WVSNP Grant Management System (WVSNP-GMS) Audit-Grade, Offline-Ready Application + Grant Operations Platform

Prepared for: West Virginia Spay Neuter Program Administrator
Prepared by: PROVENIQ Foundation
Date: February 04, 2026

Executive summary

WVSNP-GMS is a purpose-built, audit-safe software system for the West Virginia Spay Neuter Program (WVSNP) that replaces spreadsheet-driven workflows with a deterministic, immutable event log and automatically generated WVDA-ready submission artifacts (PDF packet + official template-filled XLSX). It is designed specifically for rural connectivity realities (offline-first), strict financial accountability (integer money + deterministic rounding), and statutory/FAQ compliance-especially around LIRP (low-income) rules such as "no proof of income," "must honor while funds remain," and "no donation solicitation."

Why this exists (the operational problem)

WVSNP administration and grantee execution are high-stakes and time-bounded: deadlines are hard, reimbursement math must be consistent, and audits require clear evidence of who did what and when. In practice, spreadsheet-centric processes create predictable failure modes:

• Version drift: multiple "final" spreadsheets and PDFs circulating with uncertain provenance
• Rounding disputes: small math differences compound across claims and invoices
• Over-commit risk: vouchers and reimbursements can unintentionally exceed available grant funds
• Connectivity gaps: clinics and grantees can't rely on continuous internet access
• Compliance sensitivity: LIRP requires rules that are easy to violate unintentionally (proof requests, donation prompts, co-pay errors)

What the app does (plain-English)

WVSNP-GMS treats every action as an immutable, time-stamped event (an "event log"). From that log, the system derives current views (applications, grants, vouchers, balances) and produces official artifacts (PDF/XLSX) with cryptographic fingerprints. Instead of editing records in place, changes are recorded as new events (amendments, corrections, voids). This creates an audit trail that is both human-readable and machine-verifiable.

Core design principles (audit-grade logic)

Principle	Why it matters
Immutable event log is the only source of truth	No silent edits. Projections can be dropped and rebuilt from the event log at any time.

Dual time (occurredAt + ingestedAt)	Business/client time is recorded; server-ingested time is authoritative for ordering and deadline enforcement.
Deterministic money math	All money is stored as integer cents (BIGINT) and computed using BigInt with ROUND_HALF_UP locked.
No last-write-wins	Offline conflicts are handled as explicit reject/resolve flows, not overwrites.
DB-enforced immutability	Canonical tables reject UPDATE/DELETE at the database layer, not just by policy.
Artifact integrity	Every generated PDF/XLSX is logged with SHA-256, tied to a replay watermark so reviewers can reproduce it exactly.

Major features (what you get)

Phase 1 - Application System (WVDA-ready submissions)
• Guided applicant wizard aligned to WVDA tabs/sections
• Eligibility gating and completeness scoring (what's missing, what's risky)
• Attachment upload + malware scan/quarantine controls
• Attestation capture (structured yes/no questions, time-stamped)
• Priority factor computation (transparent scoring breakdown)
• Export engine: PDF packet + official WVDA XLSX template filled (no formatting recreation)
• XLSX parity check: validates required cells are populated before submission
• Deadline enforcement: server clock is the only gate; UI countdown is display only
• Offline fairness option: server-issued submission tokens for rural connectivity realities

Phase 2 - Grant Operations (voucher + encumbrance controls)
• Encumbrance pipeline (available / encumbered / liquidated / released) with invariant checks
• Voucher issuance (including offline tentative issuance with TTL)
• LIRP bucket partition ("firewall"): no commingling with general funds
• LIRP rules enforcement: must-honor while funds remain; no co-pay; certification required; no proof uploads
• Anti-solicitation guard: donation prompts are suppressed in LIRP flows; canonical evidence is recorded for generated artifacts

Phase 3 - Claims & Invoices (end-to-end reimbursement lifecycle)
• Vet clinic portal for claim submission and receipt capture
• Claim approval/denial/adjustment as events (no silent edits)
• Automatic liquidation and remainder release when claim < voucher max
• Invoice aggregation and payment tracking with full audit trail

How the money logic prevents disputes

WVSNP-GMS makes the reimbursement formula explicit and deterministic:

• All amounts are stored as integer cents (no floating point).
• Reimbursement rate is stored as a rational fraction: grantAwardCents / (grantAwardCents + matchCents).
• Reimbursement is calculated using BigInt and ROUND_HALF_UP to the cent.
• Encumbrance and liquidation rules ensure the program cannot over-commit funds.

This eliminates "spreadsheet math drift" and produces the same answer every time, on any machine.

Encumbrance lifecycle (voucher control)

Every grant dollar is always in exactly one state:

AWARDED → AVAILABLE → ENCUMBERED → LIQUIDATED
…and RELEASED flows back into AVAILABLE (expiry/void/partial redemption/amendment).

Invariant enforced in projections:
available + encumbered + liquidated = awarded

```
Release triggers (automatic, auditable):
- Voucher expires -> release full reserved amount
- Voucher voided -> release full reserved amount
- Claim approved below max -> liquidate actual + release remainder
- Voucher amended -> adjust delta (increase encumbrance or release)
- Tentative expired -> release reserved amount (server sweep job)
```

Offline-first without 'last write wins'

When connectivity is unreliable, WVSNP-GMS uses an outbox pattern:

• Client records events locally with client-generated UUIDs.
• On reconnection, the server validates each event against current authoritative state and stamps ingestedAt.
• Events are accepted or rejected individually; conflicts are resolved via explicit amendment/void events, not overwrites.

For vouchers issued offline, the system supports "tentative vouchers" that must be confirmed by the server and that automatically expire (TTL) to prevent ghost reservations.

Deadline enforcement that is legally defensible

Deadlines are enforced by server-ingested time only. Client clocks are recorded but never trusted to determine whether a submission is on time.

To support rural/offline fairness without trusting client time, the app can issue a server-signed, time-bound submission token while the user is online. Tokens are cryptographically bound (application + user, optionally device) and are one-time use. Token consumption is recorded as a canonical event.

Exports and evidence (what WVDA reviewers receive)

The export engine produces:

1) **PDF Application Packet** - a consistent, reviewer-friendly packet generated from the event log.
2) **Official WVDA XLSX Template (template-fill)** - the system loads the WVDA-provided workbook and fills mapped cells without modifying formatting.

Each artifact is logged with:
• SHA-256 hash (fingerprint)
• generation timestamp
• replay watermark (the exact ingestedAt + eventId boundary used)

This provides a reproducibility story: the same inputs recreate the same outputs, and reviewers can trust that the spreadsheet they see matches the submission record.

Security and risk controls

• Malware scanning and quarantine for uploads (attachments are not trusted by default).
• Role-based access: canonical tables are INSERT-only; UPDATE/DELETE are blocked by DB triggers.
• Full trace context on events: correlationId/causationId supports forensic reconstruction of workflows.
• Token replay protection: submission tokens are consumed once and cannot be reused.

Implementation status and rollout approach

WVSNP-GMS is designed to be delivered in phases to minimize launch risk:

• Phase 1: Application "sieve" - produce WVDA-acceptable submissions and enforce the January application deadline.
• Phase 2: Grant operations - vouchers + encumbrance controls (including LIRP partitioning).
• Phase 3: Claims/invoices - complete reimbursement lifecycle with vet portal.

This phased approach allows immediate benefit (clean applications + exports) while progressively adding operational modules.

What I'd like from WVDA (next steps)

To align the system tightly to WVDA review workflows, the most valuable inputs are:

• The current official FY2026 application workbook (template) and any known "required cell" list or reviewer checklist
• The exact attestation questions WVDA requires (if there is a standard set)
• Any guidance on acceptable evidence formatting (PDF ordering, naming conventions, etc.)
• Confirmation of LIRP program list and any language requirements around "no proof" and "no solicitation"

With those inputs, the mapping/parity rules can be made fully deterministic and WVDA-proof.

Contact

PROVENIQ Foundation - WVSNP-GMS (Provide preferred email/phone here)