River Refugium Project (RRP)

CERNUNNOS FOUNDATION

BRIGHT MEADOW GROUP

Systems Analysis and Solutions Consulting

Document Title:

Appendix G: Fiber Production Pathway

RRP Document Number:

RRP0002-AppG

Version by date time group:

04 AUG 2026 0001

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RIVER REFUGIUM PROJECT Cernunnos Foundation Bright Meadow Group	**Appendix G — Fiber Production Pathway** Document No: RRP0002-AppG | Version: 1.0 | 04 AUG 2026 0001 Status: Published — New document, issued against Series Version 2.0 | Supersedes: None *Contact: robert@brightmeadowgroup.com | www.cernunnosfoundation.com*

Abstract

Appendix G defines the fiber production pathway — an RRP deployment mode in which captured nitrogen and phosphorus are converted into textile and industrial fiber. It is the least contamination-constrained pathway in the framework: nothing is ingested and nothing must survive in ground contact, which makes it the pathway of choice for the degraded, industrial, and uncharacterizable water that disqualifies every other use. That freedom is real but not unlimited, and Sections 7 and 8 define precisely where it stops. The appendix specifies two fiber classes and their species, the growing architecture inherited from Appendix F, a retting strategy that recovers a process abandoned on pollution grounds by internalizing its effluent, the cotton case as the framework's hardest and most valuable problem, a three-destination qualification structure, and the product ladder. All yield, quality, and processing figures are provisional literature proxies pending RRP pilot data per RRP8.

1. Position Within the RRP Framework

1.1 What This Pathway Is

The fiber pathway converts captured nutrient into plant fiber for textile and industrial use. RRP4 §§3.2 through 3.6 already assign five greenhouse types to fiber crops — cotton, hemp, jute, flax, and nettle. This appendix is the full development of those assignments into an operating pathway with species selection logic, processing architecture, qualification structure, and product routing.

It is the third pathway in the deployment set and the one that changes the site selection calculus most, because it is the only pathway that can be sited on water the others must refuse.

1.2 The Three-Pathway Comparison

	Appendix E — Feed	**Appendix F — Coppice**	**Appendix G — Fiber**
Turnover	Days to weeks	Years	One season
Binding constraint	What may enter an animal	What survives in ground contact	What may touch skin — and only for the textile fraction
Eligible water	Tier I and II only	Most; metals constrain the compost loop	All tiers, including Tier III
Where contamination bites	At harvest — tissue analysis	In recycled media and in wood	At the char, not the harvest (§8)
RRP6 fit	Needs Slot Type F	Needs standing-stock class	Fits existing Slot Types B and D (§11)

Table G-1. *Three pathways compared. Fiber is the only one that can take the worst water in the watershed.*

1.3 Relationship to Existing Series Documents

Document	Relationship to Appendix G
RRP3 §2	Covered water tower. Section 6.3 uses it as a condensing surface for the dry-air requirement in cotton finishing and fiber drying.
RRP4 §§3.2–3.6	Cotton, Hemp, Jute, Flax, and Nettle Houses. This appendix is the full development of those five assignments.
RRP4 §3.9	⚠️ Bamboo House currently reads as textile fiber intent. Bamboo textile routes are excluded per Appendix F §7.4; bamboo is a pole and char crop. Correction required.
RRP5	Thermochemical routing. Receives shive, tow, gin trash, and all off-grade material. Also the point at which metals concentrate rather than disappear — see Section 8.
RRP6 §5	Modular slot framework. Slot Type B (fast-fiber terrestrial) and Slot Type D (textile fiber) already exist and substantially fit this pathway. No amendment proposed.
RRP8	Governing document for measurement standards. Retting tank effluent monitoring in §5.5 is additive to Axis 2.
Appendix E	Source-water tier logic and the trace metal framework apply. Cottonseed routed to feed re-enters the full Appendix E qualification protocol — see §6.5.
Appendix F	Growing architecture. Channel datum, river rock corridor, compost habitat, bucket offset, flux cycling, and two-stage refugium are inherited without modification. See Section 4.

2. The Contamination Argument

Every other pathway in this framework is governed by what the biomass is allowed to contain. Feed is constrained by what may enter an animal. Coppice is constrained by what must survive decades in ground contact and by what leaches out of a post into pasture soil.

Fiber is not eaten and does not have to hold a fence up. That single fact makes it the pathway that can be sited on water no other use will accept.

The consequence for deployment strategy is substantial. Appendix E §6 defines Tier III — municipal stormwater, water downstream of a treatment outfall, industrial corridors, legacy-contaminated watersheds, mine-influenced water, any source that cannot be characterized — and rules it categorically ineligible for feed. Appendix F is constrained on those same sites by the compost recycling loop.

Tier III is where the fiber pathway belongs. These are frequently the most degraded reaches in a watershed, the ones with the strongest nutrient loading, the weakest competing land use, and the least political resistance to intervention. The pathway that can take them is the pathway that gets sited where the problem is worst.

2.1 Where the Freedom Stops

The freedom is real and it is not unlimited. Two boundaries are absolute and are developed in later sections.

- Textile certification tests the finished good, not the field. Schemes covering consumer textiles screen for heavy metals, residues, and restricted substances in the product a person wears. Fiber destined for cloth is subject to that testing regardless of how tolerant the growing stage was. See Section 7.

- Thermochemical processing destroys organics; it does not destroy metals. Toxins, pharmaceutical residues, and most pesticide compounds do not survive HTC or HTL. Cadmium, lead, and arsenic do, and they concentrate. See Section 8.

The correct statement of the pathway's advantage is therefore narrower than it first appears and more durable for being narrow: fiber removes the ingestion constraint and the durability constraint. It does not remove the contamination question. It relocates it.

3. Fiber Classes and Species

3.1 Class B — Bast Fiber

Bast fiber is the phloem tissue of the stem, running the length of the stalk outside the woody core. Harvest is a mowing operation: cut at the base, bundle, process. There is no picking, no ginning, and no seed-fiber separation.

This is the class that carries the pathway. European flax and hemp processing runs on commercially available scutching, hackling, and decortication equipment today — the machinery gap that constrains cotton in Section 6 largely does not exist here.

Species	Botanical	Cycle	Primary Products	Notes
Flax	Linum usitatissimum	90–120 days ⚑	Linen fiber, tow, linseed, shive	Highest-value bast textile. Dual-use fiber and seed. Cool-season tolerant.
Hemp	Cannabis sativa	90–120 days ⚑	Long fiber, tow, hurd, seed	Highest tonnage. Hurd is a substantial second product. Regulatory gate per §9.1.
Jute	Corchorus spp.	120–150 days ⚑	Sacking, cordage, geotextile, composite	Warm, humid requirement. High volume, coarse fiber, industrial rather than apparel.
Kenaf	Hibiscus cannabinus	120–150 days ⚑	Composite, pulp, cordage, absorbent core	Warm-season. Strong industrial and automotive composite demand.
Nettle	Urtica dioica	Perennial; multiple cuts ⚑	Fine apparel fiber, high-turnover biomass	Perennial — apply Appendix F standing-stock logic. RRP4 §3.6 notes it thrives in nutrient-heavy conditions.
Ramie	Boehmeria nivea	Perennial; 3–6 cuts/yr ⚑	Fine, strong apparel fiber	Exceptional strength. Degumming is chemically demanding and is the limiting step, not growing.

⚑ **PROVISIONAL:** *Cycle lengths are open-field agronomic figures. Growth under continuous nutrient supply in controlled environment may differ substantially, and fiber fineness and strength under this culture method are entirely unmeasured. Fiber quality is not a function of tonnage and must not be inferred from it.*

Table G-2. *Class B bast fiber species. Nettle and ramie are perennial and route through Appendix F standing-stock logic.*

3.2 Class S — Seed Hair Fiber

Cotton (Gossypium spp.) is the only member of this class and is treated separately in Section 6. The fiber is not stem tissue but a seed appendage, which changes the harvest operation, the processing chain, the environmental requirement at maturity, and the equipment situation completely.

It is the hardest crop in this pathway and the most valuable to solve.

3.3 Difficulty Ordering

For deployment sequencing purposes, ordered by total system difficulty rather than by market value:

- Flax and hemp — easiest. Mow harvest, established processing equipment, mature markets, tolerant of the growing architecture.
- Kenaf and jute — similar mechanically, warmer climate requirement, industrial rather than apparel markets.
- Nettle — moderate. Perennial management, less developed processing chain, thrives in exactly the nutrient conditions this system produces.
- Ramie — growing is straightforward; degumming is a chemical process that must be solved before the crop makes sense.
- Cotton — hardest end to end, and Section 6 is the reason.

4. Growing Architecture

The growing architecture for this pathway is inherited from Appendix F Section 4 and is not restated here. Fixed channel datum, rounded river rock as corridor and behavioral containment boundary, compost as root habitat, container offset as the per-species water-table tuning mechanism, flux cycling specified as root-zone gas exchange, and the two-stage primary and secondary refugium structure all apply without modification.

Why Fiber Is Architecturally Easier Than Coppice

Most fiber crops are annuals harvested in a single season. That removes almost every hard problem in Appendix F: no multi-year standing stock, no decade-long root relationship, no permanent bed that cannot be cleaned out, no rotation-block financial structure, and no accumulation of recycled compost metals across ten harvests.

The bed can be serviced between crops. The media can be replaced. The financial model already has a shape for it. Appendix F had to solve the hard version of the growing problem, and this pathway inherits the solution without inheriting the difficulty.

4.1 Differences From the Coppice Case

- Annual cycle permits between-crop bed servicing, which removes the upstream solids specification constraint imposed by Appendix F §4.9.
- Root systems are shallow and short-lived. Behavioral containment is trivially satisfied and container offset requirements are correspondingly less demanding.
- Bast crops are grown at high stem density deliberately — crowding suppresses branching and produces the long, straight, unbranched stems that yield long-line fiber. This is the opposite of the spacing logic in every other pathway.

- Nettle and ramie are perennial and revert to Appendix F standing-stock handling for both bed management and financial treatment.

4.2 The Density Rule

Fiber quality is a function of plant architecture, and plant architecture is a function of competition. A widely spaced flax plant branches, and a branched stem produces short, tangled fiber suitable only for tow. Dense stands produce the tall unbranched stems that long-line fiber requires. Fertility, light, and spacing must be managed toward stem form rather than toward biomass maximum — the two objectives diverge, and a system optimized for tonnage will produce a large quantity of low-grade fiber.

This is the single most important agronomic distinction between the fiber pathway and every other pathway in the framework. ⚑ PROVISIONAL — optimal density under continuous nutrient supply is unestablished and is a first-order pilot question.

5. Retting — Recovering an Abandoned Process

Bast fiber must be separated from the woody core and from the pectins binding it to surrounding tissue. That separation is retting, and it is a microbial process rather than a mechanical one. It is also the step that determines fiber quality more than any other.

5.1 The Historical Trade-Off

Method	Process	Fiber Result	Why It Is or Is Not Used
Dew retting	Stems spread in field; fungal action over weeks; turned periodically	Variable in color, strength, and degree of retting; weather-dependent	Dominant method today because it has no effluent. Inconsistency is accepted as the cost.
Water retting	Stems submerged in tanks or ponds; anaerobic bacterial action over days	Superior and repeatable — cleaner, stronger, more uniform fiber	Largely abandoned in Europe on pollution grounds. The effluent is the problem, not the fiber.
Enzymatic retting	Controlled pectinase treatment in a managed vessel	Highly controllable and consistent	Enzyme cost is the constraint. Benchmark case rather than default.
Chemical retting	Alkali or acid treatment	Fast; degrades fiber strength	Excluded from this framework on both quality and environmental grounds.

Table G-3. *Retting methods. The quality ranking and the environmental ranking are inverted — which is the opening this pathway exploits.*

5.2 The Systems Argument

Water retting produces the better fiber and was given up because of what came out of the tank. The effluent is high in biochemical oxygen demand, loaded with organic acids, pectins, and dissolved plant compounds, and it strips dissolved oxygen from any water body receiving it.

That effluent is not a waste stream inside this framework. It is a feedstock the system was already built to process.

A high-BOD, organic-acid-bearing, nutrient-rich liquid is exactly what the primary refugium and biofiltration train in RRP3 are designed to oxidize and stabilize. The solid fraction routes to HTL per RRP5. Nutrients released from the stems during retting return to the crop water rather than leaving the site.

The RRP therefore makes water retting viable again by internalizing the reason it was abandoned — and takes consistent, repeatable, higher-grade fiber as the return. This is the strongest single argument in the fiber pathway and it is a systems argument rather than an agronomic one. No individual grower can make it, because no individual grower owns a biofiltration plant.

5.3 Configuration

- Retting in dedicated tanks rather than in open ponds, permitting temperature control, monitoring, and effluent capture.
- Warm water accelerates the process substantially; waste process heat per RRP5 is directly applicable.
- Retting endpoint determined by test, not by schedule. Under-retted stems will not separate; over-retted stems lose fiber strength irreversibly, and the window is narrow.
- Effluent routed to the primary refugium, never to the crop channel directly — a BOD shock load into the alley bed would produce the anoxic failure described in Appendix F §4.3.
- Retting water is partially reusable across batches, and reuse accelerates subsequent batches by carrying an established microbial population. Reuse limits are unestablished. ⚑ PROVISIONAL

5.4 Post-Retting Mechanical Chain

Standard and commercially available for flax and hemp: breaking to fracture the woody core, scutching to remove the broken shive, hackling to comb and align the long-line fiber, with tow recovered as the short-fiber byproduct. Hemp decortication equipment serves the same function at higher throughput and coarser tolerance.

Shive and tow are not waste. Shive is a bedding, board, and composite feedstock and a clean HTC input; tow is spun into coarser yarn or used in composites and nonwovens.

5.5 Effluent Monitoring

Additive to RRP8 Axis 2, at the retting tank outlet before it enters the primary refugium: BOD, dissolved oxygen, pH, total nitrogen, total phosphorus, and volume per batch. This stream is the highest-strength internal load in the pathway and its characterization determines refugium sizing for any deployment running water retting at scale.

6. The Cotton Case

Cotton is the hardest crop in this framework and the one with the largest prize attached. It merits its own section because nearly every difficulty in it is specific to the crop rather than to the pathway.

6.1 The Argument Is Not Yield

Aquaponically grown cotton will not outproduce Delta field cotton on lint per acre, and no version of this appendix should claim otherwise.

Cotton's environmental cost is not primarily the fiber. It is the pesticide load, the irrigation draw, and the soil degradation that follows continuous row cropping. A closed system running on recovered nutrient produces cotton with no soil loss, no runoff contribution, no pesticide export, and no aquifer draw.

The comparison that matters is not yield per acre. It is yield per acre of damage — and on that axis there is currently no competition, because no one is measuring it.

Organic cotton at industrial scale, with a documented and continuously published environmental record per the RRP8 open data doctrine, is a product that does not presently exist in the market.

6.2 The Humidity Conflict

This is the crop's central technical problem within the pathway. Cotton wants a hot, humid growing season and a hot, dry finish. Bolls open and fiber cures in low humidity. A saturated greenhouse at boll opening produces boll rot, staining, and downgraded micronaire and color grade — the parameters that determine what lint is worth.

The environment that grows the plant fights the environment that finishes the crop. Any deployment must be able to run two distinct humidity regimes in the same structure across one season.

6.3 The Tower as Dehumidifier

The covered water tower described in RRP3 §2 is a large, cool, enclosed condensing surface with hydraulic head behind it. Circulating house air across it drops moisture out as recoverable water rather than venting it — which is materially cheaper than air exchange and does not discard the heat with the humidity.

Two constraints. Condensing surface area rather than tower volume is the governing variable, and a tall narrow tower offers less than its capacity suggests. And holding a low-humidity band across a multi-week boll finish is a different and heavier duty than trimming peak humidity off a grow house. ⚑ PROVISIONAL — unsized for this duty.

RRP3 §2 currently lists the tower's functions as hydraulic head, passive aeration, and surge absorption. Atmospheric moisture recovery should be added when the series is next revised, and its relationship to the evaporation greenhouse in RRP4 §4 stated, since both perform condensation work with no documented relationship between them.

6.4 The Harvest Gap

Cotton harvest equipment — spindle pickers and stripper harvesters — is field machinery, built for open rows at field scale. Greenhouse-row fiber harvest equipment does not exist, because greenhouse-row fiber does not exist.

Hand picking is historically how it was done and remains viable at pilot scale, but it is not a basis for industrial deployment. This is a genuine chicken-and-egg constraint and it is stated as such rather than assumed away.

Design opportunity: a boll harvester dimensioned for controlled-environment row spacing is a defined and tractable mechanical engineering problem, and one with no incumbent. It is identified here as a Bright Meadow Group development item rather than as an assumption in the deployment case.

6.5 Cottonseed — A Cross-Pathway Constraint

Ginning separates lint from seed, and cottonseed is a real product: oil, and meal that is a conventional ruminant feed ingredient. Gossypol limits its use in monogastric rations.

Cottonseed routed to feed is subject to the entire Appendix E qualification protocol without exception — including the source-water tier rule. A Tier III site produces feed-ineligible seed regardless of how the lint is classified. RRP4 §3.2 already specifies non-food cotton, and that specification should be read as governing the seed as well as the lint on any site where the water does not qualify under Appendix E §6.

On a Tier I or Tier II site the seed is a genuine second revenue stream. On Tier III it routes to oil for industrial use, or to HTL.

7. Destination Qualification

The fiber pathway does not use a single eligibility determination. It uses three destination classes, and a single harvest may be split across them.

Destination	Products	Testing Requirement	Eligible Source Water
T — Textile	Apparel, home textiles, anything in prolonged skin contact	Finished-good testing against the applicable certification scheme: heavy metals, restricted substances, residues. Testing is on the product, not the field.	Tier I and II routinely; Tier III only where finished-good testing clears
I — Industrial	Cordage, geotextile, composite, insulation, board, nonwoven, pulp	Performance specification only. Contaminant limits generally governed by end-use rather than by fiber origin.	All tiers
X — Thermochemical	HTC and HTL feedstock; hydrochar; bio-oil	None on the fiber. Testing moves to the char per Section 8.	All tiers, without qualification

Table G-4. *Destination classes. A single crop is routinely split — long-line to T or I, tow and shive to X.*

7.1 The Split Is Normal

Unlike the feed pathway, where a batch either qualifies or does not, fiber routinely divides by fraction within a single harvest. Long-line fiber goes to textile or industrial; tow and shive go to industrial or thermochemical; gin trash goes to thermochemical.

This makes the fiber pathway structurally resilient in the same way the Appendix E disposition hierarchy makes the feed pathway resilient, but by a different mechanism: not by demotion on failure, but by simultaneous parallel routing of different fractions of the same crop.

7.2 Traceability

Textile certification and the organic and traceability premium both depend on documentation rather than on assertion. Batch identity from channel to bale to finished good must be maintained, and the open data doctrine in RRP8 is an asset here rather than an obligation — a continuously published environmental record is precisely what a traceability claim requires and what most supply chains cannot produce.

8. Metals Do Not Burn

Thermochemical processing destroys organics. It does not destroy elements.

This distinction governs the entire contamination position of the pathway and is the most likely point of error for a reader who has absorbed Section 2 and stopped there.

- Destroyed by HTC and HTL: cyanotoxins, pathogens, pharmaceutical residues, and the large majority of pesticide and herbicide compounds. Organic molecules do not survive the reactor.
- Not destroyed: cadmium, lead, arsenic, mercury, chromium, and every other metal. The organic mass is driven off to char, oil, and gas while the inorganic fraction remains, arriving in the solid product more concentrated than it entered.

The fiber itself is therefore genuinely unconstrained on the biological hazards, which is the source of the pathway's siting freedom. The constraint reappears one step downstream, in what the resulting char can be used for.

8.1 Where the Testing Point Moves

Char End Use	Constraint	Requirement
Soil amendment	Tightest. Metals applied to soil enter the food system and accumulate.	Full metals assay on every batch. Tier III char should be presumed ineligible pending assay.
Fuel and industrial feedstock	Loose. Combustion emissions and process compatibility govern.	Assay for process compatibility and emissions compliance.
Activated carbon precursor	Application-dependent; potable water treatment is tightly regulated.	Assay against the specific application standard.
Disposal	Regulatory classification. High-metal ash may be a characteristic hazardous waste.	Leachate testing. This is the gate that converts a product into a cost.

Table G-5. *Char destination constraints. The fiber is unconstrained; the char is not.*

8.2 Recovery Arrives From the Opposite Direction

Appendix E §8 establishes the framework: dispersal is the damage, and concentration converts an unrecoverable dispersal into a defined stream with a known assay. That framework applies here and applies more strongly, because the fiber pathway is deliberately sited on the most metal-loaded water in the watershed.

A Tier III fiber deployment is, structurally, a phytoextraction operation that happens to produce marketable fiber while it works. The review criteria in Appendix E §8.3 — metal identity, enrichment factor, throughput, co-occurrence, ash classification, buyer access — apply without modification. ⚑ PROVISIONAL — no RRP recovery data exists.

9. Regulatory Gates

9.1 Hemp Compliance Testing

Industrial hemp cultivation in the United States is subject to federal and state licensing and to mandatory testing against a delta-9 THC concentration limit. A crop testing above the limit must be destroyed regardless of its fiber quality or its environmental performance.

Two consequences specific to this framework. Cultivar selection and testing compliance are gating conditions on the hemp crop, not administrative details, and must be established before planting. And controlled-environment culture with continuous nutrient supply may affect cannabinoid expression in ways open-field cultivar data does not predict — which makes compliance testing a pilot question rather than a settled one. ⚑ PROVISIONAL

9.2 Textile Certification

Consumer textile certification schemes test finished goods for heavy metals, restricted substances, and residues. Certification is obtained on the product by the party placing it on the market, and a fiber producer's environmental record does not substitute for it.

Bright Meadow Group does not provide regulatory or certification advice, and nothing in this appendix constitutes a determination of certifiability for any operator. Deployments intending to sell into certified textile channels should establish the testing pathway before the first crop, not after it.

10. Product Ladder

Rung	Product	Source Fraction	Notes
Q-1	Certified apparel fiber	Long-line flax, hemp, ramie, nettle; premium cotton lint	Highest value per unit mass. Requires §9.2 certification and §7.2 traceability.
Q-2	Uncertified textile and home goods	Long-line fiber not routed to certification	Substantial market without the certification overhead.
Q-3	Cordage, canvas, sacking, geotextile	Jute, kenaf, coarse hemp, tow	High volume, tolerant specification, all source tiers eligible.
Q-4	Composite, insulation, nonwoven, board	Tow, short fiber, kenaf, hurd	Automotive and construction demand. Absorbs everything failing textile grade.
Q-5	Seed and oil	Linseed, hempseed, cottonseed	Feed and food routing subject to Appendix E in full — see §6.5.
Q-6	Pulp and bedding	Shive, hurd, stalk residue	Established markets for hemp hurd in particular.
Q-7	HTC/HTL feedstock and char	Gin trash, retting solids, all off-grade material	Terminal routing per RRP5. Char end use constrained per Section 8.

Table G-6. *Fiber product ladder. Unlike Appendix E and F, rungs are occupied simultaneously by different fractions of the same crop rather than sequentially on failure.*

11. Economics

11.1 The Area Problem

Lint and long-line fiber are low-value-per-square-foot products by the standards of controlled-environment agriculture. A greenhouse built at industrial capital cost and planted to fiber alone is unlikely to clear that cost on fiber sales.

The fiber pathway does not stand on fiber revenue. It stands on a stack, and the stack must be built explicitly rather than left for a reader to assemble.

- Layer 1 — fiber across rungs Q-1 through Q-4, plus seed at Q-5 and shive at Q-6.

- Layer 5 — nutrient trading credits, unusually strong here because the pathway is sited on the highest-loading water available.
- Layers 2 and 3 — hydrochar and bio-oil from Q-7, which is a larger fraction of total mass in this pathway than in any other.
- Layer 7 — productized side-streams, including any Section 8 recovery.
- Layer 8 — environmental data, and the traceability record that supports the premium in §11.2.

11.2 The Premium Is the Argument

Commodity fiber pricing will not support this pathway. Documented, traceable, pesticide-free, soil-neutral fiber with a continuously published environmental record is a different product in a different market, and the apparel sector has demonstrated willingness to pay for verified provenance.

The open data doctrine in RRP8 is therefore a commercial asset in this pathway specifically. Most fiber supply chains cannot document their environmental performance at all. This one publishes it continuously as a condition of its own design.

11.3 Cost Structure

- Retting — tank capital, thermal input, and the refugium capacity to absorb the effluent load per §5.5.
- Mechanical processing — breaking, scutching, hackling or decortication. Commercially available for flax and hemp; a capital line rather than a development problem.
- Harvest — mowing for Class B; unresolved for cotton per §6.4.
- Humidity control — material only for cotton, per §6.2 and §6.3.
- Certification and testing — fixed cost favoring aggregation, as in the Appendix E hub model.

11.4 RRP6 Fit

Unlike Appendix E and Appendix F, this pathway requires no amendment to the modular slot framework. Slot Type B (fast-fiber terrestrial, 6–12 weeks, high nitrogen uptake) and Slot Type D (textile fiber, 12–20 weeks) already exist in RRP6 §5 and substantially describe the Class B and Class S crops respectively.

Nettle and ramie are the exception: as perennials they carry the Appendix F standing-stock treatment rather than turnover-slot treatment. That is a species-level routing decision, not a framework gap.

12. Deployment Scales

12.1 Scale G-1 — Single Crop, Dew Retted

One channel run planted to flax or hemp, harvested by mowing, dew retted on site, processed on small-scale or contracted breaking and scutching equipment. No retting effluent load, therefore no additional refugium capacity required. Products at rungs Q-3 and Q-4 initially. This is the entry configuration and the one that will generate the first fiber quality data under this culture method.

12.2 Scale G-2 — Water Retted With Effluent Recovery

Adds tank retting with effluent routed to the primary refugium per Section 5, which is the point at which the pathway's distinctive systems argument becomes operational and fiber quality becomes consistent enough to target rungs Q-1 and Q-2. Requires refugium capacity sized to the retting load and the monitoring regime in §5.5.

12.3 Scale G-3 — Tier III Remediation Deployment

Fiber sited deliberately on water no other pathway can accept, with output routed to industrial and thermochemical destinations and the Section 8 char assay regime in force. This is the configuration in which the fiber pathway does what nothing else in the framework can, and the one most likely to attract public remediation funding rather than agricultural funding.

12.4 Scale G-4 — Cotton

Requires the humidity regime in §6.2, the tower duty in §6.3, and a harvest answer per §6.4. Not recommended as a first deployment at any site. Hand-picked pilot scale is the appropriate first step and is sufficient to answer the fiber quality and boll finish questions before any equipment development is committed.

13. What the Pilot Must Prove

No field-validated data exists for fiber culture in this configuration. Open-field agronomic figures describe growth but say nothing about fiber quality under continuous nutrient supply, which is the variable that determines whether the pathway produces a commodity or a premium product.

- Fiber fineness, tensile strength, and length under continuous nutrient supply, by species — the first-order question. Abundant nitrogen produces large plants and may or may not produce good fiber, and tonnage is not a proxy.
- Optimal stand density for stem form rather than for biomass, per §4.2.
- Retting endpoint determination — a reliable field or bench test for the narrow window between under-retted and over-retted.
- Retting effluent load characterization: BOD, volume, and nutrient content per tonne of stem, which sets refugium sizing for Scale G-2 and above.
- Retting water reuse limits across sequential batches.
- Metal uptake into fiber tissue by species on Tier III water, and partitioning between fiber, shive, and seed.
- Char metal grade and leachate classification per Section 8 — the gate on the whole Tier III siting case.
- Cotton boll finish under managed humidity, and the tower condensing duty required to hold the band.
- Hemp cannabinoid expression under controlled-environment continuous-feed culture, against §9.1 compliance limits.
- Whether textile certification is achievable on Tier II and Tier III fiber, tested rather than assumed in either direction.

14. Provisional Status

⚑ **PROVISIONAL** — All cycle lengths, yields, fiber quality figures, retting parameters, and processing throughputs in this appendix are drawn from open-field agronomic and industrial literature or are unestablished. Fiber quality under continuous nutrient supply in controlled environment is entirely unmeasured, and it is the variable on which the pathway's economics depend. No figure in this document should be used as the basis for a capital commitment, a supply contract, a certification claim, or a credit claim without site-specific validation.

Closing Note

The fiber pathway is where this framework can go to the places it is least welcome and most needed — the industrial reaches, the stormwater outfalls, the legacy-contaminated corridors that every agricultural use has to refuse. It can go there because nobody eats a shirt.

That freedom is bounded, and Sections 7 and 8 are where the bounds are drawn. Metals do not burn. Certification tests the finished good. A pathway that overstated its tolerance would fail at exactly the sites it was designed to serve.

What it offers in return is a process the industry gave up on because it could not handle the effluent, and a crop the industry grows by stripping soil and spraying pesticide across a continent. This system already has the effluent problem solved. That is not a coincidence — it is what happens when the cleanup and the production are the same machine.

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 proxies pending replacement by RRP pilot data per RRP8. Regulatory references are provided for orientation and do not constitute legal, certification, or regulatory advice.

1. *Bright Meadow Group, "RRP3 — Water Treatment & Biofiltration," Version 2.0, §2 Pump House & Flow-Lift Architecture. CF/BMG, 01 April 2026.*

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