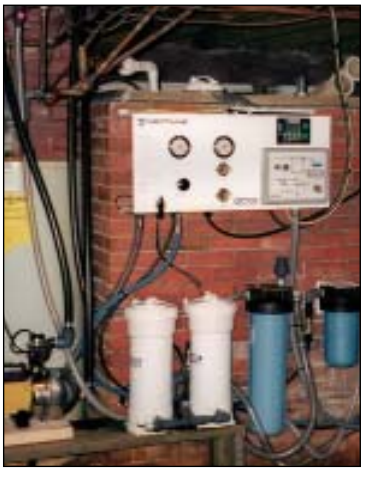
Potable Water for Secluded Sites

Q: We are building on an island that does not currently have a supply of fresh water. What options are available to the owners? In particular, is small-scale desalination feasible for individual homes, and if so, what's involved in the installation and maintenance of such a system?

A: There are two general strategies available to provide drinking water for a coastal home: *water making*, using reverse-osmosis desalination, and *water harvesting,* which involves catching and storing rainwater. Some combination of these two strategies is probably in the future for all coastal residents in order to solve the looming water problems, though technologies of different scales will be required, depending on the community.

WATER MAKING

For individual homes, the same technology that ships and other marine vessels have been using to make potable water from seawater is available from land-based systems as well. These "water makers" remove salt from seawater by reverse osmosis — a process that pushes prefiltered seawater through a polyamide plastic membrane (similar in look and feel to cellophane). According to Kathy Fruehauf of Great Water in Brunswick, Maine (www.great-water.com), this desalination, or "desal" process relies on a combination of "brute force and a little magic." The brute force is water pressure — about 800 psi — which is needed to push a percentage of the incoming seawater through the membrane. This pressure, however, is confined to the "brine stream": the flow of seawater pulled from offshore that flows through the membrane array. Approximately 10% to 30% of the brine stream makes it to the other side of the membrane as fresh water (called "product water" in the vernacular of the desalination industry), while all the salts and other chemical impurities in the water are flushed



GREAT WATER, INC.

NOT YOUR AVERAGE WATER PURIFIER. This 4,000-gallon-per-day system designed and installed by Great Water serves a bed and breakfast in Isle au Haut, Maine. At left, the main panel is mounted above the prefilters — a series of bag filters (blue) followed by a series of pleated paper filters (white). The membranes through which the brine stream flow are mounted in a nearby array (above).

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back into the sea. The product water is stored in a cistern, from which it is pumped into a pressure tank to serve as the home's water supply under ordinary household pressure.

The magic part is really a function of molecular physics. The membrane is semipermeable, allowing water molecules through but not ions (most salts) or larger suspended molecules, such as bacteria, urea, or chemical pollutants. As a result, the product water from a reverse osmosis, or RO, system is chemically pure and perfectly sterile.

The most delicate part of the system is the membrane, which can easily become clogged. Water must be drawn from a fairly deep water source that is relatively clear, and then before passing through the membrane array, this water must be filtered to remove large particles, such as plankton and algae. A typical prefilter system used by Great Water includes a series of bag filters, which Fruehauf compares to a tube sock inside a filter housing that collects large particles. From there, the brine stream flows through a series of pleated paper filters to remove smaller and smaller particles. These filters typically need to be maintained seasonally: bag filters can be rinsed and replaced; paper filters must be replaced. If properly filtered and drawn from a relatively clear source, the RO membrane might last four to five years.

The size of the system will depend on the household water needs. A single residence typically requires a system capable of producing 1,000 gallons per day. A bed and breakfast, which typically has a higher demand for clean linens and bathing, might require a system capable of producing 4,000 gallons per day. Prices on the equipment alone will vary from about $16,000 to $30,000, which includes prefilters, pumps (both a high-pressure pump to move the brine stream and a low-pressure pump to move the product water), and a main panel, which has controls for adjusting pressure, pump speed, and water quality. Installation, of course, will be more. While it's possible to buy a plug-and-play system, it's not a system that you can just hand over to the average plumber. It's recommended you work with a company that specializes in marine desalination systems (of which there are many), is familiar with high-pressure plumbing, and understands the delicate nature of the membranes. In addition to ensuring that the system will meet the water needs of your clients, the company can also advise you on seasonal maintenance requirements and walk you through what's required to shut the system down for the off-season when the house may not be occupied.

WATER HARVESTING

Rain catchment is a common practice in many island communities for gathering fresh water; in Bermuda and the U.S. Virgin Islands, catchment cisterns are a code-required part of every new home. Typically, they are used to collect water for washing and irrigation more than for drinking. While rainwater has a neutral pH and is free of salt, it can be easily polluted by fallout on the roof from air pollution, trees, and blowing debris. It will not be as chemically pure as product water from an RO desalination plant. If a household system combines water from these two sources, they should be kept separate.

In general terms, a rainwater harvesting system consists of a catchment system (the roof — metal, tile, and slate are preferred for potable water systems), a conveyance system (gutters, downspouts, and piping), filtration, and storage (typically a concrete, ferro-cement, or fiberglass cistern tank). With a system intended to collect potable water, a critical component is the roofing. Smooth metal roofing with a baked-on, non-oil finish is preferred for rainwater collection but sometimes not allowed by homeowners associations. Composition shingles are the least desirable: by-products from the roofing itself can pollute the water, and the granules tend to clog the filters. Any roofing with a rough or porous surface (like wood shingles or concrete tile) tends to collect dirt and mildew, requiring a more robust filtering system.

The Texas Manual on Rainwater Harvesting, available online at www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf, provides detailed information about the catchment components, water treatment options, and system sizing. This comprehensive 88-page manual includes case studies and Texas building code considerations, giving a good overview of backflow concerns and other issues related to "dual system" water supplies. — *Clayton DeKorne*