

Future 'ocean cities' need green engineering above and below the waterline

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Artificial islands can cause huge environmental issues for coastlines. Credit: The Forest City Project

Population growth has seen skylines creep ever higher and entire cities rise from ocean depths. The latest "ocean city" is the Chinese-developed [Forest City](#) project. By 2045, four artificial islands in Malaysia will cover 14km² of ocean (an area larger than 10,000 Olympic swimming pools), and support 700,000 residents.

Often overlooked, however, is the damage that artificial islands can cause to vital seafloor ecosystems. But it doesn't have to be this way. If proper planning and science are integrated, we can develop the design strategies that will help build the "blue-green" ocean cities of tomorrow.

Colonising the ocean frontier

Ever growing numbers of human-made structures are occupying our oceans. Cities built on artificial islands in the ocean are providing a solution for urban planners trying to manage the population squeeze.

And yet, so-called "[ocean sprawl](#)" dates as far back as [Ancient Egypt](#). Over the past few centuries, artificial islands have been built through [land reclamation](#). Land reclamation is the process of creating new land from existing water bodies.

The Netherlands, for instance, has been draining lakes and expanding its coastline to [fight the advance of the sea](#) since the 1500s. The Dutch actually built one of the first and largest artificial islands, which is [now home to some 400,000 people](#). Japan's third-busiest airport, the [Kansai International Airport](#), was built on an [artificial island](#) in 1994. China has also been building into the oceans, reclaiming [more than 13,000km² of seafloor](#) and an estimated [65% of tidal habitat](#) since the 1950s.

Using Google maps, we were able to identify more than 450 artificial islands around the world, including the famous Palm Islands of Dubai. These are often celebrated as [engineering marvels](#), but at what cost to the marine environment?



Credit: SpaceX from Pexels

We can't ignore what lies beneath

Marine habitats have always been essential for human life in coastal regions. They provide food, building and crafting materials, and less-known services such as [coastal protection, nutrient cycling and pollution filtration](#).

The creation of artificial islands causes [large changes to the seabed](#) by permanently smothering local habitats. In many parts of the world, existing habitats provide the foundation for artificial island construction. For instance, artificial islands in the tropics are often built directly on

top of coral reefs. This leads to considerable destruction of already threatened ecosystems.

Land reclamation also impacts nearby habitats that are particularly sensitive to murky waters, such as coral reefs and seagrass beds. In Singapore, land reclamation is associated with [coral reef decline due to sedimentation and resulting light reductions](#). Singapore has lost [nearly 45% of the country's intertidal reef flats and almost 40% of intertidal mudflats](#).

When the ecological, economic, and social value of [marine habitats](#) are considered, artificial islands and ocean sprawl seem to be indulgences that we cannot afford. The effects would be akin to the suburban sprawl of the 20th century. To avoid this cost, we need to address the complexities of the underwater world in urban planning and development.

"Blue urbanism"

In his book [Blue Urbanism](#), Timothy Beatley calls for urban planners to consider and value [ocean](#) ecosystems. He argues that we need to recognise the [psychological value of human connections to blue space](#), and extend green practices on land into marine environments. While some artificial island developments such as the Forest City project are touted as "eco-cities", more could be done both to minimise impacts below the waterline and integrate underwater environments into [city](#) life.

Why not combine a "Forest City" with the principles of a "Sponge City"? While native plantings in a forest city could help to reduce air pollution, sponge cities seek to "absorb" and reuse rainwater, thus reducing pollution entering the oceans through stormwater runoff. Around artificial islands, developers could also embrace the [water filtration powerhouse](#) of the oceans: active oyster reefs.

The location of future constructions should also be carefully evaluated to ensure the preservation of important marine habitats. Artificial islands have the potential to create fragmented seascapes, but with careful spatial planning and smart designs, they could create corridors for some [climate migrants](#) or those threatened species most at risk from [habitat loss](#).

Designs based on ecological principles can reduce the impacts of artificial [islands](#) on natural habitats. However, applications of "blue-green" infrastructure remain largely untested at large scales. New designs, building strategies and spatial planning that integrate seascapes and landscapes are an opportunity for both "smarter" cities and experimentation for the development of successful blue-green technologies.

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