



Directing the Flow

# Leading Surge Protection Solutions

Partner with Aquestia to protect your  
water systems against the damaging  
effects of water hammer





## The Surge Phenomenon

The rapid opening or closing of valves, starting or stopping of pumps, or other abrupt changes in a water system's hydraulic conditions can cause sudden changes in flow velocity. When flow velocity is suddenly decelerated - such as when a valve is closed or a pump is shut off - the kinetic energy of the water (the inertia of the water column) is converted into potential energy. The extreme high-pressure waves caused, known as 'upsurge', may exceed the pressure rating of the system. Conversely, when a pump starts or a valve opens, the sudden increase in flow velocity can cause a drop in pressure, resulting in a 'down surge' that might reach sub-atmospheric pressure levels, and even create a complete vacuum that can damage pipes and equipment.

Defining the relationship between velocity changes and pressure changes, using the Joukowsky equation:

$$\Delta p = \frac{c \Delta v}{g}$$

Where

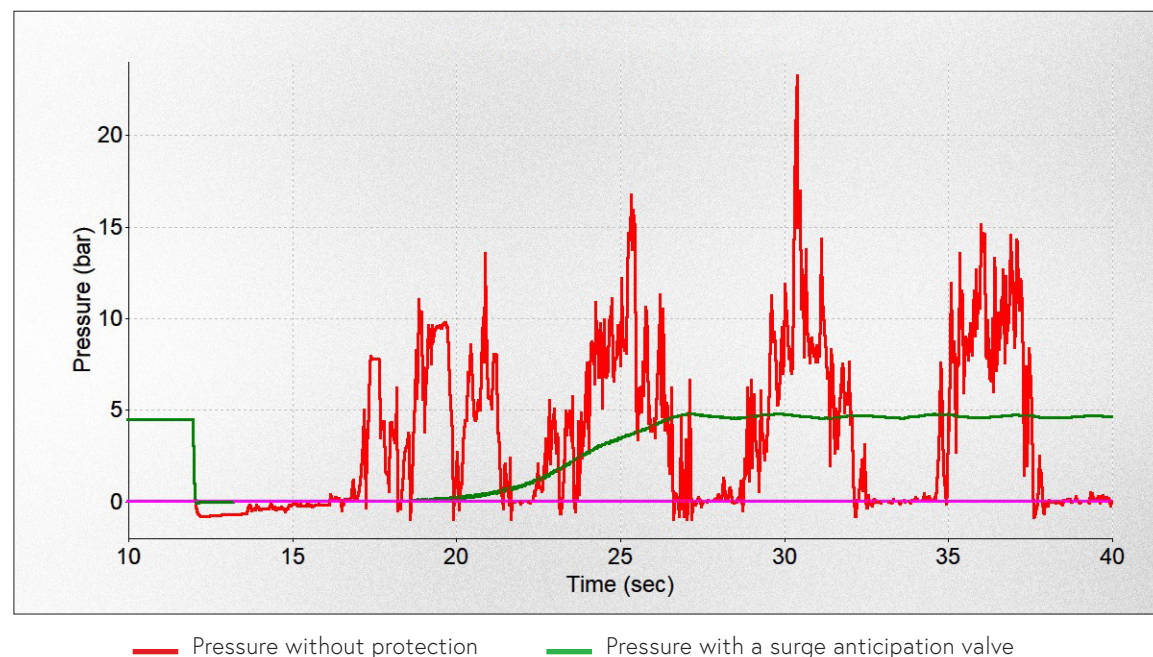
- $\Delta p$  = Pressure change (m)
- $c$  = Wave speed (m/s)
- $\Delta v$  = Velocity change (m/s)
- $g$  = Acceleration due to gravity (m/s<sup>2</sup>)

Example =  $\Delta v$  of 1 m/s in metal pipeline, will produce a  $\Delta p$  of 100 m (10 bar)

The sharp high- and low-pressure variations caused by these surges of pressure back through the pipeline may result in a phenomenon known as water hammer, which can have severe consequences for water system, including:

- Damage to pipes, valves, seals, and other infrastructure.
- Potential pipe collapse or bursting, leading to costly repairs and service disruptions.
- Cavitation and other phenomena, which can erode and degrade equipment over time.
- Reduced system efficiency and reliability, impacting your ability to deliver water safely and consistently.
- Rapid aging of the system.

Check Valve Downstream Pressure







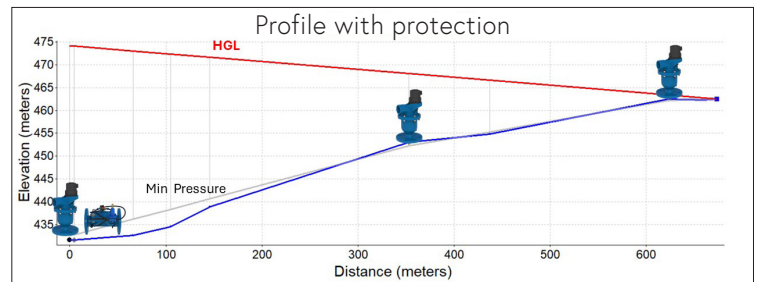
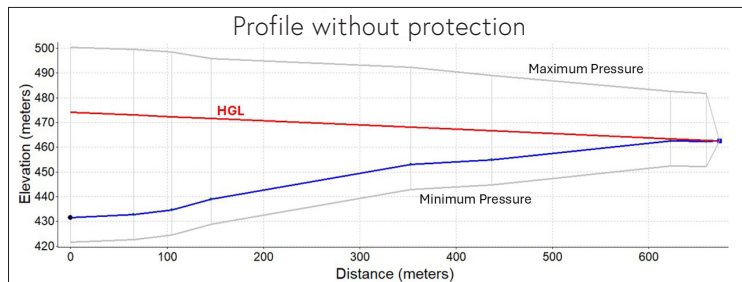
# Our Advanced Surge Prevention Solutions

Understanding the dynamics of water hammer is crucial for maintaining the integrity and performance of your water infrastructure. With a wealth of expertise and decades of practical experience in the field, our team of experienced engineers uses state-of-the-art software - such as KYPipe for surge analysis, a data logger for pressure change monitoring and recording instrument, and Aquestia's own valve-sizing tools - to design tailored solutions that suit the needs of your specific segment and water infrastructure. Our diverse range of innovative products and solutions - including air valves, check valves, surge tanks, and surge control valve applications - work in harmony to eliminate hazardous vacuum conditions, handle extreme pressure fluctuations, and ensure the efficient and reliable operation of your pipelines and pumping stations.

## KYPipe Design-Stage Surge Analysis

Aquestia's applications engineers are available to support your system designers, by performing surge analysis testing with KYPipe software. Simply submit relevant data about the system, such as pumping station data, pipeline properties and profile, and other hydraulic features. We then analyze potential feature performance in different scenarios, first to obtain a baseline, and then with various surge protection devices installed, to identify the correct product to provide the optimal solution.

Example: water system profiles, before and after installation of protection devices.



## Data Logger Operational-Stage Surge Analysis

If your system is already up and running, our applications engineers can collect real-time, online data about pump starts/ stops using our Data Logger pressure change monitoring and recording instrument. Installed on your pumping station, this software collects detailed data that enables our engineers to determine whether additional protection is required, and options for possible installations.





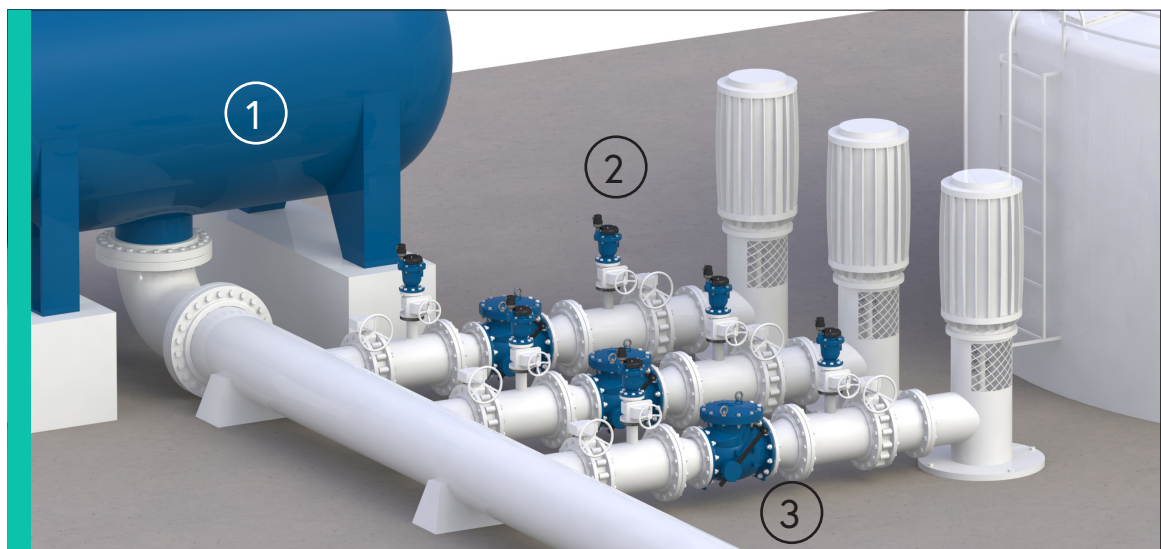
# Aquestia's Surge Solutions for Waterworks

Supply systems in waterworks segments require special configuration to provide protection from high pressure and flow. Aquestia offers a wide range of accessories designed to suit the relevant pressure, and enable the system to function properly, both in the course of daily operations and in the event of a sudden power failure. The following illustrations show two main options for protecting a pumping station from a surge, where the pump has tripped due to a power failure: one based on a bladder surge tank; one based on surge anticipation valves. The correct option should be selected in consultation with an applications engineer, after a surge analysis has been performed, and taking into account other parameters provided by the customer.

## Bladder surge tank solution

This solution, shown below in a pumping station that has a water supply tank, comprises air valves (2) and check valves (3). The connection of the bladder surge tank (1) directly to the main pipeline ensures that no surge can build up in the system in the event of a pump trip.

1. **Bladder Surge Tank**  
for Fresh Water
2. **A.R.I. D-060 NS**  
Non-slam, Combination  
Air Valve
3. **A.R.I. NR-040**  
Removable Cover Check  
Valve



## Surge anticipation valve solution

This solution, shown below in a deep well pumping station, comprises dynamic (2) and combination air valves (1) and pump control valves (3). In the event of a pump trip, the surge anticipation control valves (4) open to prevent a surge building up in the system.

1. **A.R.I. D-060 NS**  
Non-slam, Combination  
Air Valve
2. **A.R.I. D-070**  
Dynamic Combination  
Air Valve
3. **DOROT S300 BC**  
Pump Control Valve
4. **DOROT S100 RE**  
Surge Anticipation  
Valves







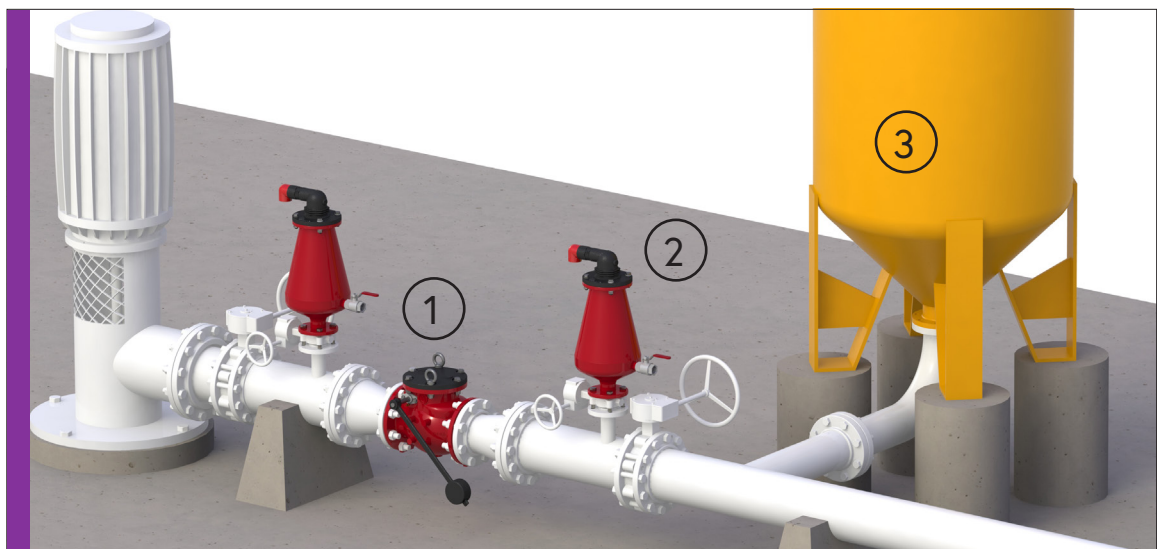
# Aquestia's Surge Solutions for Wastewater

Wastewater systems require tailored, durable products that can protect them from the extremely harsh conditions in which they operate.

## Bladder surge tank solution

This solution, shown below in a sewerage pumping station, comprises combination air valves (2) and check valve (1). A bladder surge tank (3) installed on the main pipeline prevents the buildup of a surge in the system, in the event of a pump trip.

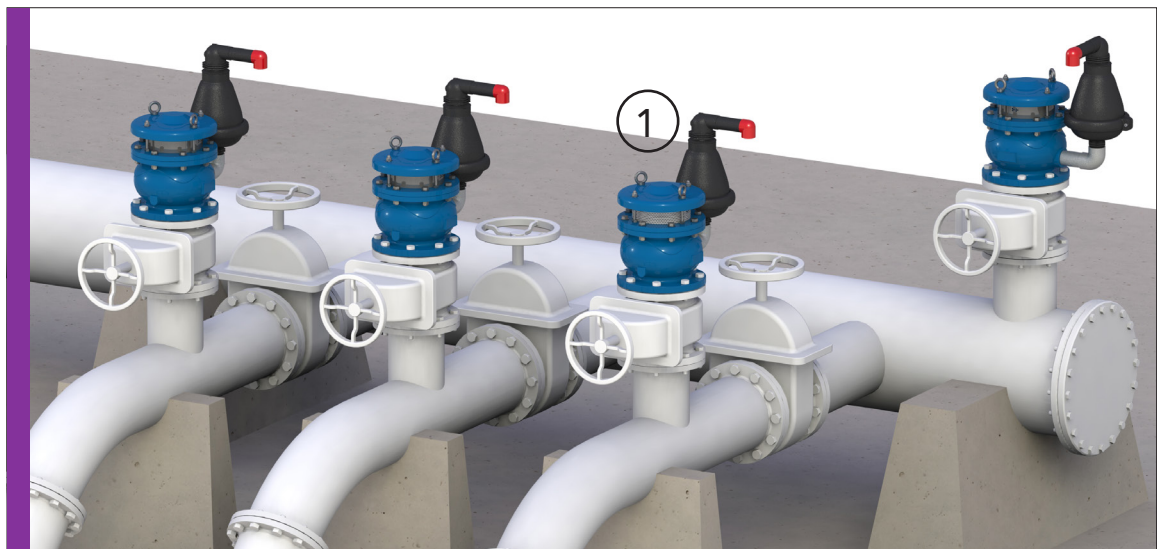
1. **A.R.I. NR-040 FS**  
Check Valve
2. **A.R.I. D-020 NS**  
Non-slam, Combination Air Valve for Wastewater
3. **Bladder Surge Tank**  
for Wastewater



## Vacuum breaker solution

The vacuum breaker solution, shown below in a sewerage pipeline system, prevents vacuum conditions from occurring when large volumes of air are required to enter the pipeline. This is normally a closed, spring-loaded, full-bore valve, designed to seal "drip tight", and to open fully when pressure drops from positive pressure.

1. **A.R.I. VB-060 D-025**  
Disc-type,  
Spring-loaded  
Vacuum Breaker





## Aquestia's Surge Solutions for Irrigation

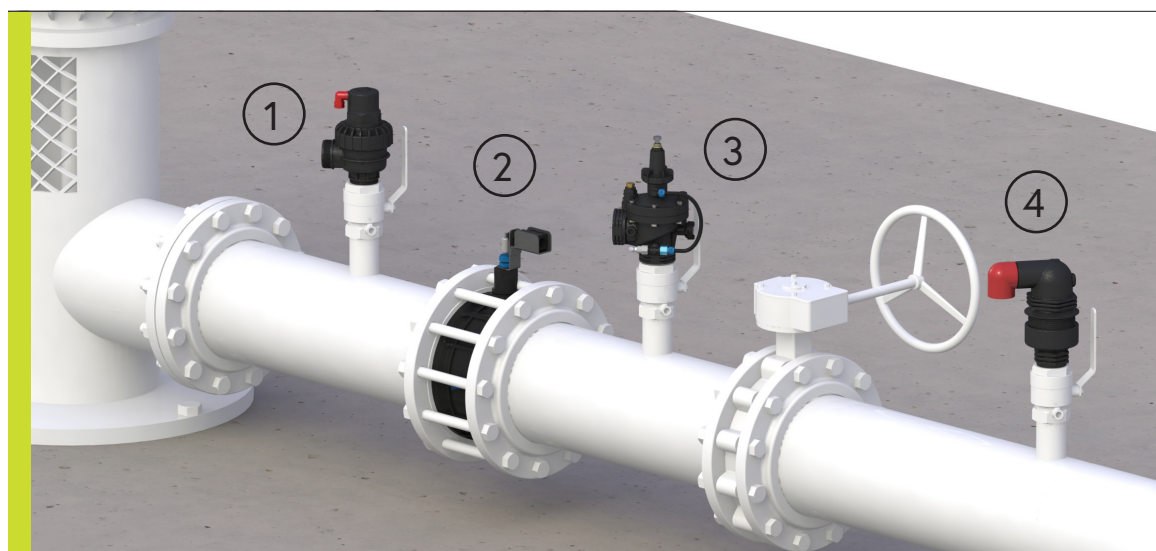
There are a variety of water sources that may feed into an irrigation water system as well as other variables. The pumping station should therefore be carefully designed, built and operated, taking into account the relevant water source/s, topography and operating conditions, such as flow, pressure and water quality.

Additionally, an agriculture supply and irrigation system is characterized by frequent stopping and starting, often several times a day. As a result, any surge that is caused could also occur several times a day, increasing the risk of damage to the system. Aquestia offers a wide range of accessories to enable the system to function properly, both during the course of its daily operation, and in the event of a sudden power failure.

### Typical irrigation pumping station solution

This solution, shown below in an irrigation pumping station, features a combination air valve (4) and a dynamic combination air valve (1) that prevents upsurges in the event of pump failure, by discharging air and rising pressure. The check valve (2) protects the pump from backflow and, at the same time, when the pressure rises above working operation, the quick pressure relief valve (3) opens to prevent high pressures.

1. **A.R.I. D-070 P**  
Dynamic Combination  
Air Valve
2. **A.R.I. NR-010**  
Wafer Style Check  
Valve
3. **DOROT S80 A QR**  
Quick Pressure Relief  
Valve
4. **A.R.I. D-040**  
Combination Air Valve



Partner with Aquestia to protect your water systems against the damaging effects of water hammer



Directing the Flow