# Jacobs



# **Replica Parametric Design and Preview**



Around the world, communities are working to sustainably manage water resources for a variety of needs. With population growth, aging infrastructure, and climate risk, the management of water resources is becoming more complex. These complexities present challenges for municipalities and industries to manage water in a sustainable and economical way. To address these challenges, Jacobs has developed a unique software suite, including Replica Parametric Design and Replica Preview.

This software generates conceptual-level designs and cost estimates for municipal and industrial water and wastewater projects that facilitate sustainable and economical decision-making early in the project. Replica Parametric Design integrates the three main conceptual components of early project planning (facility design criteria and footprints, construction cost estimates, and life cycle cost and emissions estimates) to provide a clearer picture of project scope and cost than traditional conceptual estimating techniques. From proposals to preliminary design, Replica Parametric Design streamlines the design development of concepts and facilitates making informed, defensible decisions that enable project advancement.

With over 120 process models, Replica Parametric Design can be used on nearly all water and wastewater projects worldwide for conceptual design, cost estimating, and technology comparison. Replica Parametric Design utilizes parametric engineering algorithms based on the successful implementation of previous projects to provide detailed and accurate scope, cost estimates, and 3D visualizations for projects early in their lifespans. Compared with traditional conceptual estimating techniques, Replica Parametric Design yields a much clearer picture of the project's unique scope and provides a Class 4 cost estimate to inform technical decision-making before investing in further detailed design. For each model, Replica Parametric Design outputs a 3D visualization of the facility layout based on general arrangement drawings derived from previous projects. This supports early stakeholder understanding and civil site layout.

## Typical applications for Replica Parametric Design and Preview:

- Drinking water treatment plants
- Wastewater treatment plants
- Industrial water treatment plants
- Water and wastewater conveyance
- Greenfield and upgrades/expansion projects

## Value of using Replica™

- Accurate and detailed cost estimates early in the project lifespan
- Eliminates reliance on scaling cost based on similar projects, rules of thumb, cost curves, or manual quantity take-off cost estimating techniques
- Substantially reduces time required to develop estimates
- Increases cost estimate accuracy through the use of quantity take-offs and a material unit cost approach
- Quickly provides capital and lifecycle cost, footprint, energy use, and environmental impact information for alternatives in multi-attribute decision models
- Enables 3D visualization of facilities early in the project
- Supports improved water management decision-making Replica<sup>™</sup> also produces lifecycle

Replica Parametric Design also produces lifecycle costs, energy usage, and an environmental impact summary, which includes greenhouse gas emissions, for each project. The environmental impact summary is based on key construction quantities (e.g. concrete, steel, earthwork, etc.) as well as facility power, chemical, and residuals consumption and/or generation. Early estimates of environmental impacts help to inform more sustainable water management decision-making.



# Examples of Replica Parametric Design projects

Project	Client	Replica Parametric Design Conceptual (10%) Design Estimate	Actual Construction Bid Award	% Difference
150 mgs (560 MLD) Tacoma Green River Facility Expansion	Tacoma Water, WA	\$187M	\$185M	+1.1
20 mgd (70 MLD) Whatcom Falls WTP Dissolved Air Floatation	City of Bellingham, WA	\$13.0M	\$12.6M	+3.2
92 mgd (348 MLD) San Juan-Chama Treatment Facility	ABCWUA, Albuquerque, NM	\$144.3M	\$159.5M	-10.5
100 mgd (379 MLD) Twin Oaks Valley Treatment Plant	San Diego County, Water Authority	\$150.8M	\$157M	-4.1
30 mgd (114 MLD) Upper Valley WTP	El Paso Water Utility, TX	\$28.7M	\$27.4M	+4.5
15 mgd (57 MLD) Buckman Direct Diversion Project	City and County of Santa Fe, NM	\$192M	\$186M	+3.2
50 mgd (189 MLD) Peter Binney WPF	City of Aurora, CO	\$211M	\$190M	+10
30 mgd (114 MLD) Phase I WTP Expansion	City of Loveland, CO	\$7.6M	\$6.5M	+14.5
38 mgd (144 MLD) Phase II WTP Expansion	City of Loveland, CO	\$20M	\$23.5M	-17
8 mgd (30 MLD) Long Pond WTP	Falmouth, MA	\$39.2M	\$41.2M	-5.1
19.3 mgd (73 MLD) Poughkeepsie WTP Ozone and Centrifuge Upgrade	Poughkeepsie, NY	\$16.7M	\$17.1M	-2.4



#### HRSD Aquifer Replenishment System Project (Hampton Roads, Virginia)

- Advanced treatment of wastewater effluent for injection into drinking water aquifer
- Replica<sup>™</sup> models developed for multiple 20 MGD (76 MLD) advanced water treatment alternatives
- Treatment design included membrane filtration (MF), reverse osmosis (RO), and ultraviolet advanced oxidation process (UVAOP)

#### SABESP Parque Novo Mundo Direct Potable Reuse Project (São Paulo, Brazil)

- Upgraded existing treatment plant for direct potable reuse to supplement potable water supplies
- Designed to respond to periods of drought in Brazil
- Treatment approach included coarse and filtration (MF) fine screens, bioreactor, membrane bioreactor

"We have never seen such innovation, detailed planning, and information developed in such a short time scale by any consultant."

### — Paulo Nobre, SABESP Wastewater Technology Manager

"[Jacobs'] Replica<sup>™</sup> platform allowed us to quickly and efficiently evaluate many identified facility alternatives. This enabled our team to more effectively discuss the options, evaluate alternatives, and make informed decisions. The ability to quickly move from a concept, with construction and life-cycle cost estimates, to a scaled 3D model that could be dropped onto our site layout, was invaluable. The application of the Replica<sup>™</sup> toolset moved our project forward rapidly, providing defensible estimates and the ability to effectively evaluate project and environmental impacts. This information provided the groundwork for subsequent phases and allowed us to move forward with confidence in designing our preferred solution.

- Roger McClain, Park City Municipal Corporation Public Utilities Engineering Manager



Find out more about Replica



See Replica
Parametric Design in action



See Replica Visualization in action

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## Environmental Impact Calculator (EIC)

The Environmental Impact Calculator (EIC) – a feature available within Replica Parametric Design<sup>TM</sup> – provides a summary and visual representation of the emissions in each of the five categories: power, chemicals, construction (only for single events, not life cycle emission), solids handling, and biogenic emissions.

An 'alternative comparison' tab in the EIC compares the current facility operation profile, and the proposed facility operation profile that calculates the total equipment operation % MWh/Yr. and Tonne CO2e/Yr. savings, and projected monetary savings based on facility data and survey results. **Emissions Summary** 



(Note: Construction emissions are a single emission event, not a life cycle emission. They are shown for comparison)

Outputs from Replica Parametric Design<sup>™</sup> can be used as inputs into carbon monitoring tools/certification processes.





Find out more about Replica See Replica Parametric Design in action

See Replica Visualization in action

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