Pool Volume Calc.com

TECHNICAL REFERENCE

The *formulas* behind every calculator

Exactly how poolvolumecalc.com computes volume, equipment sizing, water, energy and cost — pulled straight from the calculation engine.

FOUNDATIONS

Constants & the master formula

Every pool volume reduces to one idea: the footprint area of the water's surface multiplied by its average (mean) depth, converted to gallons.

```
Volume (US gallons) = Footprint area (ft²) × Mean depth (ft) × 7.48
```

Internally all geometry is computed in feet and cubic feet; unit conversion happens only at the end. The precise factor 7.48051948 gal/ft^3 is used, not the rounded 7.5 (which over-estimates by ~0.26%).

CONVERSIONS USED EVERYWHERE

$1\ ft^3 = 7.48051948\ gal$	cubic feet → US gallons
1 US gal = 0.83267384 imp gal	US → imperial gallons
1 US gal = 3.78541178 L	US gallons → litres
$1\ ft^3 = 0.0283168466\ m^3$	cubic feet → cubic metres
1 m = 3.28083989 ft	metric length inputs → feet
1 gal water = 8.34 lb	used in heater energy
1 CCF = 748.051948 gal	hundred cubic feet (water billing)
1 therm = 100,000 BTU	natural-gas heating cost

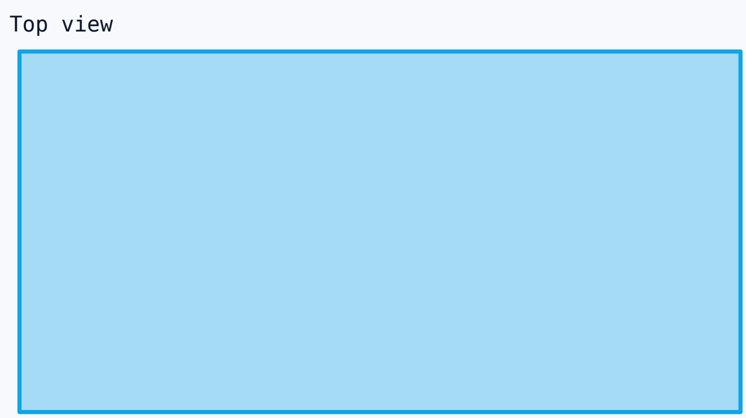
POOL VOLUME · BY SHAPE

Water-surface (footprint) area, per shape

Each pool shape has its own footprint-area formula. The pages that follow give the formula, the calculator's own diagram, and a worked example for every shape — that area then feeds the master formula with the mean depth from the depth-profile section.

Rectangle

```
Area = Length × Width
```



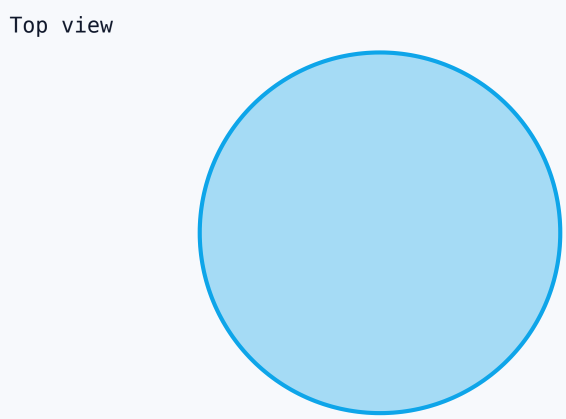
$512\ ft^2$	5.5 ft	21,065
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 32 ft × 16 ft pool = 512 ft^2. Sloped 3 ft → 8 ft gives a mean depth of 5.5 ft. Volume = 512 × 5.5 × 7.48 ≈ 21,065 US gallons.

Round / circular

$$\text{Area} = \pi \times (\text{Diameter} \div 2)^2$$



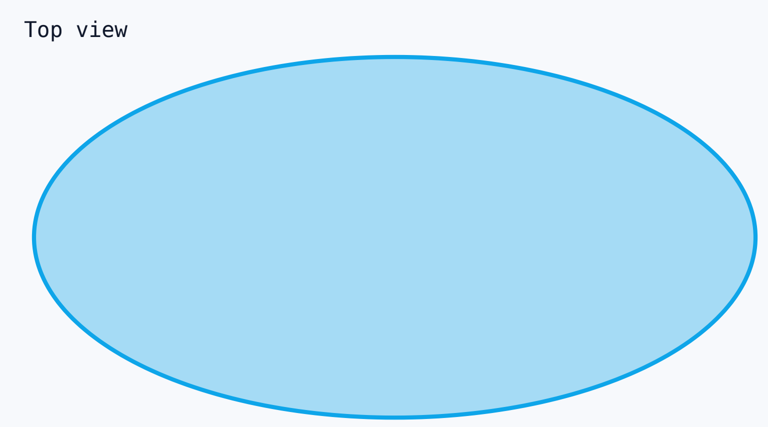
452.4 ft²	4 ft	13,536
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 24 ft round pool = $\pi \times 12^2 = 452.4$ ft². At a flat 4 ft depth, Volume = $452.4 \times 4 \times 7.48 \approx 13{,}536$ US gallons.

Oval

$$\text{Area} = \pi \times (\text{Length} \div 2) \times (\text{Width} \div 2)$$



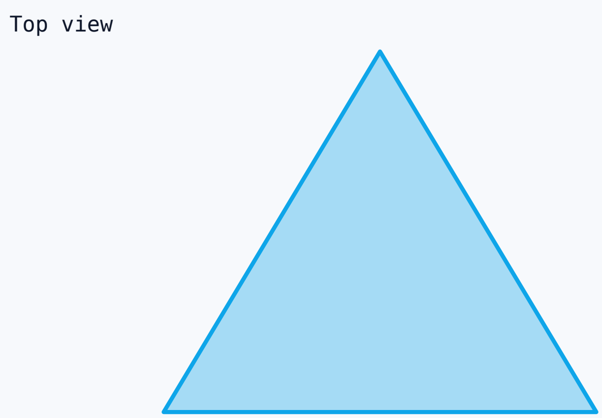
402.1 ft^2	4 ft	12,032
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 32 ft × 16 ft oval = π × 16 × 8 = 402.1 ft^2. At a flat 4 ft depth, Volume = 402.1 × 4 × 7.48 ≈ 12,032 US gallons.

Triangle

```
Area = ½ × Base × Height
```



240 ft^2	4 ft	7,181
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A triangle with base 24 ft and height 20 ft = ½ × 24 × 20 = 240 ft^2. At a flat 4 ft depth, Volume = 240 × 4 × 7.48 ≈ 7,181 US gallons.

Kidney

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Area = (Width A + Width B) × Length × 0.45
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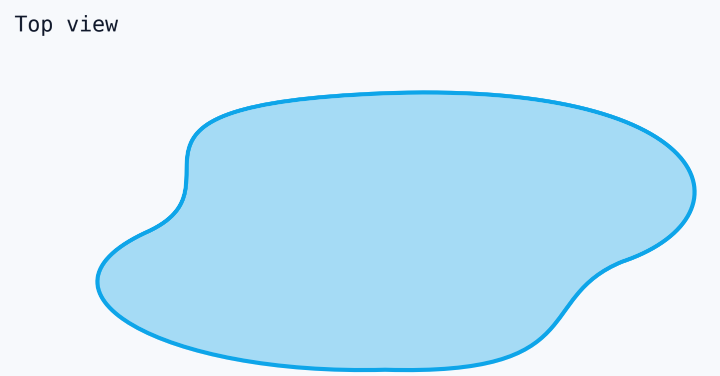


374.4 ft^2	4.5 ft	12,603
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

With Width A 16 ft, Width B 10 ft, Length 32 ft: Area = (16 + 10) × 32 × 0.45 = 374.4 ft^2. Sloped 3 ft → 6 ft gives mean depth 4.5 ft. Volume ≈ 12,603 US gallons.

Roman

$$\text{Area} = \text{Length} \times \text{Width} + \pi \times (\text{Width} \div 2)^2$$

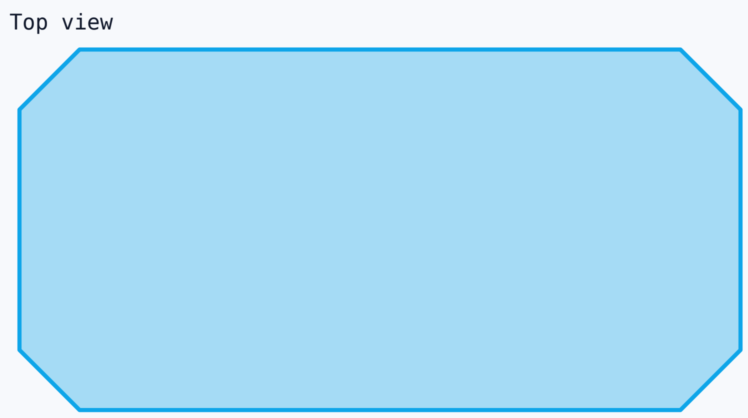
626.7 ft^2	4 ft	18,753
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 30 ft × 15 ft Roman pool = (30 × 15) + π × 7.5^2 = 626.7 ft^2 (rectangle + two semicircular ends). At 4 ft, Volume ≈ 18,753 US gallons.

Grecian

$$\text{Area} = \text{Length} \times \text{Width} - 2 \times \text{Cut}^2$$



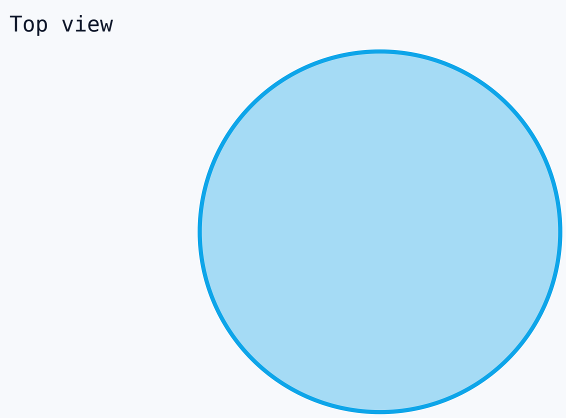
437.5 ft^2	4 ft	13,091
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 30 ft × 15 ft Grecian pool with 2.5 ft corner cuts = (30 × 15) – 2 × 2.5^2 = 437.5 ft^2. At 4 ft, Volume ≈ 13,091 US gallons.

Hot tub / spa

`Volume = Footprint area × (Water-above-seats + 0.4 × Footwell depth) × 7.48`



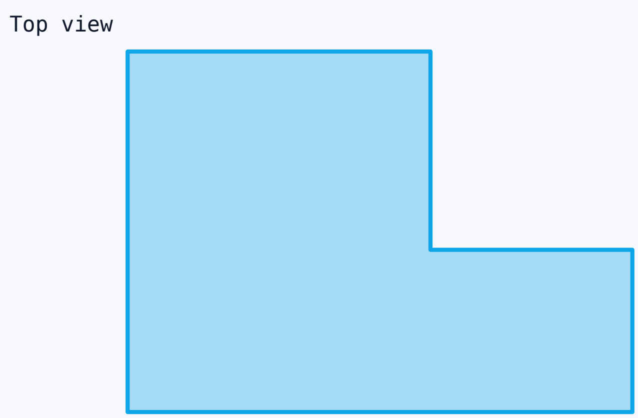
38.5 ft²	2.1 ft	605
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 7 ft round spa: footprint = $\pi \times 3.5^2 = 38.5$ ft². Seats mean the effective mean depth is 2.1 ft (1.5 above seats + 0.4 × 1.5 footwell). Volume ≈ 605 US gallons.

L-shaped

Total area = $(L_1 \times W_1) + (L_2 \times W_2)$ — the two rectangles combined



280 ft²	4 ft	8,378
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

Leg 1 = 20 × 10 = 200 ft²; Leg 2 = 10 × 8 = 80 ft²; total 280 ft². At a flat 4 ft depth, Volume = 280 × 4 × 7.48 ≈ 8,378 US gallons.

Freeform / lagoon

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Total area = sum of every simple section you add (Σ section areas)
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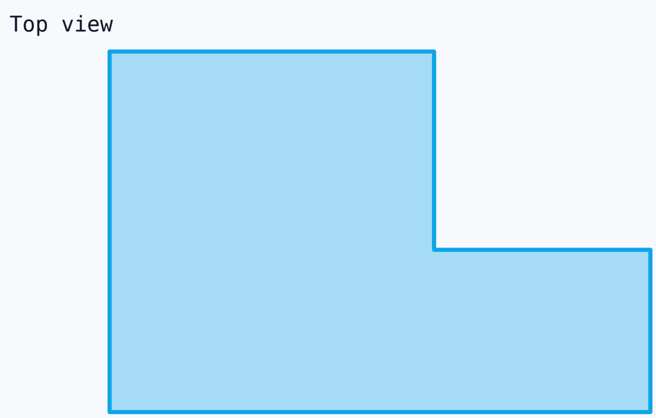


296 ft^2	4.5 ft	9,964
SURFACE AREA	MEAN DEPTH	US GALLONS

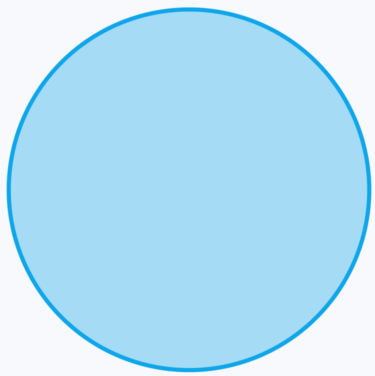
WORKED EXAMPLE

Split the pool into simple shapes: e.g. 18 × 12 = 216 ft^2 plus 10 × 8 = 80 ft^2 = 296 ft^2. At a 4.5 ft mean depth, Volume = 296 × 4.5 × 7.48 ≈ 9,964 US gallons.

Above-ground

Area = π × (Diameter ÷ 2)² (round kit) · or the Oval formula for oval kits

Top view



452.4 ft²	4.5 ft	15,228
SURFACE AREA	MEAN DEPTH	US GALLONS

WORKED EXAMPLE

A 24 ft round above-ground kit = π × 12² = 452.4 ft². Filled to 4.5 ft, Volume = 452.4 × 4.5 × 7.48 ≈ 15,228 US gallons.

Volume from a known surface area

When you choose "I know my surface area", the number you enter replaces the shape formula above and feeds the master formula directly — so it works for any shape, from a plan or spec sheet.

Volume (US gallons) = Entered surface area (ft^2) × Mean depth (ft) × 7.48

The mean depth still comes from your floor profile (next section): flat = depth; sloped = (shallow + deep) ÷ 2; hopper and spa as shown there.

Worked example — 385 ft^2 with a sloped 3 ft → 6 ft floor

Mean depth = (3 + 6) ÷ 2 = 4.5 ft. Volume = 385 × 4.5 × 7.48 ≈ 12,960 US gallons (≈ 49,000 litres).

Interior (wetted) surface area

The liner and solar-cover calculators need the pool's interior surface — floor plus walls — not just the water surface. The walls use the perimeter, and a sloped floor covers more area than its flat footprint.

Interior surface = Floor + Walls (+ sloped-floor extra)

Floor = the water-surface (footprint) area above. Walls = Perimeter × Wall height, where wall height is the average water depth (for a spa: water-above-seats + footwell depth). A sloped or hopper floor adds the extra length of the incline.

PERIMETER, PER SHAPE (DRIVES THE WALLS)

Rectangle

$$\text{Perimeter} = 2 \times (\text{Length} + \text{Width})$$

Round

$$\text{Perimeter} = \pi \times \text{Diameter}$$

Oval

$$\text{Perimeter} = \pi(a + b) \times [1 + 3h \div (10 + \sqrt{4 - 3h})]$$

Ramanujan ellipse approximation, with $a = \text{Length} \div 2$, $b = \text{Width} \div 2$, $h = ((a - b) \div (a + b))^2$.

Triangle

$$\text{Perimeter} = \text{Base} + \text{Height} + \sqrt{\text{Base}^2 + \text{Height}^2}$$

Roman

$$\text{Perimeter} = 2 \times \text{Length} + \pi \times \text{Width}$$

Two straight sides plus the two semicircular ends (one full circle of diameter = width).

Grecian

$$\text{Perimeter} = 2 \times (\text{Length} + \text{Width}) - 8 \times \text{Cut} + 4 \times \text{Cut} \times \sqrt{2}$$

Straight edge removed by the four 45° corner cuts, plus the chamfer faces added back.

Kidney

$$\text{Perimeter} \approx \text{Ellipse-perimeter}(\text{Length}, \text{average width}) \times 1.1$$

+10% over a plain ellipse for the concave waist.

$$\text{Sloped-floor extra} = (\sqrt{\text{Run}^2 + \text{Drop}^2} - \text{Run}) \times \text{Width-across}$$

Run = the pool length (or the slope run on a hopper floor); Drop = Deep – Shallow. Because the floor sheet follows the incline, it covers more than its flat projection — the term most liner calculators miss. Vinyl liner material then = Interior surface × (1 + waste%).

Mean depth, per floor profile

The mean depth is what turns footprint area into volume. Sloped and hopper floors are integrated properly — not approximated by a single number.

Flat

`Mean depth = Depth`

Uniform depth everywhere.

Sloped

`Mean depth = (Shallow + Deep) ÷ 2`

A constant slope from shallow to deep end; the average equals the wedge's mean.

Hopper / deep-end (compound floor)

`Mean depth = (S·d_s + T·(d_s+d_d)/2 + D·d_d) ÷ (S + T + D)`

A flat shallow shelf (run S, depth d_s), a sloped transition (run T), then a flat deep bottom (run D, depth d_d). Each zone is weighted by its run length.

Spa (two-zone, seats)

`Mean depth = Water-above-seats + FootwellFraction × Footwell-depth`

Seats displace the lower shell, so a spa holds less than a plain cylinder. Footwell fraction (open floor) defaults to 0.40.

Filling, delivery, leaks & covers

`Water fill cost = (Gallons ÷ Unit-gallons) × Price-per-unit (+ optional sewer)`

Unit-gallons: per 1,000 gal = 1000, per CCF = 748.052, per gallon = 1. Sewer (if billed on water) adds (gallons ÷ unit) × sewer rate.

`Hose fill time (min) = Gallons ÷ Hose-GPM`

Default hose flow: ½" = 9 GPM, ⅝" = 12 GPM, ¾" = 18 GPM.

`Truck delivery: Loads = ⌈Gallons ÷ Truck-capacity⌉ ; Cost = Loads × Price-per-load (or (Gallons ÷ 1000) × Price-per-1000)`

Default capacity 5,000 gal; default $350/load. The tool shows tap vs truck side by side and flags the cheaper.

`Leak test: Excess drop = Pool drop - Bucket drop ; Gallons lost/day = (Excess ÷ 12) × Surface ft² × 7.48052 ÷ Days`

Verdict: ≤ 1/16" excess = evaporation; ≤ ¼" = possible leak; more = likely leak. Both pool and bucket lose the same to evaporation, so the extra pool drop is the leak.

`Cover water saved/day = (Evap-inches ÷ 12) × Surface ft² × 7.48052 × Cover-effect`

Cover-effect defaults to 0.95 (stops ~95% of evaporation). Evaporation defaults to 0.25"/day.

`Cover heat saved/yr = Monthly-heating-cost × Heating-months × Heat-reduction ; Payback (yrs) = Cover-price ÷ Total-annual-saved`

Heat reduction defaults to 0.50 (DOE quotes 50–70%).

Turnover, TDH, filters & heating

`Turnover time (hrs) = Gallons ÷ (Flow-GPM × 60) ; Daily runtime = Turnover × Turns-per-day`

Flow needed for a target turnover = Gallons ÷ (Target-hours × 60). Residential pools usually target 1–2 turnovers/day.

`Pump power (W) = HP × 746 ÷ Motor-efficiency ; kWh/day = (Watts ÷ 1000) × Hours/day ; Cost/day = kWh × Rate`

Motor efficiency defaults to 0.70. Monthly = ×30, yearly = ×365. Wattage can be entered directly for accuracy.

`Variable-speed (pump affinity laws): Flow ∝ Speed , Power ∝ Speed³`

Per speed tier: Flow = Full-flow × Speed% ; Watts = Full-watts × Speed%³ ; kWh = (Watts ÷ 1000) × Hours. Half speed → half flow but ~⅛ the power — the real reason variable-speed pumps save.

`Target flow (GPM) = Gallons ÷ (Turnover-hrs × 60) → TDH (ft) = Friction head + Equipment head`

Equipment head (filter, heater, etc.) defaults to 25 ft — often the largest term, and the one naive tools omit.

`Friction (Hazen-Williams, PVC C=150): ft/100ft = [0.2083 × (100 ÷ C)^1.852 × Q^1.852 ÷ d^4.8655] × 2.31`

Q = GPM, d = pipe inside diameter (in). The 0.2083 form gives psi/100 ft; ×2.31 converts psi → feet of head. Pipe velocity (ft/s) = 0.4085 × GPM ÷ d^2 (flagged above ~5 ft/s).

`Filter area (ft²) = Required-GPM ÷ Media-rate ; Required-GPM = Gallons ÷ (Turnover-hrs × 60)`

Media rate (design / max GPM per ft^2, NSF Std 50): Sand 15 / 25 · D.E. 2 / 2.5 · Cartridge 0.375 / 1. Sand charge ≈ (Gallons ÷ 10,000) × 150 lb.

`Heater energy: BTU = Gallons × 8.34 × ΔT ; With losses = BTU × Loss-factor ; Heat-up time = BTU-with-losses ÷ Heater-BTU/hr`

ΔT = target temperature rise (°F). Loss factor defaults to 1.25 (~20% surface losses). Gas cost = (BTU ÷ 100,000) × Price-per-therm.

Liner, excavation, solar cover & bather load

$$\text{Liner material (ft}^2) = \text{Interior surface area} \times (1 + \text{Waste\%})\ ;\ \text{Weight} = \text{Material ft}^2 \times \text{Gauge-weight}$$

Waste defaults to 10%. Gauge weight (lb/ft²): 20-mil 0.10 · 27-mil 0.135 · 28-mil 0.14. Material cost range = Material ft² × $1.50–3.00 (material only, not a made-to-shape liner quote).

$$\text{Excavation: Dig} = (L + 2\cdot\text{overdig}) \times (W + 2\cdot\text{overdig}) \times (\text{avgDepth} + \text{overdig}) \rightarrow \text{Bank yd}^3 = \text{Dig} \div 27\ ;\ \text{Loose yd}^3 = \text{Bank} \times (1 + \text{Swell})$$

Over-dig defaults to 1.5 ft (walls, base, crew room). Soil swell: sand 12% · loam 22% · clay 30% · rock 50%. Truck trips = ⌈Loose ÷ 10–12 yd³⌉.

$$\text{Solar rings: Ring area} = \pi \times (\text{Dia} \div 2)^2\ ;\ \text{Effective/ring} = \text{Ring area} \times 0.78\ ;\ \text{Rings} = \lceil(\text{Surface} \times \text{Coverage}) \div \text{Effective-per-ring}\rceil$$

0.78 packing factor (circles can't tile a rectangle). Coverage target defaults to 75%. A solid blanket is simply cut to the pool's surface area.

$$\text{Bather load} = \Sigma \lfloor\text{Zone area} \div \text{Area-per-bather}\rfloor$$

Area per bather: shallow 15 ft² · deep 20 ft² · spa 10 ft². An estimate — the local health code is the authority.

COST OF OWNERSHIP

True cost / ROI

$$\text{Annual total} = \text{Energy} + \text{Water} + \text{Heating} + \text{Maintenance} + \text{Insurance} + \text{Property-tax}$$

Each is a recurring cost the user estimates. Defaults exist for all six.

$$\text{Operating total} = \text{Annual total} \times \text{Years}\ ;\ \text{N-year total} = \text{Build cost} + \text{Operating total}$$

Build cost is a low–high range (mid = average). Resale/equity is deliberately not computed — it's too local to estimate honestly.