

# Desalination Plant Design — Engineering Report

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Prepared with EngiMetric Engineering Workspace.

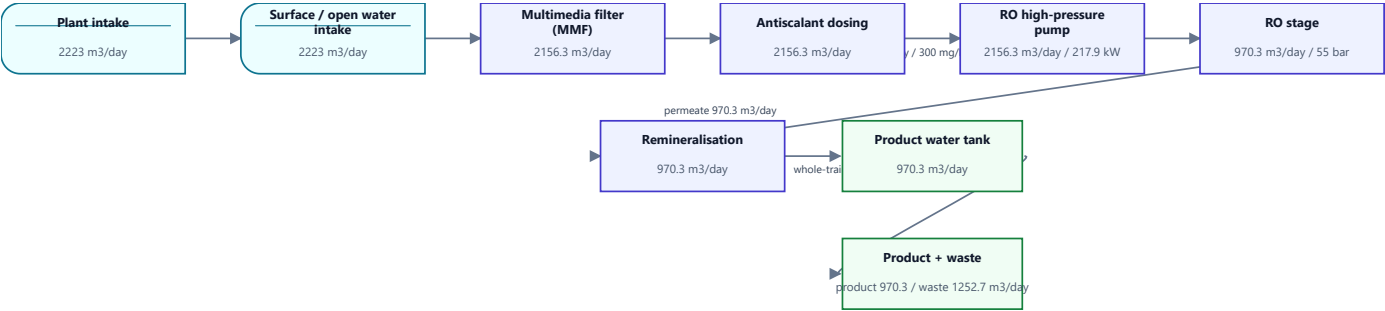
This package is a preliminary engineering calculation. It carries no approval, no professional seal and no signature, and every result remains subject to verification by a qualified professional engineer against project-specific data and applicable codes.

## Document

EngiMetric Engineering Workspace · preliminary engineering package, subject to engineer review.

## Process Flow Diagram

Configured treatment train, projected from the same canonical train the interactive diagram draws. Process order and identities are identical to the designer; pumps, vessels and balance figures are engineering annotations on those processes, not extra process stages. A figure shown as Required input was not supplied and has not been assumed.



# Desalination Plant Design — Engineering Report

**Project:** Desalination Plant Design

## Calculation Summary

Desalination Plant Designer:

- Plant product (m³/day): 970.34 m³/day (calculated)
- Plant recovery (%): 43.65 % (calculated)
- Plant water pass: 1 dimensionless (calculated)
- Tdh-ro-high-pressure-pump: 560.85 m (calculated)
- Total-pressure-ro-high-pressure-pump: 55 bar (calculated)
- Motor-power-ro-high-pressure-pump: 217.88 kW (calculated)

## Desalination Plant Designer

Tool: Desalination Plant Designer (desalination-plant-designer)

URL: /water/desalination/plant-designer/

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Inputs:

- Plant intake flow (m³/day) = 2223 m³/day (user-provided)
- Req product flow (m³/day) = 1000 m³/day (user-provided)
- Req recovery (%) = 45 % (user-provided)
- Req operating (h) = 24 h/day (user-provided)
- Req product tds (mg/L) = 300 mg/L (user-provided)
- Hyd static head (m) = 3 m (user-provided)
- Hyd pump efficiency (%) = 70 % (user-provided)
- Hyd motor efficiency (%) = 90 % (user-provided)

Results:

- Plant product (m³/day) = 970.34 m³/day (calculated)
- Plant recovery (%) = 43.65 % (calculated)

- Plant water pass = 1 dimensionless (calculated)
- Tdh-ro-high-pressure-pump = 560.85 m (calculated)
- Total-pressure-ro-high-pressure-pump = 55 bar (calculated)
- Motor-power-ro-high-pressure-pump = 217.88 kW (calculated)

Validation:

- mass-balance: Water balance — intake = product + waste: Pass. The whole-plant water balance closes (residual 0.0000 m3/day).
- mass-balance: Salt balance — feed salt = product salt + waste salt: Not applicable. The salt check is skipped while any stage is missing its TDS. Concentrate TDS is derived by salt conservation, never assumed. Next: Supply feed and product TDS on every stage to enable the salt check.
- flow: Flow continuity — every stream has a flow from the balance: Pass. All 7 modelled stream(s) carry a flow derived from the plant mass balance.
- hydraulics: Hydraulic duty — every pump has a total dynamic head: Data required. 2 of 3 pump duty(ies) have no complete head: Transfer / booster pump (head components: frictionLossM, minorLossesM, residualPressureBar), Well submersible pump (hydraulic design basis components). Next: Supply the named head components under the hydraulic design basis (static head, pipe geometry, minor losses, discharge pressure).
- hydraulics: Pump power — motor power calculable for every duty: Data required. Motor power is not calculable for 2 duty(ies): Transfer / booster pump, Well submersible pump. Next: Complete the head basis and supply pump and motor efficiency to calculate motor power.
- equipment: Equipment sizing — each item sized or explicitly marked: Data required. 2 item(s) are not sized: Reverse osmosis — ro-stage (needs pumpEfficiencyPct); Well submersible pump (needs duty flow basis). Next: Supply the named sizing inputs, or accept the item as data-required.
- equipment: Design mode — every existing / hybrid item carries an engineering verification: Pass. All 10 modelled item(s) are new-design items.
- design: Process stages — every stage has an engineering role and recovery: Pass. All 4 stage(s) are configured with recovery and unit sizing.
- design: Unit consistency — no value without a unit, no unit without a value: Pass. Every model value carries an explicit unit, and no missing value is presented as a number.

Warnings:

- [info] Plant-wide water balance closes: intake + make-up = product + waste.
- [info] Stage "ro-stage": concentrate TDS is derived at 63391 mg/L by salt conservation — confirm against solubility / scaling data before use.

Assumptions:

- Plant recovery is an engineer-supplied target: Plant recovery is an engineer-supplied design target. The model derives feed flow from it (feed = product ÷ recovery) and never assumes a recovery. (owner: process engineer; basis: Stated design target — no document reference attached unless supplied; review: engine rule (not applicable))
- Concentrate TDS is derived, never assumed: Concentrate TDS is derived by salt conservation (feed×TDS = product×TDS + waste×TDS). No removal percentage is assumed for the concentrate. (owner: process engineer; basis: Salt balance over the plant and each stage; review: engine rule (not applicable))
- Equipment is never auto-selected: Equipment is selected explicitly by the engineer. The model does not auto-select products, manufacturers, models or standard sizes. (owner: process engineer; basis: Equipment selection by the engineer, not the software; review: engine rule (not applicable))
- A missing hydraulic component stays missing: Hydraulic head components are optional engineer inputs; a missing component stays missing and head is never assumed. (owner: process engineer; basis: Hydraulic design basis (optional inputs); review: engine rule (not applicable))
- RO pump discharge equals the stated feed pressure: The RO high-pressure pump discharge pressure equals the engineer-supplied stage feed pressure; it is never invented. (owner: process engineer; basis: Stage feed-pressure basis on the RO row; review: engine rule (not applicable))
- Unsized equipment stays required input: Equipment that cannot be sized from available inputs is reported as required input; no standard size is assumed. (owner: process engineer; basis: Sizing completeness per equipment item; review: engine rule (not applicable))

## Related Calculations

## Basis of this package

Synthetic Demonstration / Educational Example — Not a Project Design. The inputs are a documented demonstration basis; replace every one of them with your own project data before use.

Values shown as required input were not supplied and have not been assumed. No price, manufacturer, model or reference is invented anywhere in this package.

## Plant flow streams (from the engineering model)

Every stream below is produced by the same engineering model that draws the process flow diagram.

| Stream                     | From                       | To                    | Flow          | TDS           | Status  |
|----------------------------|----------------------------|-----------------------|---------------|---------------|---------|
| Raw intake                 | Source / intake            | Filter                | 2223.0 m3/day | 35000 mg/L    | Derived |
| multimedia-filter product  | Filter                     | Chemical dosing       | 2156.3 m3/day | not specified | Derived |
| ro-stage product           | Reverse osmosis — ro-stage | Posttreatment         | 970.3 m3/day  | 300 mg/L      | Derived |
| ro-stage waste             | Reverse osmosis — ro-stage | Concentrate           | 1186.0 m3/day | 63391 mg/L    | Derived |
| remineralisation product   | Posttreatment              | Product water tank    | 970.3 m3/day  | not specified | Derived |
| antiscalant-dosing product | Chemical dosing            | Well submersible pump | 2156.3 m3/day | 35000 mg/L    | Derived |

| Stream                     | From                  | To                         | Flow          | TDS        | Status  |
|----------------------------|-----------------------|----------------------------|---------------|------------|---------|
| antiscalant-dosing product | Well submersible pump | Reverse osmosis — ro-stage | 2156.3 m3/day | 35000 mg/L | Derived |

## Equipment duty and sizing (from the engineering model)

| Equipment                  | Duty flow      | Total dynamic head | Size                                                   | Status         | Needs                         |
|----------------------------|----------------|--------------------|--------------------------------------------------------|----------------|-------------------------------|
| Source / intake            | required input | required input     | not requested                                          | Derived        | —                             |
| Filter                     | required input | required input     | Process unit sizing: Feed flow at unit 92.6 m³/h       | Calculated     | —                             |
| Chemical dosing            | required input | required input     | Process unit sizing: Feed flow at unit 89.8 m³/h       | Calculated     | —                             |
| Reverse osmosis — ro-stage | required input | required input     | Process unit sizing: Membrane elements installed 36 ea | Required input | pumpEfficiencyPct             |
| Posttreatment              | required input | required input     | Process unit sizing: Feed flow at unit 40.4 m³/h       | Calculated     | —                             |
| Transfer / booster pump    | 92.59 m3/h     | required input     | not requested                                          | Derived        | —                             |
| Well submersible pump      | required input | required input     | not requested                                          | Required input | duty flow basis               |
| RO high-pressure pump      | 89.85 m3/h     | 560.8 m            | not requested                                          | Derived        | —                             |
| Product water tank         | required input | required input     | not requested                                          | Required input | storage residence time (days) |
| Concentrate                | required input | required input     | not requested                                          | N/A            | —                             |

## Sizing inputs and the engine behind each size

Blank sizing inputs mean the size was not requested, not that a default was used.

- Filter / Process unit sizing: Feed flow at unit 92.6 m³/h | required-input | processDesign.designProcessTrain
- Filter / Filter sizing: not requested | not-applicable | filterSizing.calculateFilterSizing
- Filter / Antiscalant dosing: not requested | not-applicable | antiscalantDosing.calculateAntiscalantDosing
- Filter / Stage feed line: not requested | not-applicable | hydraulics.calculatePipeSizing
- Chemical dosing / Process unit sizing: Feed flow at unit 89.8 m³/h | required-input | processDesign.designProcessTrain
- Chemical dosing / Filter sizing: not requested | not-applicable | filterSizing.calculateFilterSizing
- Chemical dosing / Antiscalant dosing: not requested | not-applicable | antiscalantDosing.calculateAntiscalantDosing
- Chemical dosing / Stage feed line: not requested | not-applicable | hydraulics.calculatePipeSizing
- Reverse osmosis — ro-stage / Process unit sizing: Membrane elements installed 36 ea | calculated | processDesign.designProcessTrain | needs pumpEfficiencyPct
- Reverse osmosis — ro-stage / Filter sizing: not requested | not-applicable | filterSizing.calculateFilterSizing
- Reverse osmosis — ro-stage / Antiscalant dosing: not requested | not-applicable | antiscalantDosing.calculateAntiscalantDosing
- Reverse osmosis — ro-stage / Stage feed line: not requested | not-applicable | hydraulics.calculatePipeSizing
- Posttreatment / Process unit sizing: Feed flow at unit 40.4 m³/h | required-input | processDesign.designProcessTrain
- Posttreatment / Filter sizing: not requested | not-applicable | filterSizing.calculateFilterSizing
- Posttreatment / Antiscalant dosing: not requested | not-applicable | antiscalantDosing.calculateAntiscalantDosing
- Posttreatment / Stage feed line: not requested | not-applicable | hydraulics.calculatePipeSizing
- Product water tank / Product water tank: data required | required-input | tank.calculateTankStorage | needs storage residence time (days)

## Plant energy (traceable to calculated pump duties)

- Installed motor power: 217.9 kW across 1 calculated pump duty(ies).
- Specific energy: not available. Missing: motor power for every pump duty (complete head plus efficiencies).
- Source: hydraulics.calculatePumpMotorPowerKw (sum over calculated pump duties)

## Configured treatment train (process order, duty and engineering basis)

The engineer configured 7 process step(s) in this order. This is the canonical train the interactive diagram and the process flow diagram both project. Every duty below was produced by the named engine; EngiMetric assumes none of them.

| # | Process                     | Area               | Status         | Flow          | TDS           | Calculated duty                                                                                                                 |
|---|-----------------------------|--------------------|----------------|---------------|---------------|---------------------------------------------------------------------------------------------------------------------------------|
| 1 | Surface / open water intake | Intake / raw water | Preliminary    | 2223.0 m3/day | not specified | Surface / open water intake: Engineer Review — no validated quantitative basis in EngiMetric yet [preliminary, engineer review] |
| 2 | Multimedia filter (MMF)     | Pretreatment       | Required Input | 2156.3 m3/day | not specified | needs filtration rate (m³/m²/h), water depth (m), media effective size (mm)                                                     |
| 3 | Antiscalant dosing          | Pretreatment       | Required Input | 2156.3 m3/day | not specified | needs dose rate (mg/L), product strength (mass %)                                                                               |

| # | Process               | Area            | Status         | Flow          | TDS           | Calculated duty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---|-----------------------|-----------------|----------------|---------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | RO high-pressure pump | Reverse osmosis | Calculated     | 2156.3 m3/day | not specified | Design flow: 89.85 m³/h [calculated, process model]; Required head: 560.85 m [calculated, hydraulic basis]; Hydraulic power: 137.27 kW [calculated, hydraulics.calculatePumpMotorPowerKw]; Motor power: 217.88 kW [calculated, hydraulics.calculatePumpMotorPowerKw]; Pump efficiency: 70 % pump / 90 % motor [calculated, engineer input]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 5 | RO stage              | Reverse osmosis | Calculated     | 970.3 m3/day  | 300 mg/L      | Feed flow: 2156.31 m³/day [calculated, plantMassBalance]; Permeate flow: 970.34 m³/day [calculated, plantMassBalance]; Concentrate flow: 1185.97 m³/day [calculated, plantMassBalance]; Stage recovery: 45 % [calculated, engineer input (process train)]; Product TDS: 300 mg/L [calculated, engineer input (process train)]; Concentrate TDS (derived): 63390.91 mg/L — by salt conservation, verify against solubility [calculated, plantMassBalance (salt conservation)]; Feed pressure basis: 55 bar g [calculated, engineer input (stage row)]; Membrane area required: 2695.39 m² [calculated, ro/elementCount.calculateRoElementCount]; Membrane area installed: 2880 m² [calculated, ro/elementCount.calculateRoElementCount]; Membrane elements installed: 36 ea [calculated, ro/elementCount.calculateRoElementCount]; Pressure vessels: 6 ea [calculated, ro/elementCount.calculateRoElementCount]; Actual permeate flux: 14.04 L/m²/h [calculated, ro/elementCount.calculateRoElementCount] |
| 6 | Remineralisation      | Post-treatment  | Preliminary    | 970.3 m3/day  | not specified | Remineralisation: Engineer Review — no validated quantitative basis in EngiMetric yet [preliminary, engineer review]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 7 | Product water tank    | Product water   | Required Input | 970.3 m3/day  | not specified | needs residence time (days), fill rate (m³/h)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## Treatment train water balance and engineering checks

Whole-train water balance, as computed by the engine:

| Term     | Value                               |
|----------|-------------------------------------|
| Intake   | 2223.000000 m3/day                  |
| Product  | 970.339500 m3/day                   |
| Waste    | 1252.660500 m3/day                  |
| Balance  | CLOSED                              |
| Residual | residual 0 m3/day at full precision |

Engineering checks:

| Check                                   | Status         | Detail                                                                                                | Next action                                                     |                                                             |                                       |
|-----------------------------------------|----------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------|
| Required inputs outstanding             | required-input | Multimedia filter (MMF): filtration rate (m³/m²/h), water depth (m), media effective size (mm)        | Antiscalant dosing: dose rate (mg/L), product strength (mass %) | Product water tank: residence time (days), fill rate (m³/h) | Supply the named inputs on each step. |
| Preliminary processes — Engineer Review | preliminary    | Surface / open water intake, Remineralisation have no validated quantitative basis in EngiMetric yet. | Confirm the design basis for each preliminary process.          |                                                             |                                       |
| Whole-train water balance closes        | pass           | Intake = product + waste within 0 m³/day.                                                             | —                                                               |                                                             |                                       |

## Treatment train equipment requirements (generated from the train, not selected)

Each requirement names the process that generated it and the engine that sized it. No product is selected by EngiMetric.

| Requirement          | Description                                                              | Quantity      | Design flow   | Head    | Pressure | Power    | Capacity             | Basis                                           | Status          | Notes                                                                                                                                                                                                                                                                                            |
|----------------------|--------------------------------------------------------------------------|---------------|---------------|---------|----------|----------|----------------------|-------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INTAKE-01-INTAKE     | Surface / open water intake structure (bar screen, headwall, trash rack) | not specified | 2223.0 m3/day | —       | —        | —        | —                    | engineer input                                  | Engineer Review | Intake works: bar screen area from approach velocity, submergence dep and tidal/sea level basis. EngiMetric I no validated scree sizing model, so n area is calculated.; The lift from the intake to treatmer a separate hydrau duty, sized from tl stated head. It belongs to no wel equipment. |
| PRE-02-FILTER-VESSEL | Multimedia filter (MMF) — vessel and media                               | not specified | 2156.3 m3/day | —       | —        | —        | —                    | filterSizing.calculateFilterSizing              | Required Input  | The filter engine sizes filtration ARE only. Vessel count requires the manufacturer unit size; EngiMetric d not assume one.; filtration rate (m³/m²/h); water depth (m); media effective size (mm                                                                                                |
| PRE-03-DOSING-SKID   | Antiscalant dosing — dosing pump and day tank                            | 1.0 skid      | 2156.3 m3/day | —       | —        | —        | —                    | ro/antiscalantDosing.calculateAntiscalantDosing | Required Input  | Dose rate and product strength i engineer inputs fr a data sheet.; dose rate (mg/L); produ strength (mass %)                                                                                                                                                                                     |
| RO-04-PUMP           | RO high-pressure pump — calculated duty                                  | 1.0 ea        | 2156.3 m3/day | 560.8 m | —        | 217.9 kW | —                    | hydraulics.calculatePumpMotorPowerKw            | Calculated      | No verified catalog product covers thi duty; shown as an engineering requirement.                                                                                                                                                                                                                |
| RO-05-RO-ELEMENTS    | RO membrane elements                                                     | 36.0 ea       | 970.3 m3/day  | —       | 55.0 bar | —        | 2695.4 m² total area | ro/elementCount.calculateRoElementCount         | Calculated      | Element area, flux and elements per vessel are engineer/membra supplier inputs.                                                                                                                                                                                                                  |
| RO-05-RO-VESSELS     | RO pressure vessels                                                      | 6.0 vessel    | 970.3 m3/day  | —       | 55.0 bar | —        | —                    | ro/elementCount.calculateRoElementCount         | Calculated      | —                                                                                                                                                                                                                                                                                                |
| POST-06-CONTACT      | Remineralisation — contact vessel                                        | not specified | 970.3 m3/day  | —       | —        | —        | —                    | engineer input                                  | Preliminary     | Preliminary: no validated model in EngiMetric. Engine Review.                                                                                                                                                                                                                                    |
| PROD-07-PRODUCT-TANK | Product water storage tank                                               | 1.0 ea        | 970.3 m3/day  | —       | —        | —        | —                    | tank.calculateTankStorage                       | Required Input  | residence time (days); fill rate (m³                                                                                                                                                                                                                                                             |

## Treatment train bill of quantities (quantities only, no prices)

Quantities come from the generated requirements. EngiMetric holds no price data, so every line is price-unavailable by design.

| Item | Tag              | Description                                                              | Quantity          | Design flow   | Capacity | Engineering basis | Status          | Commercial        |
|------|------------------|--------------------------------------------------------------------------|-------------------|---------------|----------|-------------------|-----------------|-------------------|
| 1    | INTAKE-01-INTAKE | Surface / open water intake structure (bar screen, headwall, trash rack) | Not specified no. | 2223.0 m3/day | —        | engineer input    | Engineer Review | price-unavailable |

| Item | Tag                  | Description                                   | Quantity                                                                                                                                                                                                                      | Design flow   | Capacity             | Engineering basis                               | Status         | Commercial        |
|------|----------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------|-------------------------------------------------|----------------|-------------------|
| 2    | PRE-02-FILTER-VESSEL | Multimedia filter (MMF) — vessel and media    | Required input: The filter engine sizes filtration AREA only. Vessel count requires the manufacturer unit size; EngiMetric does not assume one., filtration rate (m³/m²/h), water depth (m), media effective size (mm) vessel | 2156.3 m3/day | —                    | filterSizing.calculateFilterSizing              | Required Input | price-unavailable |
| 3    | PRE-03-DOSING-SKID   | Antiscalant dosing — dosing pump and day tank | 1 skid                                                                                                                                                                                                                        | 2156.3 m3/day | —                    | ro/antiscalantDosing.calculateAntiscalantDosing | Required Input | price-unavailable |
| 4    | RO-04-PUMP           | RO high-pressure pump — calculated duty       | 1 ea                                                                                                                                                                                                                          | 2156.3 m3/day | —                    | hydraulics.calculatePumpMotorPowerKw            | Calculated     | price-unavailable |
| 5    | RO-05-RO-ELEMENTS    | RO membrane elements                          | 36 ea                                                                                                                                                                                                                         | 970.3 m3/day  | 2695.4 m² total area | ro/elementCount.calculateRoElementCount         | Calculated     | price-unavailable |
| 6    | RO-05-RO-VESSELS     | RO pressure vessels                           | 6 vessel                                                                                                                                                                                                                      | 970.3 m3/day  | —                    | ro/elementCount.calculateRoElementCount         | Calculated     | price-unavailable |
| 7    | POST-06-CONTACT      | Remineralisation — contact vessel             | Preliminary — Engineer Review vessel                                                                                                                                                                                          | 970.3 m3/day  | —                    | engineer input                                  | Preliminary    | price-unavailable |
| 8    | PROD-07-PRODUCT-TANK | Product water storage tank                    | 1 ea                                                                                                                                                                                                                          | 970.3 m3/day  | —                    | tank.calculateTankStorage                       | Required Input | price-unavailable |

## Modular package scope (delivery grouping, not a design change)

A package / skid scope is a delivery concept: it groups the stages you selected for factory integration and changes no flow, quality, balance or equipment quantity the plant model calculated.

Package scope: Required input — Package scope not stated — none of the 7 package-eligible step(s) has been selected for factory integration, so all 7 are delivered site-installed. This changes no flow, quality, balance or equipment quantity.

Inside the package: no step selected (required input — the tool never assumes a package scope)

Site-installed: Surface / open water intake; Multimedia filter (MMF); Antiscalant dosing; RO high-pressure pump; RO stage; Remineralisation; Product water tank  
Envelope: Modules in package required input; Envelope length required input; Envelope width required input; Envelope height required input; Package dry weight required input

No container geometry, skid frame weight or transport data is assumed by EngiMetric; unsupplied figures stay required input.

## Product Requirement

Required product flow: 1000 m³/day

Target product TDS: 300 mg/L

## Engineering Requirements

REQ-raw-water-transfer-pump — Raw water transfer pump [derived] flow=92.59 head=data required

REQ-well-submersible-pump — Well submersible pump [data-required] flow=data required head=data required

REQ-ro-high-pressure-pump — RO high-pressure pump [derived] flow=89.85 head=560.85

## Assumptions

Equipment is selected explicitly by the engineer; EngiMetric does not auto-select products.

## Warnings

No equipment has been selected by the engineer and no engineering requirements were produced — the schedule and BOQ are empty.

## Engineering Verification Status

Preliminary Engineering Package — Subject to Engineer Review and Approval.

# References & Disclaimers

This is a preliminary engineering calculation. Results must be verified by a licensed professional engineer against project-specific criteria and governing codes.

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This is a preliminary engineering calculation. Results must be verified by a licensed professional engineer against project-specific criteria and governing codes. EngiMetric does not fabricate prices, manufacturers, models, references or engineering values, and any value shown as required input is genuinely missing.

