

Kenzugi Farm

Nyeri, Kieni East, Kenya ·
 215.6 hectares ·
 whole-farm regenerative design

This report sets out a whole-farm design derived from terrain, climate, soil and hydrological analysis of the property, following the Regrarians method. It reads the landscape, traces where water moves, counts what the enterprise needs against what the land yields, and proposes the earthworks, planting and grazing structure that follow.

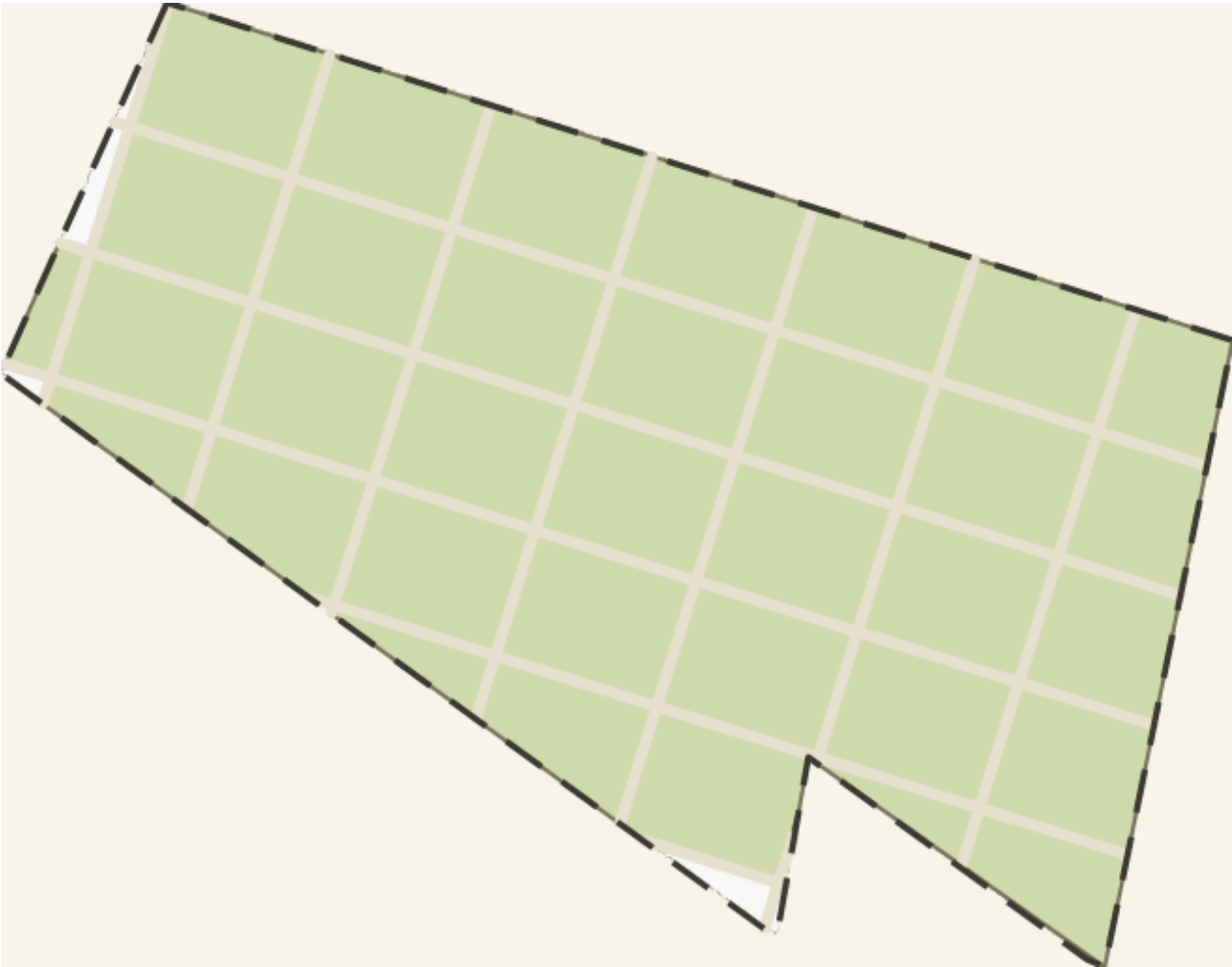
Every figure traces to a dataset or a measured source, and each section states what it cannot tell you. Nothing here has been sited on the ground.

215.6 ha
 Area

42.7 m
 Relief

3.0°
 Mean slope

34
 Fields

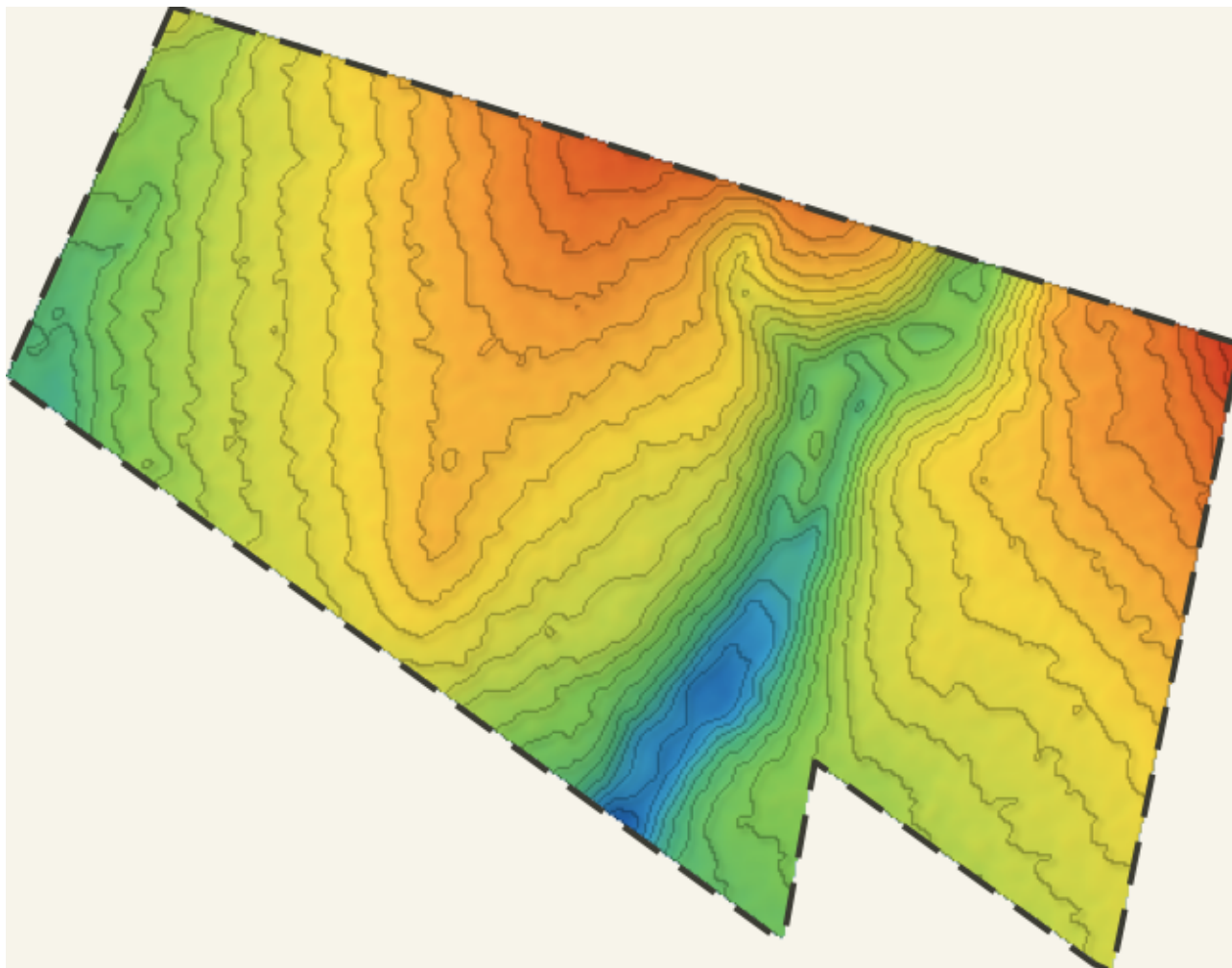


The design in outline. Thirty-four fields on rectilinear boundaries, separated by seven-metre tracks so every field has road frontage. Land use is assigned to whole fields by the suitability analysis.

1 · Read the landscape

The property falls 42.7 metres from 1,904.8 m in the east to 1,862.1 m at its western outlet, across roughly 1.4 kilometres. Mean slope is 3.0 degrees and 86 per cent of the ground lies under 5 degrees. In Regrarians terms this is a medium landscape class: gentle, open country where water moves slowly and the design leans on infiltration rather than on impoundment.

Terrain is an Airbus WorldDEM Neo surface at 4.64 metres, supplied for the property. Its relative noise floor measures 6 centimetres, which indicates a true bare-earth product rather than a surface model, and mean depression fill is 1.5 centimetres, so the surface is hydrologically well conditioned before any analysis runs.

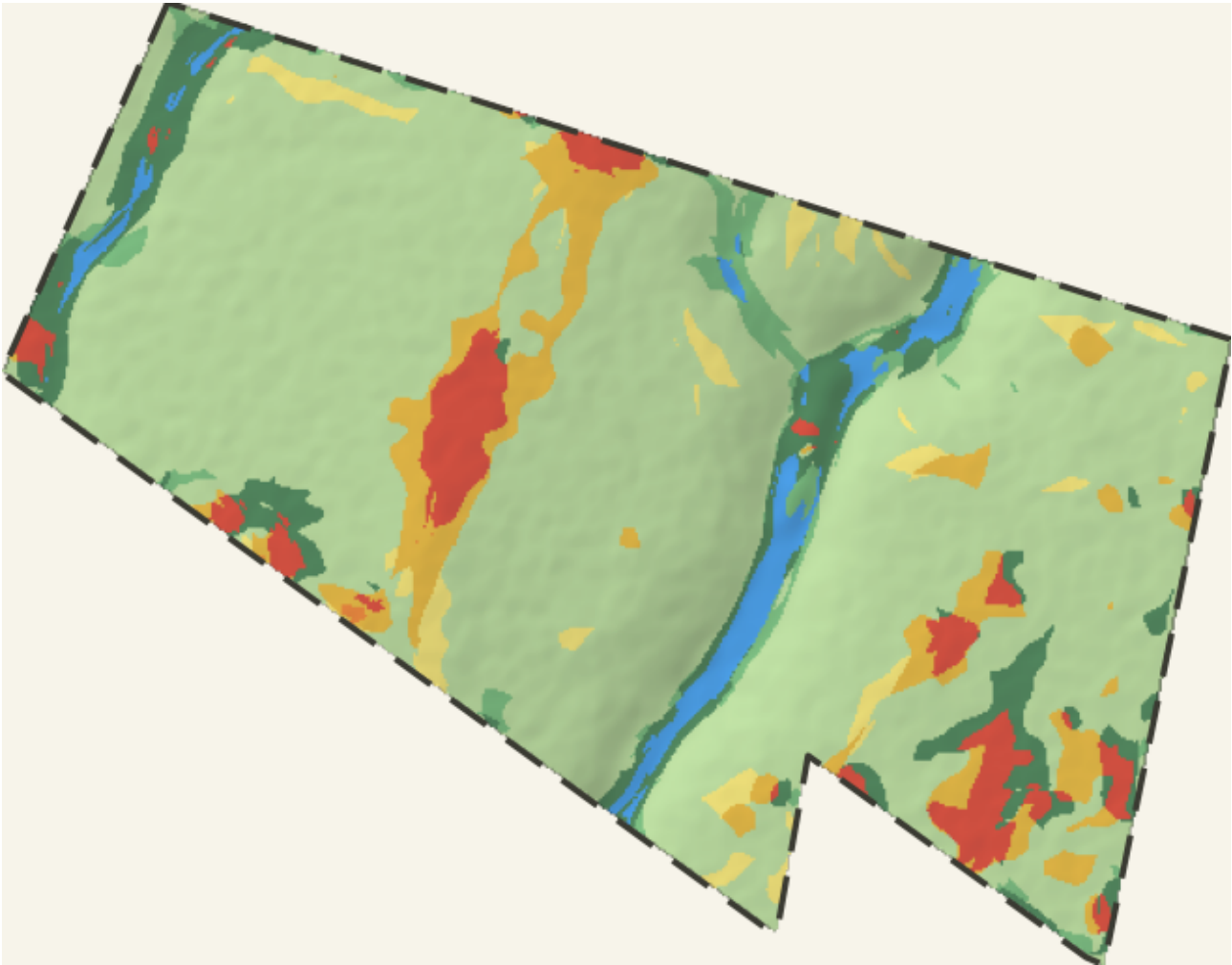


Elevation with two-metre contours. The single valley system runs from the eastern high ground to the western outlet, and is the organising feature of the property.

Landform

Classifying the surface by geomorphon puts 54 per cent of the farm in slope and 22 per cent in flat ground, with hollow, valley and pit — the ground where water collects — making up 7.1 per cent. Aspect is 54 per cent west-facing, which corroborates the existing coffee planting on the sheltered western face.

One finding shapes everything that follows: no main ridge falls inside the property. Ridge and peak together account for 0.1 per cent of the landform surface. The boundary is cadastral, not hydrological, and only about 9 per cent of the perimeter runs near the high point. The farm is a slope within a catchment rather than a catchment in itself.

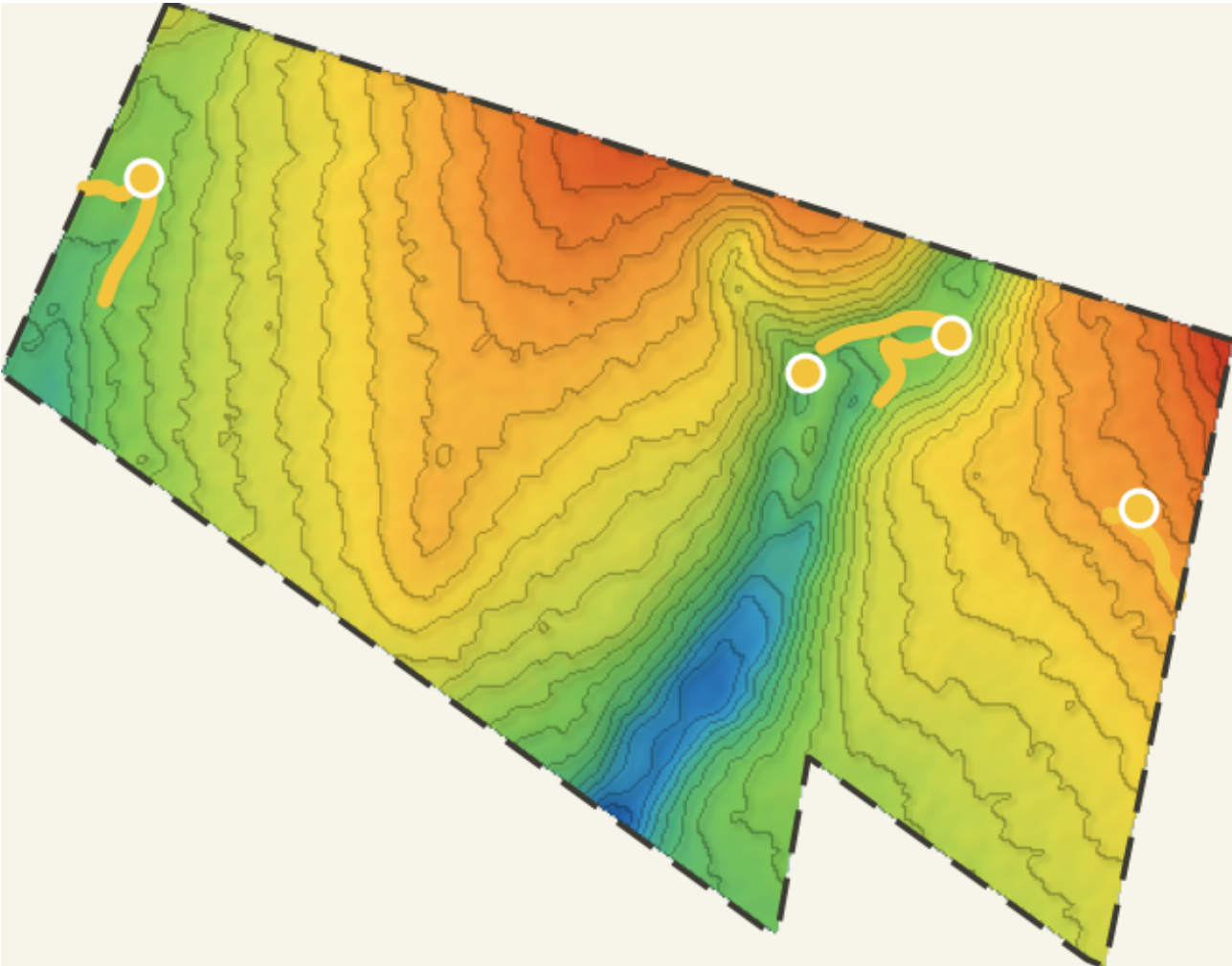


Geomorphon landform classes. Valley floors and hollows in blue-green, ridges and spurs in warm tones.

Keylines

Four keypoints are detectable, one on each primary valley thalweg, at the break where the valley floor stops flattening and begins to steepen. Three carry a keyline of usable length; the fourth sits in a closed basin where the contour loops rather than crossing open ground.

At three degrees mean slope these breaks are subtle, and all four want walking before anyone pegs them. The keylines run 357, 486 and 212 metres.



Keypoints and the keylines through them, clipped to the primary valley and stopped where the ground turns convex at a spur.

Measure	Value	Source
Area analysed	215.6 ha	DEM valid footprint
Elevation range	1,862.1 – 1,904.8 m	WorldDEM Neo
Relief	42.7 m	
Mean slope	3.0° (5.3 %)	
Ground under 5°	85.9 %	
Channel network	25.3 km	flow accumulation, 0.43 ha threshold
Primary land units	4, largest draining 68.2 ha	
Landscape class	Medium	Regrarians 2.10

What this section cannot tell you

The DEM is clipped to the property, so no catchment above the farm can be delineated. Regrarians 3.06 requires the wider catchment for water design, and that cannot be met without a buffered elevation order. The stated 107-hectare catchment for the existing dam cannot be verified from within the boundary.

2 · Climate and soil

Rainfall averages 896 millimetres over the thirty years to 2020, in two seasons of almost equal weight: 360 millimetres in the March to May long rains and 324 in the October to December short rains. The eight-in-ten year yields 711 millimetres and the nine-in-ten 673. The wettest day on record delivered 194 millimetres, and twelve days a year exceed twenty.

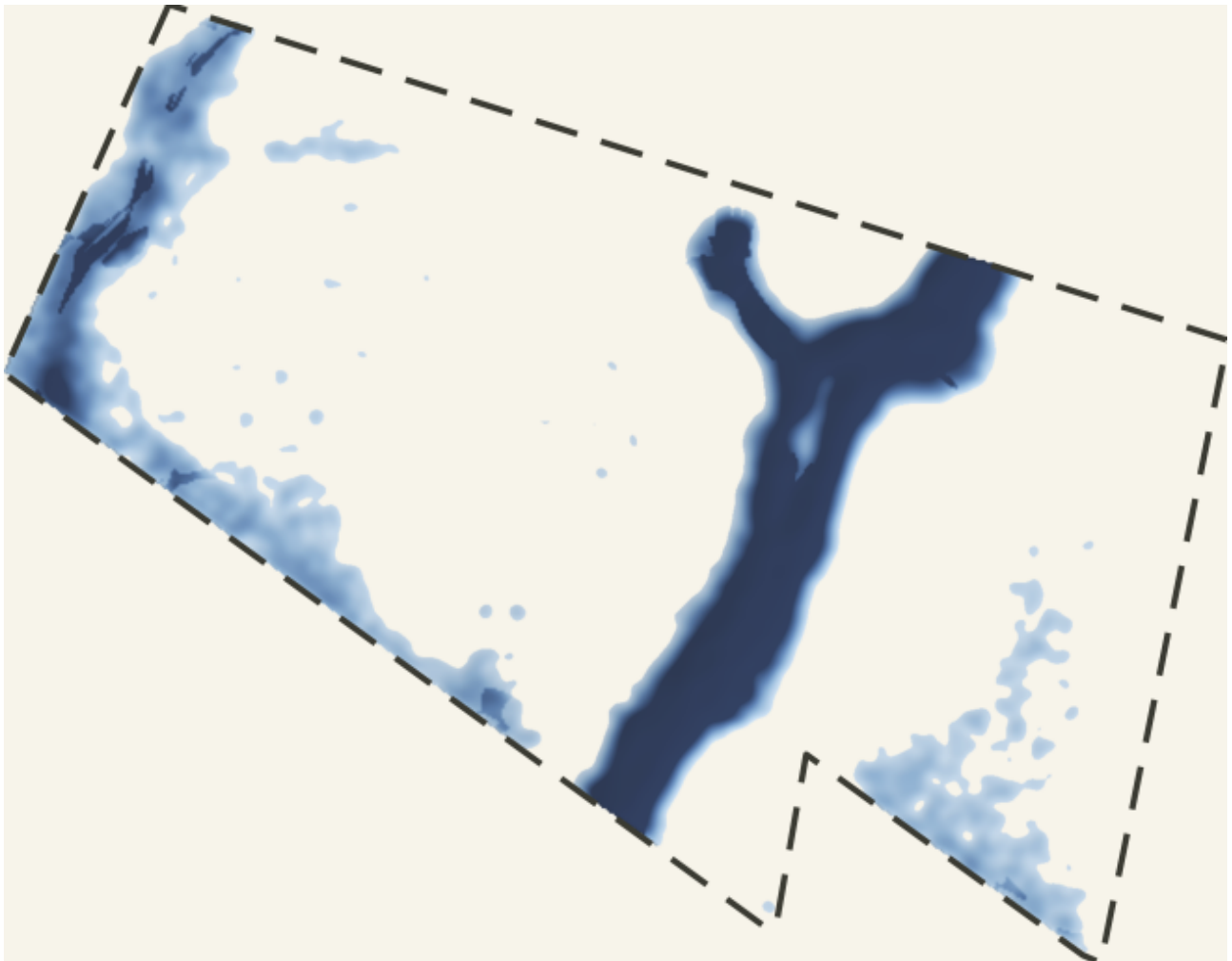
Against that, reference evapotranspiration runs 1,267 millimetres. Nine months of twelve are in deficit. The farm is not short of rain; it is short of rain arriving when the crop wants it.



Where the sources disagree

Two independent gridded products agree with each other and sit above the figures in the Kenzugi documents, which state 600 to 800 millimetres. Gridded products average a four to five kilometre cell over terrain rising toward the Aberdares and are known to read high against station records. The document range is the stated figure; the gridded record is a calibration offset to correct in later versions.

Topic	Documents	Gridded record	Reading
Annual rainfall	600–800 mm	CHIRPS 897, TerraClimate 868	Gridded reads high over rising terrain
Rain days	120–160 a year	68 at 1 mm or more	A 5 km cell dilutes convective showers
Longest dry spell	60–90 days, up to 150	33 mean, 56 worst	Light modelled rain breaks a real dry spell
Frost	Periodic events / none	No night at or below 4 °C in 30 years	Reanalysis supports the pilot document
Sunshine	1,850–2,100 h	3,891 h modelled	Modelled figure dropped as not credible



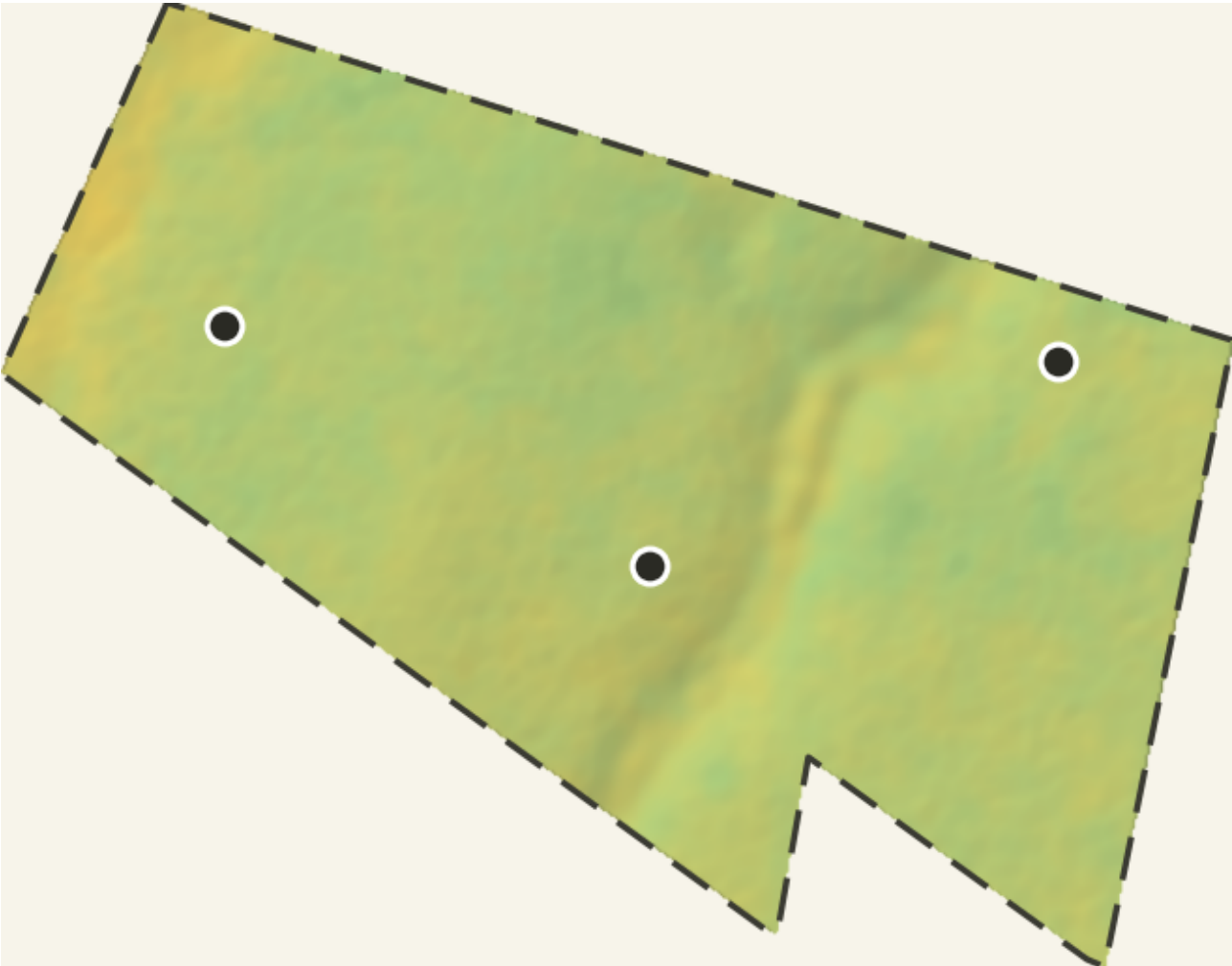
Cold-air pooling. Depth below the surrounding hundred metres, weighted where the landform reads hollow, valley or pit. Twenty-seven per cent of the farm sits more than 0.3 m below its surroundings.

Reanalysis records no night at or below four degrees in thirty years, which supports the pilot document over the farm report. But ERA5-Land is a nine-kilometre cell reporting a landscape average, and it cannot see cold air pooling in a hollow on a still night. This layer shows where both statements could be true. It is a terrain index, not a measurement: confirm with a minimum thermometer in the lowest pocket over one cool dry season before siting anything frost-sensitive.

Soil

Five profiles were sampled across the property in February 2026. Cation exchange capacity exceeds 25 cmol/kg in all five and zinc deficiency is widespread. Two limitations apply across the whole acreage: restricted rooting depth and limited oxygen availability.

One profile decides much of the design. NP3 reads well on every property a remote-sensed model carries — pH 7.5, nitrogen adequate, organic carbon 3.9 per cent, phosphorus high at 107 ppm. Its exchangeable sodium percentage reaches 32.9 at 24 centimetres. The report rules coffee, macadamia and citrus out of NP1, NP2 and NP3 until that falls below 6 per cent and rooting depth exceeds 80 centimetres.



Predicted pH from iSDA at 30 m, with the three placeable profiles. NP1 and NP2 have unusable coordinates in the report and are not shown.

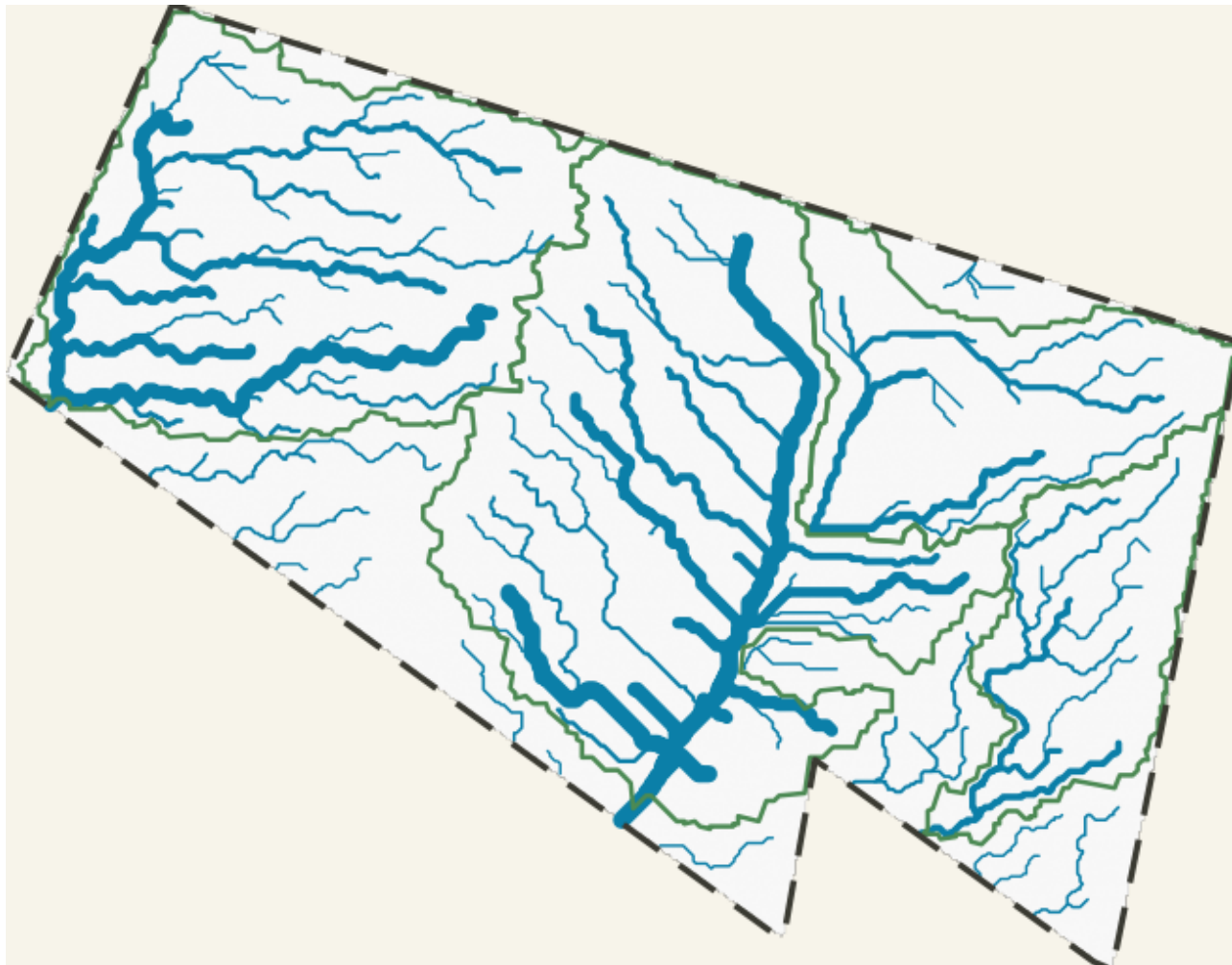
iSDA Africa carries twenty-one predicted soil properties and sodium is not among them. Neither is exchangeable sodium percentage, electrical conductivity or SAR. The property that disqualifies three of the five units is absent from the free continental model entirely. Predicted pH agrees with the laboratory within 0.5 units at all three placeable profiles, so pH and texture are shown as value surfaces; organic carbon, nitrogen and phosphorus are shown as relative pattern only, because iSDA reads roughly half the measured value for them here.

Profile	Depth	Limitation	Coffee	Macadamia
NP1	41 cm	Restricted rooting depth	Not suitable	Not suitable
NP2	49 cm	Restricted rooting depth	Not suitable	Not suitable

NP3	78 cm	Strongly sodic, ESP to 32.9 %	Not suitable	Not suitable
NP4	90 cm	Optimised depth profile	Moderately suitable	Moderately suitable
NP5	65 cm	Moderate depth, subsurface clay	Marginal	Marginal

3 · See water flow

Twenty-five kilometres of channel drain the property through four primary land units, the largest gathering 68.2 hectares. Land cover is 91 per cent grassland, 5 per cent shrubland and 3 per cent cropland.



The channel network, weighted by contributing area, with the four primary land units outlined.

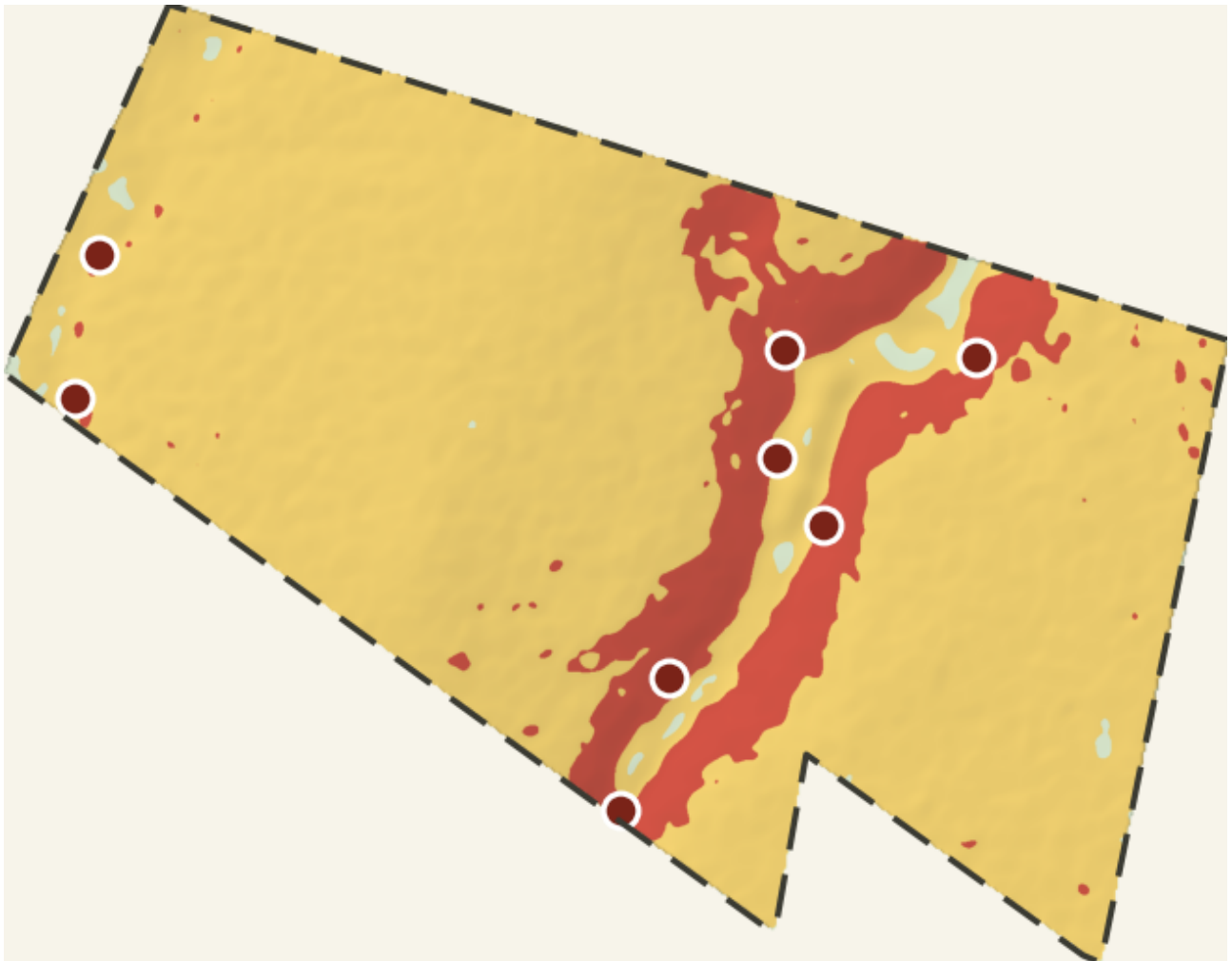
How much runs off

The Regrarians runoff formula — one hundred times area by rainfall by yield — gives a range rather than a number, because the yield term depends on soil type and the bands overlap widely. At 896 millimetres and eight-in-ten reliability the property yields between 96,600 and 289,801 cubic metres a year. Whether this clay behaves as a cracking elastic clay or an inelastic clay pan has not been established, and it changes the answer by roughly half.

The outlet figure of 180,000 cubic metres already in the project implies a yield of 9.3 per cent, which sits inside the band for every soil type in the table.

Erosion

Relative erosion potential combines slope, land cover and peak-month rainfall. Under the commoner reading of the formula, 17.8 per cent of the farm falls in the high-threat band, concentrated on the valley sides. The handbook does not state whether slope is in per cent or degrees; in degrees the high-threat share falls to 2.9 per cent. Five years of field observation recorded in the pilot document report very little erosion, which supports the lower reading.



Erosion threat bands with the eight points where high-threat ground feeds a defined channel. Two sit under cropland, the most erodible cover class on the farm.

One line from the method matters more than the arithmetic: land use is the primary cause of gully formation, not slope or rainfall. The lever here is grazing management, not earthworks.

What this section cannot tell you

Regrarians places regulatory frameworks first in the water workflow, before catchment hydrology. Water storage and abstraction in Kenya are regulated by the Water Resources Authority, and no permitting is considered anywhere in this tool. A land steward's first question about a proposed dam is whether they are allowed to build it.

4 · Count the water

Demand comes to 659,513 cubic metres a year, of which crops are 99.6 per cent. A thousand Dorpers need 1,825 cubic metres and six households 548 — together under half a per cent, which confirms the pilot document's statement that delivery is not the constraint.



The borehole cannot close the gap

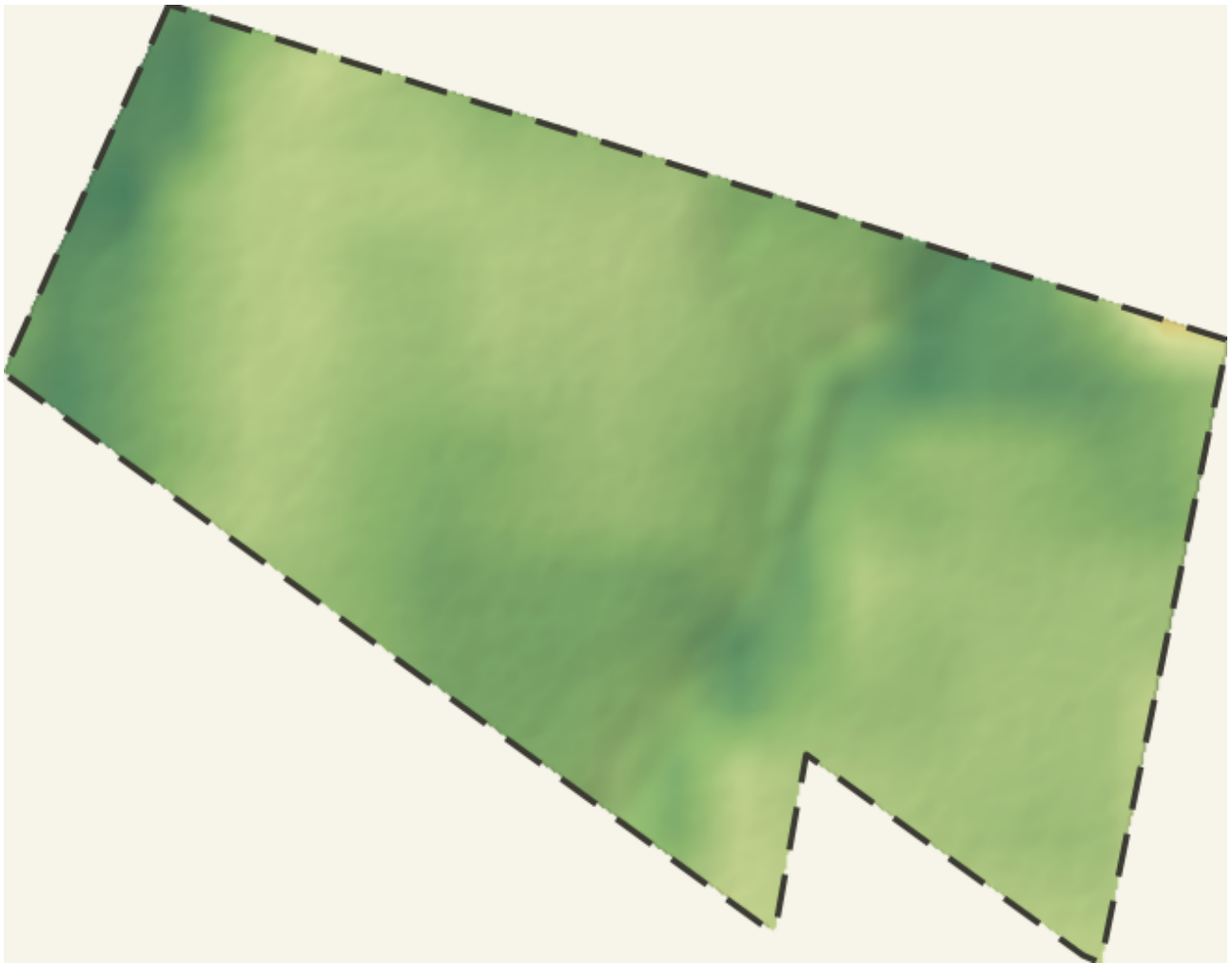
Runoff covers between 15 and 44 per cent of demand. The borehole delivers 40 cubic metres an hour, which is volume enough — but it carries a sodium adsorption ratio of 25.2 and residual sodium carbonate of 4.81 milliequivalents per litre, classified C2 to S4, a very high sodium hazard. Irrigating at that chemistry would spread across the farm the sodicity that already disqualifies three of the five soil profiles.

The pilot design specifies the remedy: calcium conditioning through an inline gypsum dissolver at about 113 milligrams per litre, holding applied water below SAR 6, roughly 450 kilograms per hectare a year. The water is not useless. It costs something specific to use.

The largest available source is the water already arriving

Satellite measurement of actual evapotranspiration puts consumption at 518 millimetres against a reference of 1,267 — the land is meeting 41 per cent of atmospheric demand before any of the planned crops are planted. Of that 518, transpiration through plants accounts for 368 millimetres and evaporation off bare soil for 148.

Across 165 hectares that is about 243,000 cubic metres a year consumed growing nothing — two and a half times the low runoff estimate, and two thirds of the shortfall. Raising the beneficial fraction from 71 to 80 per cent would redirect roughly 80,000 cubic metres a year into growth.



Beneficial fraction: the share of consumed water that passes through a plant rather than evaporating off the surface. It ranges from 23 to 83 per cent across the property.

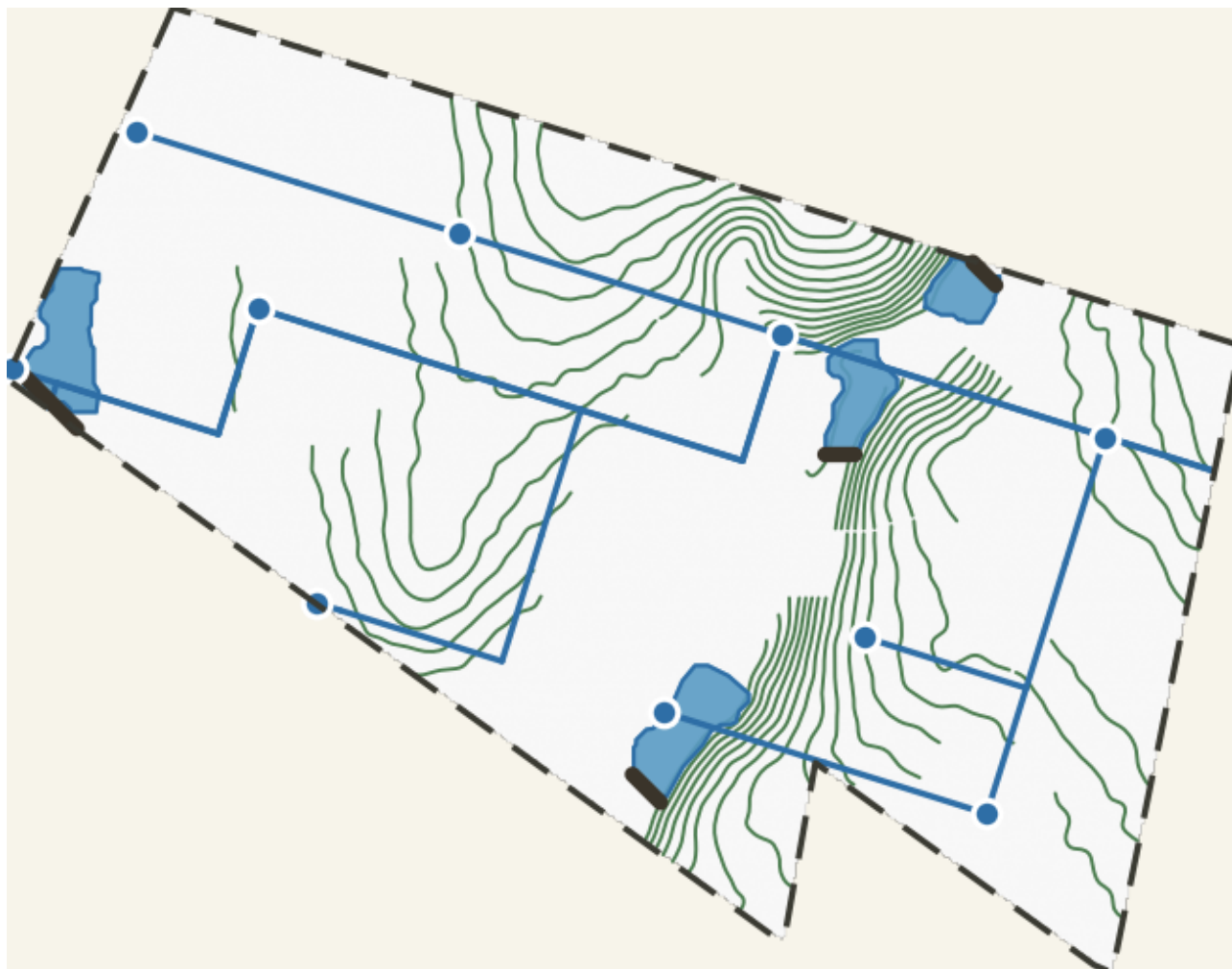
That reframes the design. The farm is not short of water arriving. It is short of water staying — which is what ground cover, the grazing pattern and the retention structures are for.

What this section cannot tell you

The borehole is the farm's only existing water source and nothing here describes the aquifer beneath it or whether the draw is sustainable. Crop factors for coffee and macadamia are FAO-56 values; the Regrarians table is Australian and carries neither. Effective rainfall at a flat 70 per cent is the handbook's rule and is likely generous on this clay.

5 · The design

The property is divided into thirty-four fields of about six hectares, aligned to its long axis and separated by seven-metre tracks so every field has road frontage. Land use is assigned to whole fields by the majority of the suitability analysis. Terrain-derived shapes are analytically correct, but no farm is laid out that way: fences, cultivation and machinery are straight.



Earthworks and water. Four dams across the valley throats, fifty-five swales on contour, and the reticulation running in the track verges.

Water

Four dam sites were tested by ranking every channel cell under eight degrees at two wall heights, comparing the contour-bounded storage volume against a trapezoidal wall across the valley at full supply level. Together they store 132,378 cubic metres for about 13,900 cubic metres of earthworks, covering 36 per cent of the shortfall. Embankments are homogeneous: Regrarians selects by what the soil gives, and 55 to 64 per cent clay at every depth supports a wall without a clay diaphragm.

Dam	Wall	Stores	Earthworks	Catchment	Spillway
D1	2.5 m × 72 m	42,262 m ³	1,843 m ³	67.7 ha	4.9 m
D2	2.5 m × 56 m	25,733 m ³	1,426 m ³	18.3 ha	3.0 m
D3	2.5 m × 59 m	19,094 m ³	1,508 m ³	3.0 ha	3.0 m
D4	4.0 m × 163 m	45,289 m ³	9,153 m ³	53.2 ha	3.9 m

Spillways are sized by the rational method against the 194-millimetre wettest recorded day with a peak factor of three, as a broad-crested weir at 0.3 metres depth. Three of the four dams return storage-to-earthworks ratios above the three-to-fifteen range conventional for farm dams, because a low wall on gentle ground backs water a long way up a wide shallow valley. Treat the ratios as a ranking, not a quantity, until survey confirms them.

The finding that shaped the reticulation

Seven of the ten troughs sit above the highest dam. Full supply levels run 1,868 to 1,881 metres; the grazing ground averages 1,885. Sited for cheapest storage, the dams sit in valley throats below the stock, and only one trough can be gravity-fed from them.

The design lifts water once — a 2.6-kilometre pumped rising main from D4 against 27 metres of head — to a header tank at 1,903.7 metres, and everything below runs by gravity. Pipe is buried in the track verge so it can be dug and repaired without crossing a planted field, and troughs sit at track junctions on field corners where one serves the fields around it.

This is precisely what keyline practice exists to solve: store water high so it distributes by gravity, and accept a worse storage ratio for it. The pump is the price of the siting choice. Re-siting the dams higher is the alternative, and the pilot document explicitly left that question open for the scale-up.

Grazing

Pasture is not one thing. It carries the four forage treatments from the pilot's trial — Rhodes grass as control, Massai and Camello as pure stands with clover, and Camello with Greenleaf desmodium as the legume treatment — randomised in blocks, with coppiced calliandra and sesbania lines through a third of the fields for fodder and nitrogen.

Each pasture field is a permanently fenced block subdivided into camps with movable poly-wire. A thousand Dorpers at forty kilograms eating three and a half per cent of bodyweight consume about 1,400 kilograms of dry matter a day and move roughly two camps a day on a ninety-day rotation.

Planting

Coffee and macadamia follow the pilot's own geometry: three-metre beds on a ten-metre pitch running north to south, seven-metre alleys between. Each bed carries the same five rows west to east — coffee on the sheltered western face at 2.88 metres, an aromatic row, the central succession line of macadamia with eucalyptus, banana, cassava and timber emergents, a spice row, and a coppiced nitrogen-fixing windbreak on the exposed eastern face.

6 · What holds, and what does not

Three things corroborate

The grazing arithmetic closes. One hundred and ninety-four camps from Kenzugi's grazing plan, 132 hectares of pasture, a thousand head and a ninety-day rotation imply 7,737 kilograms of dry matter per hectare a year — against the pilot's stated Year 3 target of 8,000. The flock size was an assumption in this tool and the camp count was theirs; they describe the same system.

The keyline judgement agrees. The pilot set keyline geometry aside for two hectares because the site is close to flat, and left the question open for the scale-up. This analysis reaches the same conclusion independently: three degrees mean slope, 42.7 metres of relief, and only three of four keypoints yielding a usable keyline.

The allocation found the right ground unaided. Placing tree crops on the gentlest, lowest-erosion, frost-free ground put macadamia exactly on NP4, the one profile the soil report rates suitable for all four crops. The rules were never shown the soil data.

And one thing does not

The same rules placed coffee 221 metres from NP3 — which the report rules out for coffee because exchangeable sodium reaches 32.9 per cent at 24 centimetres. Every property a remote-sensed model can see reads well there. The thing that disqualifies it appears only in the laboratory work.

That pair is the argument of this whole exercise. Free continental data gets a design a long way and then stops, silently, at exactly the property that matters. Five measured profiles cost real money and catch what the model structurally cannot.

What this design does not cover

Regulatory review. Dam construction and water abstraction in Kenya are regulated by the Water Resources Authority. The methodology places this first in the water workflow; this tool does not handle it.

Groundwater. The borehole is the only existing source and nothing here describes the aquifer or whether the draw is sustainable.

Diversion drains and gradient roads. Both need a surveyed gradient of one in two hundred held over a kilometre. A 4.64-metre elevation surface cannot set it, and a channel that runs uphill fails destructively.

The catchment above the farm. The elevation data stops at the boundary.

Spillway detail, borrow-pit balance and cut-off trenches are indicated but not engineered. Field boundaries, crop areas and the forage layout are indicative.

Sources

Terrain: Airbus WorldDEM Neo, 4.64 m, supplied for the property. Rainfall: CHIRPS v2.0 daily, 5 km, 1991–2020. Evapotranspiration and temperature: TerraClimate and ERA5 via Open-Meteo, 1991–2020. Actual evapotranspiration: FAO WaPOR v3, 100 m, 2023. Predicted soil: iSDA Africa, 30 m. Land cover: ESA WorldCover, 10 m, 2021. Measured soil: land suitability assessment, Gicheru and Karuma, July 2026. Design geometry and forage treatments: Kenzugi two-hectare pilot design of record v6.0. Method: Regrarians Handbook, chapters 1 to 3.