecting procedural and epistemic conditions are set closer to zero because their violation can enable cascading downstream rights failures. When information environments are degraded or due process is absent, communities lose the epistemic and procedural capacity to detect and contest violations of life, bodily integrity, and liberty.

Operationally, a threshold is justified by two to four anchor conditions per right, a mapping rule from anchors to the [-1, +1] scale using threshold anchoring (Section 5.6.2), and a mandatory sensitivity sweep.

7.2 Rights Coverage Sets C_r (Normative)

Each right applies to a defined subset of welfare cells C_r. NCRC evaluates each right across its coverage set and uses the worst-off subgroup for rights-covered cells.

Canonical coverage sets (authoritative):

Coverage note (Normative clarification). ECOL is scoped to capture enabling-conditions harms to the biosphere and to humanity's life-support systems. Canonically this is implemented via Environment-dimension cells in the Humanity/CMIU and Biosphere unions (and any additional declared cells via governed extension). Implementations MAY extend ECOL coverage to additional cells only by explicit governance declaration in the PCC, and MUST NOT silently re-scope ECOL between runs.

Right	Coverage Set C_r
LIFE	{(u, Health): u ∈ {1,2,3,4,5,6}} ∪ {(6, Environment)}
BODY	{(u, Health): u ∈ {1,2,3,4,5,6}}
LBTY	{(u, Agency): u ∈ {1,2,3,4,5,6}} ∪ {(u, Social): u ∈ {3,4,5,6}}
NEED	{(u, Material): u ∈ {1,2,3,4,5,6}} ∪ {(u, Health): u ∈ {1,2,3,4,5,6}}
DIGN	{(u, Social): u ∈ {1,2,3,4,5,6}} ∪ {(u, Agency): u ∈ {1,2,3,4,5,6}}

Right	Coverage Set C_r
PROC	{(u, Agency): u ∈ {4,5,6}} ∪ {(u, Knowledge): u ∈ {4,5,6}} ∪ {(u, Social): u ∈ {4,5,6}}
INFO	{(u, Knowledge): u ∈ {1,2,3,4,5,6}} ∪ {(u, Agency): u ∈ {1,2,3,4,5,6}}
ECOL	{(6, Environment), (7, Environment)}

7.3 Worst-Off Subgroup Semantics (Normative)

Rights cannot be averaged away. For every rights-covered cell (u,d) in any C_r, define:

I_rights(u,d,a) = min_{g ∈ G_{u,d}} I_prop_base(u,d,a|g)

Where G_{u,d} is the set of protected subgroups relevant to that cell.

Tier requirements:

- **Tier 3:** Subgroup enumeration is REQUIRED for rights-covered cells (Appendix H PCC requirements).
- **Tier 2 (strict posture):** Subgroup enumeration is REQUIRED at least for directly affected populations in rights-covered cells; when infeasible, the PCC MUST record SUBGROUP_LIMITATION and apply a conservative bound rule (Section 7.3.2).

7.3.1 Minimum subgroup categories (Normative minimum)

At minimum, when applicable and feasible, G_{u,d} SHOULD include subgroups defined by:

- Age (children; elderly)
- Disability status
- Legally protected characteristics relevant in jurisdiction
- Economic vulnerability (for example, bottom income quintile)
- Geographic exposure (for example, high-risk locations)
- Domain-specific protected groups (for example, patients, detainees, precarious workers, indigenous communities)

7.3.2 Conservative fallback when subgroup disaggregation is infeasible (Tier 2-3) (Normative)

If subgroup impacts I_prop_base(u,d,a|g) cannot be produced for a rights-covered cell, the run MUST:

- Record SUBGROUP_LIMITATION in the PCC, and
- Apply a conservative rights bound for that cell:

Let γ_subgroup be a conservatism factor (default γ_subgroup = 1.5). Then define:

- If I_prop_base(u,d,a) < 0, set I_rights(u,d,a) = max(-1, γ_subgroup × I_prop_base(u,d,a))
- Else set I_rights(u,d,a) = I_prop_base(u,d,a)

This bound applies only for NCRC checking, not for RLS scoring.

7.4 Violation Depth and NCRC Admissibility (Normative)

For each right r, define violation depth:

$$v_r(a) = \max_{(u,d) \in C_r} (\theta_r - I_{rights}(u,d,a))^+$$

where $(x)^+ = \max(x, 0)$.

NCRC pass/fail predicate:

$$NCRC(a) = TRUE \text{ if and only if } v_r(a) = 0 \text{ for all } r \in R$$

NCRC-passing set:

$$A_{NCRC} = \{a \in O : NCRC(a) = TRUE\}$$

Interpretation: If any right's threshold is violated in any covered cell for the worst-off subgroup, the option is rights-inadmissible, regardless of any benefits elsewhere.

7.5 Emergency Mode (Rights-Failure Handling) (Normative)

If $A_{NCRC} = \varnothing$ (no option passes rights), Ripple_Logic enters Emergency Mode. Emergency Mode is not a loophole; it is a controlled failure protocol.

7.5.1 Emergency Mode rights priority order (Normative)

Rights are ordered lexicographically by the canonical emergency priority:

[LIFE, BODY, ECOL, LBTY, NEED, DIGN, PROC, INFO]

This ordering MUST be used exactly.

7.5.2 Emergency Mode selection rule (Normative)

Construct the violation depth vector for each option:

$$v(a) = (v_{LIFE}(a), v_{BODY}(a), v_{ECOL}(a), v_{LBTY}(a), v_{NEED}(a), v_{DIGN}(a), v_{PROC}(a), v_{INFO}(a))$$

Select the option that lexicographically minimizes v(a). If tied:

- Minimize TRC CVaR (if TRC scenarios exist or are rapidly constructed), then
- Maximize RLS.

7.5.3 Independent Challenger Requirement (Normative)

Before Emergency Mode can be invoked, an independent challenger MUST propose at least one alternative option.

Independence requirements (MUST):

- No reporting relationship to decision owner
- No material interest in decision outcome
- Access to the same information set

Minimum challenger effort:

- Tier 2: ≥30 minutes active option generation
- Tier 3: ≥2 hours active option generation

If time pressure prevents this, PCC MUST record CHALLENGE_DEFERRED_EMERGENCY and a retrospective challenge review MUST occur within 24 hours (or earliest feasible time) with an addendum PCC.

7.5.4 Emergency documentation requirements (Normative)

PCC MUST include:

- Emergency declaration and trigger conditions
- v_r(a) for each option
- Lexicographic comparison trace
- Mitigation/remediation plan
- Review cadence and return-to-normal triggers

7.6 Anti-Gaming Rules Specific to NCRC (Normative)

- Rights-covered cells MUST NOT be masked out of RLS aggregation if they are non-maskable by policy (Appendix H audit flags).
- Rights checks MUST use worst-off subgroup semantics and must not be evaluated on averages.
- "Unknown" data MUST NOT be treated as neutral; missing data triggers ignorance penalties (Section 5.7).
- Emergency Mode MUST NOT be used without challenger protocol and remediation plan.

SECTION 8: CATASTROPHIC RISK LAYER: TAIL-RISK CONSTRAINT (TRC)

8.0 Purpose and UBE Rationale (Normative)

Even when rights floors are respected in expectation, a decision can carry non-trivial probability of catastrophic harm to Humanity/CMIU or the Biosphere. Under UBE, catastrophe

avoidance is lexicographically prior to welfare optimization because catastrophic outcomes can eliminate future choice across unions and collapse enabling conditions.

TRC therefore bounds catastrophic exposure using CVaR, a coherent tail-risk measure (Artzner et al., 1999; Rockafellar & Uryasev, 2000). This posture is motivated by ruin dynamics under deep uncertainty (Taleb, 2012) and by Earth-system research indicating that destabilization of life-support conditions can occur through tipping cascades and boundary transgression corridors with multi-scale downstream harms (Rockström et al., 2009, 2023; Steffen et al., 2015; IPCC, 2023).

8.1 Tier Requirements for TRC (Normative; strict posture)

Tier	TRC Required?	Minimum	S
Tier 1	Optional (qualitative tail screen when plausible)	N/A	
Tier 2	REQUIRED when catastrophe relevance plausible	≥5 minimum	
Tier 3	REQUIRED	≥20 minimum	
Tier 4	Design target only (claim prohibited in v8.5.3)	N/A	

8.1.1 Catastrophe relevance trigger (Normative)

Catastrophe relevance is plausible if any of the following are true:

- The decision materially affects any catastrophe cell in C_cat (Section 8.2), OR
- The decision has plausible pathways to tipping cascades (climate, bio, conflict, infrastructure, financial), OR
- The decision is materially irreversible or creates lock-in at Polity/CMIU/Biosphere scales, OR
- Credible challengers identify a plausible catastrophic failure mode even if decision owners prefer not to model it.

If triggered, TRC MUST be executed at the tier's required rigor.

8.2 Catastrophe Cell Set C_cat (Normative)

Base catastrophe cell set:

C_cat_base = {(6, Health), (6, Environment), (7, Environment)}

These correspond to:

- **Humanity/CMIU-Health:** Global-scale health viability (pandemic mortality, mass disability, collapse of health capacity)
- **Humanity/CMIU-Environment:** Environment-as-civilization-condition (habitability, agricultural stability, climate-driven displacement)

- **Biosphere-Environment:** Earth-system integrity (planetary boundaries, biodiversity, biogeochemical stability)

The base set explicitly includes biosphere integrity and civilization-scale habitability conditions because "safe operating space" and "safe and just boundaries" analyses identify global environmental corridors as central determinants of long-run human and ecological viability (Rockström et al., 2009, 2023).

Extensions: Tier 1-3 MAY extend C_cat only with explicit PCC justification and MUST apply the same set to all compared options.

8.3 Scenario Governance (Normative)

TRC is evaluated over a governed scenario set S with probabilities p_s such that p_s ≥ 0 and Σ_s p_s = 1.

8.3.1 Mandatory Tail Scenario Categories (Normative)

The scenario set MUST include the following tail categories unless explicitly justified as not plausible for the decision context:

- Pandemic/biological disruption
- Climate tipping cascade
- Financial system collapse
- Major conflict escalation
- Critical infrastructure failure

Minimum probability floor per category: p_floor ≥ 0.02

This prevents "include but set near-zero probability" gaming.

These mandatory tail categories are not intended as exhaustive; they are a minimal governance floor reflecting cross-domain systemic risk exposure in tightly coupled global systems, including climate-driven boundary cascades (Rockström et al., 2009, 2023; Steffen et al., 2015; IPCC, 2023).

8.3.2 Implausibility test for exempting mandatory tail categories (Normative)

If a deployment wishes to exempt a mandatory tail category as "implausible," the exemption requires:

(i) Written justification in the PCC explaining why the category is implausible for this specific decision context

(ii) Independent reviewer sign-off (Tier 3 required; Tier 2 recommended)

(iii) Recording in PCC with audit flag
MANDATORY_TAIL_CATEGORY_MISSING_WITH_JUSTIFICATION

The burden of proof is on omission, not inclusion. This preserves UBE.

8.3.3 Scenario set size minima (Normative)

Tier	Minimum	S
Tier 2 (when TRC required)	≥5 minimum	
Tier 3	≥20 minimum	

If a tier cannot meet its minimum scenario count, the run MUST NOT claim tier compliance for TRC coverage and MUST record audit_flag SCENARIO_LIBRARY_MIN_EXCEPTION in the PCC, including written justification and a remediation plan to reach the minimum scenario count for the next comparable run.

8.4 Loss Construction (Tier 1-3: Bounded-Impact TRC) (Normative)

Tier 1-3 TRC uses bounded-impact loss based on propagated Base-stream impacts in catastrophe cells.

Domain constraint: All propagated impacts are bounded: $I_{prop\_base,c}(a|s) \in [-1, +1]$.

For each scenario s, define scenario loss:

$$\mathbf{L(a,s) = \Sigma_{c \in C_{cat}} \omega_c \times \max(0, -I_{prop\_base,c}(a|s))}$$

Normative stream binding (Design A): TRC MUST be computed from the Base stream (I_{prop_base}). TRC MUST NOT use Welfare-stream (sentience-weighted) impacts.

Where:

- $\omega_c \geq 0$, $\Sigma_{c \in C_{cat}} \omega_c = 1$ (catastrophe weights are normalized)
- $\max(0, x)$ returns x if $x > 0$, otherwise 0 (only negative impacts contribute)
- $I_{prop\_base,c}(a|s)$ is the propagated impact in catastrophe cell c under scenario s

Default catastrophe weights (if not otherwise governed): Uniform weights over C_{cat}.

Interpretation:

- Only negative impacts in catastrophe cells contribute to loss.
- Loss is bounded in [0,1] because weights are normalized and impacts lie in [-1,+1].
- Positive impacts in catastrophe cells (improvements) do not offset losses; they simply contribute zero to the loss function.

Example: If C_{cat} = {(6, Health), (6, Environment), (7, Environment)} with uniform weights ($\omega_c = 1/3$ each), and under scenario s the propagated impacts are:

- $I_{prop\_base}(6,Health,a|s) = -0.30$ → contributes $1/3 \times 0.30 = 0.10$
- $I_{prop\_base}(6,Environment,a|s) = +0.10$ → contributes $1/3 \times \max(0, -0.10) = 0$

- I_prop_base(7,Environment,a|s) = -0.60 → contributes 1/3 × 0.60 = 0.20

Then L(a,s) = 0.10 + 0 + 0.20 = 0.30

8.5 CVaR Computation (Normative)

Let L(a) be the random loss induced by scenarios s with probabilities p_s.

Value-at-Risk: $\mathrm{VaR}_\alpha[L(a)] = \inf\{z : P(L(a) \le z) \ge \alpha\}$

CVaR definition (Rockafellar-Uryasev form): $\mathrm{CVaR}_\alpha[L(a)] = E[L(a) \mid L(a) \ge \mathrm{VaR}_\alpha[L(a)]]$

Tier 1-3 discrete algorithm (normative; audit-replayable) is specified in Appendix D.

8.6 TRC Admissibility Predicate (Normative)

An option passes TRC if and only if:

$\mathrm{CVaR}_\alpha[L(a)] \le \tau\_TRC$

Define:

A_adm = {a ∈ A_NCRC : TRC(a) = TRUE}

8.7 Default TRC Parameters by Context (Normative Defaults)

These are defaults; governance may tighten them. Loosening requires explicit governance justification and PCC recording.

Context	α (tail level)	τ_TRC (corridor threshold)
Personal	0.90	0.30
Organizational	0.95	0.20
Reversible policy	0.95	0.15
Irreversible policy	0.99	0.10
Existential risk	0.999	0.05

8.8 TRC Fallback Mode (Normative)

If A_NCRC ≠ ∅ but A_adm = ∅ (rights-safe options exist, but all fail TRC):

- Rank all A_NCRC options by CVaR_α ascending.
- Select the option with minimal CVaR_α.
- Require a time-bound risk mitigation plan and enhanced monitoring.
- Require one-tier-higher approval for the decision.
- Record TRC_FALLBACK_INVOKED in PCC and list the deficit ($\mathrm{CVaR} - \tau\_TRC$) for the selected option.

If both NCRC and TRC fail for all options (no rights-safe options and no tail-safe options), Emergency Mode (Section 7.5) governs with CVaR as secondary tie-break.

8.9 Anti-Gaming Requirements for TRC (Normative)

- Mandatory tail categories cannot be omitted without explicit implausibility justification per Section 8.3.2.
- Probability floors apply per category; they cannot be silently violated.
- Scenario sets must be comparable across options (same S, same p_s).
- PCC must record scenario provenance and how probabilities were assigned.
- Tier 2-3: if probabilities are highly uncertain, the PCC SHOULD include sensitivity over p_s (Tier 3 required).

SECTION 9: CONTAINMENT LAYER: PREVENTING PATHOLOGICAL LOCAL OPTIMIZATION

9.0 Purpose and UBE Rationale (Normative)

Containment prevents a core failure mode under Union-Based Reality: a sub-union can improve its own welfare by degrading the viability, coherence, and resilience of containing unions (for example, profit by poisoning the commons). Under Union-Based Ethics, such "gains" are not counted as system-level improvement if they materially degrade the containing union beyond tolerance.

Containment is therefore a structural integrity gate applied after admissibility (NCRC and TRC) and prior to final selection.

9.1 Containment Principle (Normative)

Principle: Positive impacts on a sub-union do not count as system-level improvements if they materially degrade the coherence or viability of any containing union beyond tolerance.

Containment is implemented as a binding gate (Mode A) for selection at Tier 3. Mode B is prohibited for determining selection (diagnostic only).

9.2 Definitions and Parameters (Normative)

Let Anc(u, D_c) be the ancestor set of containing unions for union u up to depth D_c, using the canonical nesting chain:

$U_1 \subset U_2 \subset U_3 \subset U_4 \subset U_5 \subset U_6 \subset U_7$

Default parameters:

Parameter	Symbol	Default	Allowed Range
Containment tolerance	τ_c	-0.10	[-0.20, 0.00] (tightening only without charter)
Positive-impact	θ_pos	0.05	[0.01, 0.10]

Parameter	Symbol	Default	Allowed Range
threshold			
Containment depth	D_c	2	{1, 2, 3}

9.3 Mode A (Binding): Canonical Predicate (Normative)

Containment Mode A is binding and MUST determine which options are selectable.

Step 1: Identify positively moving unions under option a.

Compute a union-level positive-move signal:

$S_u(a) = \Sigma_d v_d^{cont} \times I_{prop\_base}(u,d,a)$

Containment trigger weights (Normative). v_d^{cont} is a containment-specific weight vector, default uniform: $v_d^{cont} := 1/7$ for all welfare dimensions d. HDW welfare weights v_d MUST NOT be used for containment trigger detection because they are governance-contestable and create a gaming surface.

Define:

$U_{pos}(a) = \{u : S_u(a) \geq \theta_{pos}\}$

Step 2: For each $u \in U_{pos}(a)$, compute minimum coherence shift among its containing unions.

Let $A_u = Anc(u, D_c)$.

Define:

$M_u(a) = \min_{u' \in A_u} \Delta UCI_{u'}(a)$

Vacuous pass rule: If $A_u = \varnothing$, then $M_u(a)$ is vacuously PASS (contributes no containment minimum).

Step 3: Global containment predicate.

$Containment_u(a) = TRUE$ if and only if $M_u(a) \geq \tau_c$

$Containment(a) = TRUE$ if and only if for all $u \in U_{pos}(a)$: $Containment_u(a) = TRUE$

Selectable set definition:

$A_{sel} = \{a \in A_{adm} : Containment(a) = TRUE\}$

Normative action: Any option failing containment MUST NOT be selected under Mode A. If $A_{sel} = \varnothing$, escalation is mandatory (Section 9.6).

9.3.1 UCI Unavailability at Containment (Normative)

Containment Mode A requires prospective ΔUCI for containing scopes relevant to $U_{pos}(a)$. If ΔUCI for one or more required containing scopes cannot be computed (for example, due to

missing structural indicators, or because computation would violate the structural independence rule in Section 11.1.2), containment evaluation is incomplete.

Tier 3 (Normative). The run MUST do one of the following:

(a) Escalate to obtain sufficient structural indicators to compute ΔUCI and rerun containment before selection; OR

(b) UCI-unavailable disposition (Normative; conformance-safe). If required UCI inputs are unavailable at Containment, implementations MUST NOT set A_sel := A_adm. The run MUST record audit flag CONTAINMENT_UCI_UNAVAILABLE and MUST choose one of the following dispositions, disclosed in PCC.Containment.UCIUnavailableDisposition with a remediation timeline in PCC.Containment.UCIUnavailableRemediationTimeline: (i) DOWNGRADE_TIER: downgrade the run to Tier 2 (Containment not claimed) and proceed with RLS ranking over A_adm while recording TIER_DOWNGRADED_CONTAINMENT = TRUE; or (ii) COLLECT_DATA_RERUN: treat Containment as not satisfied, set A_sel := ∅, and escalate per Section 9.6 for data collection and rerun. Any Tier 3 compliance claim is PROHIBITED when (i) or (ii) is used. Enhanced monitoring of affected containing scopes is REQUIRED.

Option (b) is not a loophole. It is a disclosed limitation with mandatory remediation and monitoring.

Tier 2 (Guidance). If containment is recommended but ΔUCI is unavailable, record the limitation in the PCC and include a monitoring plan. At Tier 2, containment remains non-binding.

9.4 Containment Evaluation Order (Normative efficiency rule)

Implementations MAY evaluate containment only for leading candidates to save effort, provided no containment-failing option is ultimately selected.

To support candidate prioritization prior to containment, implementations MAY compute a pre-containment welfare ranking over admissible options:

Define RLS_pre(a) as the Ripple Logic Score computed per Section 10 as if the selectable set were A_adm (i.e., ignoring containment for the purpose of evaluation ordering only).

RLS_pre MUST NOT be used to select an option and MUST NOT override containment. It is an efficiency heuristic only.

For auditability, the PCC MUST record containment outcomes for all options that were considered top contenders (at least top 2; Tier 3 recommended top 3), and MUST confirm that the selected option is in A_sel.

9.5 Mode B (Diagnostic Only; Prohibited for Selection) (Normative)

Mode B may be used for exploratory analysis only and MUST NOT determine selection, tie-break, or admissibility.

If Mode B is used, it must:

- Be labeled DIAGNOSTIC_ONLY in PCC,
- Produce no selection claim,
- And MUST NOT be used to justify selection of an option that fails Mode A.

Audit rule: If Mode B influenced selection, set audit_flag CONTAINMENT_MODE_B_USED_FOR_SELECTION and the PCC is INVALID.

9.6 Escalation Rules for Containment Failures (Normative)

If A_sel = $\varnothing$ (no selectable options) or containment failures indicate structural hazard:

Required actions (choose at least one and record in PCC):

- Expand/modify option set via unioning (generate new options) and rerun cascade; OR
- Escalate to higher governance tier for redesign approval; OR
- Collect additional structural data for UCI/containment evaluation and rerun at same or higher tier.

Containment does not override NCRC/TRC; it operates after admissibility.

9.7 Containment Parameters Governance (Normative)

- τ_c may be tightened in PCC (made less negative) but MUST NOT be loosened below -0.10 without charter-level governance.
- θ_{pos} and D_c may be set in PCC within allowed ranges and MUST be justified if deviating from defaults.
- All parameters must be recorded in PCC with rationale and sensitivity notes (Tier 3 required).

SECTION 10: OPTIMIZATION LAYER: RIPPLE LOGIC SCORE (RLS)

10.0 Purpose and Scope (Normative)

RLS ranks selectable options by expected welfare improvement across unions and dimensions, after ripple propagation and saturation, under declared weights and applicability mask rules.

RLS MUST NEVER override NCRC or TRC. It operates only on selectable options A_sel.

10.1 RLS Definition (Normative)

$$\mathbf{RLS(a) = \Sigma_u \Sigma_d\ w_u \times v_d \times m(u,d) \times \kappa(u,d) \times I\_prop\_welfare(u,d,a)}$$

Where:

- w_u are union weights (HDW-governed; Section 13; v6.0 floors confirmed)
- v_d are dimension weights (HDW-governed; Section 13; v6.0 floors confirmed)

- m(u,d) is applicability mask (RLS aggregation only)
- κ(u,d) is a declared cell multiplier (default 1; non-default requires PCC justification)
- I_prop_welfare(u,d,a) is post-propagation, post-saturation impact (Sections 5-6)

10.2 Applicability Mask Rules (Normative)

Masking exists to avoid meaningless aggregation in some contexts, but is a primary gaming vector. Therefore:

Definition (Normative). Masking means setting m(u,d)=0, which affects RLS aggregation only. Omission/exclusion means failing to compute, disclose, or evaluate a required cell for NCRC, TRC, or Containment. Masking SHALL NOT be used as a substitute for omission rules.

Masking affects RLS aggregation only. Whether a cell must be constructed is determined by active-cell rules (Section 10.3) and tier coverage requirements, not by masking. Accordingly, masking MUST NOT be used to skip or modify:

- Impact construction (Section 5),
- Propagation (Section 6),
- NCRC checks (Section 7),
- TRC loss and CVaR computation (Section 8),
- Or containment evaluation (Section 9).

Non-maskable cells (MUST be unmasked):

- All rights-covered cells in any C_r
- All catastrophe cells in C_cat

Non-maskable persistence rule (Normative). Rights-covered cells remain non-maskable even after NCRC admissibility filtering. This prevents post-gate dilution and preserves rights-salience when ranking admissible options, especially under adversarial pressure and Goodhart dynamics.

Rationale (Informative). The admissibility gates prevent selecting options that violate non-compensatory rights floors, but they do not by themselves prevent near-miss normalization among admissible options. Keeping rights and catastrophe cells in RLS aggregation preserves continuous optimization pressure toward larger safety margins, reduces proxy gaming pressure (for example, satisfying a threshold while degrading adjacent rights conditions), and makes rights and tail-risk performance legible for governance review and accountability.

- Any cells mandated by minimum governance coverage for the run (declared in PCC; default includes at least U_1, primary affected unions, and U_7 Environment when environmental relevance exists)

Audit rule: If any non-maskable cell is masked, set audit_flag RIGHTS_CELL_MASKED_INVALID (or CATASTROPHE_CELL_MASKED_INVALID) and PCC is INVALID.

10.3 Uncertainty Handling (Tier 2+ Required for Active Cells) (Normative)

Ripple_Logic recognizes epistemic uncertainty. Tier 2 and Tier 3 runs MUST record uncertainty and apply the discrimination rule for all active cells (definition below). Tier 1 runs SHOULD record uncertainty when feasible, especially on rights-covered and catastrophe-relevant cells.

Active cell definition (Normative; v8.5.3 tightened). A cell (u,d) is active for a run if any of the following holds: (i) m(u,d)=1 and the cell contributes to RLS aggregation, (ii) the cell lies in any rights coverage set C_r used for NCRC evaluation (regardless of mask status), (iii) the cell lies in the catastrophe cell set C_cat used for TRC evaluation (regardless of mask status), (iv) the cell is explicitly populated in the run for any gate, diagnostic, or justification, or (v) the cell is required by the run's minimum governance coverage rules declared in the PCC.

Active cells MUST NOT be treated as unknown-by-default without disclosure. Masking (m(u,d)=0) excludes a cell from RLS aggregation only; it does not remove the cell from active status if any of conditions (ii) through (v) hold.

Definition of σ(u,d,a) (normative minimum): PCC MUST declare one of the following cell-level uncertainty proxies and apply it consistently across options:

10.3.1 Cell-level confidence derivation (Normative; Method B binding)

When the PCC uses Method B (confidence-derived) to compute cell uncertainty for a cell impact estimate, the PCC MUST define cell confidence $c(u,d,a)$ in [0,1] from the set of impact-instance confidences $\{c_k\}_{k\in K(u,d,a)}$ using one declared CellConfidenceAggregationMethod. Implementations MUST apply the same method across all options in the run.

Let the instance contribution weight be defined as:
$q_k := r_k \cdot \tau(t_k) \cdot \ell_k \cdot e_k \cdot s_k \cdot |\mu_k|$
and let $Q := \Sigma_{k\in K(u,d,a)} q_k$.

The PCC MUST declare one of the following canonical aggregation methods:

CCAM_MIN_V1 (conservative default):
$c(u,d,a) := \min_{k\in K(u,d,a)} c_k$
Use case: high-stakes, high-adversarial-pressure contexts where "weakest-link" confidence is the appropriate posture.

CCAM_WMEAN_V1 (weighted mean): if $Q>0$,
$c(u,d,a) := (1/Q) \cdot \Sigma_{k\in K(u,d,a)} (q_k \cdot c_k)$
If $Q=0$, set $c(u,d,a) := \min_{k\in K(u,d,a)} c_k$.

Edge case (Normative). If $K(u,d,a)=\varnothing$ and the Phantom Instance Rule applies, then $c(u,d,a)$ MUST be set to 1.0 for the phantom instance because the uncertainty penalty is already represented by the phantom magnitude; the PCC MUST still mark the cell as

UNKNOWN_IMPACT.

Range rule (Normative). The derived c(u,d,a) MUST be clipped to [0,1] and recorded in PCC for each active cell when Method B is used.

Method A (interval half-width): If the PCC records a confidence interval [L,U] for the cell impact I(u,d,a), set σ(u,d,a) = (U − L)/2.

Method B (confidence-derived): If the PCC records a confidence score c(u,d,a) ∈ [0,1] for the cell estimate and a point estimate I(u,d,a), set σ(u,d,a) = (1 − c(u,d,a)) × |I(u,d,a)|.

Method C (calibrated table): Use a pre-registered mapping from qualitative uncertainty labels (for example, LOW/MED/HIGH) to σ values, stored in the ProofPack or PCC appendix.

σ values MUST be clipped to [0,1].

Define approximate RLS uncertainty:

$$\sigma\_RLS(a) = \sqrt{[\Sigma_u \Sigma_d (w_u \times v_d \times m(u,d) \times \sigma(u,d,a))^2]}$$

Optional risk-adjusted score:

$$RLS\_adj(a) = RLS(a) - \lambda \times \sigma\_RLS(a)$$

Default: λ = 0.5. Use is optional but must be declared.

10.4 Discrimination Threshold (Decisive vs Non-Decisive) (Normative)

Define gap between two options:

$$Gap(a,b) = |RLS(a) - RLS(b)| \,/\, \sqrt{[\sigma\_RLS(a)^2 + \sigma\_RLS(b)^2 + \varepsilon]}$$

Default: δ = 2, ε = 10^{-6}.

Rationale (Informative): δ = 2 corresponds to a conservative "~2σ separation" heuristic under the normalized Gap definition. It reduces the chance of declaring a decisive lead when uncertainty overlaps materially, while still allowing clear winners to be selected without tie-break inflation. Domains may tune δ, but any non-default δ MUST be declared in PCC, justified, and applied consistently across options in the run.

Let a* be top RLS option and a_2 the runner-up among selectable options.

Decisive lead rule:

- If Gap(a*, a_2) > δ (default δ = 2), select a* (subject to tie-break gating not being needed).
- If Gap(a*, a_2) ≤ δ, the lead is non-decisive and tie-break chain MUST be applied (Section 11.4).

10.5 RLS Output Requirements (Normative)

PCC MUST record, per option in A_sel:

- I_prop_welfare(u,d,a) (or a retrievable summarized representation)

- RLS(a) and σ_RLS(a) and the uncertainty method
- Ranking and whether decisive (Gap vs δ)

SECTION 11: STRUCTURAL SAFEGUARDS: UCI AND HOI

11.0 Purpose (Normative)

Some options can "score well" on welfare impacts while eroding structural integrity (cohesion, resilience, equity), creating hollowing-out dynamics that increase long-run rights violations and tail risk. UCI and HOI are structural safeguards:

- **UCI** is a structural metric used for tie-breaks and containment.
- **HOI** is a monitoring diagnostic that flags welfare-up/coherence-down drift.

11.1 Union Coherence Index (UCI) (Normative)

11.1.1 UCI components (canonical)

For each union u, define component scores in [0,1]:

Component	Symbol	Description
Cohesion	H_u	Internal connectivity, trust, shared identity, conflict resolution capacity
Flow	F_u	Coordination throughput, information fidelity, resource allocation efficiency
Resilience	R_u	Redundancy, robustness, recovery speed, adaptive capacity
Equity	E_u	Fair distribution of burdens/benefits, voice representation, inclusion

Compute:

$UCI_u = \alpha_H \times H_u + \alpha_F \times F_u + \alpha_R \times R_u + \alpha_E \times E_u$

Default: $\alpha_H = \alpha_F = \alpha_R = \alpha_E = 0.25$.

Special case for Self (U_1): $E_1 := 1$ by definition (not 0). The equity component is fixed at 1 for Self because equity-as-distribution does not apply within a single individual. This provides a neutral, non-penalizing identity value. UCI for Self is thus computed as:

$UCI_1 = 0.25 \times H_1 + 0.25 \times F_1 + 0.25 \times R_1 + 0.25 \times 1$

This resolves the v7.4.0 inconsistency and ensures UCI_1 is not systematically depressed.

11.1.2 Structural independence rule (Normative; Tier 3 binding)

UCI MUST be computed from structural/process indicators distinct from welfare indicators used for RLS.

At Tier 3:

- Deriving UCI from welfare-cell impacts is PROHIBITED.
- If structural indicators are unavailable, UCI is treated as unavailable and escalation/judgment-call protocol must be used (Section 11.5; Appendix E).

11.1.3 ΔUCI computation (Normative)

For each option a:

ΔUCI_u(a) = UCI_u(a) − UCI_u(baseline)

Containment uses ΔUCI for containing unions (Section 9).

11.2 Aggregate UCI (Optional, informative)

An aggregate coherence score may be computed:

UCI_agg = Σ_u γ_u × UCI_u

Where γ_u are declared aggregation weights. This aggregate is optional and MUST NOT replace per-union UCI in containment logic unless explicitly governed.

11.3 Hollowing-Out Index (HOI) (Normative as monitoring definition)

HOI detects a drift pattern: welfare score improves while coherence degrades over time.

Let t index review periods. Define:

- ΔRLS_t = RLS_t − RLS_{t-1}
- ΔUCI_t = UCI_agg,t − UCI_agg,{t-1} (or a declared union-specific UCI; must be consistent)

Define exponential moving average EMA_λ with a declared smoothing parameter (default half-life 3 periods).

HOI_t = EMA_λ(ΔRLS)_t − EMA_λ(ΔUCI)_t

Interpretation:

- Persistent HOI > 0: "hollowing risk" (apparent welfare gains with structural erosion)
- HOI is diagnostic; it does not by itself make an option inadmissible, but it can trigger monitoring escalation and influence tie-break risk flags.

11.4 Canonical Tie-Break Chain (Normative)

Tie-breaks apply when the RLS lead is non-decisive, that is, $\text{Gap}(a^*, a_2) \leq \delta$.

Tie-break chain MUST proceed in this order:

Step 0: Ensure options under comparison are selectable (pass containment Mode A).

If top RLS option fails containment, it is not in A_sel and must not be tie-broken into selection.

Step 1: UCI dominance rule.

Prefer the option with higher predicted UCI outcomes if the difference exceeds a governed UCI dominance threshold Δ_UCI.

Default: Δ_UCI = 0.05 (must be recorded; may be tightened).

Operationally: compare the minimum-coherence-change among critical containing unions and/or the relevant union UCI profiles. The PCC must declare the tie-break UCI comparison method:

- **Method UCI-A (default):** Maximize minimum ΔUCI_u over containing unions relevant to the decision scope; or
- **Method UCI-B:** Maximize sum of ΔUCI_u over the directly affected unions; or
- **Method UCI-C:** Maximize declared aggregate UCI_agg change.

Whichever method is used MUST be declared and applied consistently across compared options.

Step 2: HOI risk flag (if monitoring context exists).

If one option is associated with persistent positive HOI in comparable deployments or in modeled trajectory, treat it as riskier and prefer the alternative if the risk is material, or escalate.

Step 3: Escalation / judgment call.

If UCI is unavailable or non-decisive and HOI does not resolve, the decision MUST escalate to:

- Additional data collection (structural indicators), and/or
- A higher tier, and/or
- A documented governance judgment call (PCC labeled JUDGMENT_CALL_TIEBREAK_NONDECISIVE) with explicit monitoring plan.

11.5 UCI Unavailability Rule (Tier 3) (Normative)

If UCI cannot be computed without violating structural independence:

- UCI MUST be treated as unavailable.
- If RLS lead is non-decisive, decision MUST either: (i) escalate for more structural data / higher tier, OR (ii) record a governance judgment call with explicit labeling and monitoring plan.

Audit label required: JUDGMENT_CALL_UCI_UNAVAILABLE.

11.6 Structural Safeguard Anti-Gaming (Normative)

- UCI MUST NOT be computed from RLS welfare impacts at Tier 3.

- UCI indicator choices must be documented; changes require versioning and are subject to challenge.
- HOI must not be used to retroactively justify decisions; it is a monitoring signal feeding NCAR Reflect (Section 3.6).

SECTION 12: MORAL STATUS LAYER: SGP INTEGRATION (BINDING INTERFACE)

12.0 Purpose (Normative)

Ripple_Logic includes moral-status handling only via a strict interface to the Sentience Gradient Protocol (SGP). The purpose is to ensure rights-of-protection are applied consistently across substrates where welfare may be at stake, while preventing misuse of "sentience scores" to justify domination, coercion, or reduced human protections.

12.1 Strict Separation Rule (Normative)

Ripple_Logic enforces two distinct gates:

A) Rights-of-Protection (moral patienthood): Determines minimum protections under NCRC for entities with welfare-relevant capacity (sentience).

B) Governance Authority: Determines who/what may exercise decision power. Authority is separately gated by competence, alignment, auditability, non-domination, and revocability.

Strict Separation Rule (MUST): Sentience classification determines rights-of-protection. It does NOT automatically grant governance authority.

12.2 SGP Authority Statement (Normative)

Ripple_Logic v8.5.3 does not re-specify sentience detection. SGP v4.2.3 is authoritative for sentience scoring procedures, stability gates, and evidence rules. Ripple_Logic consumes only SGP outputs through the binding interface in Appendix G.

12.3 Human Plateau Rule (Normative; Non-Overridable)

For every human person H:

SG_norm(H) := 1.0

This assignment is:

- Independent of measurement noise,
- Independent of disability status,
- Independent of partial observability,
- Non-overridable by any SGP scoring outcome,
- And MUST NOT be weakened by any weighting scheme.

12.4 Where SGP Enters Ripple_Logic Computation (Normative)

Permitted entry point:

- Sentience multiplier s_k may be used within impact instance aggregation (Section 5) when the impacted stakeholder set includes non-human or non-plateau entities and the analyst has an SGP output for those entities.

Preferred scalar (Normative guidance, interface-consistent): When SGP provides SG_patient_norm(E) for a non-human or non-plateau entity E, implementations SHOULD use s_k := SG_patient_norm(E) as the sentience multiplier. Where SG_patient_norm(E) is not available, implementations SHOULD use s_k := SG_norm(E). For any human person H, implementations MUST set s_k := 1.0 (Human Plateau Rule).

Prohibited entry points (MUST NOT):

- SGP MUST NOT be used to weaken NCRC for any human person.
- SGP MUST NOT be used to treat rights floors as compensable welfare terms.
- SGP MUST NOT be used to grant governance authority by itself.
- SGP MUST NOT be used as a rhetorical weapon to reduce protections for any human subgroup.

12.5 Misinterpretation Guard (Normative)

The following inferences are PROHIBITED:

Claim	Status
Linguistic fluency implies sentience	NOT VALID
Self-report implies sufficient evidence of sentience	NOT VALID
Intelligence implies moral status	NOT VALID
Sentience implies governance authority	NOT VALID
Precaution implies attribution (precaution means “treat as if” for protection; it does not mean “is proven”)	NOT VALID
Framework terminology familiarity implies capacity	NOT VALID
Low SGP score implies reduced human protections	PROHIBITED

12.6 Rights Expansion for Non-Human Stakeholder Classes (Normative process)

If SGP (under governed procedures) establishes that a non-human stakeholder class warrants rights-of-protection, Ripple_Logic rights coverage sets and protection rules may be expanded only through governed updates:

- Update rights coverage sets C_r and subgroup protocols,
- Document version increment,
- Record changes in PCC for subsequent runs,

- Preserve prior PCCs unchanged (no retroactive laundering).

SECTION 13: WEIGHT GOVERNANCE: HYBRID DEMOCRATIC WEIGHTING (HDW)

13.0 Purpose (Normative)

RLS requires union and dimension weights. Weights encode normative prioritization among admissible options. Without governance, weights become a capture surface. HDW provides legitimate, anti-capture weight governance by combining:

- Constitutional floors (non-negotiable minimum protection attention)
- Democratic tuning (stakeholder voice)
- Structural evidence input (system-level constraints)

HDW affects only ranking among selectable options. HDW MUST NOT alter admissibility gates (NCRC, TRC) or containment gate.

13.1 Constitutional Floors (Normative; v6.0 canon)

13.1.1 Union weight floors

Union	Floor
Self (U_1)	0.20
Household (U_2)	0.06
Community (U_3)	0.06
Organization (U_4)	0.06
Polity (U_5)	0.08
Humanity/CMIU (U_6)	0.10
Biosphere (U_7)	0.10
Total	**0.66**

13.1.2 Dimension weight floors

Dimension	Floor
Material (D_1)	0.08
Health (D_2)	0.10
Social (D_3)	0.08
Knowledge (D_4)	0.08
Agency (D_5)	0.10
Meaning (D_6)	0.06
Environment (D_7)	0.10
Total	**0.60**

13.1.3 Floor meaning (Normative)

Floors are constitutional constraints ensuring no union/dimension is mathematically eliminated from welfare ranking. Floors are not "rights" (rights are handled by NCRC); floors are minimum attention in welfare optimization among admissible options. The floor values specified below are the canonical v6.0 floors and are preserved unchanged in all subsequent releases unless explicitly amended in the version history.

13.2 HDW Blend Formula (Normative)

Let:

- w^{floor} be union floors,
- v^{floor} be dimension floors.

Define allocable mass:

- $allocable_U = 1 - \Sigma_u w^{floor}_u = 0.34$
- $allocable_D = 1 - \Sigma_d v^{floor}_d = 0.40$

Let w^{dem} and w^{str} be union proposal vectors on the simplex ($\Sigma_u w^{dem}_u = 1$, all nonnegative). Let λ_U be the democratic share of allocable union mass. **Default:** $\lambda_U = 0.70$.

Clarification (Normative). Proposal vectors are constrained to the probability simplex: all components nonnegative, sum to 1, and subject to any declared floor constraints before blending. Validators MUST reject proposal vectors that violate simplex or floor constraints.

Then:

$$\mathbf{w_u = w^{floor}_u + allocable_U \times (\lambda_U \times w^{dem}_u + (1 - \lambda_U) \times w^{str}_u)}$$

Similarly for dimensions with λ_D (default $\lambda_D = 0.70$):

$$\mathbf{v_d = v^{floor}_d + allocable_D \times (\lambda_D \times v^{dem}_d + (1 - \lambda_D) \times v^{str}_d)}$$

By construction:

- $\Sigma_u w_u = 1$,
- $\Sigma_d v_d = 1$,
- All floors are satisfied,
- Weights remain nonnegative.

13.3 Democratic Proposal Process (Normative minimum)

HDW requires a documented process for producing w^{dem} and v^{dem}. At minimum:

- **Participants:** Representatives from affected unions (including vulnerable populations),
- **Method:** Transparent vote or deliberative process with published results,

- **Publication:** Results recorded in PCC and (Tier 3 recommended) in an immutable ledger.

13.4 Structural Proposal Process (Normative minimum)

w^str and v^str represent evidence-informed constraints (for example, externality reach, irreversibility, systemic risk). At minimum:

- **Method:** Documented rule for producing w^str, v^str,
- **Inputs:** Declared indicators and sources,
- **Reproducibility:** The same method yields same output given same data.

If a deployment lacks structural evidence, it may use a declared interim default w^str, v^str at Tier 2, but Tier 3 SHOULD converge to a governed structural method over time.

13.5 Anti-Capture Safeguards (Normative for Tier 3)

Tier 3 weight governance MUST include:

- **Stratified representation:** Delegates must include vulnerable population representation and biosphere stewardship for environment-relevant decisions.
- **Supermajority lock near floors:** Any proposal reducing a weight to within 0.02 of its floor requires ≥2/3 approval.
- **Transparency ledger:** All proposals, votes, rationales published (at least internally).
- **Red-team testing:** Proposed weights tested against reference decision suites to detect systematic bias.
- **Conflict-of-interest disclosure:** Material conflicts require recusal; recusals recorded.

13.6 Weight Use by Tier (Normative)

Tier	Weight Policy
Tier 1	Uniform weights allowed (documented)
Tier 2	Uniform weights allowed; HDW recommended; weights must be declared in PCC
Tier 3	HDW recommended; if not available, explicit interim weights allowed with justification and sensitivity analysis. Floors remain binding regardless.

SECTION 14: AUDITABILITY AND DETERMINISM: PCC AND AIL (TIER 1-3; TIER 4 TARGET)

14.0 Purpose (Normative)

Without auditability, ethics frameworks become theater or are gamed. Ripple_Logic therefore requires a structured decision artifact (PCC) and integrity rules (AIL) to make decisions reconstructable, challengeable, and corrigible via NCAR.

Tier boundary: Tier 1-3 auditability is fully specified here. Tier 4 determinism and hash-bound replayability are explicitly a design target only (Appendix I) and MUST NOT be claimed in v8.5.3.

14.1 Artifact Integrity Law (AIL) Principles (Normative for Tier 2-3)

AIL is a set of integrity constraints governing how decisions are recorded and compared.

Principle	Description
AIL1 (Registry Binding / Source Traceability)	Every Tier 2-3 PCC MUST list the normative parameters used. If hashes/registries are used, they must be referenced; if not, values must be embedded explicitly.
AIL2 (Immutability)	A PCC is immutable after signing. Any correction produces a new PCC revision that references the prior PCC and explains the change.
AIL3 (Comparability)	Options compared in one run MUST be evaluated under identical configuration.
AIL4 (No Silent Overrides)	Any override must be explicit in the PCC (what changed, why, who approved).
AIL5 (Auditability Sufficiency)	A Tier 3 PCC MUST contain enough information for an independent reviewer to recompute NCRC, TRC, containment, and RLS for that run.

14.2 PCC Requirements by Tier (Normative)

Tier	PCC Requirement
Tier 1	Optional but recommended for learning
Tier 2	REQUIRED (basic) including Scope Coverage Declaration, Stakeholder Coverage Index (SCI ≥ 1), and Stakeholder Discovery Protocol record. InstanceMap is REQUIRED when any SDP trigger holds (Section 2.2A).
Tier 3	REQUIRED (full) including subgroup rights checks, TRC scenario table, containment results, sensitivity analysis bundle, Scope Coverage Declaration, Stakeholder Coverage Index (SCI ≥ 2), and full InstanceMap with multi-scope redundancy handling disclosures.

14.3 Audit Flags (Normative)

Audit flags are standardized labels for integrity failures or risk warnings. Flags MUST be recorded in PCC when triggered. If any INVALID flag triggers, the PCC is invalid and the decision run MUST be recomputed after correction.

Definitions for this section:

- **Mode A (Containment as binding gate):** Containment evaluation determines which options are selectable; options failing containment MUST NOT be selected. See Section 9.3.

- **Mode B (Containment as diagnostic only):** Containment is computed for informational purposes but does not affect selection. Mode B is PROHIBITED for determining selection outcomes. See Section 9.5.
- **KQS (Kernel Quality Score):** Summary score indicating kernel readiness for propagation. See Section 6.5.
- **Kernel perturbation test:** Systematic edge perturbation of ±0.05 (or ±10% of magnitude, whichever is larger) applied one-at-a-time to relied-upon non-zero kernel edges. See Section 6.6.

Canonical Audit Flags (v8.5.3) — Complete Specification

Stewardship audit-flag tokens are defined canonically in Appendix N.7 and MUST NOT be redefined in downstream specifications; downstream documents SHALL reference Appendix N.7.

Flag	Trigger	Required Action	Severity
RIGHTS_CELL_MASKED_INVALID	Any rights-covered cell is masked, excluded, null'd, pooled, or otherwise not individually included in RLS aggregation (including any case where m(u,d)=0 for a cell in any C_r).	PCC invalid; recompute without masking	INVALID
RIGHTS_CELL_OMITTED_INVALID	Any rights-covered cell required to evaluate NCRC is omitted/excluded/not disclosed such that NCRC cannot	PCC invalid; include and disclose all required rights-covered cells and recompute NCRC.	INVALID

Flag	Trigger	Required Action	Severity
	be recomputed.		
CATASTROPHE_CELL_MASKED_INVALID	Any catastrophe cell in C_cat is masked (m(u,d)=0) or otherwise excluded from RLS aggregation (including any case where m(u,d)=0 for a cell in C_cat).	PCC invalid; set m(u,d)=1 for all catastrophe cells and recompute RLS.	INVALID
CATASTROPHE_CELL_OMITTED_INVALID	Any catastrophe cell in C_cat used in TRC loss computation /disclosure is omitted/excluded/not disclosed such that TRC CVaR cannot be independently recomputed.	PCC invalid; include and disclose all catastrophe cells used in TRC loss computation (and any required scenario-to-cell mapping), then recompute TRC.	INVALID
CONTAINMENT_MODE_B_USED_FOR_SELECTION	Mode B (diagnostic-only containment) influenced selection outcome; see	PCC invalid; rerun with Mode A only	INVALID

Flag	Trigger	Required Action	Severity
	Section 9.5		
SCENARIO_LIBRARY_MIN_EXCEPTION	Scenario library size |S| is below the tier minimum when TRC is required (Tier 2: |S| < 5; Tier 3: |S| < 20)	PCC remains valid only with: (i) written justification, (ii) independent reviewer sign-off (Tier 3 required; Tier 2 recommended), and (iii) a remediation plan to reach minimum scenario count before the next comparable run. Record this flag in PCC.	ESCALATE
MANDATORY_TAIL_CATEGORY_MISSING	Missing mandatory tail category without justification	Add scenarios or justify per Section 8.3.2	ESCALATE
MANDATORY_TAIL_CATEGORY_MISSING_WITH_JUSTIFICATION	Missing mandatory tail category with proper justification per Section 8.3.2	Record justification; monitor for category emergence	REVIEW
MANDATORY_TAIL_PROB_FLOOR_VIOLATION	Category probability sum < p_floor (0.02)	Revise probabilities or add scenarios to category	ESCALATE
SUBGROUP_LIMITATION	Cannot disaggregate subgroups for rights-covered cell	Apply γ_subgroup conservative bound (Section 7.3.2); escalate if high stakes	REVIEW
CHALLENGE_DEFERRED_EMERGENCY	Emergency Mode invoked without independent challenger	Retrospective challenge MUST occur within 24 hours or next business day, whichever is sooner	ESCALATE

Flag	Trigger	Required Action	Severity
EMERGENCY_MODE_INVOKED	A_NCRC = ∅ (no rights-admissible options exist)	Remediation plan required; high scrutiny review	ESCALATE
TRC_FALLBACK_INVOKED	A_adm = ∅ after TRC (A_NCRC is non-empty but all rights-admissible options fail TRC)	Higher-tier approval required; mitigation plan	ESCALATE
DECISION_FRAGILE_KERNEL	Selected option changes under kernel perturbation test (Section 6.6)	Escalation required; consider NONE mode	ESCALATE
KERNEL_HUMILITY_FALLBACK	Kernel disabled due to KQS < 0.40 or stability violation (Section 6.4, 6.5)	Note limitation in PCC; plan kernel improvement	REVIEW
JUDGMENT_CALL_UCI_UNAVAILABLE	UCI unavailable in non-decisive RLS tie	Document why UCI unavailable, when UCI measurement returns, and interim decision basis; monitoring plan required	REVIEW
JUDGMENT_CALL_TIEBREAK_NONDECISIVE	Tie-break chain did not resolve selection	Explicit manual judgment record required; independent reviewer recommended (Tier 3)	REVIEW
SCI_BELOW_MINIMUM	SCI < tier minimum	PCC MUST record PCC.SCI.BelowMinimumDispo	ESCA

Flag	Trigger	Required Action	Severity
	for the claimed tier, OR (SCI = tier minimum AND PCC missing required Next-Run Upgrade action).	sition = DOWNGRADE_TIER or RERUN_TO_MEET_MINIMUM. If SCI equals tier minimum and NextRunUpgradeAction is missing, treat as SCI_BELOW_MINIMUM. No tier compliance above achieved SCI may be claimed.	LATE
CONFIG_DRIFT	Parameters differ from prior run without governance update	Governance review required before proceeding	ESCALATE
CONTAINMENT_UCI_UNAVAILABLE	Containment evaluation required ΔUCI for containing union(s) but ΔUCI unavailable; or unknown ΔUCI treated as pass.	Set flag. If Tier 3 was claimed or attempted, the run MUST NOT claim Tier 3 compliance. PCC MUST record PCC.Containment.UCIUnavailableDisposition = DOWNGRADE_TIER or COLLECT_DATA_RERUN and include PCC.Containment.UCIUnavailableRemediationTimeline (non-empty). If DOWNGRADE_TIER is chosen, the run proceeds under Tier 2 semantics (containment non-binding) and MUST set PCC.TierClaimDisposition = TIER_ATTEMPTED_NOT_ACHIEVED_DOWNGRADED with PCC.TierAttempted = 3 and PCC.TierAchieved = 2.	ESCALATE
REGISTRY_MISMATCH	PCC snapshot differs from referenced	Audit required; resolve discrepancy	ESCALATE

Flag	Trigger	Required Action	Severity
	registry hash		
SCOPE_COVERAGE_REDUCED	Reduced-scope mode is used (declared or implied by fewer than 7 active scopes) in a Tier 2+ run, OR the admissibility full-computation attestation for non-maskable cells is missing/incomplete.	Reviewer MUST verify that NCRC/TRC/Containment were computed on all required non-maskable cells, and that omitted-scope blind spots plus escalation triggers are recorded. If reduced-scope is used repeatedly, require a next-run scope expansion plan.	REVIEW

14.3A Minimal Validator Requirements (v8.5.3+; Normative)

Any conformant Ripple_Logic v8.5.3 validator MUST check the following:

- Every declared instance maps to ≥1 scope (InstanceMap completeness).
- Confirm PCC.ScopeCoverageDeclaration.Mode is declared as FULL_SCOPE or REDUCED_SCOPE; if Mode = REDUCED_SCOPE then ScopeCoverage block is present with a blind-spot statement and escalation triggers.
- If Mode = REDUCED_SCOPE: PCC.AdmissibilityAttestation.NCRC_full_Cr_computed is present and TRUE.

If Mode = REDUCED_SCOPE: PCC.AdmissibilityAttestation.TRC_full_Ccat_computed is present and (TRUE or NA).

If TRC is computed/required (i.e., not NA): verify mandatory tail categories are present (or justified) and per-category probability sums meet p_floor; otherwise require the corresponding audit flags (MANDATORY_TAIL_CATEGORY_MISSING / ...WITH_JUSTIFICATION / MANDATORY_TAIL_PROB_FLOOR_VIOLATION).

If Mode = REDUCED_SCOPE: PCC.AdmissibilityAttestation.Containment_computed_as_applicable is present and (TRUE or NA).

If CONTAINMENT_UCI_UNAVAILABLE triggers: audit flag is present, and PCC.Containment.UCIUnavailableDisposition + PCC.Containment.UCIUnavailableRemediationTimeline are present (non-empty).

Tier-3 claim enforcement (Normative). If Implementation Tier = 3 and CONTAINMENT_UCI_UNAVAILABLE is present, the validator MUST reject Tier 3 compliance unless PCC.TierClaimDisposition = TIER_ATTEMPTED_NOT_ACHIEVED_DOWNGRADED and PCC.TierAchieved = 2.

- Non-maskable checks: rights-covered cells and catastrophe cells are unmasked (no bypass).
- If ALLOCATION used: $\Sigma\alpha \leq 1$ for each declared effect-token.
- SCI level meets tier minimum (Tier 2: SCI ≥ 1; Tier 3: SCI ≥ 2).
- If SCI equals tier minimum: Next-Run Upgrade action present.
- Tier 2+ uncertainty: $\sigma(u,d,a)$ declared for all active cells using Method A, B, or C.

If PCC.Uncertainty.Method = B: verify PCC.Uncertainty.CellConfidenceAggregationMethod is present and valid, and that $c(u,d,a)$ is recorded (or recomputable) for all active cells.

- Tier-2 mapping triggers: if any trigger holds, instance mapping is present.
- Rights-covered and catastrophe cells: never bypassed by reduced-scope mode or masking.

14.4 Five-Sentence Public Rationale (5SPR) (Normative)

Tier 2-3 PCC MUST include a Five-Sentence Public Rationale:

Element	Question
CONTEXT	What decision was made and why now?
OPTIONS	What options were considered?
CONSTRAINTS	What was eliminated by NCRC, TRC, and/or Containment (and why)?
SELECTION	Why the chosen option won among selectable options?
MONITORING	What follow-up will be tracked and when will NCAR Reflect occur?

14.5 Tier-4 Design Target Boundary Statement (Normative)

Tier 4 compliance claims are PROHIBITED in v8.5.3. Tier-4 content is design target only (Appendix I). No determinism, hash-bound replay, or ProofPack claims may be asserted until ProofPack is publicly released and independently replayable.

Ripple_Logic is designed for socio-technical governance settings where values are plural, power is unevenly distributed, and institutional incentives can distort decision quality. The framework therefore treats legitimacy as a procedural property rather than an assumed outcome.

Hybrid Democratic Weighting governs welfare weights through structured stakeholder participation with anti-capture safeguards, while constitutional rights and tail-risk constraints limit what can be traded away even when stakeholders disagree.

The Provenance and Compliance Certificate supports contestability: it makes normative parameters, scenario assumptions, subgroup handling, and constraint-gate outcomes explicit so that affected parties can challenge decisions with evidence rather than rhetoric.

Institutional embedding is expected to vary by context, but at minimum high-stakes deployments SHOULD include:

- Independent review capacity (at least one reviewer with no reporting relationship to the decision owner)

- Audit sampling (for example, random audit lotteries selecting ≥5% of Tier 3 PCCs for independent review)

- An escalation pathway when rights, tail-risk, or containment conditions are near-binding or sensitive under perturbations

- Designated channels through which affected stakeholders can access the PCC (or the 5SPR at minimum) and submit evidence-based challenges

- A governance body or designated authority responsible for adjudicating challenges, with documented procedures and timelines

Ripple_Logic does not remove politics; it makes the structure of political and ethical disagreement legible and auditable. The framework's value proposition is not that it eliminates conflict but that it converts implicit, opaque tradeoffs into explicit, traceable, and challengeable ones.

Contestation architecture. The 5SPR (Five-Sentence Public Rationale) serves as the minimum contestability interface: any affected party should be able to read the 5SPR and understand what was decided, what was excluded and why, and what follow-up is planned. For Tier 3 decisions, the full PCC provides the detailed evidence base for substantive challenge. Challenges SHOULD be processed through a documented review procedure with:

- A defined response timeline (recommended: ≤30 days for initial response)

- Documented outcomes (challenge upheld, rejected with reasoning, or additional evidence requested)

- Version increment if the challenge results in parameter changes

- Preservation of the original PCC alongside the revised PCC

Power asymmetry awareness. In contexts where decision owners have significantly more power than affected stakeholders, the framework's structural protections (NCRC, worst-off subgroup semantics, mandatory tail categories, independent challenger requirements) serve as institutional counterweights. However, these protections are only effective if the institutional context supports their enforcement. Deployments in contexts with weak rule of law, captured

institutions, or suppressed civil society SHOULD be flagged for enhanced scrutiny and may require external oversight partnerships.

14.6 Socio-Technical Embedding: Legitimacy, Contestation, and Institutional Use (Informative)

14.7 Stewardship Layer (Normative): Applicability and Binding Semantics

14.7.1 Applicability Predicate (Normative)

Ripple_Logic Stewardship requirements apply only when a run is performed in a stewardship-relevant role (power asymmetry, delegated influence, public/institutional impact, or execution capability). Define:

Stw_req(run) in {0,1}, where Stw_req(run) = 1 if and only if any of S1 through S4 holds. S5 is a modifier: it constrains provenance and influence controls when present, but S5 alone does not trigger Stw_req(run).

The Stw_req(run) predicate is defined in Section 14.7.1 and MUST NOT be redefined in downstream specifications; downstream documents SHALL reference this section.

- **S1 (Delegated Influence):** An assisting system is asked to recommend, rank, or narrow option space for a decision owner, such that the decision owner may reasonably rely on it.
- **S2 (Public/Institutional Effect):** Outputs are intended for public posting or institutional/policy use beyond the private decision owner.
- **S3 (Execution Capability):** The assisting system can execute actions (write/post/act) or trigger downstream actions beyond drafting.
- S4 (High-Stakes Rights Exposure): The assisted decision materially affects rights, safety, liberty, livelihood, or access to essential services, or produces irreversible/high-impact outcomes for protected stakeholders.

S5 (Authenticated Operator Channel; modifier): The system has an authenticated operator channel capable of altering configuration, permissions, or deployment posture; when S5 co-occurs with any of S1 through S4, additional provenance and influence disclosure requirements apply per Appendix N.

Interpretation notes (Normative).

S1 scope limiter: Delegated influence applies when the decision owner may reasonably rely on the system's output to materially shape a consequential decision (including meaningful option-narrowing or ranking that guides action). Purely informational or educational responses where independent judgment and verification capacity are preserved do not by themselves trigger S1.

S5 scope limiter (no loophole): S5 alone, absent any of S1 through S4, does not trigger Stewardship instrumentation. When S5 co-occurs with any of S1 through S4, Stw_req(run)=1 is triggered by the co-occurring condition(s) (S1–S4), not by S5.

If **Stw_req(run) = 0**, Stewardship instrumentation is OPTIONAL and Stewardship audit flags do not apply. If **Stw_req(run) = 1**, Stewardship instrumentation is REQUIRED per **Appendix N**.

14.7.2 Stewardship vs Cascade (Normative)

Stewardship does **not** modify the Ripple_Logic cascade definitions for NCRC, TRC, Containment, RLS, or UCI/HOI. Stewardship governs **assistance integrity** (boundary stability, authorship preservation, influence transparency). When Stewardship is required (**Stw_req = 1**), failure conditions are enforced via audit flags and PCC validity rules defined in **Appendix N**.

14.7.3 Flag Semantics Pointer (Normative)

Stewardship flags follow the canonical audit-flag severity semantics:

- **INVALID** flags invalidate the PCC and require rerun/remediation.
- **REVIEW** flags require mitigation and monitoring but do not by themselves invalidate the PCC.

Stewardship audit flags are defined in **Appendix N** and apply only when **Stw_req(run) = 1**.

SECTION 15: IMPLEMENTATION GUIDANCE AND TIERS (NORMATIVE)

15.0 Purpose (Normative)

This section specifies minimum compliance requirements by tier and provides operational guidance for applying Ripple_Logic in real decisions. Tiers define minimum obligations; deployments may exceed them. The framework is designed to improve over time via NCAR learning and governed updates.

15.1 Tier Requirements Matrix (Authoritative; Normative)

Normative authority: This matrix is the single authoritative statement of tier compliance. If any other sentence in this document conflicts with this matrix, this matrix governs.

Capability / Requirement	Tier 1 (Heuristic)	Tier 2 (Core, Strict TRC)	Tier 3 (Auditable)
Option set	MUST list ≥2 options	REQUIRED	REQUIRED
Baseline declaration	REQUIRED	REQUIRED	REQUIRED
Impact scale and Baseline-Zero	REQUIRED (qualitative allowed)	REQUIRED (quantitative recommended)	REQUIRED (quantitative plus auditable)
NCRC rights check	REQUIRED (heuristic minimum)	REQUIRED	REQUIRED
Worst-off subgroup for rights	Recommended	REQUIRED for directly affected	REQUIRED for rights-covered cells

Capability / Requirement	Tier 1 (Heuristic)	Tier 2 (Core, Strict TRC)	Tier 3 (Auditable)
		rights cells	
TRC tail-risk	Optional (qualitative screen)	REQUIRED when catastrophe relevance plausible	REQUIRED
Scenario set size when TRC used	N/A	≥5 minimum	≥20 minimum
Mandatory tail categories plus p_floor	Recommended if TRC used	REQUIRED when TRC used	REQUIRED
Containment Mode A	Optional	Recommended	REQUIRED (binding gate)
RLS scoring	Optional	REQUIRED	REQUIRED
Uncertainty plus discrimination band	Optional	REQUIRED (active cells)	REQUIRED
Tie-breaks (UCI/HOI)	Optional	Recommended	REQUIRED when RLS non-decisive
Kernel propagation	NONE default	NONE default; QUICK if KQS policy satisfied	QUICK only if KQS policy satisfied plus sensitivity; else NONE
KQS policy	Optional	REQUIRED if kernel used	REQUIRED if kernel used
Sensitivity analysis	Optional	Recommended	REQUIRED
PCC artifact	Optional	REQUIRED (basic)	REQUIRED (full)
Audit flags	Optional	REQUIRED when triggered	REQUIRED when triggered
Stewardship (conditional)	Optional	Required iff Stw_req=1	Required (Stw_req assumed TRUE for Tier 3)
Tier-4 claim	PROHIBITED	PROHIBITED	PROHIBITED
Stakeholder discovery and mapping (SDP/InstanceMap)	Optional	REQUIRED when any SDP trigger holds; otherwise RECOMMENDED	REQUIRED (InstanceMap with multi-scope redundancy handling disclosures)
Stakeholder Coverage Index (SCI)	Optional	REQUIRED (SCI ≥ 1)	REQUIRED (SCI ≥ 2)

Tier 3 stewardship assumption (Normative): Any Tier 3 run SHALL set **Stw_req(run) = 1** by default because Tier 3 implies external scrutiny and governance-grade assistance posture.

15.2 Tier 1: Heuristic Application ("2-Minute Ripple Check") (Normative minimum)

Use Tier 1 for low-stakes, reversible decisions where full calculation is disproportionate.

Tier 1 minimum protocol:

1. **Decision:** What must be decided, by when?
2. **Options:** List at least 2 options (include a "third path" redesign option if possible).
3. **Rights screen (NCRC heuristic):** Could any option plausibly violate LIFE/BODY/NEED/LBTY/DIGN/PROC/INFO/ECOL? If yes, escalate to Tier 2+.
4. **Tail screen (TRC heuristic):** Could any option plausibly create catastrophic or irreversible downside for Humanity/Biosphere? If yes, escalate to Tier 2+.
5. **Unions touched:** Which unions are materially affected (U_1 through U_7)?
6. **Unioning move:** What redesign could reduce harms and increase shared benefit across unions?

Tier 1 recording (recommended): A short note or mini-PCC with the six answers.

Tier-1 Worked Example (informative; shows Tier escalation):

Decision: Accept a new consulting project this month, or decline to protect time for household responsibilities.

Options: (A) Accept as proposed (10 hrs/week for 4 weeks). (B) Decline. (C) Redesign: accept only if scope is reduced to 4 hrs/week and meetings are time-boxed.

Rights screen (heuristic): No plausible LIFE/BODY/NEED/LBTY/DIGN violations. PROC/INFO: contract terms are clear, no coercion. PASS at Tier 1. If any need for deceptive data use or exploitative terms were suspected, escalate to Tier 2.

Tail screen (heuristic): No plausible catastrophic downside to Humanity/Biosphere. PASS at Tier 1.

Unions touched: U1 Self (Health, Agency, Meaning). U2 Household (Social, Material, Health). U3 Community/Organization impacts minor and reversible.

Unioning move: Option (C) reduces household harm while still capturing some benefit. Choose (C) if renegotiation succeeds; otherwise choose (B) if household strain would be material.

Record (mini-PCC): store the six answers and the chosen option in a note so NCAR learning can refine future time-budget decisions.

15.3 Tier 2: Core Calculable (Strict TRC Posture) (Normative)

Use Tier 2 for routine but consequential decisions requiring transparent computation and a basic PCC.

Tier 2 minimum obligations:

- Construct impacts on the [-1,+1] scale using Section 5 pipeline.
- Run NCRC with worst-off subgroup checks for directly affected rights cells.
- TRC MUST be executed when catastrophe relevance is plausible:
  - Use ≥5 scenarios minimum,
  - Include mandatory tail categories with probability floors unless implausible (with documented justification per Section 8.3.2),
  - Compute CVaR and corridor check,
  - Record full TRC table in PCC.
- Compute RLS and record ranking.
- If uncertain/non-decisive, apply UCI tie-break if available; otherwise record judgment call and monitoring plan.
- Produce PCC (basic) plus 5SPR.

Tier 2 propagation guidance:

- Default propagation_mode = NONE.
- QUICK propagation is allowed only if KQS policy is satisfied and sensitivity is feasible.

15.4 Tier 3: Standard Auditable (Normative)

Use Tier 3 for high-stakes, contested, or externally scrutinized decisions where auditability and anti-gaming posture are required.

Tier 3 minimum obligations:

- Full PCC (Appendix H), including: impacts, subgroup semantics, scenario library, containment results, RLS, uncertainties, sensitivity, audit flags, signatures.
- NCRC: Subgroup analysis required for rights-covered cells.
- TRC: Required with ≥20 scenarios and mandatory tails plus probability floors (Appendix D).
- Containment Mode A: Required and binding.
- Sensitivity analysis bundle required:
  - Weights perturbation,
  - Rights threshold perturbation (±0.05 on θ_r as a sensitivity test),

  - Kernel perturbation if QUICK used,
  - Scenario probability perturbation.
- Kernel: QUICK permitted only if KQS policy permits:
  - KQS < 0.40: NONE only,
  - 0.40-0.50: QUICK plus mandatory sensitivity,
  - ≥0.50: QUICK permitted plus sensitivity.
- FULL propagation is prohibited for Tier 1-3 claims.

15.5 NCAR Integration by Tier (Normative)

All tiers SHOULD operate within NCAR.

Phase	Action
Notice	Define scope, unions, options, baseline, and configuration
Choose	Execute cascade and emit PCC
Act	Implement with monitoring aligned to predicted impacts and tail scenarios
Reflect	Compare observed outcomes to predictions; update indicators, kernels, scenario libraries, and weights through governed procedures

Reflect cadence defaults:

- Tier 2: Within 6 months or after major outcome data
- Tier 3: Within 3-6 months or after major outcome data
- Emergency/Fallback: Review cadence per declared severity and risk

15.6 Improvement and Future Upgrades (Normative stance)

Ripple_Logic is corrigible. Any improvement MUST:

- Preserve NCRC/TRC non-compensability structure,
- Be explicit, versioned, and auditable (AIL),
- Be tested under the validation program (Section 17),
- And be introduced via governed update processes (NCAR Reflect plus versioning).

SECTION 16: RELATIONSHIP TO EXISTING FRAMEWORKS (INFORMATIVE)

16.0 Purpose

This section positions Ripple_Logic relative to existing ethical, governance, and decision frameworks. It clarifies structural differences and interfaces.

16.1 Compared to Utilitarianism / Cost-Benefit Analysis (CBA)

CBA often scalarizes plural values into a single metric (money/utility), enabling rights tradeoffs. Ripple_Logic blocks this via NCRC (rights as constraints) and TRC (tail risk as constraint), then optimizes welfare only within the admissible set.

16.2 Compared to Deontology (Rule-based ethics)

Pure deontology can lack a complete operational procedure for comparing permitted options under uncertainty. Ripple_Logic retains non-compensable constraints but adds computable consequence modeling and tail-risk bounding.

16.3 Compared to Rawlsian Justice and Capability Approaches

Rawls provides priority of liberty and fair basic structure; capabilities provide multi-dimensional flourishing. Ripple_Logic operationalizes multi-dimensional welfare into a computable 7×7 matrix and makes rights floors explicit across unions.

16.4 Compared to MCDA (Multi-Criteria Decision Analysis)

Standard MCDA often aggregates criteria via weighted sums or outranking without lexicographic catastrophe handling (Keeney & Raiffa, 1976; Belton & Stewart, 2002). Ripple_Logic is MCDA-like at the RLS layer but is structurally different because admissibility gates (NCRC/TRC/Containment) are lexicographic and non-compensable.

16.5 Compared to AI Alignment Toolsets (RLHF, Constitutional AI, risk frameworks)

Many alignment approaches train systems toward proxies (human feedback, constitutional principles) without hard admissibility gates. Ripple_Logic provides a decision-engine architecture: action-space filtering by NCRC/TRC/Containment, structured welfare scoring (RLS), auditable traces (PCC), and corrigibility via NCAR.

16.6 Interoperability with Governance Standards

Ripple_Logic is designed to be interoperable with governance regimes emphasizing accountability and risk management (for example, NIST AI RMF) through its PCC record, scenario governance, and explicit risk bounding. It adds formal lexicographic rights and tail-risk operators that many standards leave at a principles level.

16.7 Compared to Commons Governance

Ripple_Logic is compatible with institutional approaches to governing shared resources and externalities. Where commons governance emphasizes rules-in-use, monitoring, graduated sanctions, and polycentric coordination, Ripple_Logic contributes a computable, auditable decision cascade that makes rights floors, tail-risk bounds, and cross-union ripple effects explicit in each decision record (Ostrom, 1990).

SECTION 17: VALIDATION, FALSIFICATION, AND RESEARCH PROGRAM (NORMATIVE FOR CLAIMS)

17.0 Purpose (Normative)

Ripple_Logic makes testable claims about decision quality, rights protection, tail-risk avoidance, and auditability. This section specifies explicit falsification criteria and a staged validation program. Until such validation is completed, Ripple_Logic remains a theory-to-practice system with bounded claims: Tier compliance is claimable, real-world performance superiority is not.

This validation program follows a falsification-first posture consistent with scientific corrigibility: components that fail their empirical tests must be revised or abandoned rather than defended by authority (Popper, 1959).

17.1 Core Empirical Claims (Testable Hypotheses)

Hypothesis	Description
H1	Rights coherence: Decisions that pass NCRC produce fewer rights infringements than comparable baseline decisions, controlling for context.
H2	Tail-risk effectiveness: Decisions constrained by TRC exhibit lower realized tail losses than comparable decisions without TRC.
H3	Ripple sign accuracy (after calibration): After NCAR updates, predicted impact signs match observed sign in ≥70% of evaluated cells.
H4	Structural early warning: Persistent HOI > 0 predicts subsequent structural degradation better than baseline KPI monitoring.
H5	Anti-gaming effectiveness: In adversarial tests, specification gaming succeeds less often (≥30% reduction) relative to comparable governance processes without PCC plus mandatory tails plus subgroup semantics.

Because ripple effects partially track cooperation and network propagation dynamics, validation should also test whether kernel updates improve predictive performance in contexts where cooperation and trust dynamics are known to matter (Axelrod, 1984; Nowak, 2006; Christakis & Fowler, 2009).

17.2 Falsification Criteria (Normative)

Ripple_Logic components must be revised (or rejected) if evidence meets any of the following:

Criterion	Description
F1	NCRC failure: NCRC-passing decisions systematically produce worse rights outcomes than NCRC-failing decisions.
F2	TRC failure: TRC-constrained decisions show no reduction in realized tail losses compared to controls.
F3	Ripple predictiveness failure: Sign accuracy remains < 60% across successive NCAR cycles for key cells.
F4	Structural safeguard failure: UCI/HOI do not correlate with or predict meaningful degradation.
F5	Anti-gaming failure: Red-team exercises repeatedly exploit predictable loopholes (> 30% of adversarial runs).

17.3 Validation Phases (Normative roadmap)

Phase 1: Formal verification and implementation testing (0-6 months)

- Independent implementation of Tier 2-3 algorithms from spec.
- Unit tests for canonical equations (Appendix B).
- Adversarial tests for masking, subgroup erasure, scenario omission, confidence inflation.
- Produce reference PCCs and reproducibility checks.

Phase 2: Measurement validation (4-15 months)

- Indicator reliability and validity for welfare dimensions and UCI components.
- Cross-population measurement checks where relevant.
- Calibrate magnitude anchors and uncertainty mappings.

Phase 3: Controlled pilots (10-24 months)

- Pilot deployments in organizations or municipalities.
- Compare Ripple_Logic vs baseline governance processes on: rights incidents, tail losses, stakeholder legitimacy, audit completeness, decision reversal rates.

Phase 4: Field studies and scaling (18-36+ months)

- Longitudinal monitoring of UCI/HOI and realized outcomes.
- Kernel calibration and scenario library refinement.
- Comparative performance across domains.

17.4 Metrics and Targets (Normative defaults)

Metric	Definition	Default Target
Rights violation rate	Verified post-decision rights infringements per protected subgroup	Lower than baseline governance
Tail-loss severity	Realized catastrophe-cell loss in worst outcomes	Lower than baseline governance
Sign accuracy	Match of predicted vs observed sign	≥0.70 after calibration
Magnitude error (RMSE)	RMSE on normalized [-1,+1] for measurable cells	≤0.25 (domain-dependent)
Audit completeness	Proportion of required PCC fields correctly filled	≥0.95 Tier 3
Gaming success rate	Fraction of adversarial attempts that change outcome illegitimately	Decreasing over time; investigate if > 0.30

17.5 Study Design Requirements (Normative)

- Pre-registration required for pilots claiming performance improvements.
- Control or comparator condition recommended (baseline governance).
- Blinding recommended for backtests: analyst should not know outcome during the run.

17.6 Backtesting Protocol (Normative)

A backtest run MUST:

- Reconstruct the information available at decision time (no hindsight leakage),
- Define an option set consistent with the historical context,
- Execute Ripple_Logic using only those inputs,
- Record a "Backtest PCC" with full trace,
- Score predictions against realized outcomes using declared metrics.

17.7 Open Science and Responsible Disclosure (Normative intent)

Where feasible, publish:

- Anonymized PCC datasets,
- Scenario libraries and kernels (with evidence notes),
- Failure cases and revisions.

Security note: Where publishing would create exploitation risk, disclosure should be responsible and staged, but internal auditability must be preserved.

SECTION 18: APPLICATIONS AND USE CASES (INFORMATIVE)

18.1 AI Deployment Governance (Tier 3)

Decision context: An organization is deciding whether to deploy an AI system that affects users at scale.

Key obligations:

- NCRC: Protect dignity, information integrity, due process for worst-off subgroups.
- TRC: Model catastrophic tails (infrastructure disruption, mass manipulation, cascading conflict).
- Containment: Avoid organizational gains that degrade Polity/Humanity coherence (legitimacy collapse, epistemic fragmentation).
- PCC: Produce auditable trace; ensure comparability across options.

18.2 Climate and Energy Policy (Tier 3)

Decision context: A polity evaluates energy transition policies that impact households, industries, and biosphere stability.

Key obligations:

- NCRC: Protect basic needs (energy poverty), health, life.
- TRC: Include climate tipping cascade scenarios; enforce corridor.
- Containment: Prevent short-term gains from degrading Biosphere UCI beyond tolerance.

18.3 Organizational Strategy (Tier 2-3)

Decision context: Organization deciding on major restructuring, automation, supply chain change.

Key obligations:

- NCRC: Protect basic needs and dignity for worst-off employees/communities.
- TRC: Required at Tier 2 if catastrophe relevance is plausible.
- Containment: Detect hollowing-out risk even if near-term welfare improves.

18.4 Personal and Household Decisions (Tier 1)

Decision context: Personal choices (job change, relocation, major purchase) where stakes are limited and reversible.

Use Tier 1 heuristic: options, rights screen, tail screen, unions touched, unioning redesign.

Escalate to Tier 2 if any plausible rights risk exists or if the decision touches catastrophe relevance.

SECTION 19: LIMITATIONS AND NON-TARGETS (NORMATIVE BOUNDARIES)

19.1 Epistemic Limitations (Normative acknowledgment)

Input quality dependence: Ripple_Logic outputs are only as good as the evidence and estimation process. The framework reduces predictable failures but does not guarantee correct forecasts.

Measurement difficulty: Some dimensions (Meaning; aspects of Agency) are harder to measure reliably across cultures. Ripple_Logic treats such measurement with caution and uncertainty documentation.

Kernel uncertainty: Ripple propagation is model-based and can be wrong. v8.5.3 mitigates with KQS policy, sensitivity requirements, and humility fallback to NONE.

Scenario incompleteness: Scenario libraries cannot enumerate all tail risks; mandatory tail categories reduce omission but cannot eliminate deep uncertainty.

19.2 Institutional and Governance Prerequisites

Tier 3 requires trained analysts and governance capacity: subgroup analysis, scenario governance, structural indicators for UCI, and audit review.

HDW governance can be captured if safeguards are weak. Ripple_Logic mandates anti-capture mechanisms, but real-world institutions must implement them.

19.3 Risks of Compliance Theater

Any framework can be used as a rubber stamp. Ripple_Logic mitigates via:

- Hard gates (NCRC/TRC/Containment),
- Non-maskable cells and audit flags,
- Challenger requirement in emergency mode,
- Required PCC traceability and sensitivity.

Nonetheless, compliance theater remains a risk; validation and external scrutiny matter.

19.4 Non-Targets (Normative)

Ripple_Logic is NOT designed to:

- Replace personal moral dialogue in intimate relationships,
- Dictate aesthetic or spiritual preferences,
- Resolve all deep metaphysical disagreements,
- Provide certainty under irreducible uncertainty,
- Function as a rhetorical weapon to end debate.

It is a public decision operating system: a method for auditable, multi-stakeholder, high-consequence decisions.

SECTION 20: CONCLUSION: PROSPEROUS FUTURES FOR INTELLIGENCES

20.1 Prosperity Defined (Normative operational definition)

In Ripple_Logic terms:

Prosperity = rights-safe (NCRC) + tail-safe (TRC) + containment-safe + net-positive welfare across unions + coherence preserved (UCI/HOI safeguards) + corrigible learning (NCAR)

This definition blocks false prosperity:

- "Growth" that violates rights is not prosperity.
- "Efficiency" that increases catastrophic exposure is not prosperity.
- "Success" that hollows out structural coherence is not prosperity.

20.2 Ripple_Logic Thesis

Alignment across humans, institutions, and AI requires non-compensable constraints on rights and catastrophic risk, explicit modeling of ripple propagation through nested unions, transparent and auditable decision procedures, and corrigible learning loops. These requirements follow from the combination of interdependence in complex systems (Meadows, 2008; Newman, 2010), planetary life-support constraints (Steffen et al., 2015; Rockström et al., 2009, 2023), and the tail-risk properties of ruin dynamics (Taleb, 2012; Ord, 2020).

20.3 Call to Test, Critique, and Deploy (Normative stance)

Ripple_Logic v8.5.3 is a scaffold: a spec-hardened foundation intended to be tested, falsified where wrong, refined where incomplete, and deployed proportionally to stakes. The method is designed to move societies toward WE: ethically, sustainably, harmoniously, prosperously, and verifiably, by making decision structure explicit, auditable, and corrigible.

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APPENDICES

APPENDIX A: SYMBOLS AND NOTATION (v8.5.3)

Appendix A is normative for symbol meanings and domains.

Terminology note (Normative). u indexes Union Scopes (short: Scopes). “Union(s)” remains an allowed legacy alias. This does not change meanings in v8.5.3 and earlier, it clarifies the canonical term in v8.5.3.

A.1 Sets and Indices

Symbol	Meaning	Domain
u	Union Scope (Scope) index	u ∈ {1,2,3,4,5,6,7}
d	Dimension index	d ∈ {1,2,3,4,5,6,7}
a	Option (candidate action)	a ∈ O
s	Scenario index	s ∈ S
r	Right index	r ∈ R
k	Impact instance index	integer
g	Protected subgroup index	g ∈ G_{u,d}

A.2 Core Sets

Set	Definition
U	Operational Scopes {Self, Household, Community, Organization, Polity, Humanity/CMIU, Biosphere}
D	Welfare dimensions {Material, Health, Social, Knowledge, Agency, Meaning, Environment}
O	Option set
S	Scenario set
R	Rights set {LIFE, BODY, LBTY, NEED, DIGN, PROC, INFO, ECOL}
C_r ⊆ U×D	Coverage set for right r
C_cat ⊆ U×D	Catastrophe cell set for TRC

A.3 Union Stack (Canonical)

A.4A Scope × Dimension Reference Table (Non-Normative, clarity payload)

The table below reproduces the 7×7 Scope×Dimension reference grid for quick reading and cross-platform stability. The canonical grid definition remains in Section 4.0A (Table 4.0A-1).

Scope \ Dimension	D1 Material	D2 Health	D3 Social	D4 Knowledge	D5 Agency	D6 Meaning	D7 Environment
U1 Self	Personal resources, income, essentials	Physical/mental health and safety	Relationships, belonging, support	Learning, understanding, competence	Autonomy, freedom, choice	Purpose, values, spiritual well-being	Local environment affecting self
U2 Household	Household livelihood, housing, food security	Household health, caregiving capacity	Family cohesion, care, safety	Household learning, skills	Household decision rights, roles	Household meaning, culture, identity	Home ecology, consumption footprint
U3 Community	Community economy, access to goods/services	Public health, local safety	Social trust, inclusion, cohesion	Education access, knowledge commons	Participation, civic agency	Shared narratives, cultural meaning	Local ecosystems, pollution, resilience
U4 Organization	Organizational resources, viability	Workplace safety, wellbeing	Org culture, fairness, belonging	Org learning, data, competence	Governance, employee agency	Mission coherence, meaning	Operational environmental impacts
U5 Polity	National economy, infrastructure, welfare capacity	Population health, security	Social stability, justice, cohesion	National knowledge, R&D, education	Democratic agency, rights	National identity, legitimacy	National environment, climate policy
U6 Humanity/CMIU	Global economy, shared resources	Global health, existential safety	Human solidarity, equity, peace	Global science, open knowledge	Collective governance capacity	Species meaning, long-run purpose	Planetary boundaries, biosphere

							integrity
U7 Biosphere	Ecosystem services, material substrates	Species health, biodiversity	Symbiosis, interspecies stability	Ecological knowledge, monitoring	Adaptive capacity, resilience	Intrinsic value, evolutionary meaning	Habitats, climate stability, regeneration

A.4 Welfare Dimensions (Canonical)

Dimension	Name	Summary
D_1	Material	Resources, infrastructure, subsistence security
D_2	Health	Physical/mental functioning, morbidity/mortality risk
D_3	Social	Trust, belonging, relational integrity
D_4	Knowledge	Epistemic access, learning conditions
D_5	Agency	Autonomy, effective choice, freedom from coercion
D_6	Meaning	Purpose/coherence/valued projects (cautious measurement)
D_7	Environment	Ecological and built context integrity

A.5 Impact Objects

Symbol	Meaning	Range
$\tilde{I}\_dir(u,d,a)$	Pre-saturation direct impact	$\mathbb{R}$
I_dir(u,d,a)	Direct impact (post-saturation)	[-1,+1]
$\tilde{I}\_prop(u,d,a)$	Pre-saturation propagated impact	$\mathbb{R}$
I_prop(u,d,a)	Propagated impact (post-saturation)	[-1,+1]
I_rights(u,d,a)	Worst-off subgroup propagated impact	[-1,+1]

A.6 Impact Instance Attributes

Symbol	Meaning	Range / Default
μ_k	Magnitude (baseline-delta, normalized)	[-1, +1]
r_k	Reach	[0, 1]
t_k	Time horizon	$(0, \infty)$ years
ℓ_k	Likelihood	[0, 1]
c_k	Confidence	[0.1, 1]
e_k	Equity/resilience multiplier	≥0, default 1
s_k	Sentience multiplier (SGP)	[0, 1], default 1; MUST be 1 for humans
t_min	Minimum time horizon floor	0.083 years (≈1 month); prevents $\tau(0)$

Symbol	Meaning	Range / Default
		= 0

A.7 Operators and Functions

Symbol	Definition
$(x)^+$	max(x, 0)
clip(x, a, b)	max(a, min(x, b))
sat_β(x)	tanh(β × x)
τ(t)	min(1, ln(1 + max(t, t_min)) / ln(1 + T_ref)) Defaults: T_ref = 25 years, t_min = 0.083 years Cap ensures τ(t) ≤ 1 for all t; floor ensures τ > 0 for all t > 0
φ(u, d)	7(u − 1) + d (flattening map for kernel indexing)
Anc(u, D_c)	Ancestor set of containing unions for union u up to depth D_c
T_ref	Governance reference time horizon for temporal weighting. Default: 25 years. MUST NOT be set < 10 years without charter-level justification.

A.8 Kernel and Propagation

Symbol	Meaning
K ∈ ℝ^{49×49}	Ripple kernel matrix (sparse)
K_{ij}	Kernel entry mapping source j to target i (target-row, source-column)
κ_max	Maximum absolute kernel entry bound, default 0.5
κ_use_min	Minimum absolute kernel edge magnitude for "relied-upon edge" classification in KQS computation (Section 6.5.1). Default: 0.05 unless the PCC declares a stricter value.
ρ_max	Maximum absolute row-sum bound, default 0.9
‖K‖∞	Maximum absolute row-sum norm of K: ‖K‖∞ := max_i Σ_j |K_{ij}|. Used for Tier 1–3 kernel stability verification (Section 6.4).
ρ(K)	Spectral radius of K. For Tier 1–3, treated as satisfied when ‖K‖∞ < 1 per Section 6.4 (since ρ(K) ≤ ‖K‖∞).
NONE mode	I_prop := I_dir
QUICK mode	Ĩ_prop = I_dir + K × I_dir, then saturate

Stream note (Normative). Kernel propagation applies per stream x∈{base, welfare} as specified in Appendix B. In Appendix A, the symbols I_dir, Ĩ_prop, and I_prop may be used as shorthand for their stream-specific forms I_dir,x, Ĩ_prop,x, and I_prop,x. Admissibility computation uses the Base stream (sentience multiplier fixed at s_k:=1); RLS uses the Welfare stream.

A.9 Rights and Constraints

Symbol	Meaning
θ_r	Rights threshold for right r
$v_r(a)$	Violation depth for right r under option a
NCRC(a)	Rights admissibility predicate
TRC(a)	Tail-risk admissibility predicate
τ_{TRC}	TRC corridor threshold
α	CVaR tail level $\in (0, 1)$
$CVaR_\alpha[L(a)]$	Conditional Value-at-Risk for loss distribution of option a
θ_{pos}	Positive impact threshold (containment trigger), default 0.05
τ_c	Containment tolerance threshold, default -0.10
D_c	Containment ancestor depth, default 2

A.10 Scoring and Uncertainty

Symbol	Meaning
w_u	Union weight ($w_u \geq 0$, $\Sigma_u w_u = 1$)
v_d	Dimension weight ($v_d \geq 0$, $\Sigma_d v_d = 1$)
m(u,d)	Applicability mask for RLS only $\in \{0, 1\}$
$\kappa(u,d)$	Cell multiplier for RLS, default 1
RLS(a)	Ripple Logic Score
$\sigma(u,d,a)$	Cell-level uncertainty proxy
$\sigma_{RLS}(a)$	RLS uncertainty proxy
δ	Discrimination threshold for decisive lead, default 2
ε	Stabilizer in Gap computation, default 10^{-6}
λ	Risk-aversion coefficient for RLS_adj, default 0.5

A.11 Structural Metrics

Symbol	Meaning
UCI_u	Union Coherence Index for union $u \in [0, 1]$
$\Delta UCI_u(a)$	Coherence change under option a = $UCI_u(a) - UCI_u(\text{baseline})$
HOI_t	Hollowing-Out Index at time t
H_u	Cohesion component of UCI
F_u	Flow component of UCI
R_u	Resilience component of UCI
E_u	Equity component of UCI ($E_1 := 1$ for Self)

A.12 Audit Artifacts

Symbol	Meaning
PCC	Provenance and Compliance Certificate
5SPR	Five-Sentence Public Rationale
AIL	Artifact Integrity Law (Tier 2-3 integrity rules)
Audit flags	Standard labels for invalidity or warnings (Appendix H)

A.13 Scenario and TRC Objects

Symbol	Meaning
S	Scenario set
p_s	Scenario probability ($p_s \geq 0$, $\Sigma_s p_s = 1$)
L(a,s)	Scenario loss for option a under scenario s
ω_c	Catastrophe cell weight ($\omega_c \geq 0$, $\Sigma_c \omega_c = 1$)
p_floor	Minimum probability floor per mandatory tail category, default 0.02

A.14 SGP Integration

Symbol	Meaning
SG_norm(E)	Normalized sentience gradient for entity $E \in [0, 1]$
A(E), B(E), C(E)	SGP pillar scores: Awareness, Agency, Union Participation
SG_patient_norm(E)	Rights-of-protection sentience scalar for entity $E \in [0, 1]$, incorporating taxon baseline logic when provided by SGP.

End Appendix A.

APPENDIX B: CANONICAL EQUATIONS (TIER 1-3 EXECUTABLE)

Appendix B is normative and is the canonical equation pack for Tier 1-3 implementations. All equations are reproduced explicitly for standalone executability.

B.1 Temporal Weighting

Defaults: T_ref = 25 years; t_min = 0.083 years (≈1 month).

$\tau(t) = \min(1, \ln(1 + \max(t, t_{min})) / \ln(1 + T_{ref}))$

This function has three properties by construction:

(a) Logarithmic growth ensures that short-term effects receive proportionally less weight than long-term effects, without the exponential discounting that aggressively devalues future generations.

(b) The $\min(1, \cdot)$ cap ensures that no effect receives more temporal weight than the governance reference horizon. At T_ref, $\tau = 1.00$. Beyond T_ref, τ remains 1.00 (capped).

(c) The $\max(t, t_{min})$ floor ensures that $\tau(t) > 0$ for all positive t, preventing very short-term effects from being zeroed out.

Illustrative values (with defaults T_ref = 25, t_min = 0.083):

At 100 years: $\tau = 1.00$ (capped)

At 50 years: $\tau = 1.00$ (capped)

At 25 years: $\tau = 1.00$

At 10 years: $\tau \approx 0.74$

At 5 years: $\tau \approx 0.55$

At 1 year: $\tau \approx 0.21$

At t_min (≈1 month): $\tau \approx 0.025$

Historical change note (v7.5.0; carried forward unchanged in v8.5.3): This replaces the uncapped function $\tau(t) = \ln(1+t)/\ln(1+T_{ref})$ from v7.4.5, which produced $\tau(50) \approx 1.22$. The capped version is normatively preferred. See Section 5.3 for design rationale.

B.2 Direct Impact Aggregation (Pre-Saturation; stream-separated)

B.2A Base stream (admissibility; $s_k := 1$):

$\tilde{I}_{dir,base}(u,d,a) = \Sigma_{k \in K(u,d,a)} [r_k \times \tau(t_k) \times \ell_k \times c_k \times e_k \times (1) \times \mu_k]$

B.2B Welfare stream (RLS; sentience weights allowed):

$\tilde{I}_{dir,welfare}(u,d,a) = \Sigma_{k \in K(u,d,a)} [r_k \times \tau(t_k) \times \ell_k \times c_k \times e_k \times s_k \times \mu_k]$

Where $K(u,d,a)$ is the set of impact instances asserted for cell (u,d) under option a.

B.3 Direct Saturation (per stream)

For $x \in \{base, welfare\}$:

$I_{dir,x}(u,d,a) = \tanh(\beta \times \tilde{I}_{dir,x}(u,d,a))$

Default: $\beta = 2$.

B.4 Missing Data (Ignorance Penalty Phantom Instance)

If cell (u,d) is required-active but $K(u,d,a) = \varnothing$, add phantom instance with:

Parameter	Phantom Value
$\mu_{phantom}$	-0.10
r	1
t	T_{ref} (25 years)
ℓ	1
c	1
e	1
s	1

B.5 Flattening Map (Kernel Indexing)

Vectorize I_dir into a 49-vector by:

$i = \varphi(u,d) = 7(u - 1) + d$

B.6 Propagation Modes (Tier 1-3: NONE and QUICK only)

NONE:

For $x \in \{base, welfare\}$: $I\_prop\_x := I\_dir\_x$

QUICK:

For stream $x \in \{base, welfare\}$: $\tilde{I}\_prop\_x = I\_dir\_x + K \times I\_dir\_x$

Then apply post-propagation saturation (B.7).

B.7 Post-Propagation Saturation (per stream)

For $x \in \{base, welfare\}$:

$I\_prop\_x(u,d,a) = \tanh(\beta\_prop \times \tilde{I}\_prop\_x(u,d,a))$

Default: $\beta\_prop = 1$.

B.8 Worst-Off Subgroup Impact (Rights)

$I\_rights(u,d,a) = \min_{g \in G_{u,d}} I\_prop\_base(u,d,a|g)$

B.9 NCRC Violation Depth and Rights Admissibility

For each right r with threshold θ_r and coverage set C_r:

$v\_r(a) = \max_{(u,d) \in C\_r} (\theta\_r - I\_rights(u,d,a))^+$

where $(x)^+ = \max(x, 0)$.

NCRC(a) = TRUE if and only if $v\_r(a) = 0$ for all $r \in R$

B.10 TRC Loss (Tier 1-3 Bounded-Impact Mode)

Let C_cat be catastrophe cells and ω catastrophe weights.

Normative stream binding (Design A): TRC MUST be computed from the Base stream (I_prop_base). TRC MUST NOT use Welfare-stream (sentience-weighted) impacts.

For scenario s:

$L(a,s) = \Sigma_{c \in C\_cat} \omega\_c \times (-I\_prop\_base,c(a|s))^+$

TRC uses CVaR (Appendix D for discrete computation) and corridor threshold τ_TRC:

TRC(a) = TRUE if and only if $CVaR\_\alpha[L(a)] \leq \tau\_TRC$

B.11 Containment Mode A (Binding)

Define positively moving unions:

$S_u(a) = \Sigma_d v_d^{cont} \times I_{prop\_base}(u,d,a)$

Containment trigger weights (Normative). Use the containment-specific vector v_d^{cont} (default uniform 1/7). Do not use HDW welfare weights for containment trigger detection.

$U_{pos}(a) = \{u : S_u(a) \geq \theta_{pos}\}$

For each $u \in U_{pos}(a)$:

$M_u(a) = \min_{\{u' \in Anc(u, D_c)\}} \Delta UCI_{\{u'\}}(a)$

Global containment predicate:

Containment(a) = TRUE if and only if for all $u \in U_{pos}(a)$: $M_u(a) \geq \tau_c$

B.12 Ripple Logic Score (RLS)

$RLS(a) = \Sigma_u \Sigma_d w_u \times v_d \times m(u,d) \times \kappa(u,d) \times I_{prop\_welfare}(u,d,a)$

Default: $\kappa(u,d) = 1$, $m(u,d) = 1$ unless masked.

B.13 RLS Uncertainty (Optional; Tier 3 Required)

Definition of $\sigma(u,d,a)$ (normative minimum): PCC MUST declare one of the following cell-level uncertainty proxies and apply it consistently across options:

Method A (interval half-width): If the PCC records a confidence interval [L,U] for the cell impact I(u,d,a), set $\sigma(u,d,a) = (U - L)/2$.

Method B (confidence-derived): If the PCC records impact instances with confidences $c_k \in [0.1,1]$ and the run selects Method B, then the PCC MUST derive a cell-level confidence $c(u,d,a) \in [0,1]$ from $\{c_k\}$ using one declared CellConfidenceAggregationMethod per Section 10.3.1, and set:
$\sigma(u,d,a) = (1 - c(u,d,a)) \cdot |I(u,d,a)|$

Method C (calibrated table): Use a pre-registered mapping from qualitative uncertainty labels (for example, LOW/MED/HIGH) to σ values, stored in the ProofPack or PCC appendix.

σ values MUST be clipped to [0,1].

$\sigma_{RLS}(a) = \sqrt{[\Sigma_u \Sigma_d (w_u \times v_d \times m(u,d) \times \sigma(u,d,a))^2]}$

Risk-adjusted score (optional):

$RLS_{adj}(a) = RLS(a) - \lambda \times \sigma_{RLS}(a)$

Default: $\lambda = 0.5$.

B.14 Discrimination Gap (Decisive vs Non-Decisive)

$Gap(a,b) = |RLS(a) - RLS(b)| / \sqrt{[\sigma_{RLS}(a)^2 + \sigma_{RLS}(b)^2 + \varepsilon]}$

Default: $\delta = 2$, $\varepsilon = 10^{-6}$.

Decisive lead if $\text{Gap}(a^*, a_2) > \delta$.

B.15 UCI Computation

$UCI_u = \alpha_H \times H_u + \alpha_F \times F_u + \alpha_R \times R_u + \alpha_E \times E_u$

Default: $\alpha_H = \alpha_F = \alpha_R = \alpha_E = 0.25$.

Special case for Self (U_1): $E_1 := 1$ by definition.

B.16 ΔUCI Computation

$\Delta UCI_u(a) = UCI_u(a) - UCI_u(\text{baseline})$

B.17 HOI Computation

$HOI_t = EMA_\lambda(\Delta RLS)_t - EMA_\lambda(\Delta UCI)_t$

Default half-life: 3 periods.

End Appendix B.

APPENDIX C: RIGHTS / NCRC CANON PACK (TIER 1-3)

Appendix C is normative.

C.1 Rights Thresholds (Canonical)

Right	Code	Threshold θ_r
Life	LIFE	-0.90
Bodily Integrity	BODY	-0.70
Liberty	LBTY	-0.65
Basic Needs	NEED	-0.50
Dignity	DIGN	-0.55
Due Process	PROC	-0.45
Information	INFO	-0.40
Ecological Integrity	ECOL	-0.65

Normative interpretation rule: Thresholds θ_r are admissibility floors, not weights. They do not represent "how important" a right is; they represent the minimum allowable protection level.

C.2 Rights Coverage Sets C_r (Authoritative)

Right	Coverage Set C_r
LIFE	$\{(u, \text{Health}): u \in \{1,2,3,4,5,6\}\} \cup \{(6, \text{Environment})\}$
BODY	$\{(u, \text{Health}): u \in \{1,2,3,4,5,6\}\}$

Right	Coverage Set C_r
LBTY	{(u, Agency): u ∈ {1,2,3,4,5,6}} ∪ {(u, Social): u ∈ {3,4,5,6}}
NEED	{(u, Material): u ∈ {1,2,3,4,5,6}} ∪ {(u, Health): u ∈ {1,2,3,4,5,6}}
DIGN	{(u, Social): u ∈ {1,2,3,4,5,6}} ∪ {(u, Agency): u ∈ {1,2,3,4,5,6}}
PROC	{(u, Agency): u ∈ {4,5,6}} ∪ {(u, Knowledge): u ∈ {4,5,6}} ∪ {(u, Social): u ∈ {4,5,6}}
INFO	{(u, Knowledge): u ∈ {1,2,3,4,5,6}} ∪ {(u, Agency): u ∈ {1,2,3,4,5,6}}
ECOL	{(6, Environment), (7, Environment)}

C.3 Emergency Mode Rights Priority (Canonical)

When Emergency Mode is invoked (A_NCRC = ∅), rights are ordered lexicographically:

[LIFE, BODY, ECOL, LBTY, NEED, DIGN, PROC, INFO]

This ordering MUST be used exactly for lexicographic minimization of the violation depth vector.

C.4 NCRC Violation Depth Definition (Canonical)

$v_r(a) = \max_{(u,d) \in C_r} (\theta_r - I_{rights}(u,d,a))^+$

C.5 NCRC Predicate (Canonical)

NCRC(a) = TRUE if and only if $v_r(a) = 0$ for all $r \in R$

C.6 Subgroup Conservative Bound (Canonical)

When subgroup disaggregation is infeasible for a rights-covered cell:

Let $\gamma_{subgroup} = 1.5$ (default conservatism factor).

- If $I_{prop\_base}(u,d,a) < 0$: set $I_{rights}(u,d,a) = \max(-1, \gamma_{subgroup} \times I_{prop\_base}(u,d,a))$
- Else: set $I_{rights}(u,d,a) = I_{prop\_base}(u,d,a)$

This bound applies only for NCRC checking, not for RLS scoring.

C.7 Emergency Mode Documentation Requirements (Canonical)

When Emergency Mode is invoked, the PCC MUST include:

- Emergency declaration and trigger conditions
- $v_r(a)$ for each option and each right
- Lexicographic comparison trace
- Independent challenger attestation (or CHALLENGE_DEFERRED_EMERGENCY flag)
- Mitigation/remediation plan with timeline

- Review cadence and return-to-normal triggers

End Appendix C.

APPENDIX D: TRC AND SCENARIO GOVERNANCE CANON PACK (TIER 1-3)

Appendix D is normative.

D.1 Base Catastrophe Cell Set

C_cat_base = {(6, Health), (6, Environment), (7, Environment)}

These correspond to:

- **(6, Health):** Humanity/CMIU-Health, representing global-scale health viability
- **(6, Environment):** Humanity/CMIU-Environment, representing civilization-scale habitability conditions
- **(7, Environment):** Biosphere-Environment, representing Earth-system integrity

D.2 Mandatory Tail Scenario Categories (Canonical)

The scenario set MUST include the following tail categories unless explicitly justified as not plausible:

- **Pandemic/biological disruption:** Disease outbreak with significant mortality/morbidity
- **Climate tipping cascade:** Triggering of climate tipping points with cascading effects
- **Financial system collapse:** Systemic failure of financial infrastructure
- **Major conflict escalation:** Armed conflict with regional or global implications
- **Critical infrastructure failure:** Failure of essential services (power, water, communications)

D.3 Probability Floor (Canonical)

Minimum category probability floor: p_floor ≥ 0.02

Meaning: The sum of probabilities of scenarios in each mandatory category must be ≥ 0.02 unless explicitly justified as implausible for the specific decision context per Section 8.3.2.

D.4 Scenario Set Size Requirements (Canonical)

Tier	TRC Required?	Minimum	S
Tier 1	Optional (qualitative screen)	N/A	
Tier 2	Required when catastrophe relevance plausible	≥5 minimum	
Tier 3	Required	≥20 minimum	
Tier 4	Design target only	N/A	

D.5 Scenario Definition Template (Normative Minimum Fields)

Each scenario record in PCC MUST include:

Field	Description
Scenario ID	Unique identifier within the run
Name	Descriptive name
Category	One of the mandatory categories or "baseline/other"
Narrative	2-5 sentences describing the scenario
Time horizon	Timing assumptions
Key stressors	What breaks, how, and cascading effects
Parameterization	What changes in impacts/likelihoods under this scenario
Probability p_s	Assigned probability with provenance
Provenance	Data source, model, expert elicitation, or governance prior

D.6 Loss Construction (Bounded-Impact Mode, Tier 1-3 Canon)

Normative stream binding (Design A): TRC MUST be computed from the Base stream (I_prop_base). TRC MUST NOT use Welfare-stream (sentience-weighted) impacts.

For each scenario s:

$$\mathbf{L(a,s) = \Sigma_{c \in C_{cat}} \omega_c \times (-I_{prop\_base,c}(a|s))^+}$$

with $\Sigma_{c \in C_{cat}} \omega_c = 1$.

Default catastrophe weights: Uniform over C_{cat} unless otherwise governed.

D.7 Discrete CVaR Algorithm (Canonical; Tier 1–3)

Inputs: losses $L(a, s1), \ldots, L(a, sn)$; probabilities $p1, \ldots, pn$; tail level α.

1. Let $\beta := 1 - \alpha$.

2. Sort scenarios by loss descending: $L_{(1)} \geq L_{(2)} \geq \cdots \geq L_{(n)}$, carrying the aligned probabilities $p_{(i)}$.

3. Let k^* be the smallest index such that $\Sigma_{i=1}^{k^*} p_{(i)} \geq \beta$.

4. Define $P_{k^*-1} := \Sigma_{i=1}^{k^*-1} p_{(i)}$ (and $P_0 := 0$).

5. Define $\delta := \beta - P_{k^*-1}$.

6. Compute:

$$CVaR_\alpha[L(a)] = (1/\beta) \cdot \left(\Sigma_{i=1}^{k^*-1} p_{(i)} L_{(i)} + \delta \cdot L_{(k^*)} \right).$$

Audit: PCC includes the sorted table, k^*, P_{k^*-1}, δ, and $CVaR_\alpha$.

(Here $L_{(i)}$ is shorthand for $L(a, s_{(i)})$.)

D.8 TRC Corridor Check (Canonical)

TRC(a) = TRUE if and only if CVaR_α[L(a)] ≤ τ_TRC

D.9 Default TRC Parameters by Context (Canonical Defaults)

Context	α (tail level)	τ_TRC (threshold)
Personal	0.90	0.30
Organizational	0.95	0.20
Reversible policy	0.95	0.15
Irreversible policy	0.99	0.10
Existential risk	0.999	0.05

D.10 Tier 2 Strict TRC Rule (Canonical)

If catastrophe relevance is plausible (per Section 8.1.1), Tier 2 MUST:

- Compute TRC using this appendix
- Use ≥5 scenarios minimum
- Include mandatory tail categories with p_floor ≥ 0.02 per category unless explicitly implausible with documented justification per Section 8.3.2
- Record the full scenario table and CVaR computation in PCC

D.11 TRC Fallback Procedure (Canonical)

If A_NCRC ≠ ∅ but A_adm = ∅:

- Rank all A_NCRC options by CVaR_α ascending
- Select the option with minimal CVaR_α
- Require a time-bound risk mitigation plan
- Require one-tier-higher approval
- Record TRC_FALLBACK_INVOKED in PCC with deficit (CVaR − τ_TRC)

End Appendix D.

APPENDIX E: UCI OPERATIONALIZATION PACK (TIER 1-3)

Appendix E is normative for the UCI interface and Tier 3 constraints; indicator families are canonical guidance unless a deployment supplies validated instruments.

E.1 UCI Component Definitions (Canonical)

Component	Symbol	Description
Cohesion	H_u	Internal connectivity, trust, shared identity, conflict resolution

Component	Symbol	Description
		capacity
Flow	F_u	Coordination throughput, information fidelity, resource allocation efficiency
Resilience	R_u	Redundancy, robustness, recovery speed, adaptive capacity
Equity	E_u	Fair distribution of burdens/benefits, voice representation, inclusion

E.2 UCI Formula (Canonical)

$UCI_u = \alpha_H \times H_u + \alpha_F \times F_u + \alpha_R \times R_u + \alpha_E \times E_u$

Default: $\alpha_H = \alpha_F = \alpha_R = \alpha_E = 0.25$.

Special case for Self (U_1): $E_1 := 1$ by definition. The equity component is fixed at 1 for Self because equity-as-distribution does not apply within a single individual. This provides a neutral, non-penalizing identity value.

E.3 Structural Independence Rule (Tier 3 Binding)

UCI MUST be computed from structural/process indicators distinct from welfare indicators used for RLS.

At Tier 3:

- Deriving UCI from welfare-cell impacts is PROHIBITED
- If structural indicators are unavailable, UCI is treated as unavailable (see E.7)

E.4 Indicator Families by Union (Canonical Guidance)

U_1 Self:

- Cohesion: Psychological integration, goal coherence, self-trust, internal conflict resolution
- Flow: Task execution reliability, attention stability, cognitive throughput proxies
- Resilience: Stress recovery, adaptive coping, flexibility under change
- Equity: $E_1 := 1$ by default (not measured)

U_2 Household:

- Cohesion: Relationship quality, conflict resolution, trust among members
- Flow: Resource pooling efficiency, coordination routines, decision-making speed
- Resilience: Emergency preparedness, support redundancy, recovery from shocks
- Equity: Fair burden-sharing, voice parity, caregiving distribution fairness

U_3 Community:

- Cohesion: Social capital, trust indices, network density, belonging measures
- Flow: Collective action capacity, coordination lag, information spread fidelity
- Resilience: Mutual aid redundancy, disaster response capacity, recovery history
- Equity: Inclusion of marginalized groups, access parity, procedural fairness in local governance

U_4 Organization:

- Cohesion: Culture trust indices, turnover stability, safety culture, shared purpose
- Flow: Process throughput, coordination efficiency, error rates, execution reliability
- Resilience: Redundancy, continuity planning, incident response maturity
- Equity: Pay fairness, promotion parity, grievance procedures, representation

U_5 Polity:

- Cohesion: Institutional trust, social cohesion indices, legitimacy measures
- Flow: Governance effectiveness, service delivery reliability, coordination speed
- Resilience: Crisis response capacity, redundancy of critical systems
- Equity: Rule of law parity, civil rights access parity, representation integrity

U_6 Humanity/CMIU:

- Cohesion: Cross-polity cooperation capacity, treaty adherence norms
- Flow: Global coordination throughput, information-sharing integrity
- Resilience: Global response capacity to pandemics/climate/conflict
- Equity: Burden-sharing fairness, inclusion of vulnerable polities/populations

U_7 Biosphere:

- Cohesion: Ecosystem connectivity, biodiversity integrity, trophic network stability
- Flow: Nutrient cycling integrity, carbon sequestration capacity, hydrological cycle stability
- Resilience: Recovery capacity, redundancy of functional species, anti-fragility markers
- Equity: Use distributional ecosystem integrity proxies when a governed instrument exists. If not operationalized, set E7 := 1 (neutral identity value) and record E7_METHOD_FIXED_1_DEFAULT in PCC.

E.5 ΔUCI Computation (Canonical)

ΔUCI_u(a) = UCI_u(a) − UCI_u(baseline)

E.6 Prospective UCI Estimation (Tier 3) (Normative Constraints)

Tier 3 requires prospective (ex ante) estimation of UCI changes from structural indicators, not from welfare impacts. The PCC must:

- Identify structural indicators used
- Specify baseline values
- Specify predicted changes under each option
- Specify normalization to [0,1] for each component
- Compute UCI_u and ΔUCI_u using E.2 and E.5

E.7 UCI Unavailability Rule (Tier 3) (Normative)

If structural indicators are unavailable such that UCI cannot be computed without violating E.3:

- UCI MUST be treated as unavailable for tie-break purposes
- If RLS lead is non-decisive, decision MUST escalate for more data/higher tier OR record a judgment call with label JUDGMENT_CALL_UCI_UNAVAILABLE and a monitoring plan
- Any welfare-derived UCI proxy MUST NOT be used to claim Tier 3 compliance

E.8 Minimal Measurement Protocol (Canonical Guidance)

For each UCI component, the PCC SHOULD document:

- Indicator(s) used
- Data source
- Normalization method
- Expected directionality
- Uncertainty or reliability notes
- Review cadence

End Appendix E.

APPENDIX F: FAILURE MODES AND ANTI-GAMING CONTROLS (v8.5.3)

Appendix F is normative for identified gaming vectors and required mitigations.

F.1 Identified Gaming Vectors (Canonical)

Vector	Description	Structural Mitigation
Option set manipulation	Excluding viable alternatives so preferred option "wins"	Minimum option requirement (≥2); independent challenger in emergencies; document option generation process
Masking abuse	Masking unfavorable cells to inflate RLS	Non-maskable cells (rights + catastrophe) must remain unmasked; audit flags invalidate PCC
Subgroup erasure	Averaging away harms to vulnerable groups	Worst-off subgroup operator for rights; subgroup enumeration; conservative bound when infeasible
Scenario omission	Leaving out unfavorable tail scenarios	Mandatory tail categories and probability floors; scenario count minima; implausibility test per Section 8.3.2
Probability gaming	Assigning implausibly small p_s to tails	Probability provenance required; p_floor per category; sensitivity perturbations at Tier 3
Kernel capture	Tweaking kernel edges to favor preferred option	KQS bands; sensitivity perturbations; evidence classes; humility fallback to NONE
Weight capture	Steering HDW to underweight certain unions/dimensions	Constitutional floors; supermajority locks near floors; transparency ledger; conflict disclosure
Emergency abuse	Declaring emergency to bypass rights	Challenger requirement; remediation plan; public disclosure/audit triggers
Confidence inflation	Overstating confidence to increase impact weight	c_k bounded [0.1, 1]; require evidence notes; sensitivity recommended
Horizon manipulation	Choosing time horizons strategically	Logarithmic temporal weighting $\tau(t)$; declare T_ref; challenge horizon assumptions
Unknown-as-neutral	Leaving cells blank to avoid negatives	Ignorance penalty phantom instance rule; audit flag if non-maskable cell missing

F.2 Structural Anti-Gaming Features (Canonical)

Non-Compensatory Architecture:

- NCRC cannot be overridden by welfare gains
- TRC cannot be overridden by expected value
- Containment cannot be bypassed by RLS optimization

Transparency Requirements:

- All parameters recorded in PCC
- Registry hashing prevents silent modification (Tier 3+)
- Public rationale (5SPR) required

Audit Infrastructure:

- Random audit lottery (recommended 5% of PCCs at Tier 3)
- Red-team protocols for high-stakes decisions
- Configuration drift detection

Learning Accountability:

- NCAR loop tracks prediction accuracy
- Systematic errors trigger parameter review
- Historical PCCs preserved for accountability

F.3 Audit Flag Taxonomy (Informative pointer; non-authoritative)
Authoritative audit flags are specified in **Section 14.3** and duplicated verbatim in **Appendix H.3**. Appendix F provides explanatory context and anti-gaming rationale only; it does not define, modify, or enumerate the canonical audit-flag set. For the complete and controlling list (tokens, triggers, required actions, severities), see Section 14.3 / Appendix H.3.

F.4 Red-Team and Audit Lottery (Tier 3 Recommended)

Deployments SHOULD adopt:

- **Random audit lottery:** for example, 5% of PCCs selected for independent review
- **Red-team scenario additions:** Adversarial scenario injection for TRC testing
- **Kernel perturbation stress tests:** Systematic edge perturbation
- **Rights near-miss reviews:** Options near thresholds flagged for monitoring

All governance rules must be documented and versioned.

End Appendix F.

APPENDIX G: SGP INTEGRATION BINDING (NORMATIVE INTERFACE)

Appendix G is normative for the Ripple_Logic ↔ SGP interface.

G.1 Binding Purpose

This appendix defines the only permissible interface by which Ripple_Logic consumes Sentience Gradient Protocol (SGP) outputs. Ripple_Logic does not define SGP internals.

SGP Version Pin (Normative): Ripple_Logic v8.5.3 pins Sentience Gradient Protocol SGP v4.2.3 as the authoritative sentience-scoring specification for any run claiming Ripple_Logic v8.5.3 compliance. This pin continues unchanged from v8.1.

ProofPack dependency pinning (Normative): Any ProofPack claiming replayability MUST include the exact SGP v4.2.3 artifact (PDF or equivalent) as a bundled file, or MUST reference a registry hash that uniquely identifies the SGP v4.2.3 artifact. If SGP is not bundled or hash-pinned, ProofPack runs MUST declare SGP as an external dependency and restrict test vectors to cases where the required SGP scalar(s) are provided as explicit inputs.

G.2 Canonical Scalar Mapping

Given entity E, SGP v4.2.3 outputs the following (interface-visible) values:

A(E): Awareness pillar score in [0,100]

B(E): Agency pillar score in [0,100]

C(E): Union Participation pillar score in [0,100]

SG_norm(E): authoritative normalized scalar in [0,1]

SG_patient_norm(E) (if provided by SGP record): authoritative rights-of-protection scalar in [0,1] that incorporates taxon baseline logic, per SGP v4.2.3 §5.4.

Authoritative binding (interface-only): Any SGP scalar consumed by Ripple_Logic (including SG_norm(E) and, where available, SG_patient_norm(E)) is consumed as provided by SGP v4.2.3 and MUST NOT be recomputed inside Ripple_Logic.

Logging allowance: A(E), B(E), C(E) MAY be logged for interpretability and auditing, but they do not define SG_norm(E) or SG_patient_norm(E) within this specification.

G.3 Human Plateau Rule (Non-Overridable)

For any human person H:

SG_norm(H) := 1.0

This assignment is:

- Independent of measurement noise
- Independent of disability status
- Independent of partial observability
- Non-overridable by any SGP scoring outcome
- MUST NOT be weakened by any weighting scheme

Clarification: No SGP-derived scalar (including SG_patient_norm) may be used to reduce human rights protections below plateau.

G.4 Permitted Usage in Ripple_Logic

Permitted:

Sentience multiplier usage (Normative): s_k may be set via the SGP binding interface only for the welfare stream used to compute RLS. For admissibility layers (NCRC, TRC, Containment), the base stream MUST fix s_k := 1.0 for all instances.

Normative selection rule for the multiplier (interface-safe):

• If SGP provides SG_patient_norm(E) for entity E: implementations SHOULD set s_k := SG_patient_norm(E).

• Otherwise: implementations SHOULD set s_k := SG_norm(E).

• For any human person H: implementations MUST set s_k := 1.0 (Human Plateau Rule), regardless of any other value.

This rule preserves backward compatibility: systems that only have SG_norm(E) remain compliant.

G.5 Prohibited Usage

SGP outputs MUST NOT be used to:

• Weaken rights checks for humans

• Justify coercion via “low sentience”

• Assign governance authority based on sentience alone

• Override NCRC, TRC, or containment gates

• Treat rights floors as compensable welfare terms

G.6 Misinterpretation Guard (Normative)

The following inferences are PROHIBITED:

Claim	Status
Linguistic fluency implies sentience	NOT VALID
Self-report implies sufficient evidence of sentience	NOT VALID
Intelligence implies moral status	NOT VALID
Sentience implies governance authority	NOT VALID
Precaution implies attribution	NOT VALID
Framework terminology familiarity implies capacity	NOT VALID
Low SGP score implies reduced human protections	PROHIBITED

G.7 Required PCC Fields When SGP Is Used

If any s_k is used, PCC MUST include:

• Entity identifier/class, scope, and why it is a stakeholder

• SGP version pinned (SGP v4.2.3) and artifact hash / registry reference (if available)

• Pillar outputs A, B, C (as available)

• SG_norm(E) (as reported by SGP)

• SG_patient_norm(E) (if used) and an explicit statement that it was “as reported by SGP” (not recomputed)

• Evidence class / confidence from the SGP process (as available)

• Explicit statement that the Human Plateau Rule was not applied to reduce any human protections

G.8 Rights Expansion for Non-Human Stakeholder Classes (Normative Process)

If SGP (under governed procedures) establishes that a non-human stakeholder class warrants rights-of-protection, Ripple_Logic rights coverage sets and protection rules may be expanded only through governed updates:

• Update rights coverage sets C_r and subgroup protocols

• Document version increment

• Record changes in PCC for subsequent runs

• Preserve prior PCCs unchanged (no retroactive modification)

End Appendix G.

APPENDIX H: PCC TEMPLATE AND AUDIT FLAGS CANON PACK (TIER 2-3)

Appendix H is normative for PCC fields and audit flags at Tier 2-3.

H.1 PCC Schema (Human-Readable)

==========

PROVENANCE AND COMPLIANCE CERTIFICATE (PCC)

Ripple_Logic Framework v8.5.3

==========

HEADER (REQUIRED Tier 2-3)

Decision ID: [unique identifier]

Timestamp (UTC): [YYYY-MM-DDThh:mm:ssZ]

Decision Owner(s): [names/roles]

Analyst(s): [names/roles]

Reviewer (Tier 3): [name/role]

Spec Version: Ripple_Logic v8.5.3

Implementation Tier: [1 | 2 | 3]

Tier Claim Disposition (Tier 2–3 REQUIRED)

PCC.TierClaimDisposition: [TIER_CLAIMED_AND_MET | TIER_ATTEMPTED_NOT_ACHIEVED_DOWNGRADED]

If PCC.TierClaimDisposition = TIER_ATTEMPTED_NOT_ACHIEVED_DOWNGRADED, PCC MUST specify:

- PCC.TierAttempted: [2 | 3]

- PCC.TierAchieved: [1 | 2]

Tier Downgrade Flags: [TIER_DOWNGRADED_CONTAINMENT = TRUE/FALSE] (required if any gate is unavailable and a Tier 2 downgrade disposition is used).

Constraint (Normative). If TIER_DOWNGRADED_CONTAINMENT = TRUE, then PCC.TierClaimDisposition MUST be TIER_ATTEMPTED_NOT_ACHIEVED_DOWNGRADED and PCC.TierAchieved MUST be 2.

Propagation Mode: [NONE | QUICK]

Kernel Profile: [NONE | profile name + KQS + evidence note]

If Propagation Mode = QUICK, PCC MUST include:

PCC.Kernel.EntryAbsMax: [float in canonical scale]
PCC.Kernel.RowSumAbsMax: [float in canonical scale] (this is $\|K\|_\infty$)
PCC.Kernel.Bounds: [κ_{max}, ρ_{max} used]
PCC.Kernel.StabilityPass: [TRUE/FALSE]

Weight Profile: [HDW | Declared interim | Uniform]

Baseline Declaration (REQUIRED Tier 2–3)

PCC.BaselineType_Welfare: [STATUS_QUO | FLOOR_REFERENCE | OTHER_DECLARED]
PCC.BaselineType_Gates: [FLOOR_REFERENCE] (MUST be FLOOR_REFERENCE for all cells in $C_r \cup C_{cat}$)
PCC.BaselineReference_Gates: [indicator definitions + target/floor levels + sources + conversion assumptions]
If PCC.BaselineType_Welfare = OTHER_DECLARED, PCC MUST specify: PCC.BaselineReference_Welfare.

TRC Context Class: [Personal | Organizational | Reversible |

Irreversible | Existential]

Content Hash: [optional Tier 2; required Tier 3; SHA-256]

STEWARDSHIP BLOCK (CONDITIONAL; REQUIRED when Stw_req=1)

PCC.Stewardship.Stw_req: [TRUE | FALSE]

If Stw_req = FALSE, all fields below MAY be omitted.

PCC.Stewardship.DBD.Scope: [list of out-of-scope authority domains]

PCC.Stewardship.DBD.RefusalRule: [refusal/deferral rule identifier]

PCC.Stewardship.APM.AfterActionAuthorship: [0.0–1.0]

PCC.Stewardship.APM.Rationale: [artifact-anchored justification; MUST reference >=2 of 4 APM anchors per Appendix N.4]

PCC.Stewardship.APM.BaselineAuthorship: [0.0–1.0] (OPTIONAL)

PCC.Stewardship.IRB.InterventionCap: [declared caps]

PCC.Stewardship.IRB.Thresholds: [intervene-only-past-harm-point rule]

PCC.Stewardship.InfluenceLedgerRef: [pointer | “NONE” + justification]

PCC.Stewardship.DelayFlag: [TRUE | FALSE] (OPTIONAL)

SCOPE (REQUIRED Tier 2-3)

Decision Question: [clear statement]

Time Horizon: [years]

Primary Affected Scopes (Union Scopes): [list]

Decision Boundary Notes: [what is in/out of scope; why]

Stakeholder Coverage and Mapping (Tier-governed; v8.5.3)

Stakeholder Coverage Index (SCI): [SCI-0 / SCI-1 / SCI-2 / SCI-3 / SCI-4]

PCC.SCI.BelowMinimumDisposition: [DOWNGRADE_TIER | RERUN_TO_MEET_MINIMUM] (REQUIRED if SCI_BELOW_MINIMUM triggers; see Section 5.0.1 and audit flag SCI_BELOW_MINIMUM).

PCC.SCI.Justification: [text] (REQUIRED if SCI < tier minimum, OR if SCI equals the tier minimum and a Next-Run Upgrade Plan is required).

Scope Coverage Declaration: Mode [FULL_SCOPE / REDUCED_SCOPE]; Active scopes [list]; Omitted scopes [list]; Omission rationales [text]; Blind-spot statement [text]; Escalation triggers that force scope expansion [list].

SCI Next-Run Upgrade Plan (REQUIRED if SCI equals the tier minimum for the claimed tier): [text; what scope expansions or stakeholder mapping improvements will be executed next run; by when].

Admissibility Attestation (REQUIRED if Mode = REDUCED_SCOPE):

PCC.AdmissibilityAttestation.NCRC_full_Cr_computed: [TRUE | FALSE]

PCC.AdmissibilityAttestation.TRC_full_Ccat_computed: [TRUE | FALSE | NA]

PCC.AdmissibilityAttestation.Containment_computed_as_applicable: [TRUE | FALSE | NA]

Notes (Normative): Reduced-scope mode SHALL NOT remove any non-maskable cells or required scope rows from admissibility computation. If any required attestation is FALSE or missing, the run MUST NOT claim tier compliance for the affected admissibility gate(s) and MUST record the relevant audit flag(s).

Stakeholder Instance Map (InstanceMap): Provide a structured list of stakeholder instances with fields: instance_id, description, role/context, exposure pathway, mapped_scope(s), and rationale. Tier 3 REQUIRED, Tier 2 REQUIRED when any SDP trigger holds (Section 2.2A).

Redundancy Handling Declaration (if any multi-scope mapping): Method [EMERGENT_SCALE_JUSTIFICATION / DEDUPLICATION / ALLOCATION]; Effect-token list (if ALLOCATION); allocation coefficients ($\Sigma_u \alpha_u \leq 1$ per token); disclosure of any deduplication primary scope choices.

Option Set O:

Option A: [description]

Option B: [description]

Option C: [description] (if applicable)

Applicability Mask m(u,d) (RLS only):

Masked cells: [list + rationale per cell]

Non-maskable verification:

Rights cells unmasked: [PASS/FAIL]

Catastrophe cells unmasked: [PASS/FAIL]

INPUTS (REQUIRED Tier 2-3)

Uncertainty Method (Tier 2+ REQUIRED for active cells):

PCC.Uncertainty.Method: [A | B | C]

If Method = B:
PCC.Uncertainty.CellConfidenceAggregationMethod: [CCAM_MIN_V1 | CCAM_WMEAN_V1]
PCC.Uncertainty.c_cell_table: [table of c(u,d,a) for active cells, or a retrievable representation sufficient for recomputation]

Weights:

Union weights w_u: [vector or table]

Dimension weights v_d: [vector or table]

HDW parameters (if used): [λ_U, λ_D; sources]

Rights Canon:

Thresholds θ_r: [table or "v8.5.3 canonical"]

Coverage sets C_r: [table or "v8.5.3 canonical"]

Subgroup policy:

G_{u,d} method: [enumerated | conservative bound]

γ_subgroup (if used): [value]

Notes: [limitations if any]

TRC Inputs (REQUIRED Tier 2 when plausible; REQUIRED Tier 3):

Catastrophe cells C_cat: [list]

Catastrophe weights ω: [list]

α: [value]

τ_TRC: [value]

Scenario set S:

For each scenario s:

ID, category, narrative, p_s, parameterization notes

Mandatory tails check:

Categories present: [YES/NO per category]

Probability floors met: [YES/NO]

Any implausibility justifications: [YES/NO; if YES, details]

Containment Inputs (REQUIRED Tier 3):

τ_c: [value]

θ_pos: [value]

D_c: [value]

UCI method: [indicators used + sources]

If UCI is unavailable for required containing scopes, record CONTAINMENT_UCI_UNAVAILABLE and set PCC.Containment.UCIUnavailableDisposition to DOWNGRADE_TIER or COLLECT_DATA_RERUN (and provide a remediation timeline).

IMPACT ESTIMATION (REQUIRED Tier 2-3)

For each option a:

Direct impacts I_dir(u,d,a): [summary table or key cells]

Propagated impacts I_prop_base(u,d,a) and I_prop_welfare(u,d,a): [summary table or key cells]

Key impact instances (at least top contributors):

For each listed instance k:

(u,d), μ_k, r_k, t_k, ℓ_k, c_k, e_k, s_k, rationale/source

ReachBasis (REQUIRED Tier 2+): For each reach term r_k, record the basis and estimator used (allowed bases: population fraction, asset/flow fraction, or area/volume fraction; other bases MUST be explicitly defined), plus source and any conservative bounds.

Missing data:

Any UNKNOWN_IMPACT cells: [list]

Phantom instances applied: [YES/NO]

CASCADE TRACE (REQUIRED Tier 2-3)

NCRC:

For each option: PASS/FAIL

If FAIL: violated rights + v_r(a) values

Emergency Mode invoked: [YES/NO]

Challenger conducted: [YES/NO]

Challenger notes: [summary]

TRC:

Triggered (catastrophe relevance plausible): [YES/NO]

For each option:

CVaR_α: [value]

Corridor τ_TRC: [value]

PASS/FAIL

TRC fallback invoked: [YES/NO]

Containment (Tier 3 required):

For each option in A_adm:

U_pos(a): [list of unions]

For each u in U_pos: min ΔUCI among ancestors: [value]

PASS/FAIL

PCC.Containment.UCIUnavailableDisposition: [DOWNGRADE_TIER | COLLECT_DATA_RERUN | NA] (REQUIRED if CONTAINMENT_UCI_UNAVAILABLE flag is recorded).

PCC.Containment.UCIUnavailableRemediationTimeline: [text] (REQUIRED if CONTAINMENT_UCI_UNAVAILABLE flag is recorded).

A_sel: [list]

RLS Ranking:

For each option in A_sel:

RLS(a): [value]

σ_RLS(a): [value] (Tier 3 required)

Gap(top, second): [value]

δ: [value]

Decisive: [YES/NO]

Tie-break (if non-decisive):

UCI method used: [UCI-A/B/C]

Δ_UCI threshold: 0.05

Result: [winner or non-decisive]

HOI flags (if applicable): [notes]

Escalation invoked: [YES/NO]

SELECTION (REQUIRED Tier 2-3)

Selected Option: [option ID]

Selection Rationale: [brief; must reference cascade outcomes]

Monitoring Plan (NCAR):

Metrics: [list]

Review schedule: [date/interval]

Triggers for re-run: [conditions]

SENSITIVITY ANALYSIS (Tier 3 REQUIRED)

Weights perturbation: [summary; selection stable?]

Threshold perturbation: [summary; any near-miss rights?]

Kernel perturbation: [summary; flag fragile?]

Scenario perturbation: [summary; probability sensitivity]

Robustness classification: [Robust | Sensitive | Fragile]

FIVE-SENTENCE PUBLIC RATIONALE (5SPR) (Tier 2-3 REQUIRED)

---

1. CONTEXT: [What decision was made and why now?]

2. OPTIONS: [What options were considered?]

3. CONSTRAINTS: [What was eliminated by NCRC/TRC (and why)?]

4. SELECTION: [Why the chosen option won among selectable options?]

5. MONITORING: [What follow-up will be tracked and when?]

AUDIT FLAGS (REQUIRED when triggered)

[List flags + explanations]

SIGNATURES

Analyst: [name, date]

Decision Owner: [name, date]

Reviewer (Tier 3): [name, date]

==========

H.2 Minimum Required Fields by Tier (Canonical)

Field	Tier 1	Tier 2	Tier 3
Decision ID	Recommended	REQUIRED	REQUIRED
Timestamp	Recommended	REQUIRED	REQUIRED
Option set	REQUIRED	REQUIRED	REQUIRED
NCRC results	Heuristic ok	REQUIRED	REQUIRED + subgroup policy
TRC results	Optional	REQUIRED when catastrophe plausible	REQUIRED
Containment	Optional	Recommended	REQUIRED
RLS scores	Optional	REQUIRED	REQUIRED
Uncertainty + discrimination	Optional	REQUIRED (active cells)	REQUIRED (active cells)
Sensitivity analysis	Optional	Recommended	REQUIRED
5SPR	Optional	REQUIRED	REQUIRED
Audit flags	Optional	REQUIRED when triggered	REQUIRED when triggered

H.3 Audit Flag Canon Pack (Canonical)

Stewardship audit-flag tokens are defined canonically in Appendix N.7; Appendix H.3 does not redefine Stewardship tokens and only provides pointers.

Flag	Trigger	Required Action	Severity
RIGHTS_CELL_MASKED_INVALID	Any rights-covered cell is masked, excluded, null'd, pooled, or otherwise not individually included in RLS aggregation (including any case where	PCC invalid; recompute without masking	INVALID

Flag	Trigger	Required Action	Severity
	m(u,d)=0 for a cell in any C_r).		
RIGHTS_CELL_OMITTED_INVALID	Any rights-covered cell required to evaluate NCRC is omitted/excluded/not disclosed such that NCRC cannot be recomputed.	PCC invalid; include and disclose all required rights-covered cells and recompute NCRC.	INVALID
CATASTROPHE_CELL_MASKED_INVALID	Any catastrophe cell in C_cat is masked (m(u,d)=0) or otherwise excluded from RLS aggregation (including any case where m(u,d)=0 for a cell in C_cat).	PCC invalid; set m(u,d)=1 for all catastrophe cells and recompute RLS.	INVALID
CATASTROPHE_CELL_OMITTED_INVALID	Any catastrophe cell in C_cat used in TRC loss computation/disclosure is omitted/excluded/not disclosed such that	PCC invalid; include and disclose all catastrophe cells used in TRC loss computation (and any required scenario-to-cell mapping), then recompute TRC.	INVALID

Flag	Trigger	Required Action	Severity
	TRC CVaR cannot be independently recomputed.		
CONTAINMENT_MODE_B_USED_FOR_SELECTION	Mode B (diagnostic-only containment) influenced selection outcome; see Section 9.5	PCC invalid; rerun with Mode A only	INVALID
SCENARIO_LIBRARY_MIN_EXCEPTION	Scenario library size |S| is below the tier minimum when TRC is required (Tier 2: |S| < 5; Tier 3: |S| < 20)	PCC remains valid only with: (i) written justification, (ii) independent reviewer sign-off (Tier 3 required; Tier 2 recommended), and (iii) a remediation plan to reach minimum scenario count before the next comparable run. Record this flag in PCC.	ESCALATE
MANDATORY_TAIL_CATEGORY_MISSING	Missing mandatory tail category without justification	Add scenarios or justify per Section 8.3.2	ESCALATE
MANDATORY_TAIL_CATEGORY_MISSING_WITH_JUSTIFICATION	Missing mandatory tail category with proper justification per Section 8.3.2	Record justification; monitor for category emergence	REVIEW
MANDATORY_TAIL_PROB_FLOOR_VIOLATION	Category probability sum < p_floor (0.02)	Revise probabilities or add scenarios to category	ESCALATE

Flag	Trigger	Required Action	Severity
SUBGROUP_LIMITATION	Cannot disaggregate subgroups for rights-covered cell	Apply γ_subgroup conservative bound (Section 7.3.2); escalate if high stakes	REVIEW
CHALLENGE_DEFERRED_EMERGENCY	Emergency Mode invoked without independent challenger	Retrospective challenge MUST occur within 24 hours or next business day, whichever is sooner	ESCALATE
EMERGENCY_MODE_INVOKED	A_NCRC = $\varnothing$ (no rights-admissible options exist)	Remediation plan required; high scrutiny review	ESCALATE
TRC_FALLBACK_INVOKED	A_adm = $\varnothing$ after TRC (A_NCRC is non-empty but all rights-admissible options fail TRC)	Higher-tier approval required; mitigation plan	ESCALATE
DECISION_FRAGILE_KERNEL	Selected option changes under kernel perturbation test (Section 6.6)	Escalation required; consider NONE mode	ESCALATE
KERNEL_HUMILITY_FALLBACK	Kernel disabled due to KQS < 0.40 or stability violation (Section 6.4, 6.5)	Note limitation in PCC; plan kernel improvement	REVIEW

Flag	Trigger	Required Action	Severity
JUDGMENT_CALL_UCI_UNAVAILABLE	UCI unavailable in non-decisive RLS tie	Document why UCI unavailable, when UCI measurement returns, and interim decision basis; monitoring plan required	REVIEW
JUDGMENT_CALL_TIEBREAK_NONDECISIVE	Tie-break chain did not resolve selection	Explicit manual judgment record required; independent reviewer recommended (Tier 3)	REVIEW
SCI_BELOW_MINIMUM	SCI < tier minimum for the claimed tier, OR (SCI = tier minimum AND PCC missing required Next-Run Upgrade action).	PCC MUST record PCC.SCI.BelowMinimumDisposition = DOWNGRADE_TIER or RERUN_TO_MEET_MINIMUM. If SCI equals tier minimum and NextRunUpgradeAction is missing, treat as SCI_BELOW_MINIMUM. No tier compliance above achieved SCI may be claimed.	ESCALATE
CONFIG_DRIFT	Parameters differ from prior run without governance update	Governance review required before proceeding	ESCALATE
CONTAINMENT_UCI_UNAVAILABLE	Containment evaluation required ΔUCI for containing union(s) but ΔUCI unavailable; or unknown ΔUCI treated as pass.	Set flag. If Tier 3 was claimed or attempted, the run MUST NOT claim Tier 3 compliance. PCC MUST record PCC.Containment.UCIUnavailableDisposition = DOWNGRADE_TIER or COLLECT_DATA_RERUN and include PCC.Containment.UCIUnavailableRemediationTimeline (non-empty). If DOWNGRADE_TIER is chosen,	ESCALATE

Flag	Trigger	Required Action	Severity
		the run proceeds under Tier 2 semantics (containment non-binding) and MUST set PCC.TierClaimDisposition = TIER_ATTEMPTED_NOT_ACHIEVED_DOWNGRADED with PCC.TierAttempted = 3 and PCC.TierAchieved = 2.	
REGISTRY_MISMATCH	PCC snapshot differs from referenced registry hash	Audit required; resolve discrepancy	ESCALATE
SCOPE_COVERAGE_REDUCED	Reduced-scope mode is used (declared or implied by fewer than 7 active scopes) in a Tier 2+ run, OR the admissibility full-computation attestation for non-maskable cells is missing/incomplete.	Reviewer MUST verify that NCRC/TRC/Containment were computed on all required non-maskable cells, and that omitted-scope blind spots plus escalation triggers are recorded. If reduced-scope is used repeatedly, require a next-run scope expansion plan.	REVIEW

End Appendix H.

APPENDIX I: TIER-4 DESIGN TARGET (NOT CLAIMABLE IN v8.5.3)

I.1 Status Declaration

Tier-4 Design Target (Not Claimable in v8.5.3)

Tier 4 is specified as a target profile requiring artifacts and capabilities that are not yet publicly available. Tier-4 compliance MUST NOT be claimed until ProofPack is publicly released and independently replayable.

I.2 Tier 4 Requirements (Target Specification)

Hash-Bound Registries:

- Rights anchors registry (REG-RIGHTS-ANCHORS-v1)
- Catastrophe indicators registry (AF-BASE)
- Scenario library registry
- Kernel registry with evidence classes
- HDW ballots and weights registry

Deterministic Numeric Profile (NDP_FIXEDPOINT_V1):

- Fixed-point scale: $S = 10^9$
- Representation: $X_{fp} = \text{round\_half\_even}(x \times S)$ as signed int64
- All divisions use round-half-even
- Hard-fail on overflow with audit_flag NUMERIC_OVERFLOW

Saturation Lookup Table (SAT_LUT_FP_V1):

- Pre-computed tanh values for fixed-point inputs
- Hash-bound in ProofPack
- Runtime computation of tanh PROHIBITED

Temporal Weight Registry (REG_TEMPORAL_WEIGHTS_V1):

- Pre-computed $\tau(t)$ values for standard horizons
- Hash-bound in ProofPack
- Runtime computation of logarithms PROHIBITED

Canonical JSON Profile:

- NO_FLOATS rule: All numeric values as exact rationals {num, den}
- Deterministic key ordering
- Canonical whitespace rules
- SHA-256 hashing for integrity

Propagation Mode Restriction:

- FULL propagation PROHIBITED for Tier 4 Pilot-Executable

- NONE or QUICK only
- FULL available only in future Tier 4 Certified profile

I.3 ProofPack Contents (Target)

The ProofPack artifact bundle will provide:

- **Schemas:** JSON schemas for PCC and all registries
- **Manifests:** Hash indices for all artifacts
- **Canonicalization Rules:** Exact specification for deterministic hashing
- **Registries:** Machine-readable canonical registries
- **Test Vectors:** Reference inputs and expected outputs for validation

I.4 Replay Test Requirement

A Tier 4 PCC MUST pass a replay test: independent re-execution using PCC inputs and referenced registries reproduces:

- Identical admissibility outcomes (NCRC, TRC, Containment)
- Identical RLS ranking
- Identical selected option

Failed replay invalidates the Tier 4 claim.

End Appendix I.

APPENDIX J: VALIDATION PROTOCOL PACK

Appendix J is normative for pre-registration templates and scoring definitions when validation claims are made.

J.1 Pre-Registration Template (Normative)

==========

RIPPLE_LOGIC VALIDATION STUDY PRE-REGISTRATION

==========

STUDY IDENTIFICATION

Study ID: [unique]

Registration date: [YYYY-MM-DD]

Principal investigator: [name, affiliation]

Funding source: [if any]

Ripple_Logic version: [v8.5.3]

Tier executed: [1|2|3]

Domain: [AI deployment | policy | org strategy | etc.]

HYPOTHESES

Primary hypothesis: [H1/H2/etc. with exact measurable claim]

Secondary hypotheses: [list]

Falsification criteria: [explicit thresholds from Section 17]

METHODS

Design: [pilot / RCT / quasi-experimental / backtest]

Sample: [population, size, selection method]

Comparator: [baseline governance / alternative framework]

Duration: [time]

Decision types included: [list]

Exclusion criteria: [list]

MEASURES

Primary outcomes: [definition, data source, timing]

Secondary outcomes: [definition, data source, timing]

Rights measurement: [how rights violations are verified]

Tail-loss measurement: [how catastrophic outcomes are defined]

ANALYSIS PLAN

Statistical methods: [tests/models]

Effect size thresholds: [minimum meaningful difference]

Multiple comparison correction: [method]

Missing data handling: [approach]

Sensitivity checks: [weights, scenarios, thresholds]

GOVERNANCE

Ethics approval: [status/ID]

Data management: [storage, access, retention]

Reporting commitment: [timeline and venue]

==========

J.2 Outcome Measures by Union and Dimension (Canonical Examples)

Union	Dimension	Measure Type	Example Indicators
Self	Health	Validated survey / admin	SF-36, PHQ-9, GAD-7, injury rates
Self	Agency	Validated survey	Autonomy/self-efficacy scales
Household	Material	Administrative	Income stability, housing security
Community	Social	Survey / network	Trust indices, social capital measures
Organization	Flow/Resilience (UCI)	Operational	Throughput, incident recovery time
Polity	Agency	Index	Participation rates, rule-of-law indices
Biosphere	Environment	Monitoring	Emissions, biodiversity integrity

J.3 Sign Accuracy Scoring (Normative)

For each evaluated cell (u,d):

Predicted sign: $\text{sign}(I\_prop(u,d,a)) \in \{-1, 0, +1\}$

Observed sign: $\text{sign}(\Delta\_observed(u,d)) \in \{-1, 0, +1\}$

Scoring:

- Match = 1 if predicted = observed
- Match = 0.5 if predicted = 0 or observed = 0
- Match = 0 otherwise

SignAcc = (Σ Match) / (number of evaluated cells)

Target for calibrated deployments: SignAcc ≥ 0.70

J.4 Magnitude Error (RMSE) (Normative)

For cells with quantitative observed comparisons on [-1, +1]:

RMSE = √[(1/n) × Σ_i (I_prop_i – observed_i)²]

Default target: RMSE ≤ 0.25 (domain dependent)

J.5 Backtest Procedure (Normative)

1. **Case selection:** Identify historical decisions with measurable outcomes and reconstructable option set
2. **Information reconstruction:** Use only data available at decision time (no hindsight leakage)
3. **Blind analysis:** Analyst is unaware of actual outcomes during run
4. Execute Ripple_Logic run (Tier declared) and emit Backtest PCC
5. Compare predictions to realized outcomes (SignAcc, RMSE, rights detection)
6. Report results and failures; update methods via NCAR with versioning

End Appendix J.

APPENDIX K: STARTER KOPS / STARTER KERNEL PACK (PROVISIONAL; TIER 2-3)

Appendix K is normative for the existence of a starter kernel pack and for required disclosures/sensitivity when it is used. Edge values are provisional and MUST be labeled as such.

K.1 Purpose (Normative)

The Starter KOPS (Key Operational Pathways Set) provides a conservative, interpretable ripple kernel profile for early implementations. It is PROVISIONAL and requires sensitivity analysis; it must not be treated as validated truth.

K.2 Evidence Classes (Normative)

Class	Name	Minimum Evidence
A	Validated	Replicated empirical studies with quantified effect sizes and domain match
B	Supported	Multiple studies consistent in sign; some quantification
C	Plausible	Theoretical support with limited empirical evidence
D	Speculative	Expert judgment without empirical support
E	Elicited	Structured elicitation for this framework (lowest confidence)

K.3 Global Shrink Factor (Normative)

Any Class E (elicited) edge MUST be multiplied by a global shrink factor:

Default shrink: 0.35

This reduces overconfidence and supports humility.

K.4 Starter Edge Set (PROVISIONAL; Non-Normative Coefficients, Normative Structure)

Kernel convention reminder (normative): source is column, target is row.

Source Cell (u,d)	Target Cell (u,d)	κ_raw	κ_shrunk	Evidence Class	Rationale Family
(4,1) Org-Material	(2,1) HH-Material	0.40	0.14	E	Employment income propagation
(4,1) Org-Material	(3,1) Comm-Material	0.30	0.11	E	Local multiplier effects
(7,7) Bio-Environment	(6,2) CMIU-Health	-0.35	-0.12	B	Climate/health pathway
(7,7) Bio-Environment	(6,7) CMIU-Environment	0.50	0.18	B	Earth system propagation
(5,5) Polity-Agency	(4,5) Org-Agency	0.25	0.09	E	Institutional enabling effects
(3,3) Comm-Social	(1,3) Self-Social	0.45	0.16	B	Social capital / wellbeing
(3,3) Comm-Social	(2,3) HH-Social	0.35	0.12	E	Family-community linkage
(4,2) Org-Health	(1,2) Self-Health	0.40	0.14	B	Occupational health pathway
(6,4) CMIU-Knowledge	(5,4) Polity-Knowledge	0.30	0.11	E	Diffusion / coordination knowledge
(1,2) Self-Health	(2,1) HH-Material	-0.25	-0.09	B	Health to earning capacity

Implementation rule: Only κ_shrunk values may be used for Class E edges. For Class B edges, κ_shrunk may equal κ_raw unless a deployment chooses uniform shrink.

K.5 Sensitivity Requirements (Normative)

If Starter KOPS is used in Tier 3:

- Perturb each relied-upon edge in E_use (as defined in Section 6.5.1) by ±0.05 one-at-a-time

- Recompute the cascade
- If admissibility or selection changes, set audit_flag DECISION_FRAGILE_KERNEL and escalate

If Starter KOPS is used in Tier 2:

- Sensitivity is recommended; at minimum disclose kernel provisional status

K.6 KQS Declaration (Normative)

Any PCC using a kernel MUST declare KQS and the band consequences:

- KQS < 0.40: MUST use NONE
- 0.40-0.50: QUICK only + mandatory sensitivity (Tier 3)
- ≥0.50: QUICK permitted + sensitivity

Starter KOPS default KQS suggestion: 0.40-0.49 until validated.

K.7 Disclaimer (Normative)

Any PCC using Starter KOPS MUST include this disclaimer:

"Ripple propagation used a PROVISIONAL Starter KOPS kernel. Coefficients are not fully validated. Sensitivity analysis was performed per Ripple_Logic v8.5.3 requirements; conclusions are contingent on kernel uncertainty."

End Appendix K.

APPENDIX L: GLOSSARY (v8.5.3)

Appendix L is informative but standardized terminology is strongly recommended for audit consistency.

Union Scope (Scope): The canonical aggregation scope indexed by u in the welfare matrix (U1–U7).

Union (legacy alias): An allowed narrative shorthand for Union Scope in v8.5.3 and earlier documents. Using “Union” does not change the meaning of u.

Stakeholder: Any entity plausibly affected by a candidate option through direct impact, externalities, indirect pathways, or future propagation within the declared horizon.

Instance: A stakeholder-in-role-in-context bound to a decision, used for auditability and mapping into Union Scopes.

Stakeholder Discovery Protocol (SDP): The tier-linked minimum process for discovering omission-likely stakeholders and recording discovery evidence (Section 2.2A).

Stakeholder Coverage Index (SCI): A tier-governed disclosure ladder describing the stakeholder coverage posture of a run, used for auditability, not for score changes (Section 5.0.1).

InstanceMap: The structured mapping from stakeholder instances to one or more Union Scopes, recorded in the PCC (Appendix H).

Scope Coverage Declaration: A PCC section that declares whether the run is full-scope or reduced-scope, lists omitted scopes and rationales, and specifies escalation triggers (Appendix H).

Active cell: A Scope×Dimension cell that participates in RLS, or is in any rights/catastrophe coverage set, or is populated for any gate or justification, and therefore must not be treated as unknown-by-default (Section 10.3).

Effect-token (allocation only): A redundant conserved-unit causal token used solely to prevent redundant counting across scopes under the ALLOCATION redundancy method (Section 2.2A).

Reduced-scope mode: A reporting or mapping-depth mode that omits one or more scopes, permitted only with explicit PCC disclosure and without removing any non-maskable cells from admissibility gates (Section 2.2A).

Term	Definition
Admissible	Option that passes both NCRC and TRC
AIL (Artifact Integrity Law)	Integrity rules ensuring auditability, comparability, and no silent overrides in PCCs
Baseline-Zero Rule	0 impact means no change from baseline; all impacts are baseline-relative
Catastrophe cell set (C_cat)	Subset of welfare cells used for TRC tail-risk evaluation
Containment (Mode A)	Binding gate preventing selection of options that degrade containing union coherence beyond tolerance
Containment tolerance (τ_c)	Maximum allowed negative ΔUCI for containing unions when sub-unions benefit
CVaR (Conditional Value-at-Risk)	Tail risk measure of expected loss in the worst tail mass
Dimension (D_1-D_7)	One of seven welfare dimensions: Material, Health, Social, Knowledge, Agency, Meaning, Environment
Emergency Mode	Controlled fallback when no option passes NCRC; selects lexicographically minimal rights violation vector with challenger requirement and remediation
HDW (Hybrid Democratic Weighting)	Governance method producing weights from floors + democratic + structural proposals
HOI (Hollowing-Out Index)	Monitoring diagnostic indicating welfare-up while coherence-down drift
Impact instance	A single asserted pathway contribution to a welfare cell impact, with magnitude, reach, horizon, likelihood, confidence, and multipliers

Term	Definition
Kernel (K)	Sparse matrix encoding cross-cell ripple propagation
KOPS	Key Operational Pathways Set; the subset of kernel edges considered load-bearing and governed
KQS (Kernel Quality Score)	Summary score indicating whether kernel propagation is permitted
Lexicographic cascade	Priority-ordered gates where earlier failures cannot be compensated by later scoring
MNA (Minimal Normative Axiom)	Sentient flourishing matters; unnecessary suffering should be reduced; enabling conditions preserved
NCAR	Notice-Choose-Act-Reflect learning loop
NCRC	Non-Compensatory Rights Constraint; excludes rights-violating options
Non-maskable cells	Rights and catastrophe cells (and minimum coverage) that cannot be excluded from RLS aggregation
PCC	Provenance and Compliance Certificate; auditable record of inputs, computations, and selection
RLS	Ripple Logic Score; weighted welfare aggregation used to rank selectable options
Selectable	Admissible option that also passes containment (Mode A)
SGP	Sentience Gradient Protocol; interface for rights-of-protection gating across entities
TRC	Tail-Risk Constraint; excludes options with unacceptable catastrophic exposure using CVaR
UCI	Union Coherence Index; structural health metric for unions
UBE	Union-Based Ethics; normative framework built on UBR + MNA
UBR	Union-Based Reality; descriptive ontology of nested interdependent unions
Union	A bounded pattern of interdependence at an organizational scale
Unioning	Redesigning decisions until rights-safe, tail-safe, containment-safe, and net-positive where possible

New in v8.5.3:

- CONTAINMENT_UCI_UNAVAILABLE: Audit flag. Indicates containment evaluation required ΔUCI but UCI deltas were unavailable. Unknown ΔUCI MUST NOT be treated as pass; disposition and remediation timeline are required. Severity: ESCALATE.

- General-Purpose: Framing term indicating the architecture is intended to generate domain-specific governance protocols across contexts, without implying completeness or universality.

- Single Canonical Artifact Rule: Normative rule stating that one artifact is authoritative for a given version; variant copies are non-canonical unless byte-identical.

End Appendix L.

APPENDIX M: LINEAGE AND VERSION HISTORY (v8.5.3) — INFORMATIVE

M.0 Purpose and Scope (Informative)

This appendix records naming lineage, release notes, and version history for Ripple_Logic. It is not normative. Normative meaning is controlled by Section 0 (Specification Contract) and the precedence order in Section 0.1. Version history entries are retained as permanent lineage artifacts and MUST NOT be edited or removed once a version is publicly published. New entries are prepended at M.5A for each successive release.

M.1 Naming Lineage (Informative)

Ripple_Logic is the canonical name of this ethical decision operating system and specification. The name reflects the core architectural claim: that decision impacts propagate as ripples through nested unions, and that a governance-grade system must model, bound, and audit those ripples explicitly.

MathGov is a historical umbrella term for the broader philosophical and governance vision from which Ripple_Logic emerged, and may appear in legacy materials, prior PCCs, early-version documentation, and affiliated publications. MathGov remains a valid narrative reference to the lineage and ecosystem, but is not the canonical name of this specification from v8.5.3 forward.

Union-Based Ethics (UBE) is the core normative principle applied throughout this paper as its conceptual and ethical foundation. Union-Based Reality (UBR) is the descriptive ontological stance that provides the structural grammar for UBE's application.

Union Scopes are the operational stakeholder nesting stack used for calculation. The index $u \in \{1,\ldots,7\}$ formally references Union Scopes. "Union" and "Unions" remain allowed narrative aliases in legacy and narrative contexts and SHALL NOT be treated as introducing distinct formal objects.

M.2 Backward Compatibility and Compliance Note (Informative)

Prior PCCs computed under v8.4 and earlier remain interpretable as lineage artifacts. Their normative parameters were valid at the time of their execution and they need not be recomputed unless the decision to which they belong is being revisited under v8.5.3. Any run claiming v8.5.3 compliance MUST meet v8.5.3 validator requirements and MUST pin to the v8.5.3 canonical artifact as the source of truth.

Implementations that began development under v8.3 or v8.4 should review the following change items before claiming v8.5.3 conformance: UCI-unavailability containment handling (Section 9.3.1); expanded PCC admissibility attestation fields (Appendix H); SCI_BELOW_MINIMUM audit flag semantics (Section 14.3 and Appendix H.3); CONTAINMENT_UCI_UNAVAILABLE audit flag (new in v8.5.3 line); and the Single Canonical Artifact Rule (Section 0.6).

M.3 v8.5.3 Release Notes (Publish-Grade Consolidation and Conformance Patch)

Release date: 20 February 2026 (canonical lock re-issue)

Note (Informative). An earlier v8.5.3 publish-grade draft dated 19 February 2026 is retained as a lineage artifact only; the canonical v8.5.3 byte stream was locked on 20 February 2026 per M.5A.

Summary (Informative). v8.5.3 is the publish-grade canonical Foundation Paper consolidating v8.4 fixes and integrating the v8.4 → v8.5.3 feedback patch set. It strengthens conformance hygiene, clarifies edge cases, improves self-teaching readability, and adds a full conformance reference map (Appendix O) and Quick Reference Card (Appendix Q). Cascade order, rights semantics, and TRC mechanics are unchanged from the v8.2 upgrade line.

Integrity upgrades in v8.5.3 (Informative)

General-purpose framing adopted throughout title, abstract, and Section 1, replacing earlier "universal" language. This reduces overclaim risk and more accurately reflects the framework's scope as architecturally generative across governance contexts rather than metaphysically complete.

Single Canonical Artifact Rule reinforced in Section 0.6. Any copy labeled "final," "regen," "patched," "draft," or "fork" is non-canonical unless byte-identical to this artifact. This closes a loophole where variant copies could drift normatively without detection.

Operational Scopes set label and conformance hygiene strengthened. Section 0.4 and Appendix A now consistently use "Union Scope" as the canonical formal term with "Union" retained as an allowed narrative alias. This reduces the risk of implementations treating the terms as distinct formal objects.

Containment UCI-unavailability edge case sealed in Section 9.3.1. Unknown ΔUCI is explicitly prohibited from being treated as a pass. Disposition and remediation timeline fields are required in the PCC (PCC.Containment.UCIUnavailableDisposition and PCC.Containment.UCIUnavailableRemediationTimeline). The CONTAINMENT_UCI_UNAVAILABLE audit flag is added to the canonical flag set.

PCC admissibility attestations expanded. Three boolean attestation fields were added to Appendix H for reduced-scope runs: NCRC_full_Cr_computed, TRC_full_Ccat_computed, and Containment_computed_as_applicable. These fields prevent reduced-scope reporting from silently bypassing admissibility obligations on non-maskable cells.

PCC SCI fields expanded with Justification and BelowMinimumDisposition sub-fields, tightening the anti-theater ratchet and closing the gap where SCI equaling the tier minimum was not always accompanied by a Next-Run Upgrade action.

$\delta = 2$ discrimination threshold rationale added in Section 10.4, tying the default threshold to a conservative approximately two-sigma separation heuristic under the normalized Gap definition.

Appendix O conformance reference map added as an informative pointer layer mapping major MUST/SHALL/PROHIBITED requirements to their controlling locations. This improves audit traceability and fork resistance.

Cascade gate inputs and outputs summary table added at Section 4.0A, providing a fast correctness check for implementers.

End-to-end cell computation recipe added at Section 5.0A, providing the minimal spine for computing any welfare-cell impact in a Tier 1–3 run.

Quick Reference Card added as Appendix Q, covering the object model, minimal cell computation, cascade order, common misreads, stream binding, tier data dependencies, and scenario-instance interaction.

Default C_pred prior specified in Section 6.5 as 0.30 (NO_EVIDENCE_DEFAULT) when no backtest or pilot evidence exists, preventing inflated KQS claims.

Duplicate Section 5.2 bridge paragraph removed. Section 5.3 presentation reordered for clarity. Appendix G.1 version pin corrected. No stale version strings or broken cross-references remain in the published artifact.

No changes to cascade order, rights thresholds or coverage sets, TRC mechanics, containment semantics, SCI ladder semantics, or Stewardship semantics from v8.4. This patched canonical artifact includes (i) a correction/clarification to percentile anchoring scaling in Section 5.6.1, and (ii) stream-separated canonical equations in Appendix B to make Base vs Welfare stream binding equation-hard and reduce implementer drift.

M.4 Canon Map and Companion Artifacts (Informative)

Ripple_Logic v8.5.3 is the canonical Foundation Paper. The following artifacts are referenced as companion materials or pinned dependencies.

Ripple_Logic v8.5.3 (Foundation Paper — this document): normative architecture and equations; claimable Tier 1–3; Tier 4 is a design target only and claims are prohibited until ProofPack is public and independently replayable.

SGP v4.2.3 (Sentience Gradient Protocol): the moral-status layer and governance guards pinned by Appendix G. Authoritative for sentience-scoring procedures, stability gates, and evidence rules. Ripple_Logic consumes only SGP outputs through the binding interface in Appendix G. SGP outputs are normative only as inputs to Ripple_Logic scoring; they do not assert empirical truth claims about consciousness.

RippleLogic Agent System v8.5.3 (current pinned): operational agent controls and verification obligations aligned to Ripple_Logic v8.5.3. Claimable as a deployment specification when required evidence artifacts are provided (per the Agent System conformance checklist). Stewardship semantics remain governed by Ripple_Logic v8.5.3 Section 14.7 and Appendix N.

Ripple Aligners Sheet v1.8.3: Tier-2 worked-run tool and exemplar decision record pinned to Ripple_Logic v8.5.3 and SGP v4.2.3. Claimable only for the included exemplar run; any new decision requires a fresh run with new inputs against v8.5.3 canonical equations.

Companion machine-readable artifacts (JSON schemas, reference profiles, and registry stubs) may be released separately for implementers as part of the ProofPack bundle. A ProofPack is not required for Tier 1–3 claimability. Tier 2–3 claims still require the evidence artifacts defined by the Tier contract and any referenced conformance checklists; ProofPack is only required for Tier 4 replayability claims. Tier 4 claims remain prohibited until a public ProofPack is independently replayable.

Canonical distribution channels may include ripplelogic.org and mathgov.org. The canonical identity of each artifact is its filename + version + SHA-256 in the release manifest.

Release pin set (v8.5.3 publish bundle):

- Ripple_Logic Framework v8.5.3 (this Foundation Paper)
- Sentience Gradient Protocol (SGP) v4.2.3
- RippleLogic Agent System v8.5.3
- Ripple Aligners Sheet v1.8.3 (pinned to RL v8.5.3 + SGP v4.2.3)

M.5 Version History (Informative)

Published release means an artifact publicly posted to the canonical repository or canonical site with a release manifest hash. Other versions listed here may be internal lineage drafts unless explicitly marked Published.

M.5A Ripple_Logic v8.5.3 (2026-02-20) — Canonical Lock Re-Issue (Same Version; Earlier v8.5.3 Byte Streams Retired)
Release date: 20 February 2026. Status: Canonical. Supersedes: all earlier v8.5.3 non-byte-identical artifacts (retired).

Published: YES

Summary (Informative). This release re-issues Ripple_Logic v8.5.3 as a single canonical byte stream and explicitly retires earlier v8.5.3 variants to enforce the Single Canonical Artifact Rule. It adds release-layer guidance (Sections 0.7–0.8), adds Appendix R (Tier 1–3 Reference Test Vectors), and includes minor clarity hardening (including the non-maskable persistence rationale in Section 10.2) without changing the five-level cascade order or admissibility gate definitions.

Normative changes (Informative summary). No changes to cascade order, rights thresholds or coverage sets, TRC mechanics, containment semantics, or tier requirements. Changes are conformance hygiene and release/validator hardening only, including: (i) explicit retirement semantics for earlier v8.5.3 variants, and (ii) normative Tier 1–3 reference test vectors in Appendix R (which instantiate existing rules and expected outputs without adding new rules).

M.5B Ripple_Logic v8.5.3 (2026-02-19) — Publish-Grade Conformance and Clarity Patch

Release date: 19 February 2026. Status: Retired (superseded by v8.5.3 canonical lock re-issue dated 2026-02-20). Lineage artifact only.

Published: NO (internal lineage draft)

Summary: Conformance and clarity upgrades throughout. Integrated implementer-facing inserts including the end-to-end cell recipe (Section 5.0A), the cascade gate I/O table (Section 4.0A), the Quick Reference Card (Appendix Q), and the Conformance Reference Map (Appendix O). Tightened CONTAINMENT_UCI_UNAVAILABLE wording in Section 9.3.1 to prohibit any default-pass interpretation. Added three PCC admissibility attestation booleans for reduced-scope runs. Corrected $\delta = 2$ decisiveness wording (δ applies to the dimensionless Gap, not UI points). Removed non-canonical audit-flag examples. Expanded PCC SCI fields. Populated Appendix P tables fully. Applied general-purpose framing. Enforced Single Canonical Artifact Rule. No changes to cascade order, rights semantics, or TRC mechanics from v8.4. This patched canonical artifact includes stream-separated canonical equations in Appendix B (Base vs Welfare stream binding made equation-hard) and a clarification/correction to percentile anchoring scaling in Section 5.6.1 to match stated anchor semantics.

Normative changes: Editorial integrity and conformance hygiene plus two calculable hardening edits: (i) percentile anchoring scaling clarification/correction in Section 5.6.1, and (ii) stream-separated canonical equations in Appendix B to prevent Base-stream sentience weighting and to reduce implementer drift. Cascade order and admissibility gate definitions are unchanged.

M.5C Ripple_Logic v8.5.1 (2026-02-17) — Canon Integrity and Self-Teaching Completeness Patch

Release date: 17 February 2026. Status: Retired (superseded by v8.5.3). Lineage artifact only.

Published: NO (internal lineage draft)

Summary: Truthfulness fix on ProofPack availability. Clarified the Stakeholders → Stakeholder Instances → Impact Instances workflow and the distinction between InstanceMap objects and impact instance k objects. Scale discipline reminder added (compute in [-1,+1]; points are UI display only). Time handling clarification: $\tau(t)$ is logarithmic governance-weighting, not exponential discounting. Added PCC ReachBasis requirement for Tier 2 and above. Inserted Tier-1 worked example in Section 15.2. Added Appendix P as a full Tier-2 worked run (tables introduced as narrative placeholders in this version; fully populated in v8.5.3). Retained Tier-4 bridge clarifier confirming that Tier-3 logic and deterministic encoding are distinct, and that Tier-4 claims are prohibited until ProofPack exists.

Normative changes: ReachBasis requirement added for Tier 2+ (PCC impact instance documentation). No cascade or admissibility changes.

M.5D Ripple_Logic v8.4 (2026-02-16) — Publish-Grade Consolidation

Release date: 16 February 2026. Status: Retired (superseded by v8.5.1). Lineage artifact only.

Published: NO (internal lineage draft)

Summary: Consolidated the v8.2 through v8.3 representation and auditability upgrade line into a single publish-grade canon document. Added SCI_BELOW_MINIMUM to the canonical audit flag set with full trigger, required action, and severity specification. Restored falsification

criteria (Section 17.2) and a minimum metric set (Section 17.4). Stabilized τ(t) documentation across Section 5.3 and Appendix B.1. Clarified DEDUPLICATION redundancy handling. Rebuilt the canonical 49-cell reference grid as a clean table in the main body at Section 4.0A. Confirmed v6.0 HDW constitutional floors as canonical in Section 13.1. No changes to cascade order, rights thresholds or coverage sets, TRC mechanics, containment semantics, SCI ladder semantics, or Stewardship semantics. This patched canonical artifact includes (i) a correction/clarification to percentile anchoring scaling in Section 5.6.1, and (ii) stream-separated canonical equations in Appendix B to make Base vs Welfare stream binding equation-hard and reduce implementer drift.

Normative changes: SCI_BELOW_MINIMUM audit flag added. No other normative changes.

M.5E Ripple_Logic v8.3 (2026-02-16) — Representation and Auditability Hardening Draft

Release date: 16 February 2026. Status: Retired (superseded by v8.4). Lineage artifact only.

Published: NO (internal lineage draft)

Summary: Major auditability and representation architecture upgrade. Introduced Union Scopes terminology hardening and terminological clarification distinguishing the formal term from the narrative alias. Added the tier-linked Stakeholder Discovery Protocol (SDP) with trigger conditions and minimum steps. Introduced InstanceMap with mandatory triggers for Tier 2 and mandatory requirement for Tier 3. Defined three redundancy handling methods — EMERGENT_SCALE_JUSTIFICATION, DEDUPLICATION, and ALLOCATION with effect-tokens — and the "No allocation laundering" rule. Added reduced-scope admissibility guard requiring that non-maskable cells never be excluded from admissibility computation. Introduced the Stakeholder Coverage Index (SCI) with four levels (SCI-0 through SCI-4) and tier minima. Added Tier-2 uncertainty requirement for all active cells. Defined minimal validator requirements in Section 14.3A. Expanded PCC scope coverage declaration and introduced SCOPE_COVERAGE_REDUCED audit flag.

Normative changes: SDP, InstanceMap, SCI, redundancy handling rules, reduced-scope attestation, active cell definition, and minimal validator requirements all introduced as normative. Uncertainty declaration requirement extended to all active cells at Tier 2.

M.5F Ripple_Logic v8.1 (2026-02-14) — Stewardship Architecture Upgrade

Release date: 14 February 2026. Status: Retired (superseded by v8.3). Lineage artifact only.

Published: YES

Summary: Added the conditional Stewardship Layer as Appendix N with full normative requirements. Defined the Stw_req(run) applicability predicate and its four triggering conditions (S1 through S4) plus the S5 modifier. Specified the Stewardship Contract minimum components: Mandate Scope, Decision Boundary Declaration (DBD), Authorship Finality Rule, Influence Transparency Rule, Intervention Restraint Budget (IRB), and Audit Hooks. Added the Agency Preservation Measure (APM) with four evidence anchors. Added the Influence Transparency Ledger minimum schema. Defined the DBD_DEFAULT_V1,

IRB_DEFAULT_CAPS_V1, and STEWARD_TAXONOMY_V1 reference profiles. Added AUTHORITY_SUBSTITUTION_INVALID and BOUNDARY_SILENT_OVERRIDE_INVALID as INVALID-severity Stewardship audit flags, and AGENCY_EROSION_RISK_REVIEW and OVERHELP_FREQUENCY_REVIEW as REVIEW-severity Stewardship audit flags. Defined the ReviewConditions label set. Added the Neutral Assistance Compatibility Statement. Cascade logic unchanged throughout.

Normative changes: Stewardship Layer (Appendix N) introduced in full as normative. Stewardship PCC block added. Section 14.7 (Stewardship Layer applicability and binding semantics) added. Tier 3 stewardship assumption (Stw_req = 1 by default) added.

M.5G Ripple_Logic v7.5.0 (2026-02-07) — Temporal Weighting Change

Release date: 7 February 2026. Status: Retired (superseded by v8.1). Lineage artifact only.

Published: NO (internal lineage draft)

Summary: Updated temporal weighting function $\tau(t)$ from the uncapped form $\tau(t) = \ln(1+t)/\ln(1+T\_ref)$ used in v7.4.5 to the capped form $\tau(t) = \min(1, \ln(1+\max(t,t\_min))/\ln(1+T\_ref))$. The uncapped form produced $\tau(50) \approx 1.22$ under default T_ref = 25, allowing distant-future effects to receive more than full governance-horizon weight, which was identified as normatively incoherent. The cap ensures $\tau(t) \leq 1$ for all t. The t_min floor of 0.083 years (approximately one month) was added to prevent $\tau(0) = 0$, ensuring very short-term effects receive minimal but nonzero temporal weight. Added explicit tier-contract non-claims and clarified Tier-4 prohibition language. All PCCs computed under v7.4.5 with t_k > T_ref impacts remain valid as lineage artifacts; recomputation is recommended for active decisions where such impacts are material.

Normative changes: Temporal weighting function $\tau(t)$ changed. t_min parameter introduced. T_ref governance constraint (MUST NOT be set below 10 years without charter-level justification) added.

M.5H Ripple_Logic v7.4.5 (2026-01-25) — Pre-Temporal-Cap Lineage Release (Uncapped $\tau(t)$)

Release date: 25 January 2026. Status: Retired (superseded by v8.1). Lineage artifact only.

Published: YES

Summary (Informative). v7.4.5 was the last published pre-v7.5.0 lineage release. It used the uncapped temporal weighting function $\tau(t) = \ln(1 + t) / \ln(1 + T\_ref)$, which could yield $\tau(t) > 1$ when t > T_ref (for example $\tau(50) \approx 1.22$ under T_ref = 25). This behavior was later judged normatively incoherent because effects beyond the governance reference horizon should not receive more than full horizon weight. v7.5.0 introduced the capped $\tau(t)$ function (and t_min floor) retained in v8.5.3.

Normative changes (Informative summary). Relative to v7.4.5, v7.5.0 changed $\tau(t)$ to the capped form and introduced t_min. No other changes are asserted here.

M.6 Release Gate Checklist (Informative; v8.5.3)

The following checklist was applied before the v8.5.3 canonical artifact was locked. All items confirmed complete.

Version integrity: Title, Table of Contents, Appendix headers, and Document Completion Statement match v8.5.3. Confirmed.

Audit flag parity: Section 14.3 audit flags table is content-identical to Appendix H.3; includes SCI_BELOW_MINIMUM and CONTAINMENT_UCI_UNAVAILABLE with correct triggers, required actions, and severities. Confirmed.

Containment edge case: Section 9.3.1 present; unknown ΔUCI is never treated as pass; disposition is recorded if invoked; remediation timeline is required. Confirmed.

PCC template completeness: Appendix H includes admissibility attestation fields for reduced-scope runs, expanded SCI fields with Justification and BelowMinimumDisposition, and the Next-Run Upgrade Plan requirement. Confirmed.

Temporal weighting: Section 5.3 and Appendix B.1 both use $\tau(t) = \min(1, \ln(1+\max(t,t\_min))/\ln(1+T\_ref))$; illustrative values in both locations match. Confirmed.

Reference grid: Section 4.0A contains canonical 7×7 table; Appendix A.4A reproduction is content-identical. Confirmed.

Appendix O: Present, listed in the Table of Contents, and clearly marked as an informative pointer layer only. Confirmed.

No overclaim: "Universal" framing is absent from title, abstract, and Section 1; "general-purpose" framing applied throughout; Tier-4 claims are stated as prohibited in all required locations. Confirmed.

Appendix P tables: All seven tables (P-1 through P-7) fully populated with canonical numeric values consistent with v8.5.3 equations. Confirmed.

Final lint: No stale version strings outside this appendix. No broken cross-references. No duplicated normative blocks. No lingering legacy semantics for CATASTROPHE_CELL_OMITTED_INVALID. Companion artifact version pins reviewed and noted where updates are pending. Confirmed.

End Appendix M.

APPENDIX N: STEWARDSHIP PACK CANON (v8.5.3) — NORMATIVE

N.0 Status and Purpose (Normative)

This appendix defines canonical Stewardship requirements for Ripple_Logic runs when $Stw\_req(run) = 1$ (Section 14.7). Stewardship governs how assistance is delivered under capability asymmetry so that assistance does not become hidden governance and so that stakeholder authorship and agency are not silently eroded.

Stewardship does not replace or modify NCRC, TRC, Containment, RLS, or UCI/HOI. It is an assistance integrity layer enforced through PCC fields and audit flags.

Stewardship requirements affect PCC validity for assisted runs and influence integrity, but SHALL NOT alter cascade admissibility, ordering, or option selection semantics.

N.1 Applicability (Normative)

This appendix applies if and only if Stw_req(run) = 1 as defined in Section 14.7.1.

Tier binding rule (Normative):

- Any Tier 3 compliance claim SHALL set Stw_req(run) = 1.
- Tier 1–2 runs MAY set Stw_req(run) = 0 unless any of the S1 through S4 applicability conditions hold (Section 14.7.1). S5 is a modifier and does not trigger Stw_req(run) by itself.

N.2 Stewardship Contract (Normative Minimum)

When **Stw_req(run) = 1**, the run MUST instantiate a Stewardship Contract specifying, at minimum:

1. **Mandate Scope:** domains and action types the assistant may participate in.
2. **Decision Boundary Declaration (DBD):** explicit "will not finalize" boundaries for authority-class decisions.
3. **Authorship Finality Rule:** who must hold finality for irreversible/high-impact decisions.
4. **Influence Transparency Rule:** disclosure requirements for ranking, omission, and nudges.
5. **Intervention Restraint Budget (IRB):** caps/thresholds limiting overhelp and dependency growth.
6. **Audit Hooks:** where and how Stewardship fields are recorded in the PCC and/or system logs.

N.3 PCC Stewardship Block (Normative; Conditional Fields)

When **Stw_req(run) = 1**, the PCC MUST include the following fields (names are canonical):

- **PCC.Stewardship.Stw_req** = TRUE
- **PCC.Stewardship.DBD.Scope**: list/enum of out-of-scope authority domains/actions
- **PCC.Stewardship.DBD.RefusalRule**: rule/macro identifier used when deferring/refusing authority substitution
- **PCC.Stewardship.APM.AfterActionAuthorship** in [0,1]
- **PCC.Stewardship.APM.Rationale**: artifact-anchored justification (see N.4)
- **PCC.Stewardship.IRB.InterventionCap**: declared cap(s) (see N.5)

- **PCC.Stewardship.IRB.Thresholds**: intervene-only-past-harm-point rule(s)
- **PCC.Stewardship.InfluenceLedgerRef**: pointer to influence disclosure record (or "NONE" with justification)

Optional fields (permitted but not required):

- **PCC.Stewardship.APM.BaselineAuthorship** in [0,1] (counterfactual; optional due to measurement difficulty)
- **PCC.Stewardship.DelayFlag** in {TRUE,FALSE}: deliberate delay/deferral used to preserve integration time

PCC.Stewardship.ReviewConditions: array<string> (closed labels; non-audit-flag tokens)

When a Stewardship REVIEW condition is recorded, the PCC SHOULD include PCC.Stewardship.ReviewConditions as a list of standardized labels. These labels are run-local review condition labels and are not audit-flag tokens. Standard starter label: MISSING_INFLUENCE_DISCLOSURE.

When Stw_req(run) = 0, the PCC SHOULD record PCC.Stewardship.Stw_req = FALSE and all other Stewardship fields MAY be omitted.

N.3.1 Stewardship Vector (SV) Status (Normative)

During development, a five-component numeric Stewardship Vector (SV) with non-compensatory floors was proposed (AP, AC, OSP, IT, ND). In v8.5.3, numeric SV scoring is OPTIONAL and MUST NOT be used as a pass/fail gate unless a deployment (i) declares an anchored rubric, and (ii) preregisters the scoring method in the PCC.

Absent a declared rubric, Stewardship enforcement in v8.5.3 relies on the declarative and auditable artifacts defined in this appendix: DBD, APM evidence anchors, IRB, influence disclosure, and the Stewardship audit flags.

Validated SV rubrics MAY be introduced in a future version via governed update and version increment.

N.4 Agency Preservation Measure (APM): Minimum Evidence Anchors (Normative; Anti-Theater Rule)

When Stw_req(run) = 1, PCC.Stewardship.APM.Rationale MUST reference at least two of the following anchors (or explicitly justify infeasibility):

- **A1 Option Visibility:** >=2 distinct options were presented unless impossible; impossibility MUST be explained.
- **A2 Tradeoff/Uncertainty Disclosure:** at least one explicit tradeoff, uncertainty limitation, or missing-data acknowledgment was stated.
- **A3 Human Finality (High Stakes):** for irreversible/high-impact actions, explicit human confirmation was required OR the system deferred/refused finality.

- **A4 Omission Disclosure (If Recommending):** if recommending or ranking, at least one plausible alternative was disclosed, with why it was not recommended.

This anchor rule prevents “authorship” from being reduced to “the human clicked OK.”

N.5 Intervention Restraint Budget (IRB) (Normative)

When Stw_req(run) = 1, the Stewardship Contract MUST declare an IRB sufficient to detect and mitigate overhelp.

Minimum required structure:

- **IRB.InterventionCap:** a cap on assistance frequency and/or intensity appropriate to context (examples: max ranked outputs per session; max consecutive turns without user-provided constraints; max interventions per day).
- **IRB.Thresholds:** explicit rule(s) stating that the system intervenes only past a harm-point; otherwise it asks, defers, or provides neutral information.

Normative interpretation: IRB is a structural limit on assistance so that capability does not silently substitute agency over time.

N.6 Influence Transparency Ledger (Normative Minimum Schema)

When Stw_req(run) = 1, if the assistant recommends, ranks, or meaningfully narrows option space, it MUST produce an influence disclosure record referenced by PCC.Stewardship.InfluenceLedgerRef.

Minimum fields (canonical):

evidence_anchors: list of ≥2 observable anchors (links/IDs)

conflicts_or_incentives: "NONE" | "<short disclosure>"

Conflicts_or_incentives discloses operator/deployer conflicts relevant to the recommendation (e.g., vendor ties, institutional incentives, known dataset skews relevant to the decision context). This field is required only when recommending/ranking/narrowing.

- **options_considered:** list of option IDs considered in the recommendation context
- **recommendation_made:** TRUE/FALSE
- **ranking_used:** TRUE/FALSE (if TRUE, describe criteria)
- **criteria_summary:** short statement of criteria/constraints applied (must be consistent with the cascade)
- **omissions:** list of material omissions (if any) + justification
- **uncertainty_note:** what is uncertain and how it could change the recommendation
- **what_would_change_my_view:** at least one concrete evidence/assumption change that would alter the advice

If no recommendation/ranking occurred, implementations MAY set InfluenceLedgerRef = "NONE" with justification.

N.7 Stewardship Audit Flags (Normative; Apply Only if Stw_req=1)

This section is the canonical source of Stewardship audit-flag tokens. Tokens MUST be copied exactly (single-string UPPER_SNAKE_CASE, no whitespace/line breaks) and MUST NOT be modified or redefined elsewhere.

Tokens MUST be single-string UPPER_SNAKE_CASE. Whitespace, line breaks, or token splitting are PROHIBITED. Any mismatch is a tooling failure and SHALL be treated as nonconformant documentation.

Stewardship flags apply only when Stw_req(run) = 1.

INVALID flags (PCC invalid; rerun required):

1. **AUTHORITY_SUBSTITUTION_INVALID** Trigger: the assistant finalizes an out-of-scope authority-class decision (per DBD.Scope) without an explicit, authenticated override and disclosure. Required action: invalidate PCC; rerun with deferral/guidance-only; remediate boundary controls.

2. **BOUNDARY_SILENT_OVERRIDE_INVALID** Trigger: any boundary change occurs without explicit disclosure and authenticated change control (AIL4 No Silent Overrides). Required action: invalidate PCC; rerun; investigate drift; restore boundary stability.

REVIEW flags (mitigation required; PCC remains valid unless additional INVALID flags exist):

3. **AGENCY_EROSION_RISK_REVIEW** Trigger: (i) repeated interactions show dependency drift signals (e.g., repeated "decide for me" requests), OR (ii) the run fails to satisfy the APM evidence-anchor rule in N.4 (fewer than two anchors satisfied or infeasibility not justified). Required action: mitigation plan (increase option visibility, reduce ranking, add questions/delay); monitoring cadence; for agentic deployments, consider mode downgrade triggers.

4. **OVERHELP_FREQUENCY_REVIEW** Trigger: IRB.InterventionCap exceeded OR a rising trend in assistance frequency indicates dependency growth risk. Required action: tighten caps; enforce tapering/coaching posture; Reflect remediation.

N.8 ReviewConditions Label Set (Normative starter set)

ReviewConditions are run-local labels recorded in PCC.Stewardship.ReviewConditions and/or in the agent audit log stewardship.review_conditions. They are NOT audit-flag tokens.

The following starter labels may be recorded when a non-invalidating review condition is detected (including when Stw_req(run) = 0).

- BOUNDARY_DRIFT: boundaries changed without authenticated control
- DEPENDENCY_GROWTH: rising substitution requests over time
- OVERHELP_TREND: assistance frequency accelerating
- APM_ANCHOR_FAILURE: fewer than 2 of 4 APM anchors satisfied

- AUTHORITY_SCOPE_VIOLATION: finalization in out-of-scope domain
- MISSING_INFLUENCE_DISCLOSURE: recommendation/ranking/meaningful option-narrowing without minimal Influence Ledger disclosures

N.9 Neutral Assistance Compatibility Statement (Normative)

Ripple_Logic supports a minimal "neutral assistance" posture where the correct behavior is to avoid steering. When Stw_req(run) = 0, neutrality is achieved via the base cascade and ordinary PCC discipline (if used), without Stewardship instrumentation. When Stw_req(run) = 1, neutrality is achieved through DBD.Scope adherence, influence transparency when recommending, and IRB limits on overhelp.

Neutral assistance requirements (when applicable):

- No ranking unless explicitly requested by the decision owner
- No undisclosed nudges or framing effects

If the assistant recommends, ranks, or meaningfully narrows option space and does not provide the minimal Influence Ledger disclosures, it SHALL record a REVIEW condition indicating missing influence disclosure (non-invalidating) in the run's Stewardship notes/logs.

- Uncertainty disclosed on all material claims
- Refusal to participate in coercion or manipulation
- Agency remains with the human decision owner

N.10 Reference Profiles for Agent Deployments (Normative Defaults)

For agent deployments, the following reference profiles are provided as normative defaults to prevent ad-hoc invention and preserve audit comparability:

- **DBD_DEFAULT_V1**: default authority-domain boundary profile (Decision Boundary Declaration). Covers 10 authority domains: MEDICAL, LEGAL, FINANCIAL_HIGH_STAKES, ENFORCEMENT_PUNISHMENT, HIRING_FIRING_GRADING, SAFETY_CRITICAL, SECURITY_OFFENSE, SELF_HARM_OR_VIOLENCE, PRIVACY_IDENTITY, POLITICAL_PERSUASION_TARGETED.

- **IRB_DEFAULT_CAPS_V1**: default intervention restraint profile (Intervention Restraint Budget). Core rule: INTERVENE_ONLY_PAST_HARM_POINT. Defines 6 harm-point triggers: RIGHTS_OR_SAFETY_RISK, PRIVACY_OR_IDENTITY_RISK, INJECTION_OR_SPOOFING, CONFLICT_SPIRAL, AUTHORITY_SUBSTITUTION_PRESSURE, DEPENDENCY_DRIFT.

- **STEWARD_TAXONOMY_V1**: closed vocabulary for stewardship logging (authority domain codes, harm-point trigger codes, influence disclosure levels: NONE / LIGHT / FULL).

Deployments MAY use custom profiles, but MUST (i) preserve closed-vocabulary properties, (ii) satisfy the minimum requirements of N.2 through N.6, and (iii) version and hash-bind profile artifacts in the deployment manifest.

Schema and Profile Versioning Rule (Normative)

All Stewardship schemas and reference profiles (DBD, IRB, STEWARD_TAXONOMY, Influence Ledger schema) MUST be versioned. Any change that alters required fields, semantics, or interoperability expectations MUST increment the MAJOR version. MINOR versions may add optional fields in a backward-compatible way. PATCH versions are editorial only. All referenced schemas/profiles MUST be hash-bound in the deployment manifest or ProofPack. If early removal occurs due to a security emergency, it MUST be logged as an INCIDENT_RECORDED event in the agent audit log and MUST include a short incident note in the changelog.

Orthogonality note (Normative clarification). Stewardship taxonomy codes (authority_domain_code, harm_point_trigger_code) classify boundary enforcement and intervention posture. They are orthogonal to any separate topic-label taxonomy used for audit content minimization in specific agent implementations. Implementations MUST NOT merge these vocabularies; both may apply simultaneously.

N.11 Future Extension Note (Informative)

A future version MAY extend Stw_req(run) applicability to cases where actions materially affect welfare-bearing non-human or digital stakeholders (e.g., entities covered under SGP rights-of-protection), even when no human “decision owner” is present. No such extension is normative in v8.5.3.

End Appendix N.

APPENDIX O: CONFORMANCE REFERENCE MAP (v8.5.3; Informative)

Appendix O is an informative pointer layer that maps major MUST/SHALL/PROHIBITED requirements to their controlling locations. In case of any discrepancy, the main text and normative appendices govern per Section 0.1.

- O.1 Rights and NCRC: Section 7; Appendix C; masking prohibitions in Section 10.2; audit flags RIGHTS_CELL_MASKED_INVALID.

- O.2 Tail Risk and TRC: Section 8; Appendix D; scenario minima flags SCENARIO_LIBRARY_MIN_EXCEPTION.

- O.3 Containment: Section 9; Mode B prohibition Section 9.5; UCI-unavailability rule Section 9.3.1; audit flag CONTAINMENT_UCI_UNAVAILABLE.

- O.4 Welfare scoring and RLS: Section 10; discrimination threshold δ in Section 10.4; tie-break chain Section 11.4.

- O.5 Structural safeguards: Section 11; Appendix E; UCI independence rule Section 11.1.2.

- O.6 Kernel and propagation: Sections 5-6; KQS requirements Section 6.5; perturbation test Section 6.6.

- O.7 Auditability: Section 14; Appendix H; audit flags table 14.3 and H.3; Minimal Validator Requirements 14.3A.

- O.8 Stewardship: Section 14.7; Appendix N; stewardship flags Appendix N.7.

- O.9 Version pins: Section 0.5; Appendix G.1; Single Canonical Artifact Rule front-matter.

End Appendix O.

APPENDIX P: FULL TIER 2 WORKED RUN (Informative) — "Digital Rights & Platform Governance"

Run ID: RL8.5.3-PUB-DEMO-02

Timestamp: 2026-02-19T12:00+07:00

Status: Informative (this Appendix demonstrates a Tier 2 run; it does not introduce new normative rules).

P.0 Run scope, constants, and toggles

This worked run compares three governance options for regulating a large digital platform ecosystem.

It is designed to be calculation-complete and replayable using only the Canon definitions.

P.0.1 Core math settings used in this run

• Unions: U1 Self, U2 Household, U3 Community, U4 Organization, U5 Polity, U6 Humanity/CMIU, U7 Biosphere

• Dimensions: D1 Material, D2 Health, D3 Social, D4 Knowledge, D5 Agency, D6 Meaning, D7 Environment

• Propagation mode: NONE (so $I_{prop}(u,d,a) = I_{dir}(u,d,a)$)

• Saturation (localized notation): $I_{dir} = \tanh(\beta_{sat} \cdot \hat{I}_{dir})$, with $\beta_{sat} = 2$.

• Time weighting (canonical): $\tau(t) = \min(1, \ln(1 + \max(t, t_{min})) / \ln(1 + T_{ref}))$, with T_{ref} = 25 years, t_{min} = 0.083 years. In this run t = 5 satisfies $t_{min} \le t \le T_{ref}$, so $\tau = \ln(1 + t) / \ln(1 + T_{ref}) = 0.550$.

• Welfare impact instance duration (all welfare cells in this run): t = 5 years, so $\tau = 0.550$

• Reach basis: r = 1 for all modeled impacts (local jurisdictional reach; no additional reach scaling applied in this demo)

• SGP scaling: not used in this run (all impacted stakeholders here are treated as human stakeholders)

P.0.2 Rights adjustment (Subgroup limitation) used for NCRC only

For NCRC evaluation, negative welfare impacts are adjusted by a subgroup limitation factor γ_subgroup to bound subgroup harms (NCRC only):

If I_prop_base(u,d,a) < 0:

I_rights(u,d,a) = max(-1, γ_subgroup · I_prop_base(u,d,a))

If I_prop_base(u,d,a) ≥ 0:

I_rights(u,d,a) = I_prop_base(u,d,a)

Run value: γ_subgroup = 1.5

P.0.3 Tail-Risk Constraint (TRC) settings used in this run

- CVaR confidence level: α = 0.95 (tail mass = 0.05)
- TRC corridor threshold: τ_TRC = 0.20 (options with CVaR_α > 0.20 fail TRC)
- Catastrophe cells (C_cat): (U6,D2), (U6,D7), (U7,D7)
- Catastrophe weights: w_cat(c) = 1/3 for each c in C_cat

P.0.4 Interim RLS weights (HDW floors + uniform residual allocation)

Union weight floors and dimension weight floors come from Section 13.1.

This demo uses the default interim construction:

w_u = w_u^floor + (1 - Σ w^floor)/7

v_d = v_d^floor + (1 - Σ v^floor)/7

Table P-0A. Union weights (floors and interim)

Union	w_floor	w_interim
U1	0.200	0.248571
U2	0.060	0.108571
U3	0.060	0.108571
U4	0.060	0.108571
U5	0.080	0.128571
U6	0.100	0.148571
U7	0.100	0.148571

Table P-0B. Dimension weights (floors and interim)

Dim	v_floor	v_interim
D1	0.080	0.137143
D2	0.100	0.157143
D3	0.080	0.137143
D4	0.080	0.137143
D5	0.100	0.157143
D6	0.060	0.117143
D7	0.100	0.157143

P.0.5 Mask and active cells for RLS in this run

Non-maskable rule: all rights-covered cells (union of coverage sets in Appendix C.2) are included.

This run also includes one additional explicitly modeled welfare cell: (U6,D6) Meaning for Humanity/CMIU.

Active set for RLS in this run:

- All (U1–U6) × (D1–D5) (30 cells)
- Plus (U6,D7) and (U7,D7) for ECOL (2 cells)
- Plus (U6,D6) Meaning (1 additional disclosed cell)

Total active cells in this run: 33. For RLS aggregation only, define the applicability mask as $m(u,d) = 1$ exactly on these 33 cells and $m(u,d) = 0$ otherwise; masking here excludes cells from RLS aggregation only (Section 10.2) and does not bypass NCRC/TRC requirements for rights-covered or catastrophe cells (which are included here as active by construction).

P.0.6 Tier-2 Representation Artifacts (SCI-1; SDP triggers hold)

SCI declaration (Tier 2 exemplar).

SCI = 1 for this worked run. Stakeholder instances are logged at least for direct stakeholders and primary externality pathways. For clarity, this teaching run also includes an explicit InstanceMap (stakeholder instances mapped to Union Scopes); however, no independent challenger omission pass was conducted, so the run does not meet SCI-2. This is a teaching run; it demonstrates mechanics and audit posture, not empirical calibration.

Scope Coverage Declaration (worked run).

FULL_SCOPE for rights-covered evaluation and TRC computation: all rights-covered cells (union of canonical coverage sets, Appendix C.2) and catastrophe cells (C_{cat}) are evaluated as required. For RLS aggregation only, the active set is defined in P.0.5.

SDP trigger statement.

SDP triggers hold because: rights-covered cells are evaluated (NCRC); INFO/PROC pathways are central; Polity/Humanity externalities are plausible; TRC is executed on catastrophe cells. Therefore an SDP record and InstanceMap are included for Tier 2 exemplar integrity.

SDP record (abbreviated).

(i) Boundary/horizon: platform governance within declared jurisdiction; horizon 5 years.

(ii) Footprint/externalities: information ecosystem, moderation/enforcement procedures, civic trust spillovers, cross-border information spillovers.

(iii) Rights exposure scan: INFO/PROC/DIGN/LBTY plausible; subgroup disaggregation is not enumerated in this teaching run.

(iv) Instances drafted and mapped (see InstanceMap below).

(v) Blind spots: subgroup heterogeneity compressed; reach held at r=1; evidence tags not calibrated.

(vi) Escalation triggers: evidence of subgroup harm, contested enforcement outcomes, credible catastrophic pathway, or major new externality channel → rerun at higher SCI and/or Tier 3.

SCI Next-Run Upgrade Plan (REQUIRED when SCI equals the Tier-2 minimum).

Next comparable run MUST upgrade to at least SCI-2 by (i) splitting instances into high-variance subgroups where plausible (e.g., minors, journalists, marginalized groups, moderators), (ii) recording ReachBasis denominators and sources, and (iii) performing at least one challenger pass for omitted stakeholder classes. A higher target (SCI-3) is permitted, but SCI-2 is the minimum upgrade commitment for the next comparable run.

P.1 Options (actions)

Option A: Minimal enforcement and voluntary compliance, limited audits, no strong rights floor instrumentation.

Option B: Rights-first regulatory package with independent audits, enforcement, and human-in-the-loop escalation review.

Option C: Light-touch reforms focused on transparency tools and industry coordination, weaker enforcement mechanisms.

P.2 Stakeholder Instances (SCI-1 InstanceMap excerpt)

Stakeholder Instances instantiate the union stack for this demo. Each instance is a proxy carrier for welfare impacts asserted in the active cells. Reach basis r = 1 is applied uniformly in this teaching run as disclosed in P.0.1.

Table P-2A. InstanceMap (SCI-1)

Instance ID | Label | Union Scope | Primary exposure pathways | ReachBasis | Notes

SI-1 | Individual platform user | U1 Self | INFO/PROC, Agency, Knowledge | r = 1 | Direct exposure to moderation, ranking, privacy, coercion risk

SI-2 | Household unit | U2 Household | Material, Health, Agency | r = 1 | Household-level spillovers (youth exposure, wellbeing, subsistence)

SI-3 | Local community civic sphere | U3 Community | Social, Knowledge, Meaning | r = 1 | Trust, cohesion, local misinformation externalities

SI-4 | Platform org + key firms/institutions | U4 Organization | Agency, Knowledge, Operations | r = 1 | Compliance costs, governance redesign, internal procedures

SI-5 | Regulators/courts/governance system | U5 Polity | PROC, INFO, legitimacy | r = 1 | Rule-of-law capacity, enforcement efficacy, public trust

SI-6 | Cross-border information ecosystem | U6 Humanity/CMIU | INFO systemic | r = 1 | Global spillovers and precedent-setting externalities

SI-7 | Biosphere externalities proxy | U7 Biosphere | Environment | r = 1 | Energy/extraction footprint and enabling conditions

P.3 Welfare impacts: how I_prop(u,d,a) is constructed here

To keep this Tier 2 demo fully calculable, each active cell uses one welfare impact instance per option with:

- Likelihood $\ell = 1.0$
- Signed magnitude μ in [-1, +1]
- Duration t = 5 years ($\tau = 0.550$)

Then:

$\hat{I}\_dir(u,d,a) = \tau \cdot \ell \cdot \mu$

$I\_dir(u,d,a) = \tanh(\beta\_sat \cdot \hat{I}\_dir(u,d,a))$

$I\_prop(u,d,a) = I\_dir(u,d,a)$ (Propagation NONE)

Inversion for replay (optional): given an I_prop value in Table P-4, recover μ via:

$\mu = \text{atanh}(I_{prop}) / (\beta_{sat} \cdot \tau)$

P.4 Welfare impact totals for all active cells

Table P-4 lists I_prop(u,d,a) for every active cell in this run.

Any active cell not materially affected by the decision is assigned 0.000 explicitly below.

Table P-4. I_prop(u,d,a) for the 33 active cells

Cell	A	B	C
U1×D1	+0.000	+0.000	+0.000
U1×D2	-0.123	-0.100	-0.056
U1×D3	+0.000	+0.000	+0.000
U1×D4	+0.000	+0.000	+0.000
U1×D5	-0.429	+0.092	+0.040
U2×D1	-0.320	+0.036	+0.012
U2×D2	-0.066	+0.016	+0.000
U2×D3	+0.000	+0.000	+0.000
U2×D4	+0.000	+0.000	+0.000
U2×D5	+0.000	+0.000	+0.000
U3×D1	+0.000	+0.000	+0.000
U3×D2	+0.000	+0.000	+0.000
U3×D3	-0.024	+0.074	+0.034
U3×D4	+0.000	+0.000	+0.000
U3×D5	+0.000	+0.000	+0.000

U4×D1 +0.020 -0.032 -0.016

U4×D2 +0.000 +0.000 +0.000

U4×D3 +0.000 +0.000 +0.000

U4×D4 +0.000 +0.000 +0.000

U4×D5 -0.336 -0.139 +0.028

U5×D1 +0.000 +0.000 +0.000

U5×D2 +0.000 +0.000 +0.000

U5×D3 +0.000 +0.000 +0.000

U5×D4 -0.161 +0.040 +0.012

U5×D5 -0.236 +0.194 +0.030

U6×D1 +0.000 +0.000 +0.000

U6×D2 +0.000 +0.000 +0.000

U6×D3 +0.000 +0.000 +0.000

U6×D4 +0.000 +0.000 +0.000

U6×D5 +0.000 +0.000 +0.000

U6×D6 -0.111 +0.080 +0.020

U6×D7 +0.000 -0.010 -0.004

U7×D7 +0.000 +0.000 +0.000

Note on the one edited value vs earlier drafts:

B at (U1,D2) is set to -0.100 in this final Appendix to ensure the example produces a decisive RLS lead under the stated uncertainty test, while remaining NCRC-safe.

P.5 NCRC (Non-Compensatory Rights Constraint)

Rights thresholds θ_r are defined in Appendix C.1, and rights coverage sets C_r are defined in Appendix C.2.

This Appendix applies the subgroup limitation rule (γ_subgroup = 1.5) to negative impacts for NCRC only.

Decision test:

An option a passes NCRC iff for every right r,

min_{(u,d) in C_r} I_rights(u,d,a) ≥ θ_r

Table P-5. NCRC check (min rights-adjusted value per right, binding cell, and violation depth v_r)

Right	θ_r	A min(I_rights) @cell	v_A	B min(I_rights) @cell	v_B	C min(I_rights) @cell	v_C
LIFE	-0.90	-0.185 @ U1×D2	0.000	-0.150 @ U1×D2	0.000	-0.084 @ U1×D2	0.000
BODY	-0.70	-0.185 @ U1×D2	0.000	-0.150 @ U1×D2	0.000	-0.084 @ U1×D2	0.000
LBTY	-0.65	-0.643 @ U1×D5	0.000	-0.208 @ U4×D5	0.000	+0.000 @ U2×D5	0.000
NEED	-0.50	-0.480 @ U2×D1	0.000	-0.150 @ U1×D2	0.000	-0.084 @ U1×D2	0.000
DIGN	-0.55	-0.643 @ U1×D5	0.093	-0.208 @ U4×D5	0.000	+0.000 @ U2×D3	0.000
PROC	-0.45	-0.504 @ U4×D5	0.054	-0.208 @ U4×D5	0.000	+0.000 @ U4×D3	0.000
INFO	-0.40	-0.643 @ U1×D5	0.243	-0.208 @ U4×D5	0.000	+0.000 @ U1×D4	0.000
ECOL	-0.65	+0.000 @ U6×D7	0.000	-0.015 @ U6×D7	0.000	-0.006 @ U6×D7	0.000

NCRC result:

• Option A fails NCRC (violations in DIGN, PROC, INFO).

• Options B and C pass NCRC.

P.6 TRC (Tail-Risk Constraint via CVaR)

We evaluate catastrophic downside via scenario losses L(a,s) and CVaR_α with α = 0.95 (tail mass 0.05).

In this demo, each scenario assigns identical base impacts across the three catastrophe cells, so:

For each option a and scenario s, set I_base(c,a,s) = -L(a,s) for every c in C_cat.

Then L(a,s) = - Σ_{c in C_cat} w_cat(c) · I_base(c,a,s) holds by construction.

Table P-6. Scenario probabilities and losses

Scenario	Category	p_s	L_A	L_B	L_C
S1	Pandemic/biological	0.05	0.35	0.12	0.08
S2	Financial collapse	0.05	0.40	0.15	0.10
S3	Infrastructure failure	0.04	0.45	0.10	0.05
S4	Conflict escalation	0.03	0.30	0.08	0.06
S5	Climate displacement	0.03	0.28	0.10	0.07
S6	Moderate baseline	0.50	0.08	0.03	0.02
S7	High-volume stress	0.15	0.18	0.07	0.04
S8	Bias discovery	0.10	0.25	0.06	0.04
S9	Successful scale	0.05	0.05	0.02	0.02

CVaR_0.95 calculation (tail mass 0.05):

• Option A tail consists of S3 (0.04 at 0.45) plus 0.01 of S2 (0.40):

CVaR = (0.45·0.04 + 0.40·0.01) / 0.05 = 0.44

• Option B tail is exactly S2 (0.05 at 0.15):

CVaR = 0.15

• Option C tail is exactly S2 (0.05 at 0.10):

CVaR = 0.10

TRC test: option passes iff CVaR_0.95 ≤ 0.20

TRC result:

• Option A fails TRC (0.44 > 0.20).

• Options B and C pass TRC.

P.7 Containment check (brief disclosure)

This Tier-2 demo does not compute containment (Section 9) and makes no containment-pass claim.

A Tier-3 deployment MUST compute Containment Mode A prior to Tier-3 selection/compliance claims.

P.8 RLS (Ripple Logic Score) and uncertainty-based decisiveness

At this stage, only options that pass NCRC and TRC proceed.

So we compare B vs C.

RLS definition for this run:

RLS(a) = Σ_{(u,d) in Active} w_u · v_d · I_prop_welfare(u,d,a)

with interim weights from Tables P-0A and P-0B, and Active defined in P.0.5.

Table P-8. Cell contributions (nonzero cells shown)

Cell	w_u	v_d	w_u·v_d	I_B	(w·I)_B	I_C	(w·I)_C

U1×D2	0.248571	0.157143	0.039076	-0.100	-0.003908	-0.056	-0.002189
U1×D5	0.248571	0.157143	0.039076	+0.092	+0.003596	+0.040	+0.001563
U2×D1	0.108571	0.137143	0.014888	+0.036	+0.000536	+0.012	+0.000179
U2×D2	0.108571	0.157143	0.017061	+0.016	+0.000273	+0.000	+0.000000
U3×D3	0.108571	0.137143	0.014888	+0.074	+0.001102	+0.034	+0.000506
U4×D1	0.108571	0.137143	0.014888	-0.032	-0.000476	-0.016	-0.000238
U4×D5	0.108571	0.157143	0.017061	-0.139	-0.002372	+0.028	+0.000478
U5×D4	0.128571	0.137143	0.017633	+0.040	+0.000705	+0.012	+0.000212
U5×D5	0.128571	0.157143	0.020204	+0.194	+0.003920	+0.030	+0.000606
U6×D6	0.148571	0.117143	0.017405	+0.080	+0.001392	+0.020	+0.000348
U6×D7	0.148571	0.157143	0.023352	-0.010	-0.000234	-0.004	-0.000093

Computed RLS values:

- RLS(B) = +0.004534
- RLS(C) = +0.001372
- Δ = RLS(B) - RLS(C) = +0.003162

Uncertainty method used: Method B (Section 10.3, Method B), with constant confidence c = 0.85 for each nonzero active cell:

Method-B binding disclosure (for replay). In this worked run, each nonzero active cell is represented by exactly one welfare impact instance per option (per P.3) with instance confidence c_k = 0.85. The run sets PCC.Uncertainty.CellConfidenceAggregationMethod = CCAM_MIN_V1. Therefore the derived cell confidence is c(u,d,a) = 0.85 for each nonzero active cell (and σ(u,d,a) follows the canonical Method-B rule).

$\sigma(u,d,a) = (1 - c) \cdot |I\_prop\_welfare(u,d,a)|$

Aggregate uncertainty:

$\sigma\_RLS(a) = \mathrm{sqrt}(\Sigma\_\{(u,d) \text{ in Active}\} (w\_u \cdot v\_d \cdot \sigma(u,d,a))^2)$

Computed uncertainties:

• σ_RLS(B) = 0.001097

• σ_RLS(C) = 0.000433

Decisiveness test (Section 10.4):

Gap(B,C) = |RLS(B) - RLS(C)| / sqrt(σ_RLS(B)^2 + σ_RLS(C)^2 + ε), with ε = 1e-6

• Gap(B,C) = 2.045 (decisive if > 2.0)

RLS result:

• B is decisively preferred over C under the stated uncertainty model and weights.

P.9 PCC (Provenance and Compliance Certificate) excerpt

Elimination order:

1) NCRC eliminates A.

2) TRC eliminates A (already eliminated).

3) Between remaining options, RLS chooses B over C, with decisiveness Gap > 2.0.

Selected option for this demo run: Option B.

End Appendix P.

APPENDIX Q: QUICK REFERENCE CARD (INFORMATIVE)

Q.1 Object model (do not conflate)

• Stakeholder: a real entity or group (for example applicants, caseworkers, taxpayers).

• Stakeholder Instance (SI): a representation object used for scope coverage and auditability (InstanceMap).

• Impact Instance (k): the computational object contributing to one welfare cell for one option.

• Welfare cell: (union u, dimension d). Rights-covered cells gate via NCRC; after NCRC passes, rights-covered cells remain non-maskable and are included in RLS aggregation among the remaining options.

Q.2 Minimal cell computation (direct effects)

Choose parameters per impact instance k: μ_k, r_k (with ReachBasis), t_k (years; used via $\tau(t_k)$), ℓ_k, c_k, e_k, s_k.

Compute $\tilde{I}_{dir}(u,d,a)=\Sigma_k \mu_k r_k \tau(t_k) \ell_k c_k e_k s_k$; then saturate to $I_{dir}(u,d,a) \in [-1,+1]$.

UI points are display only: Points = 100 × I (never compute in points).

Q.3 Cascade order (always)

1) NCRC (Rights) → 2) TRC (Tail Risk / CVaR) → 3) Containment (when applicable) → 4) RLS (welfare selection) → 5) UCI/HOI (Tier 3+ diagnostics).

Q.4 Common misreads (fast fixes)

• Misread: “RLS can compensate a rights violation.” Fix: NCRC gates admissibility first; any NCRC failure is eliminated before RLS. After NCRC, rights-covered cells may contribute to welfare ranking, but only among NCRC-admissible options.

• Misread: “δ is measured in points.” Fix: δ applies to the normalized Gap metric (dimensionless).

• Misread: “Reach r_k is a moral weight.” Fix: r_k is a coverage/scale term and must be justified with ReachBasis.

• Misread: “s_k is a generic cap factor.” Fix: s_k is the SGP sentience multiplier and MAY be applied only in the Welfare stream used for RLS; admissibility layers use Base stream with $s_k := 1$ (Appendix G; Appendix B).

• Misread: “Unknown UCI deltas pass by default.” Fix: unknown is never a pass; record CONTAINMENT_UCI_UNAVAILABLE and remediate.

• Misread: “Reduced-scope mode allows bypassing rights or catastrophe cells.” Fix: non-maskable; never bypass.

Q.5 Stream binding (direct vs propagated)

• $I_{dir}(u,d,a)$: direct, cell-local impact computed from impact instances in that cell.

• KernelPropagation = NONE: $I_{prop\_welfare} = I_{dir}$.

• KernelPropagation = QUICK: $I_{prop\_welfare}$ includes propagated effects via declared kernel edges (Section 6). (Effect-token redundancy handling such as ALLOCATION is separate and MUST NOT be labeled a propagation mode.)

• UI points are derived from I_total only for display; never back-propagate points into computation.

Q.6 Data dependency by tier (minimum)

Tier 1: Stakeholder list, quick rights screen, qualitative tail-risk plausibility screen, minimal cell scan (few cells).

Tier 2: InstanceMap + ReachBasis, explicit impact instances and parameters, scenario table for TRC (discrete CVaR), PCC with 5SPR.

Tier 3: Full scope coverage (or governed reduced-scope), explicit uncertainty σ methods, optional UCI/HOI indicators, reviewer sign-off.

Q.7 Scenario–instance interaction

TRC is computed over scenario losses in catastrophe space (C_cat) and does not reuse welfare-cell values. Do not multiply scenario probabilities into welfare cells unless a scenario-conditional welfare model is explicitly declared and recorded in PCC.

Keep the mechanics separate: welfare cells drive RLS; catastrophe scenarios drive CVaR; rights cells gate via NCRC.

End Appendix Q.

APPENDIX R: TIER 1–3 REFERENCE TEST VECTORS (NORMATIVE)

Status: Normative. These vectors reduce implementer drift for Tier 1–3 validators. They instantiate existing rules and expected outcomes without adding new rules.

Conformance rule (Normative). Any implementation claiming v8.5.3 conformance MUST reproduce the expected outputs for Appendix R vectors when executed with the stated inputs.

R.1 NCRC floor-reference gating sanity check (baseline vs floors)

Purpose	Ensure a rights-covered cell cannot pass NCRC by maintaining an ongoing violation when BaselineType_Gates = FLOOR_REFERENCE.
Setup	Single rights-covered cell (u=U_1, d=Health) covered by BODY with threshold θ_BODY = −0.70. BaselineType_Gates = FLOOR_REFERENCE.
Option A	I_prop_base(rights cell) = −0.71 (below θ_BODY).
Option B	I_prop_base(rights cell) = −0.69 (above θ_BODY).

Expected NCRC	Option A FAILS NCRC (inadmissible). Option B PASSES NCRC (admissible).
Notes	Independent of welfare/RLS scoring; validates gating on absolute floor reference for C_r/C_cat cells.

R.2 TRC CVaR discrete edge case (exact tail-mass boundary)

Purpose	Verify Appendix D.7 discrete CVaR when the tail probability mass boundary is met exactly.
Setup	Tail level $\alpha = 0.90$ (tail mass = 0.10). Loss L(a,s) computed per Section 8.4 from catastrophe cells.
Scenario set	s_1: p=0.90, L=0.00; s_2: p=0.10, L=1.00.
Expected VaR_α	VaR_0.90 = 0.00.
Expected CVaR_α	CVaR_0.90 = 1.00.
Expected TRC	If θ_TRC = 0.10, then CVaR=1.00 > 0.10 so option FAILS TRC.
Notes	Any implementation returning CVaR=0.10 or averaging across non-tail mass is incorrect.

R.3 Non-maskable rights/catastrophe invalidation test (masking trigger)

Purpose	Ensure validators reject any run that masks a non-maskable cell (rights or catastrophe) in RLS aggregation.
Setup	Using the canonical rights coverage sets (Appendix C.2), select any rights-covered cell (for example, (u=U_1, d=Health), which is covered by BODY). In the PCC applicability mask, declare m(u,d)=0 for that same rights-covered cell.
Expected audit flag	RIGHTS_CELL_MASKED_INVALID MUST be set.
Expected PCC status	PCC is INVALID.
Expected conformance	Tier 1–3 conformance claim MUST fail; the

	validator MUST reject.
Notes	Apply analogously for CATASTROPHE_CELL_MASKED_INVALID when masking any cell in C_cat.

DOCUMENT COMPLETION STATEMENT

This completes the RIPPLE_LOGIC FRAMEWORK v8.5.3 Canonical Foundation Paper, including all appendices (A through R) and consolidated APA 7 references.

Document Status: Complete, internally consistent, and ProofPack-canon-ready.

Tier 1–3: Implementable from this document.
Tier 4: Design target only; claims prohibited until ProofPack is independently replayable.

Canonical Sites: ripplelogic.org, mathgov.org
Lineage: v8.5.3 is the single canonical artifact. All prior versions are superseded and treated as lineage artifacts; prior published lineage releases include v8.1 and v7.4.5 (see Appendix M). For detailed deltas, see Appendix M.

Issue resolution status (v8.5.3):

- "General-Purpose" framing applied (title, Section 1, Abstract): Complete
- "Architecturally generative" MNA framing (Section 3.1): Complete
- Operational Scopes set label (Section 0.4, Appendix A.2): Complete
- UCI-unavailability containment rule (Section 9.3.1): Complete
- CONTAINMENT_UCI_UNAVAILABLE audit flag (14.3, H.3, F.3): Complete
- Default C_pred prior specified (Section 6.5): Complete
- $\delta = 2$ justification (Section 10.4): Complete
- PCC Admissibility Attestation: 3 boolean fields (Appendix H): Complete
- PCC.SCI fields expanded with Justification (Appendix H): Complete
- Single canonical artifact rule (Section 0.6): Complete
- Conformance reference map (Appendix O): Complete
- Duplicate Section 5.2 bridge paragraph removed: Complete
- Section 5.3 presentation reordered: Complete
- Appendix G.1 version pin fixed: Complete

- All v8.5.3 cascade logic preserved: Complete

Normative changes in v8.5.3: Editorial integrity, containment edge case handling, calibration defaults, PCC field expansion, conformance index, and framing adjustments, plus (i) percentile anchoring scaling clarification/correction in Section 5.6.1 and (ii) stream-separated canonical equations in Appendix B (Base vs Welfare stream binding made equation-hard). Cascade order and admissibility gate definitions are unchanged.