River Refugium Project (RRP)

CERNUNNOS FOUNDATION

BRIGHT MEADOW GROUP

Systems Analysis and Solutions Consulting

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RIVER REFUGIUM PROJECT Cernunnos Foundation Bright Meadow Group	**RRP12 — Deployment Economics ****&**** Revenue Stack** Document No: RRP0002.13	Version: 2.0	01 April 2026 Status: Published — Version 2.0	Supersedes: Version 1.0 (2025) *Contact: robert@brightmeadowgroup.com	www.cernunnosfoundation.com*

Abstract Note: RRP12 is retained as a standalone reference document for deployment-specific economic context. The primary economic analysis — including the three-scenario financial framework, full revenue layer documentation, capital stack, and operating cost structure — is contained in the RRP Economic Analysis Complete document (Version 2.0, 01 April 2026). This document provides supplementary deployment economics narrative and the complete 8-layer revenue stack description in long-form prose format for reference.

1. The Economic Thesis

The RRP succeeds financially because it transforms the source of environmental damage into commercially valuable outputs.[1] Riverborne nutrients, organic solids, suspended material, heat, and CO_2 — the inputs that drive ecological harm — are redirected inside the RRP node and converted into biomass, fuel precursors, carbon-negative materials, and verifiable environmental credits. The pollutant is the feedstock. The cleanup is the production process.

This principle means the system becomes more economically productive in direct proportion to how polluted the source water is. The most degraded rivers are the best business cases. This alignment between environmental need and financial incentive is the system's most important structural characteristic.

2. Three-Scenario Reference

The financial performance of the RRP under three defined scenarios is documented in the RRP Economic Analysis Complete (Version 2.0). Key reference points:[2]

- Stress Test: floor-market prices, reduced cycles, no grants. System loses money. Biology continues to function. Environmental mandate is fulfilled regardless of market conditions.

- Operating Model: industrial build at $7/sq ft, mid-market prices, full cycles. Model B profitable at 11.8% EBITDA. Model A requires one Model B satellite to cross into positive territory. $5.25/lb nitrogen credit price produces standalone Model A profitability.

- Best Case: premium prices, year-round operation, 97% uptime. Model B clears $2.37M net income on $4.35M equity, sub-1-year payback.

3. The 8-Layer Revenue Stack

The complete revenue architecture documentation — including buyer categories, market descriptions, and scenario-referenced financial ranges — is provided in the RRP Economic Analysis Complete, Section 2. The eight layers are summarized here for reference:

- Layer 1: Biomass Production — primary cash flow, commodity-tied, high volume

- Layer 2: Hydrochar — carbon-negative material, soil amendment, activated carbon precursor

- Layer 3: Bio-Oil — industrial feedstock, refinery-grade, globally tradable

- Layer 4: Carbon Sequestration Credits — hydrochar permanence, avoided emissions

- Layer 5: Nutrient Trading & Water-Quality Credits — primary revenue driver, performance-based

- Layer 6: Biogas & Heat Recovery — thermal self-sufficiency, no purchased heating

- Layer 7: Productized Side-Streams — aqueous-phase organics, fibrous residues, clarified water

- Layer 8: Environmental Data — research contracts, academic partnerships, predictive analytics

4. Long-Term National Economics

As nodes scale across watersheds, supply chains consolidate, biomass feedstock contracts stabilize, and data products gain national significance. Tribal nations adopt sovereign nodes. Rural regions anchor local processing loops. National credit markets mature around hydrochar permanence.[3] Over 20–30 years this becomes a new rural industry category — watershed restoration agriculture — producing jobs, fuel, materials, carbon storage, and restored rivers simultaneously. No other restoration approach creates a nationwide supply chain.

Notes

Citations follow Chicago Notes-Bibliography style. Internal Bright Meadow Group / Cernunnos Foundation documents are cited by document title and year. Figures marked ⚑ are provisional academic proxies pending replacement by RRP pilot data per RRP8.

- **1. ***Bright Meadow Group, **"**RRP Economic Analysis — Three-Scenario Framework,**"** Version 2.0. CF/BMG, 01 April 2026.*

- **2. ***Ibid.*

- **3. ***Bright Meadow Group, **"**RRP10 — Strategic Deployment Outlook,**"** Version 2.0. CF/BMG, 01 April 2026.*