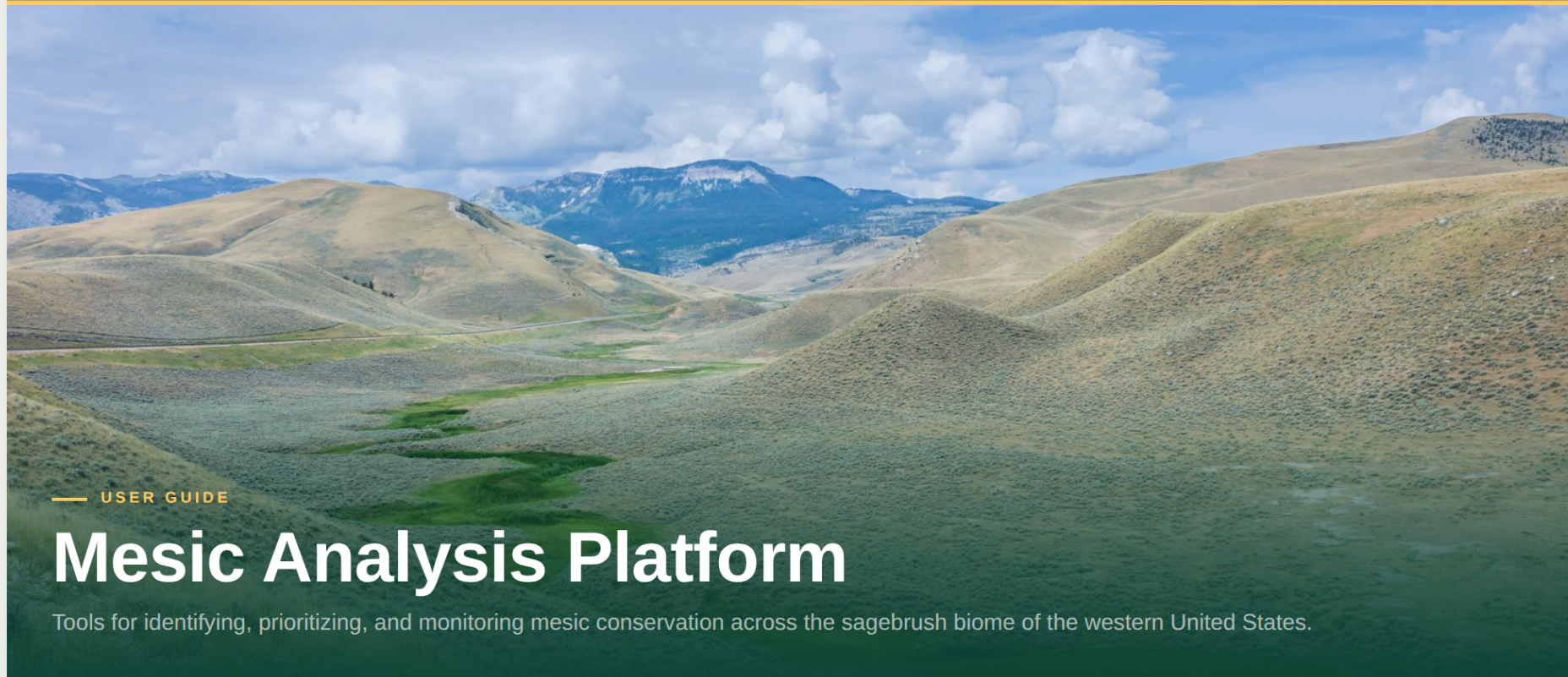




— USER GUIDE

Mesic Analysis Platform

Tools for identifying, prioritizing, and monitoring mesic conservation across the sagebrush biome of the western United States.



ABOUT THE PLATFORM

What Is Mesic?

Mesic landscapes — wet meadows, riparian corridors, seeps, and springs — occupy less than 2% of the sagebrush biome landscape yet sustain a disproportionate share of its biodiversity, forage, and resilience. These habitats provide green vegetation through the driest summer months, enabling sage-grouse, mule deer, migratory songbirds, and countless other species to persist in surrounding uplands.

The Mesic Analysis Platform (MAP) draws on 40+ years of Landsat satellite data (1984–2025) and the Valley Bottom Extraction Tool (VBET) to reveal where these resources persist, where they have degraded, and where targeted restoration will yield the greatest return. It also directly complements the **Sagebrush Conservation Design (SCD)** — filling the gap left by upland-only frameworks.

THREE APPLICATIONS

Start at analysis.mesic.app

APP 1

Mesic Watersheds

HUC12 · Regional scale

Rank subwatersheds using the Mesic Prioritization Framework — three tiers tied to vegetation persistence and SCD upland proximity.

APP 2

Mesic Resources

30 m pixel · Landscape scale

Click, draw, or upload boundaries for 40+ years of NDVI persistence and interactive time series for any area of interest.

APP 3

Mesic Valley Bottoms

10 m VBET · Valley bottom scale

Inspect VBET stream segments for floodplain condition, active floodplain proportion, and LTPBR restoration siting.

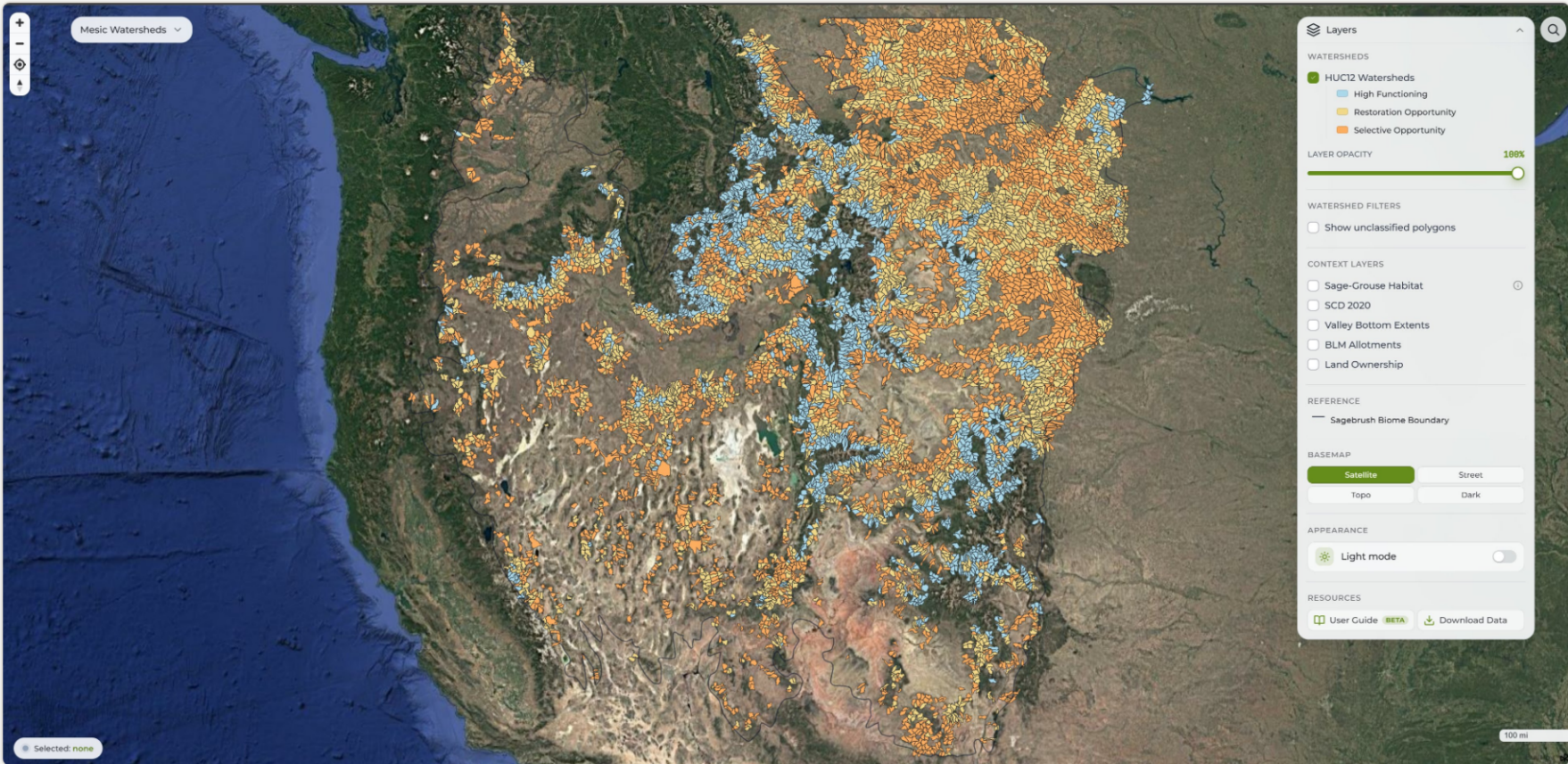


Fig. 1. Mesic Watersheds — HUC12 tier classifications across the sagebrush biome. Tier 1 (blue) = Protect & Maintain, Tier 2 (light blue) = Restore & Enhance, Tier 3 (orange) = Strategically Manage. Initiated at 75% opacity.

Mesic Prioritization Framework (Mueller et al. in review)

Watersheds (HUC12) are classified by **vegetation persistence** — how consistently mesic vegetation stays productive in late summer — and **proximity to intact sagebrush uplands** from the SCD. A decision tree filters for watersheds where $\geq 15\%$ of valley bottoms lie within 5 km of SCD Core or Growth Opportunity Areas, then assigns three management tiers.

Tier	Strategy	% of Biome	Description
Tier 1	Protect & Maintain	9%	Abundant high-persistence valley bottoms near intact uplands. Priority for easements and protection.
Tier 2	Restore & Enhance	14%	High-persistence interspersed with moderate zones — productive vegetation present but unevenly distributed. Greatest restoration return.
Tier 3	Strategically Manage	17%	Limited but present mesic in water-limited landscapes. Selective interventions; field assessment recommended.

Watershed Statistics Panel

Click any watershed to open the panel showing *Proportion of Watershed Valley Bottoms*:

Vegetation Persistence (% of years; 1984–2024)	Classes: high ($\geq 75\%$), moderate (25–74%), low (1–24%), none.
Forested (ever >10% tree cover)	Proportion of valley bottoms that ever exceeded 10% tree canopy cover.
Irrigated (≥ 5 yrs; 1986–2024)	Confirmed irrigation from IrrMapper RF v1.2 remote sensing data.
Public / Private Ownership	Ownership split of valley bottom area within the watershed.
SCD Proximity	% of valley bottoms within 5 km of Core and Growth Opportunity Areas.

FILTER TIP

Toggle *Show unclassified polygons* under Watershed Filters to display the 60% of watersheds outside the tiered thresholds — useful for full landscape context.



Fig. 2. Watershed statistics panel for Middle Rock Creek — vegetation persistence breakdown by class, land cover and ownership proportions, SCD proximity metrics, valley bottom geometry, and 41-year mean late-season NDVI time series in valley bottoms (green = above 0.3; orange = below).

Time Series Charts

41 years (1984–2025) of data *in valley bottoms*:

Mean Late-Season NDVI in Valley Bottoms

Annual mean NDVI July 15–Sept 30. Green = above 0.3; orange = below. Dashed = 0.3 threshold.

Vegetation Cover in Valley Bottoms

Annual fractional cover from RAP: Annual/Perennial Forb & Grass, Shrub, Tree. (30-meter resolution)

Drought Severity in Valley Bottoms

Palmer Drought Severity Index — compare with NDVI to distinguish climate-driven dips from persistent hydrologic decline.

Context Layers

Sage-Grouse Habitat	Bureau of Land Management Priority habitat management areas for sage-grouse.
SCD 2020	Core Sagebrush Areas, Growth Opportunity Areas, and Other Rangeland Areas.
Valley Bottom Extents	VBET-delineated valley bottom footprints (riverscapes.net/vbet).
BLM Allotments	Bureau of Land Management grazing allotment boundaries.
Land Ownership	Public vs. private land boundaries — PAD-US 4.1 (USGS).

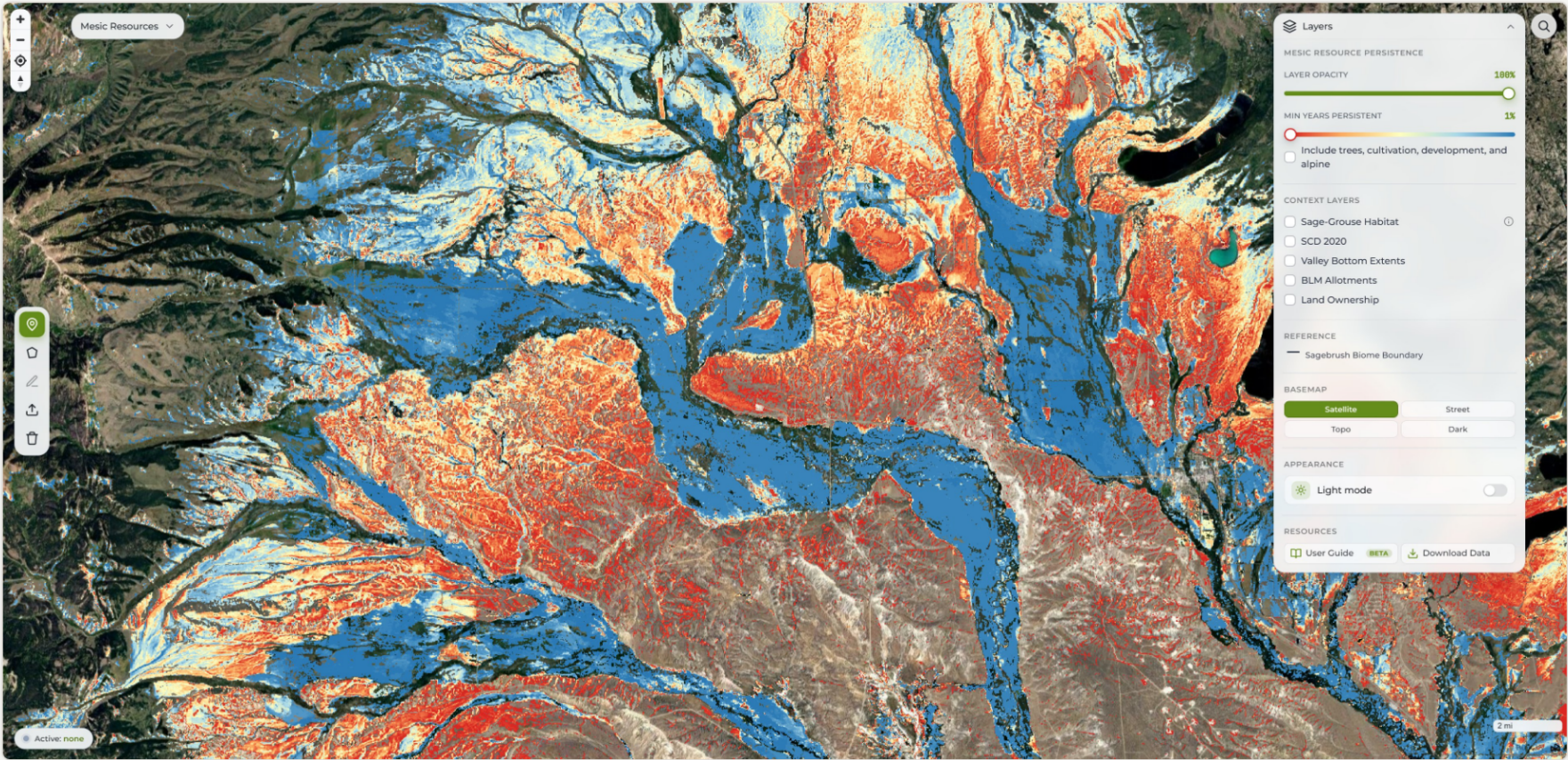
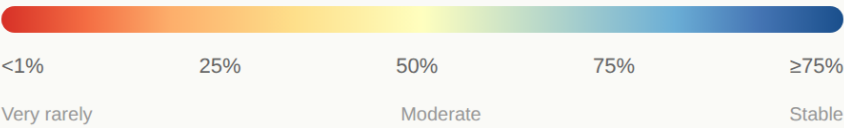


Fig. 3. Mesic Resources — 30 m NDVI persistence layer. Blue = persistently productive ($\geq 75\%$ of years, groundwater-connected); orange–red = rarely or never productive. Valley corridors stand out against the arid upland matrix.

Mesic Resource Persistence

Each 30 m pixel is colored by how frequently it supported productive herbaceous vegetation during the late growing season (July 15–September 30) from 1984 to 2025. A pixel is productive each year its NDVI meets or exceeds 0.3. **Persistence** is the percentage of those 41 years the pixel was productive — a proxy for long-term water availability.



INTERPRETATION

- Dark blue = Green mesic vegetation year-over-year.
- Orange–red = more variable productive vegetation during the late-season (less frequently productive since 1984).

LAYER CONTROLS

Min Years Productive — user defined minimum persistence threshold for displayed pixels. 25% shows locations productive in ≥ 1 of 4 years; 75% shows only the most stable, groundwater-reliant sites.

Include trees, cultivation, development, and alpine — excluded by default to focus on herbaceous mesic systems. Toggle to show all pixels.

Point, Polygon & Upload Analysis

Click a point	41-year NDVI, RAP vegetation cover, and Palmer Drought Severity Index for that location.
Draw a polygon	Outline any area — allotment, pasture, or project boundary — for mean statistics.
Upload a boundary	GeoJSON, Shapefile, or KML (WGS84, max 500,000 ac) for custom area analysis.
Generate Report	Printable PDF of all charts. Raw data: rangeland.ntsug.umn.edu/data/mesic/

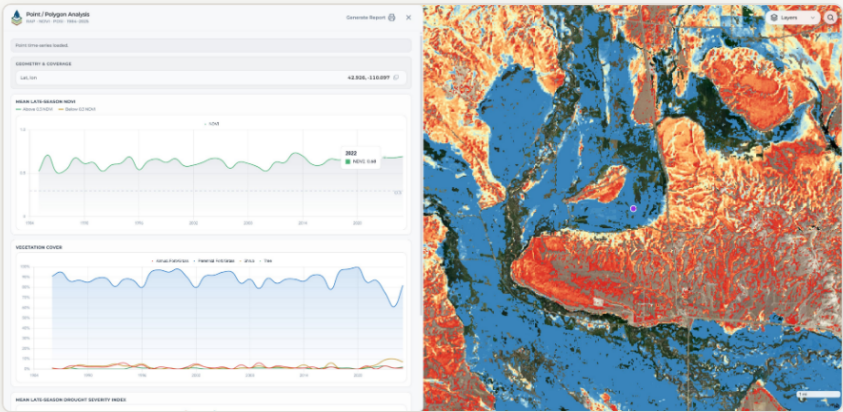


Fig. 4. Point analysis panel — 41-year mean late-season NDVI (green line consistently above 0.3), RAP vegetation cover composition, and drought severity context for a clicked location in a persistently productive valley bottom.

Time Series Charts

Three charts covering 1984–2025 for the selected area:

Mean Late-Season NDVI	Annual mean NDVI July 15–Sept 30. Green = above 0.3; orange = below. Stable green = reliable groundwater.
Vegetation Cover (RAP)	Annual fractional cover: Annual/Perennial Forb & Grass, Shrub, Tree (30-meter resolution)
Palmer Drought Severity Index	Climate context alongside precipitation — compare with NDVI to distinguish drought-driven vs. hydrologic declines.

WHAT THE LAYER SHOWS

Pre-filtered to exclude forests, cultivated lands, and developed/alpine pixels — representing wet meadows, seeps, springs, and riparian corridors rather than irrigation or conifer cover.

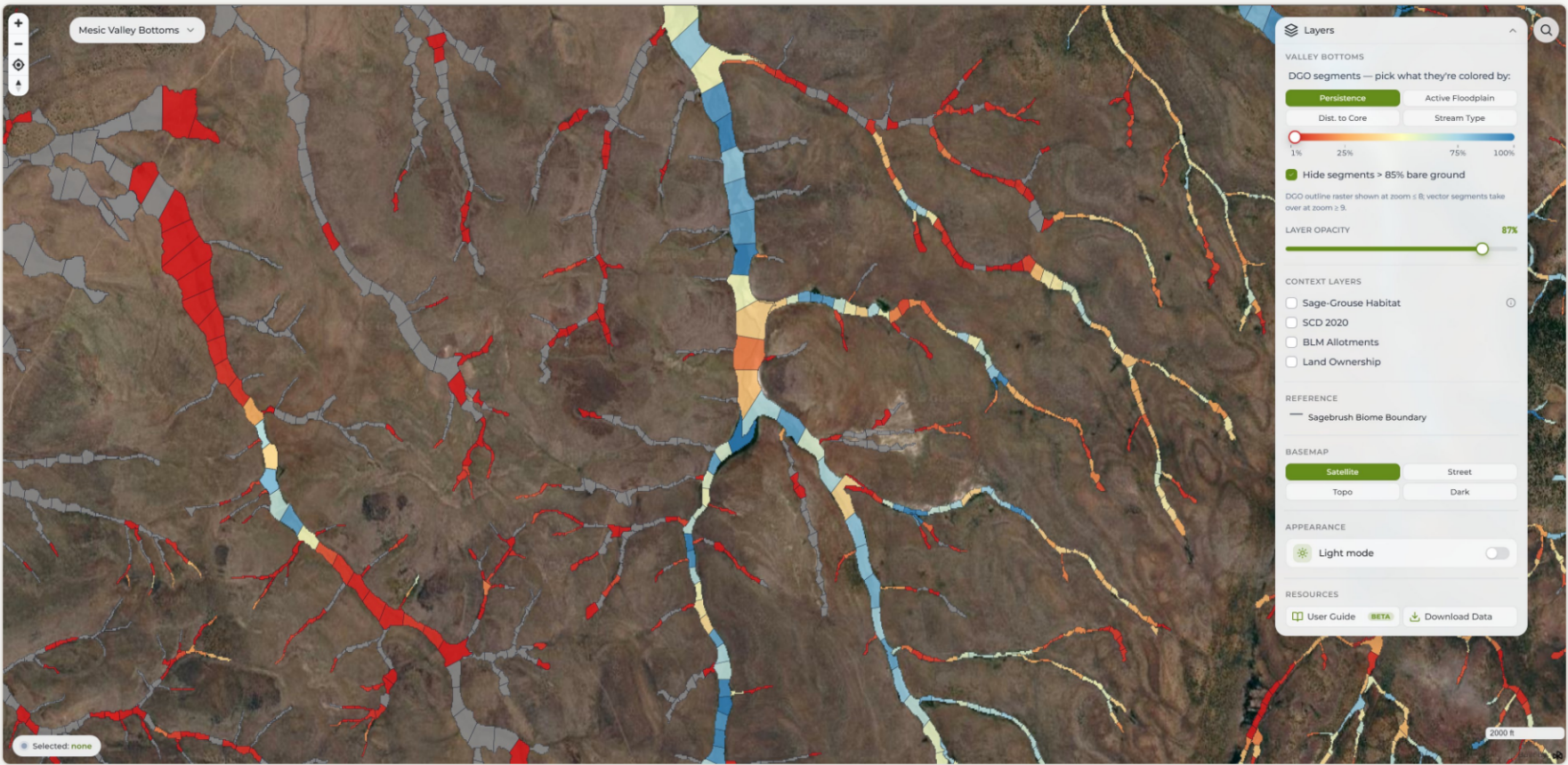


Fig. 5. Mesic Valley Bottoms in Persistence mode — VBET segments colored by vegetation persistence. Red = rarely productive; blue = consistently productive. Full vector segments load when zoomed in.

The Core Targeting Logic

Reaches with **lower persistence flanked by higher-persistence neighbors upstream and downstream** indicate localized hydrologic disconnection — channel incision or floodplain separation where LTPBR is most effective.

- Persistent vegetation above and below confirms water availability for productive vegetation
- Localized scale enables targeted, cost-effective intervention
- Reconnection restores longitudinal connectivity throughout the network

LTPBR SITING

Look for red/orange segments between blue reaches. Switch to Active Floodplain mode to confirm low hydrologically connected floodplain area — dual-flag sites are your highest-confidence LTPBR candidates.

Four Coloring Modes

- 1 Persistence

How consistently the segment supported productive late-season vegetation (average pixel value within polygon) over 40+ years. Red between blue = disconnected, priority restoration site.
- 2 Active Floodplain

Proportion of valley bottom with persistent vegetation (>50%) — measures hydrologic connectivity. Low relative to neighbors = channel incision.
- 3 Dist. to Core

Distance to nearest SCD Core Sagebrush Area. Darker = closer; higher priority for wildlife dependent on both mesic and upland habitats.
- 4 Stream Type

Flow regime: Perennial, Intermittent, Ephemeral, Canal/Other. Influences restoration feasibility and most effective management actions.

DISPLAY FILTER

Hide bare ground and water — removes segments where mean bare ground exceeds 85% OR persistent water exceeds 25%, filtering barren and open-water segments.

Min Years Productive Slider (Persistence only) — similar to the slider in the Mesic Resources app, filter out segements with lower persistence values by moving the slider on the persistence legend.

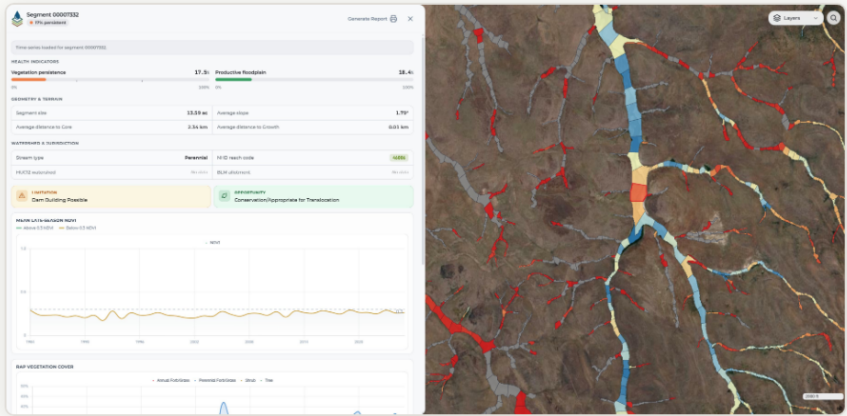


Fig. 6. Segment statistics panel — average vegetation persistence, active floodplain, health indicators, BRAT outputs, and 41-year NDVI time series.

Segment Statistics Panel

Click any segment to open a full statistics panel:

Health Indicators	Vegetation persistence (%) and Active Floodplain (%) — primary metrics for mesic function and restoration need.
Geometry & Terrain	Segment size (acres), average slope, distance to Core SCD and Growth Opportunity Areas.
Watershed & Jurisdiction	Stream type, HUC12 watershed, and BLM allotment — links the reach to land management context.
BRAT Outputs	Beaver Restoration Assessment Tool: Limitation and Opportunity flags used to decide if beaver dam analogs are feasible.
41-Year Time Series	Mean late-season NDVI and RAP vegetation cover — reach-level trend analysis for monitoring and restoration evaluation.

ZOOM & DISPLAY

Raster outlines at zoom ≤ 8 . Full clickable vector segments at zoom ≥ 9 . Use *Hide bare ground and water* to reduce visual clutter.

Low-Tech Process-Based Restoration

Once MAP identifies priority reaches, LTPBR provides cost-effective, scalable interventions to recover mesic function — slowing flow, raising water tables, and reconnecting channels with floodplains. The philosophy: *"let the river do the work"* once structural deficits (incision, floodplain disconnection, wood starvation) are addressed.

STRUCTURE	PRIMARY GOAL	BEST SUITED FOR
Beaver Dam Analog (BDAs)	Pond water, raise water table, reconnect floodplain, encourage beaver	Incised channels with floodplain potential
Post-Assisted Log Structures (PALS)	Mimic wood accumulation; roughness, habitat complexity, sediment retention	Wood-starved, simplified reaches
Zeedyk Structures	Arrest erosion and headcuts; slow, spread, sink water; rewet meadows	Low-gradient meadows, shallow headcuts

IMPLEMENTATION

Prioritize sites with intact valley floors and reconnection potential. Passive revegetation often follows once hydrology is restored. See Wheaton et al. (2019) *Low-tech Process-based Restoration of Riverscapes*.

Cross-Boundary Coordination

Mesic resources frequently straddle public and private land boundaries. Effective restoration requires conservation easements, cooperative grazing agreements, watershed-scale coalitions, and blended funding. Success depends on technical assistance, landowner incentives, and place-based trust-building.

SUGGESTED CITATION

Tilley D, Mueller KR, Morford SL, Maestas JD, Naugle DE. The Mesic Analysis Platform: Defending Mesic Resources in the Great Sagebrush Biome. Working Lands for Wildlife, University of Montana, Missoula, MT.

Mueller KR et al. (in review). Beyond Uplands: Integrating Riparian Areas into Sagebrush Conservation Design for a More Resilient West. *bioRxiv*. doi.org/10.64898/2025.12.29.696625

Questions: wlfw@technology.org · analysis.mesic.app

Shared Features — All Three Apps

Switch App	App name dropdown (top left) links all three apps. Map position preserved when switching scales.
Generate Report	Available after selecting any feature. Printable PDF for field reference or agency documentation.
Download Data	Raw data by state/county. Direct link: rangeland.nts.gov/data/mesic/
Context Layers	All apps: Sage-Grouse Habitat, SCD 2020, Valley Bottom Extents, BLM Allotments, Land Ownership (PAD-US 2025).
Basemaps	Satellite (default), Street, Topo, and Dark. Dark mode improves contrast on NDVI persistence ramps.
Light / Dark Mode	Toggle in Appearance in the Layers panel.

Which App Should I Use?

Rank watersheds for a regional program	→ Mesic Watersheds analysis.mesic.app/mesic-watersheds/
Analyze a custom area, allotment, or point	→ Mesic Resources analysis.mesic.app/mesic-resources/
Assess a stream reach or site LTPBR structures	→ Mesic Valley Bottoms analysis.mesic.app/mesic-valley-bottoms/
Not sure where to start	→ analysis.mesic.app Home page guides you to the right scale

Data Sources

NDVI	Landsat 5, 7, 8 & 9 (30 m) via Google Earth Engine
Cover data	Rangeland Analysis Platform (RAP) — rangelands.app
Valley bottoms	VBET — Riverscapes Data Exchange (data.riverscapes.net)
SCD uplands	Doherty et al. 2022 · USGS OFR 2022-1081
Land ownership	PAD-US 4.1 — USGS 2025
Irrigation	IrrMapper RF v1.2 via Google Earth Engine
Climate	GRIDMET · Palmer Drought Severity Index (PDSI)

QUICK REFERENCE

Which App Should I Use?

RANK WATERSHEDS

→ **Mesic Watersheds**
analysis.mesic.app/mesic-watersheds/

ANALYZE A CUSTOM AREA OR POINT

→ **Mesic Resources**
analysis.mesic.app/mesic-resources/

ASSESS A REACH OR SITE STRUCTURES

→ **Mesic Valley Bottoms**
analysis.mesic.app/mesic-valley-bottoms/

NOT SURE

→ **analysis.mesic.app**
Home page guides you to the right scale

RESOURCES & CONTACT

PLATFORM

analysis.mesic.app

RAW DATA

rangeland.nts.gov/data/mesic/

SOURCE CODE

[github.com/krisMueller/Beyond_Uplands_Mesic_Fra](https://github.com/krisMueller/Beyond_Uplands_Mesic_Frameworks)
meworks

VALLEY BOTTOMS

VBET · Riverscapes Data Exchange

SCD FRAMEWORK

Doherty et al. 2022 · USGS OFR 2022-1081

QUESTIONS

wlfw@technology.org

