**Changing State Technologies**
Auckland, New Zealand
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# CHANGING STATE TECHNOLOGIES

## MPR™ Technology — Trial Summary

Trial Site: Hoskin Family Farm

Solution: MPR-200 V1.0

Trial Dates: 01 May 2026 – 15 June 2026

## Executive Summary

Changing State Technologies (CST) successfully trialled its patented MPR™ (Multi-Phase Rotor) Stable Vapour Cavity pump technology at Hoskin Family Farm (H&H Karapiro Ltd), a dairy farm in Karapiro, New Zealand, owned by Matt Hoskin. Between 1 May and 15 June 2026, a prototype MPR-200 V1.0 unit was installed as a direct, in-line replacement for the existing Trevoli CM4-60 centrifugal pump in the farm's domestic water supply system.

The trial demonstrated the MPR™ pump's ability to deliver reliable, set-and-forget performance in a real-world rural residential application. Over seven weeks of continuous on-demand operation, the pump provided stable pressure and flow to two dwellings and auxiliary outlets with **zero downtime or reliability issues.** It successfully handled variable demand, including simultaneous use of multiple outlets, and proved tolerant to gas on the intake — a known limitation of conventional centrifugal pump technology. User feedback was positive, with comments noting the elimination of previous shower pressure issues and expressing being impressed with the prototype's reliable extended run time.

The trial demonstrated key MPR™ advantages, including operation unconstrained by a traditional pump curve, self-priming capability, effective integration with the existing 19-litre accumulator, and pressure-based intake control. While detailed power consumption measurement and advanced RPM optimisation were outside the scope of this initial prototype trial, the results confirmed the technology's robustness and suitability for domestic water boosting applications. The installation also highlighted future opportunities, such as relocating the pump downstream of the filtration system to further reduce energy consumption.

***Overall, the trial successfully demonstrated the MPR™ as a practical, high-reliability replacement for conventional pumps in variable-demand domestic systems, delivering improved performance and operational simplicity with strong potential for lower total cost of ownership.***

# Trial Objective

## Trial Objective

The objective of the trial was to evaluate CST's pump as a direct, drop-in replacement for the existing unit in a live domestic water supply system. The installation supplies pressurised water to two dwellings plus auxiliary outdoor hose points. Water is delivered through a triple-cartridge filter and UV steriliser, with dwellings located approximately 50 m and 80 m from the pump on level ground. A 19-litre accumulator is positioned between the pump and the filter station to stabilise flow and pressure during variable demand.

The set-up was designed to replicate typical real-world residential conditions, including intermittent and simultaneous demand from two households, moderate pipe runs, post-treatment water quality requirements, and the presence of an accumulator for pressure buffering.

## Key Objectives of the Trial

CST set out to demonstrate the following in a live operating environment:

- Seamless replacement of the existing pump with minimal disruption to the household supply.
- Delivery of the required performance and reliability under actual domestic load conditions.
- Demonstration of the pump's core technical features, specifically:
    - Operation without being constrained by a traditional pump curve
    - Reliable self-priming capability
    - Ability to handle entrained gas on the intake side
    - Robustness and sealing performance of the inlet valve mechanism
    - Power consumption characteristics of the current prototype
- Effective pressure-based intake control, with the system tuned to deliver the target flow rates.
- Compatible and stable operation when working with the 19-litre accumulator.
- Reliable basic pump operation over the trial period.
- Post-trial condition of the pump internals (wear, debris accumulation, or any other operational effects).

# Existing Set-Up

The existing water supply system draws water from a storage tank that is periodically filled by a bore pump. A Trevoli CM4-60 centrifugal pump then boosts the water through a triple cartridge filter station and UV steriliser before delivering it to two dwellings located approximately 50 m and 80 m away on level ground, as well as to auxiliary outdoor hose points. A 19-litre accumulator is installed between the pump and the filter station to help stabilise pressure and flow during variable domestic demand.

*Existing Pump Set-Up*


*Filtration System*

The Trevoli pump's specifications, as installed, are as follows:

| Parameter | Existing (Trevoli CM4-60) Specifications |
|---|---|
| Purpose | Local pressure supply for domestic water to two houses + auxiliary (outside hoses) |
| Output Pressure (Range) | 50–70 psi (3.5–5 bar) |
| Flow Rate (Range) | 80–100 L/min |
| Hours of Operation | On demand, 24/7 |
| Days of Operation | 365 days/year |
| Maximum Head | Max 50 m head |
| Maximum RPM (Range) | — |
| Ambient Temperature Range | 10–30 °C |
| Inlet Connection Size | 32 mm BSP |
| Outlet Connection Size | 25 mm BSP |
| Input (Water) | Domestic water supply |
| Other Comments | Conventional centrifugal pump serving domestic local water supply |

# CST MPR™ Solution & Approach

## The Challenge

The existing Trevoli CM4-60 pump was reliably serving the basic domestic water needs of the farm, supplying two houses and auxiliary outlets through the established filtration and UV system delivering a maximum flow rate of 50l/min. While the conventional centrifugal pump performed adequately under normal conditions, it had several known operational limitations in the Hoskin Farm environment that occasionally caused inconvenience or risk:

- Loss of prime due to gas/air on the intake – even relatively small amounts of gas could break prime, requiring manual re-priming and creating a risk of pump damage if left undetected.
- Pressure and flow drop under simultaneous use – when multiple outlets (e.g., garden hoses plus household taps) were open, pressure and flow at the furthest dwellings could fall below desirable levels.
- Limited robustness to varying conditions – the pump's performance was constrained by its traditional pump curve, making it sensitive to changes in demand or inlet conditions.

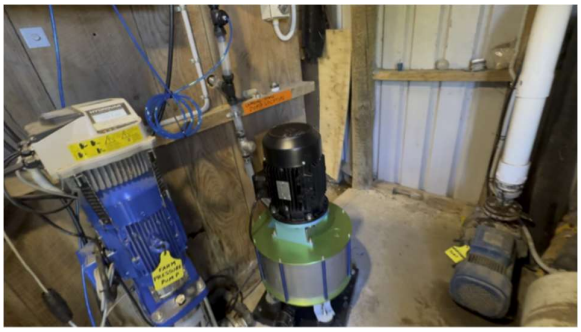
These issues, although infrequent, highlighted the need for a more tolerant and flexible pumping solution in a real-world rural domestic application.

## CST MPR™ Solution

The CST MPR™ pump was installed as a direct in-line replacement for the existing unit, with the primary goal of trialling its performance and features under live operating conditions.

Key advantages demonstrated or targeted during the trial include:

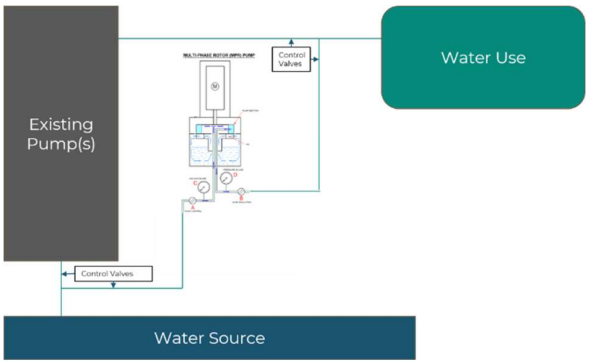
- Seamless in-line replacement – the MPR unit used the same 32 mm inlet and 25 mm outlet connections, allowing straightforward swap-in with minimal plumbing changes and no disruption to the existing pipework, accumulator, filters, or UV steriliser.
- Robustness in varying conditions – the pump is not constrained by a traditional pump curve, offers self-priming capability, and can tolerate entrained gas on the intake without losing prime or sustaining damage.
- Pressure-based control – intelligent intake control enables the system to be tuned for stable pressure and targeted flow even when demand fluctuates across multiple outlets.
- Simple installation, start-up and management – the unit requires minimal



configuration and provides straightforward operation in a 24/7 domestic environment.

- Future flexibility – although not trialled in this installation, the MPR's design opens the possibility of relocating the pump downstream of the filters and UV system, which could reduce power consumption by avoiding the need to push water through the filtration stage.

This trial therefore served as both a practical replacement exercise and a live validation of the MPR's ability to overcome the limitations of conventional pumps in domestic/rural water supply applications.

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- Robustness in varying conditions – the pump is not constrained by a traditional pump curve, offers self-priming capability, and can tolerate and consume gas on the intake without losing prime or sustaining damage.
- Pressure-based control – intelligent intake control enables the system to be tuned for stable pressure and targeted flow even when demand fluctuates across multiple outlets.
- Simple installation, start-up and management – the unit requires minimal configuration and provides straightforward operation in a 24/7 domestic environment.
- Future flexibility – although not trialled in this installation, the MPR's design with no NPSH constraints opens the possibility of relocating the pump downstream of the filters and UV system, which could reduce power consumption by avoiding the need to push water through the filtration stage.
- Future Intake control management could see reductions in power usage and possibly remove the need for an accumulator.

This trial therefore served as both a practical replacement exercise and a live validation of the MPR's ability to overcome the limitations of conventional pumps in domestic/rural water supply applications.

## The installed MPR solution is shown in the following table:

| Parameter | Existing (Trevoli CM4-60) Specifications | MPR Trial Solution | Comments |
|---|---|---|---|
| **Purpose** | Local pressure supply for domestic water to two houses + auxiliary (outside hoses) | Direct seamless replacement for domestic water supply to two houses + auxiliary (outside hoses) | |

| | | | |
|---|---|---|---|
| **Output Pressure (Range)** | 50–70 psi (3.5–5 bar) | 0–7bar | |
| **Flow Rate (Range)** | 80–100 L/min | As required, up to 50 L/min | Per actual trial requirements |
| **Hours of Operation** | On demand, 24/7 | 24 hours, on demand | |
| **Days of Operation** | 365 days/year | 365 days/year | |
| **Maximum Head** | Max 50 m head | 0 m (level ground) up to 60m system head | |
| **Maximum RPM (Range)** | — | 2500 | |
| **Ambient Temperature Range** | 10–30 °C | 5–30°C | Per actual site conditions |
| **Inlet Connection Size** | 32 mm BSP | 32 mm | |
| **Outlet Connection Size** | 25 mm BSP | 25 mm | |
| **Input (Water)** | Domestic water supply | Domestic water supply | |
| **Other Comments** | Conventional centrifugal pump serving domestic local water supply | Self-priming, pressure-based intake control, gas-tolerant on intake, unconstrained by traditional pump curve, works with 19 L accumulator | |

# Assessment

The CST MPR™ pump was trialled as a direct replacement for the existing Trevoli CM4-60 unit over a period of 7 weeks of continuous, on-demand operation with no downtime or reliability issues. The pump successfully maintained stable domestic water supply to two dwellings and auxiliary outlets, delivering consistent pressure and flow even during periods of simultaneous use.

## Quotes from the Trial

- "We can run both showers at the same time now."
- "Wow, the prototype went longer than I thought! (after 1 week)"

These user comments highlight the noticeable improvement in everyday performance and the reliable operation of the prototype beyond initial expectations.

## Key Learnings and Objectives Achieved

The trial successfully demonstrated the majority of the original objectives in a real-world domestic farm setting. The table below summarises performance against the key trial objectives:

| Trial Objective | Outcome | Comments |
|---|---|---|
| **Seamless replacement of existing pump** | Fully Achieved | Installed in-line with no plumbing modifications required |
| **Delivery of required performance & reliability** | Fully Achieved | 7 weeks continuous operation with zero failures or loss of prime |
| **Demonstration of self-priming and gas tolerance** | Fully Achieved | Handled intake gas without losing prime or causing damage |
| **Robustness of inlet valve sealing mechanism** | Fully Achieved | Performed reliably under varying conditions |
| **Pressure-based intake control & system tuning** | Fully Achieved | Critical for maintaining stable flow and pressure |
| **Operation with 19 L accumulator** | Fully Achieved | Excellent compatibility; accumulator effectively smoothed demand peaks |
| **Basic operations and trial period reliability** | Fully Achieved | No wear issues observed; prototype exceeded expectations for run time |
| **Post-trial internal inspection (wear / debris)** | Fully Achieved | No evidence of wear or debris. Superficial mineral staining observed. |

**Key Learnings**

- Intake pressure-based control proved essential for adapting to changing output pressure and flow demands across the household.
- The MPR pump integrates very effectively with a bladder accumulator, providing stable pressure without short-cycling.
- The system demonstrated strong robustness to real-world variability (demand spikes, minor air ingress, etc.).

- Future opportunity: relocating the pump downstream of the filters and UV steriliser could deliver meaningful energy savings (not tested in this trial).

## Areas Not Fully Proven

- **Power consumption / efficiency** – not measured in detail during this trial (as expected with the current prototype).
- **Advanced RPM management and inlet valve optimisation** – limited by the absence of a full control system during the trial.

# Conclusion and Recommendations

The seven-week trial of the CST MPR-200 V1.0 prototype at Hoskin Family Farm successfully demonstrated the MPR™ pump's suitability as a reliable, drop-in replacement for conventional centrifugal pumps in domestic water supply applications. Operating under real-world variable demand conditions, the unit delivered consistent pressure and flow, eliminated previous issues with loss of prime due to gas intake, and integrated seamlessly with the existing accumulator, filtration, and UV system. User feedback confirmed noticeable improvements in everyday performance, particularly stable shower pressure, while the prototype exceeded expectations for reliable continuous operation with zero downtime or failures.

This trial has demonstrated the core technical advantages of the MPR™ technology — including operation unconstrained by a traditional pump curve, self-priming capability, gas tolerance, and effective pressure-based control — in a live rural residential environment. The results reinforce the potential for lower maintenance, greater system robustness, and simplified installation compared to conventional solutions.

## Recommendations

1. **Proceed to next prototype iteration** — Incorporate lessons from this trial, particularly around optimised inlet valve and control system integration for enhanced RPM management and power efficiency monitoring.
2. **Evaluate energy-saving configuration** — Trial relocation of the MPR pump downstream of the cartridge filters and UV steriliser to quantify potential power consumption reductions.
3. **Expand field data collection** — In future installations, implement basic data logging (pressure, flow, power, and runtime) to support detailed performance analysis and TCO calculations.
4. **Commercial rollout preparation** — Use the positive outcomes from Hoskin Family Farm as a reference site. Consider additional short-term trials in similar domestic or light agricultural settings to build a broader performance dataset.
5. **Internal next steps** — Update the MPR design guidelines based on accumulator integration learnings.

In summary, the Hoskin Family Farm trial marks a significant milestone in the commercial validation of MPR™ technology. It has demonstrated the pump's reliability and practical benefits in everyday use, positioning CST to deliver smarter, more resilient fluid handling solutions to domestic, agricultural, and industrial customers.

# Appendix

## The Changing State MPR™ Value Proposition — Five Customer Outcomes

CST is on a journey to deliver real, sustainable, impact to its customers. The following value propositions are what customers care about most — not the underlying physics, but the real difference they feel from a practical standpoint.

| Outcome | Customer Problem | How MPR™ Solves It |
|---|---|---|
| **1. RELIABILITY** | Seal failure causes 39% of all pump failures and >80% of rotating equipment outages. In critical infrastructure, failure means sewage in waterways, plant shutdowns, and regulatory liability. | Zero inlet seals — the primary failure mode does not exist. No impeller erosion from cavitation. Pump continues operating under conditions that stop conventional pumps. If the inlet is blocked completely, no pump damage occurs. |
| **2. FLEXIBILITY** | Conventional pumps have a fixed pump curve. Real-world demand varies, forcing oversized pumps, multiple duty/standby sets, or inefficient off-BEP operation. | MPR™ operates on a pump plane, not a pump curve. Any combination of pressure and flow within its range — without fixed operating point constraints. One pump replaces many. |
| **3. LOWER TCO** | Purchase price is a small fraction of lifetime cost. Energy, maintenance, and downtime dominate. Cavitation reduces pump life from 10–15 years to as little as 2 years in severe cases (Xylem data). | No seal replacement cycle. No cavitation erosion. Pump adapts to demand — no throttling waste. Longer working life. Lower solution cost across CAPEX and OPEX including ancillary equipment, real estate, power, and maintenance. |
| **4. SIMPLER MANAGEMENT** | Conventional pumps require installation at or below source water level — deep sumps, elevated tanks, or pressurised supply lines. NPSH dictates installation not operational need. | MPR™ sits up to 9.5 metres above the water source. Install it where the operation needs it. VSD and inlet valve provide simple set-and-forget control. No pump curve management. No confined space entry required. |
| **5. SUSTAINABILITY** | Pumps consume nearly 20% of all electricity globally. In industrial plants, pumps account for 25–50% of total energy use. Complex multi-pump solutions multiply this cost. | Expected equal or better efficiency than conventional pumps at BEP — with better real-world performance as demand varies away from the design point. Multi-pump solutions replaced by single MPR™ module — direct energy reduction. |