SOLAR HARVESTING

Key Assumptions and Inputs

Power Output: 420 - 440 W (**430 W** used for calculations)
Efficiency: 22.8% (assumed)
Number of Panels: 181
Total Installed Capacity Range: 76.02 kW - 79.64 kW

Solar Irradiance in Fiji:
Fiji's average daily solar insolation is approximately 5.0–5.5 kWh/m²/day (**5.25 kWh/m²/day**. used for calculations)

Optimal Positioning:
Tilt Angle: Approximately 17°S latitude, facing north (Southern Hemisphere)
Azimuth: 0° (true north)
No Shading: Assumes clear skies and no obstructions

Performance Factors:
Temperature Coefficient: -0.26%/°C (HiHero spec)
Average Daytime Temperature: ~28°C (tropical climate)
(panel cell temperature may reach 60°C under direct sun, reducing efficiency)
System Losses: Account for inverter efficiency (95%), dust/humidity (5% loss), and wiring (2% loss), totalling ~12% loss
Degradation: First-year output assumes no degradation (89.4% output guaranteed after 25 years, per warranty)

Time Frame: **365 days** (1 year)

Temperature Effects

Standard Test Conditions (STC) assume 25°C cell temperature
In Fiji, cell temperature may rise to 60°C under full sun:
Temperature difference: 60°C - 25°C = 35°C
Power reduction: 35°C × -0.26%/°C = -9.1%
Adjusted output per panel: 430 W × (1 - 0.091) = **390.87 W**

Daily Energy Output

Daily Solar Insolation: 5.25 kWh/m²/day
Panel Area: 430 W panel at 22.8% efficiency under 1000 W/m² (STC) area of ~1.885 m² (calculated as 430 W / (1000 W/m² × 0.228))
Total Array Area: 181 × 1.885 m² = **341.19 m²**

Daily Energy Pre-Loss:
341.19 m² × 5.25 kWh/m²/day = **1,791.25 kWh/day** (using area method)
Using peak power: 70.75 kW × 5.25 hours (equivalent peak sun hours) = **371.44 kWh/day**

System Losses: 12% loss (1 - 0.12 = 0.88 efficiency factor).

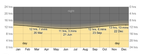
Daily Energy Output:
371.44 kWh/day × 0.88 = **326.87 kWh/day**

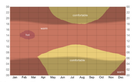
FINAL BREAKDOWN

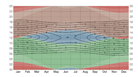
Installed Capacity: **77.83 kW** (181 panels × 430 W)
Daily Output: **326.87 kWh/day** (adjusted for temperature and losses)
Annual Output: **119,308 kWh/year** (~119.31 MWh/year)

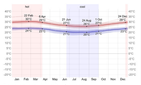
Key Factors:
5.25 kWh/m²/day insolation drives high yield
9.1% reduction due to heat (60°C cell temp)
12% system losses (inverter, dust, wiring)

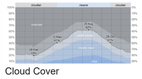
WEATHER DATA


Daylight Hours


Hourly Temperature


Solar Elevation / Azimuth


Average High / Low


Cloud Cover

ADDITIONAL WATER STORAGE

Rainwater Harvesting from Catchment Area

Key Inputs

Catchment Area: 2,827.48 m² (circular shape, radius ~30 m)
Annual Rainfall Range: 2,000 - 3,000 mm (2,500 mm assumed)
Collection Efficiency: 85% (accounting for evaporation, overflow, and losses typical in rainwater systems)
Seasonal Split:
Wet season (November - April, 6 months, ~70% of rainfall = 1,750 mm):
Dry season (May - October, 6 months, ~30% = 750 mm)

Annual Water Caught

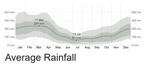
Formula: Volume (m³) = Rainfall (m) × Area (m²) × Efficiency
Calculation: 2.5 m × 2,827.48 m² × 0.85 = 6,008.15 m³
Annual Total: **6,008,150 liters** (~6 million liters)

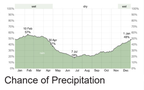
Annual Runoff Harvested

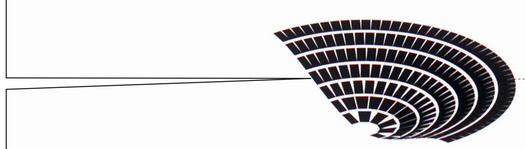
Formula: Volume (m³) = Rainfall (m) × Area (m²) × Runoff Coefficient × Efficiency.
Calculation: 2.5 m × 1,000 m² × 0.3 × 0.7 = 525 m³
Annual Runoff Total: **525,000 liters**

Total Potential Annual Water Harvested: **6,533,150 liters**

WEATHER DATA


Average Rainfall


Chance of Precipitation

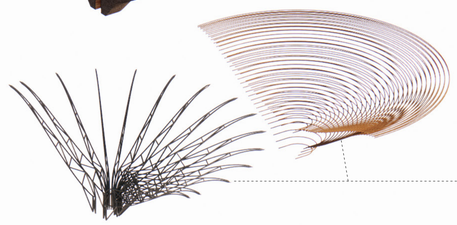


PHOTOVOLTAIC PANELS

- x 181 Panels

BOWL

- Timber bowl structure panelling (pending structural engineer, fire engineer)v
- Thatched soffit

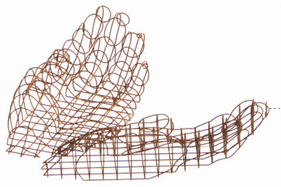


BOWL STRUCTURE

- 15 x Frame (timber or steel construction tbc, refer structural engineer)
- Structural battens

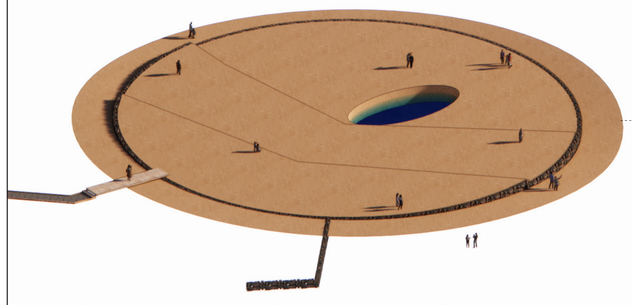
HANDS SCULPTURE

- Traditional thatching
  - Soga palm leaves
  - Reeds
  - Coconut fronds



HANDS SCULPTURE STRUCTURE

- A series of cross-gridded timber frames



GROUND

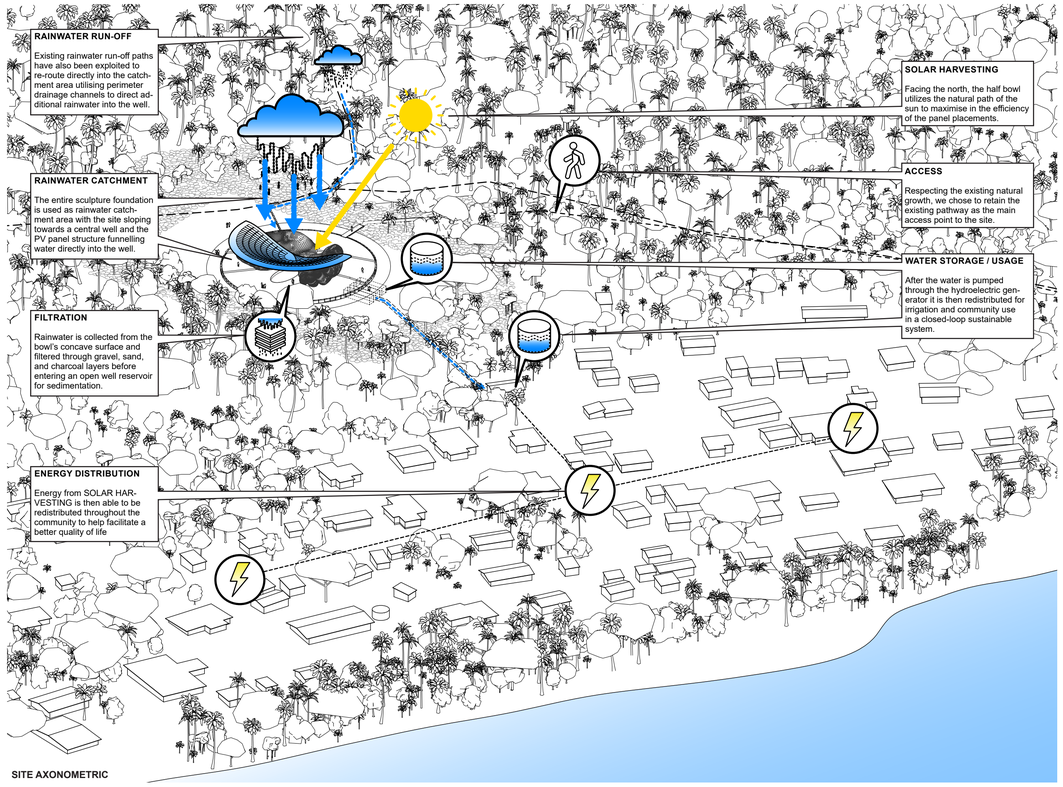
- Compact earth
- Perimeter gabion wall
- Open water well
- Main access path
- Rainwater run-off path channel

GROUND / SUB-GROUND

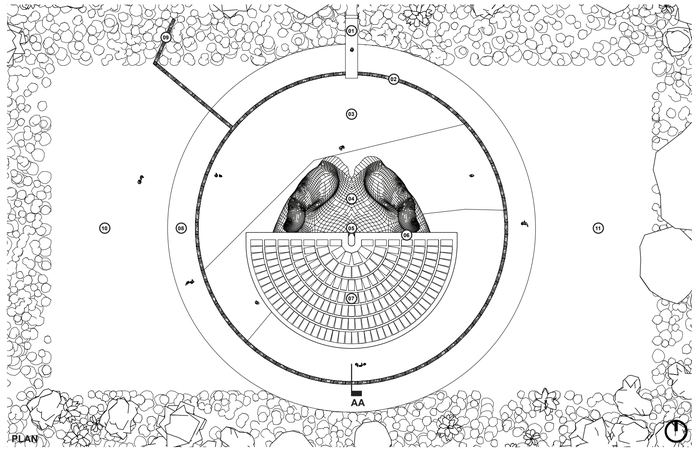
- Open water well
- Water filtration system

- 3 x 100,000L underground water storage tanks (potential for more)

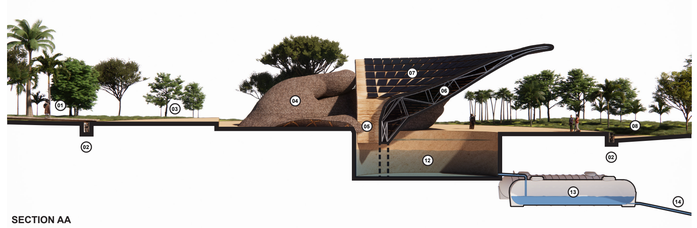
EXPLODED AXONOMETRIC



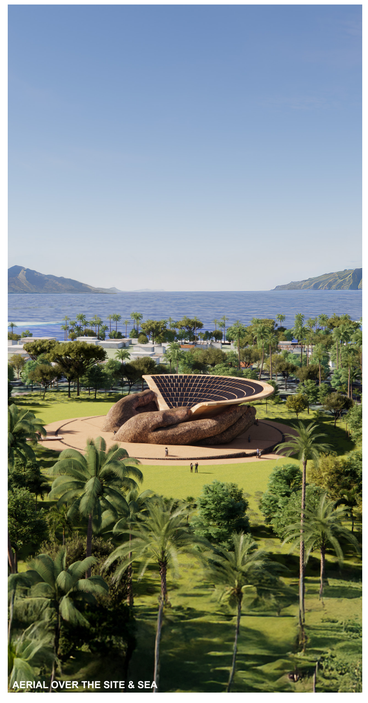
SITE AXONOMETRIC



PLAN



SECTION AA



AERIAL OVER THE SITE & SEA

SOLAR HARVESTING IN FIJI

Fiji's solar market prioritizes reliable, cost-effective, and climate-appropriate solutions over the absolute highest-efficiency panels due to its unique context as a small island nation with a dispersed population and tropical conditions. As of February 2025, the globally top-performing solar panels—such as Maxeon 7 (24.1% efficiency) and AIKO ABC (24.2%)—lead in raw efficiency but lack confirmed widespread presence in Fiji. Instead, Canadian Solar, with efficiencies up to 22.8% (e.g., HiHero series), emerges as the most prominent high-efficiency option already established in the country, distributed by local installers like Solar Fiji. QCells (up to 21.7%) is also prevalent, reflecting a focus on proven, affordable technology.

This dynamic stems from several factors: Fiji's reliance on imports through regional hubs like Australia, the need for panels to endure high heat and humidity (favoring brands with low temperature coefficients like Canadian Solar), and a market scale that doesn't yet demand premium, ultra-efficient models designed for space-constrained or high-income regions. Rural electrification and off-grid systems dominate, where durability and cost outweigh marginal efficiency gains. While cutting-edge panels like Maxeon 7 or AIKO ABC could be imported, their higher cost and limited local distribution make them less practical compared to established options like Canadian Solar, which balances efficiency, reliability, and availability for Fiji's needs.

PANEL OF CHOICE: *Canadian Solar HiHero CS6.1-54TD*

Manufacturer: *Canadian Solar Inc.*
Model: *HiHero CS6.1-54TD*
Technology: *Heterojunction (HJT) with monocrystalline silicon cells* (HJT combines crystalline silicon with thin amorphous silicon layers, enhancing efficiency and temperature performance.)
Nominal Power Output range: *420–440 W* (varies by specific variant)
Module Efficiency: Up to *22.8%* (maximum listed for the series)

SUSTAINABLE WATER MANAGEMENT SYSTEM

The project's water management system is designed to efficiently collect, purify, store, and distribute rainwater, ensuring long-term sustainability for the Marou community. At its core is an open well filtration system that naturally purifies rainwater through a multi-layered filtration process before storing it for community use. Rainwater is first funnelled from the concave surface of the kava bowl-inspired structure, optimizing collection efficiency. It then passes through a gravel and sand pre-filtration bed, which removes large debris before entering a bio-filtration system composed of charcoal, sand, and fine gravel, further purifying the water. The filtered water collects in an open well reservoir, where natural sedimentation occurs, providing a clean and reliable water source for drinking, irrigation, and groundwater replenishment.

To ensure efficient storage and distribution, the system is integrated with three 100,000-liter underground storage tanks, positioned at a higher elevation to utilize gravity-fed water distribution. This design minimizes reliance on mechanical pumping while ensuring steady water pressure throughout the community. The system is also scalable, with the potential for additional high-capacity tanks to be placed at even greater altitudes if needed. To facilitate this expansion, solar-powered water pumps can be incorporated to efficiently transport water to elevated storage points, further enhancing distribution. By combining passive gravity-fed flow with renewable energy solutions, this approach reinforces community resilience, self-sufficiency, and long-term water security, ensuring that Marou thrives in harmony with its natural environment.

LEGEND

01. Entry path
02. Perimeter gabion wall / Catchment area drainage channels
03. Compact Earth Foundation
04. Hands sculpture
05. Drainage funnel
06. Half bowl structure
07. Photovoltaic panels
08. Perimeter circulation path
09. Rainwater run-off drainage channels
10. West lawn
11. East lawn

12. Rainwater collection / filtration pool
13. Underground water storage tanks
14. Pipes connecting to hydroelectric generators