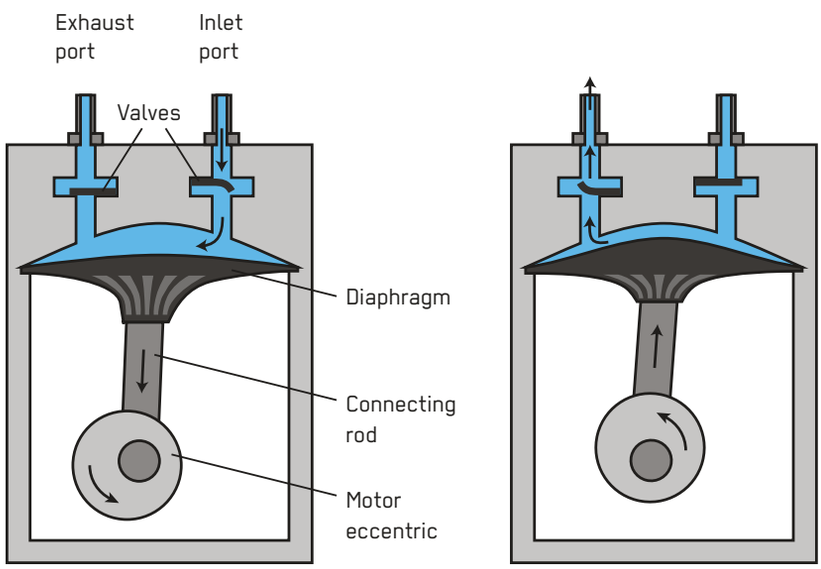
Diaphragm Pump

Response Phase	Application Level	Management Level	Objectives / Key Features
Acute Response Stabilisation ** Recovery	** Household ** Neighbourhood City	Household ** Shared ** Public	Positive displacement pump, high pressure pumping of water and for dosing of chemicals
Local Availability	**Technical Complexity**	**Maturity Level**	
** Medium	** Medium	*** High	



INLET STROKE

EXHAUST STROKE

A Diaphragm Pump is a positive displacement pump that displaces a fixed amount of water per cycle. Diaphragm Pumps use a flexible diaphragm to force fluid through the pump and are mainly applicable in the recovery phase.

Diaphragm Pumps are available in mechanical/electrical, pneumatic and hydraulically actuated forms. Commercial Diaphragm Pumps are available in a wide range of sizes, capacities and materials. The variety of materials, various actuator types and Diaphragm Pump geometries allow Diaphragm Pumps, in general, to pump a wide range of liquids apart from drinking water, including slurries of various viscosities, degrees of corrosiveness, solid content and other characteristics. Diaphragm-type pumps are also available in arrangements designed specifically for below-ground deep-well fluid abstraction.

Design Considerations: Diaphragm Pumps operate via the expansion and contraction of a diaphragm that is used to move a liquid, such as for delivering water to the surface. These pumps are a robust option for thick or viscous fluids but are not often feasible if high flow rates are needed. Material compatibility with the pumped liquid must be carefully considered. Manufacturers generally offer several options for pump body and diaphragm material to suit most types of pumped liquids and should be closely consulted for compatibility.

All positive displacement pumps are capable of generating large pressures on the discharge side, so care must be taken to ensure these pumps do not operate against closed valves or blockages without a method of protecting the downstream valves and fittings; otherwise, the pressure will continue to build in the system until the motor overloads or the weakest downstream pipe fails.

Diaphragm Pumps can also be manually operated, motor driven, or pneumatically or hydraulically powered. The Vergnet Hydro pump is one example of a deep-well Diaphragm Pump operated by foot with a pedal, and it has

a maximum recommended lift of 60 metres. The piston movement is hydraulically transmitted via a flexible hose to a rubber diaphragm down in the pumping element, and the expansion and contraction of the diaphragm is used to deliver water to the surface.
The suction head is limited by atmospheric pressure, pump design and suction pipe material and arrangement. The individual pump selected should be evaluated against suction lift requirements.

Materials: Diaphragm Pumps are available in a wide range of metallic and non-metallic materials. The manufacturer or a specialist should be consulted to determine material compatibility with the pumped fluid and environment. Options for powering Diaphragm Pumps include electric motors, compressed air or hydraulic fluid.

Applicability: Diaphragm Pumps are not appropriate for the large-scale pumping of water for community use. They are instead more useful for small, controlled flow rates, for dosing chemicals and corrosive liquids (e.g. chlorine) or for pumping water with solid particles (e.g. for pumping water containing a high percentage of suspended solids, such as when dewatering, or for slurry recirculation while drilling boreholes). As there are options that do not rely on electrical power, dewatering with Diaphragm Pumps can be achieved with compressed air if available.

Operation and Maintenance: The operating principle for Diaphragm Pumps is simple, and pumps are easily maintained. Diaphragm Pumps generally have fewer parts that wear than other pumps with rotating assemblies and bearings. Motor-operated Diaphragm Pumps will have some mechanical wearing parts, but Diaphragm Pumps operated pneumatically or hydraulically do not have wearing parts apart from the flexible membrane that is moved via a pressure differential between the pumped and the actuating fluid. Many Diaphragm Pumps are designed with the inlet and outlet valves as integral parts of the pump. The manufacturer should be consulted to determine the expected life of the membrane and wearing parts based on service conditions, duty-cycle and fluids pumped.

Health and Safety: Best safety practices should always be followed around mechanical equipment. Compressed air and hydraulic power may reduce electrical hazards but can still be hazardous or deadly if handled improperly. When pumping chemicals, proper personal protective equipment should be worn, and the manufacturer's recommendations should be followed. If engine-driven pumps are employed, potential health risks with engine emissions should be evaluated.

Costs: The cost of small Diaphragm Pumps is dependent on the material selected. For small flow rates (< 5 L/sec), prices are usually between several hundred to several thousand US dollars. Standard thermoplastic and aluminium options are typically less expensive, while specialised thermoplastic components or stainless-steel alloy components are typically the most expensive. Thermoplastic or aluminium pumps may be relatively affordable and resilient compared to other commercial pumping options. Pump power options should be considered in the cost. Compressed air supplied by a gas-powered compressor provides flexibility for pumping without electric power but may add operating costs compared to electric motor-driven options.

Social and Environmental Considerations: The end users of a water supply system typically do not interact with these pumps. The complexity of O&M of the system should be considered, but trained and capable staff are always required. For smaller, simple Diaphragm Pumps, like the Vergnet handpump, minimal training and O & M will be required. For motor driven pumps, major environmental considerations relate to use of consumables (lubrication, oil, chemicals) and power sources. A plan for the appropriate containment and disposal of consumables should be in place. For smaller pumping systems, solar power or hybrid power systems with solar panels are feasible and often have a lower environmental impact and a short payback period.

Strengths and Weaknesses:

⊕ Available in many sizes and material options
⊕ Variable flow rate
⊕ Available in various power options (manual, motorised, hydraulic power, pneumatic)
⊕ Can pump corrosive liquids and solids if properly designed
⊕ Capable of providing suction lift

⊖ Generally low flow rates only
⊖ Somewhat expensive, therefore only viable for municipal or larger installations

→ **References and further reading material for this technology can be found on page 216**