



**SOLUTIONS FOR
REDUCING FLOODING IN
MUNICIPALITIES
USING CHECK VALVES**

For the last 27 years the sea levels have risen by almost 4 inches (100mm) - with an average of $\frac{1}{8}$ inch (3.3mm) per year. It is partly attributed to the increase in ocean temperature, which causes sea water to expand. Another contributing factor is the added water from melting glaciers.

Sea level rise is, however, only a part of why flooding has become more frequent. More intense storm surges, caused by global warming, is another important reason. The combination of these factors makes coastal areas more exposed to being flooded than ever before and the problem is likely to increase in the future.

The amount of stormwater is also increasing in many geographical areas and the amount of storm water is less evenly spread. Rainwater and snow melt is appearing in larger volumes as well in many cases.

HIGH TIDE FLOODING IS INCREASING IN THE US

High tide flooding has increased nearly 50% in the last 20 years and by 100% in the last 30 years in the US. By 2035, nearly 170 coastal communities in the United States are projected to experience flooding more than 26 times per year.

Examples of areas that have been impacted by this type of flooding is Wilmington North Carolina and Mount Pleasant South Carolina. Both of these locations have been able to limit the impact of tidal flooding by using check valves.

THE CONSEQUENCES OF FLOODING CAUSE LONG TERM PROBLEMS

Flooding from high tides causes long term effects for inhabitants and will also affect the environment in a negative way. It also generates major costs for cities, its businesses, and residents. The financial impact will also lead to higher taxes or that other important infrastructure projects will be delayed. Society needs to be one step ahead of the flood.

We have divided the consequences of flooding into the following three categories:

Problems for the environment

- Untreated water from water treatment plants and pump stations can flow into the sea and other water bodies.
- When flooding occurs stormwater can be polluted and more easily transport environmental toxins to the sea and other water bodies

Problems for inhabitants

- Costs for decontamination and insurance of houses and wastewater sewers
- Bad smell in buildings
- Private property that cannot be relocated will be affected.

Problems for cities and communities

- The society will be affected and stop functioning as usual.
- Saltwater can damage roads and buildings, so it needs to be rebuilt or repaired.
- Saltwater can damage cars and public transportation equipment.
- Flooding can have a major impact on cultural objects and buildings.
- Long term costs will arise for rebuilding infrastructure and buildings.
- Short term costs will arise for decontamination, rescue, and insurances.

CONSEQUENCES OF HIGH TIDE FLOODING FOR SEWER AND STORMWATER SYSTEMS

When the water level is rising in seas and rivers, water can start to flow backwards in the sewer and stormwater system. This might lead to water levels reaching the pump stations emergency overflow. The pump station might be damaged if they will be flooded. The pump stations might also start to pump cleaned water to the water treatment plants. The backwards flow of water can also lead to flooding on streets, basements, and in wastewater systems.

When the wastewater treatment plant is flooded it needs to treat already clean water on top of the normal wastewater flow. A wastewater treatment plant constructed for a specified daily flow cannot handle increased water flows effectively. This will increase costs for wastewater treatment.

The treatment itself will also become less effective. Seawater can affect the bacteria that is used for treating wastewater. Water that is not treated according to specifications will reach the sea. This leads to an increased environmental impact and fines can be raised for not treating wastewater in line with environmental rules and regulations.



MODERN CHECK VALVES CAN MINIMIZE THE FLOODING PROBLEMS

Check valves prevent water from flowing backwards in a sewer and/or stormwater system. They are mounted in various locations to solve different types of problems.

Check valves were previously not typically built into sewer and stormwater systems from the start. It is, however, becoming increasingly common to install check valves when designing and constructing these systems.

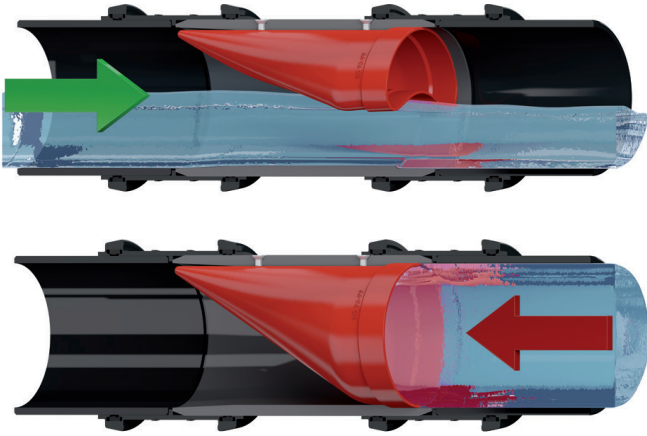
In this guide we have described 4 different common problems that can be minimized using check valves.

- Water from seas and rivers rises and enters outlets.
- Hydrogen Sulfide – a growing problem
- Sand, rocks, and seaweed cause problems related to water flow.
- Saltwater enters the sewer and stormwater system.

You can read more about these problems and the possible solutions later in this guide.

THIS IS HOW A MODERN CHECK VALVE OPERATES

WASTOP® INLINE CHECK VALVE



There are many problems derived from a reverse flow in a piping system. To prevent problems caused by backflow in a system, backflow prevention in the form of a check valve or flap gate are installed.

Wapro's WaStop Inline Check Valve has an ingenious and simple function that provides you with the best possible protection against flooding, odor control and backflow.

A wide size range makes it available to fit most types of pipes from NPS 3" to NPS 80" and it's also available in an Access Chamber for easy access from ground level.

All sizes are available in short versions or with flanges and are reversible for inlet or outlet installation and can be used vertically as well as horizontally. WaStop can be customized to fit the most problematic application and installed with a variety of attachments.

ADVANTAGES OF WASTOP®

WaStop Inline Check Valve excels in many areas. WaStop exhibits the lowest headloss on the market, 100% backflow prevention and a unique pulsating flow that keeps pipes both upstream and downstream cleaner which reduces maintenance costs.

Headloss

WaStop achieves the lowest headloss on the market by having a smooth rigid housing, a flexible membrane with low co-efficient that adapts to the amount of water moving through the valve. Low headloss decreases the risk of upstream flooding caused by resistance in the system.

Backflow Protection

Stopping backflow prevents flooding and damage. WaStop protects against backflow continuously, autonomously and seals 100% tight even at low backflow pressure levels.

Pulsating Flow

WaStop Inline Check Valves have a unique pulsating flow mechanism built into the membrane. The pulsating flow mechanism increases the velocity of the flow which flushes debris out keeping the pipes cleaner.

Installation

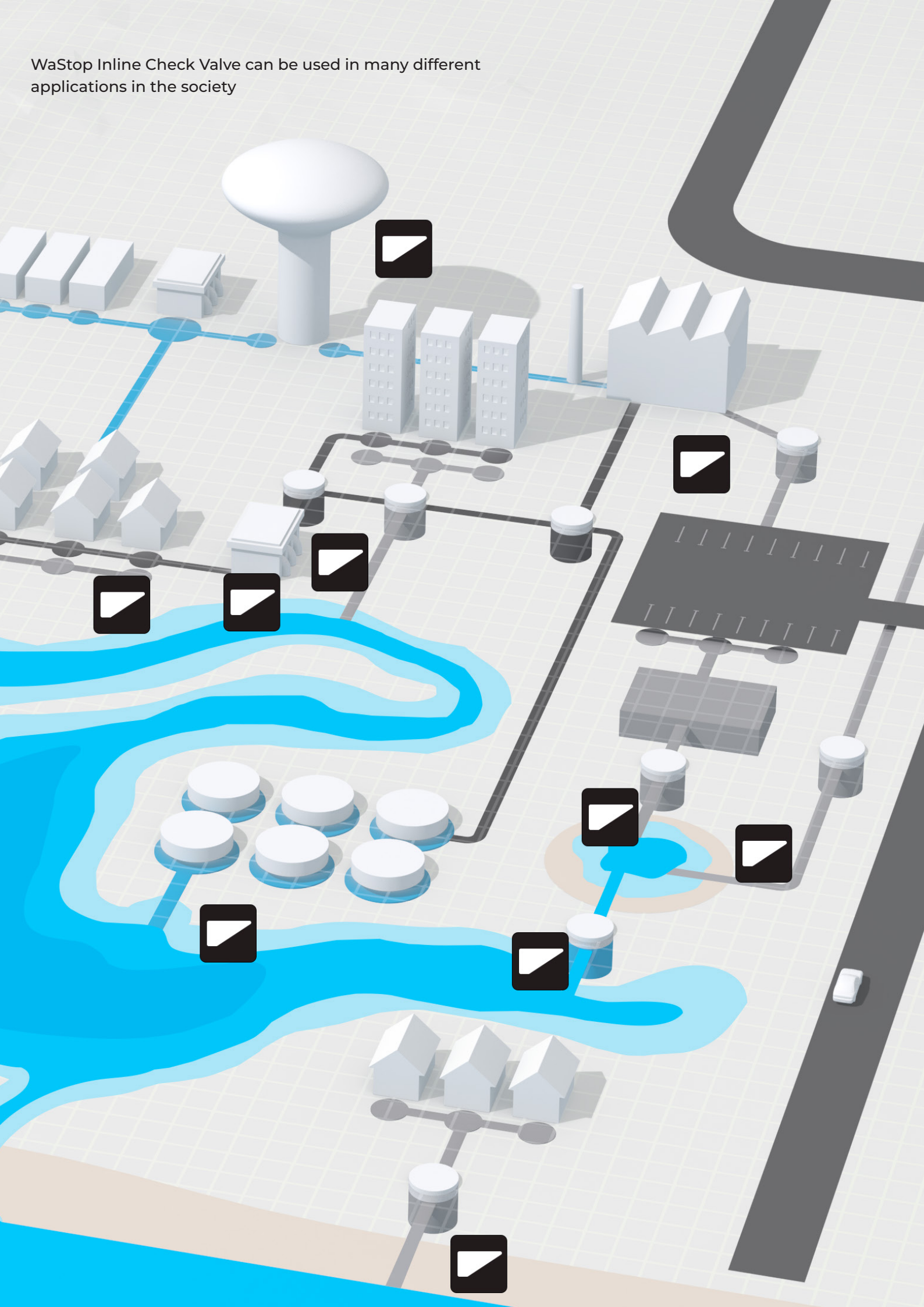
WaStop Inline Check Valves are fast and easy to install in both new and existing infrastructure. In just 30 minutes a large valve can be installed, and the job completed. Time and money are saved through a simple and quick installation requiring few tools and minimal labor.

Cost of ownership

WaStop has a low cost of ownership. This is built on several factors including the long-life expectancy of the valve, the quick installation time, and the low level of maintenance required.

Working on differential pressure the WaStop functions autonomously, without human interaction, without electricity and without constant maintenance. It just works and provides peace of mind.

WaStop Inline Check Valve can be used in many different applications in the society



THE PROCESS FOR IDENTIFYING AND SOLVING FLOODING PROBLEMS

Acute flooding problems often result in check valves having to be installed. Check valves may be necessary due to a variety or combination of factors, such as rising water levels in seas and rivers where sewer and stormwater systems have their outlets, or when large amounts of rainwater or meltwater are generated.

Often, we encounter cities and sewerage departments that must work proactively to prevent problems occurring in existing pipe networks. Problems associated with flooding are becoming increasingly common in large parts of the world. It's necessary to rebuild and renovate existing systems and ensure that new sewer and stormwater systems are built to withstand increasing floods.

Different cities in different countries may handle problems in their sewer and stormwater systems differently, depending on the problems they face and the purpose of the related solutions. Below, we have detailed a process that sufficiently and quickly solves most relevant flooding problems where the implementation of check valves is an appropriate solution.



FLOODING OCCURS

Flooding often occurs in the basement of properties. It's important that the individual responsible for the sewer and stormwater system within a city or municipality quickly receives information concerning flooding problems that arise, directly from those who are affected by the problem. It is much easier to understand the cause of a problem when the source of the flooding is obvious. Often, flooding incidents are first handled by insurance companies, which tends to delay the process of understanding the problem and complicates investigations into understanding the cause and effect of the flooding.

Many municipalities and sewer and stormwater system officials prefer using their own staff to carry out the investigations. Municipal staff typically has an easier time identifying problems and implementing measures that are not the responsibility of property owners.

Regardless of whether the sewer and stormwater system official is involved early in the process or after the insurance company has received the case, it is important to work closely with the insurance companies. Insurance companies often have standardized rules for what information needs to be collected in connection with damages and this significantly facilitates the processing of incidents.

The first step is to carry out an on-site inspection to establish whether the cause of the damage is located inside or outside the property's boundary. To find the cause of the problem the pipe network often needs to be examined visually using a camera.

FINDING THE SOLUTION TO A PROBLEM

Problems commonly occur due to blockages in the pipe system. Water can also flow backwards in pipe systems, for various reasons.

An investigation must be conducted into the cause of the flooding. Information about the current pipe system, an analysis of the current problem, as well as similar incidents that have occurred previously should all be considered in the investigation.

If a municipality doesn't have the resources to sufficiently address an issue, consultants should be involved. It is advisable to involve suppliers such as Wapro early in the process to discuss the problems that have arisen and various potential solutions, including check valves.

FIXING THE PROBLEMS

Once the solution to the problem has been identified, an external contractor is typically involved to fix the problems, however, some municipalities are capable of fixing the problems on their own.

The scope of the required measures depends on the type of solution that needs to be implemented. In a best-case scenario, a solution can be added to an existing network. In some cases, however, it may be necessary to completely rebuild the pipe system.

If the cause of a problem is located outside a privately owned property, the municipality usually resolves the problem. If a solution is implemented on a privately owned property, the owner of the property is typically responsible for maintenance.

AFTER THE PROBLEMS HAVE BEEN FIXED

Following repairs to resolve a flooding issue, the sewer and stormwater system official usually needs to provide evidence to the insurance companies that the source of the flood damage has been remedied.

PROBLEMS WHERE CHECK VALVES PLAY AN IMPORTANT ROLE IN SOLVING FLOOD RELATED PROBLEMS

WATER FROM SEAS AND RIVERS RISES AND ENTERS OUTLETS

A common fundamental problem is that water from seas and rivers rises and enters pipe system outlets.

When the sea/ivers rise, water flows into pipe systems via outlets and fills the pipes with water, water cannot flow downstream to the sea or river, thereby using up the natural storage volume for stormwater. This creates a situation where even small amounts of rainfall could result in flooding. As the pipes are full of sea/lake water there is no room for stormwater, which instead ends up flowing back into the system, up onto roads or into the sewer and/or stormwater system via spillways/emergency drains.

What then happens is that water stays on roads longer than necessary which creates traffic problems and increases the risk of traffic accidents.

If stormwater enters a sewer and/or stormwater system from an outlet, there is a risk of it flowing into so-called spillways that are positioned in between the drain and the stormwater. The rainwater can then flow into treatment plants, which puts an undue burden on the plants, increases costs and jeopardizes the safety of biological treatment processes carried out by the treatment plant.

It may also be necessary to pump water out of pumping stations, which is very costly.

Water can also flow upstream into the sewer and/or stormwater network and thereby enter houses and properties through toilets and floor drains, both of which cause costly damages and safety problems.

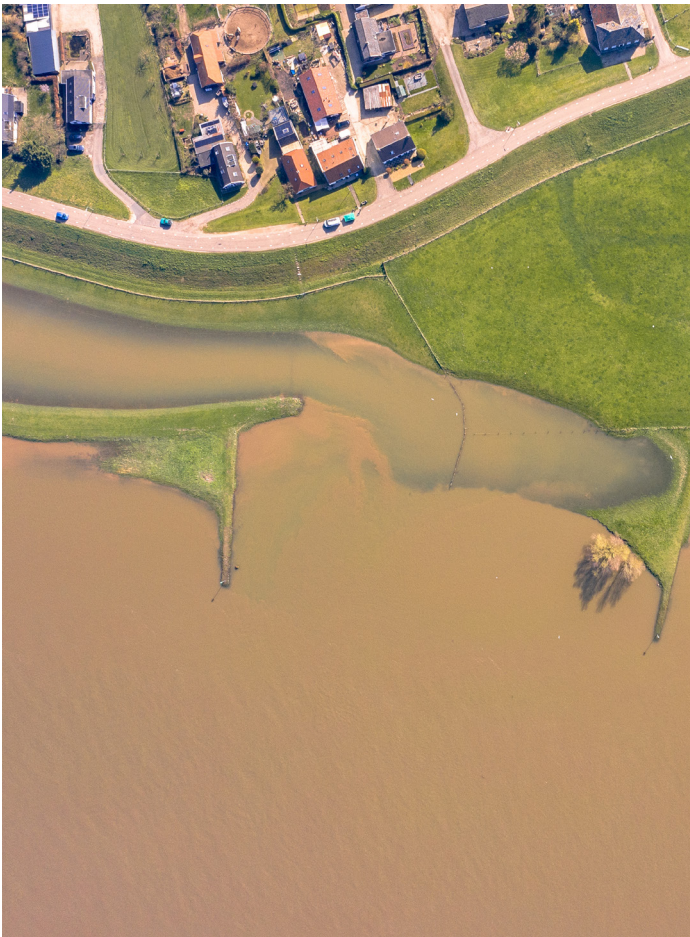
The solution to these problems is to install a check valve. These valves are most appropriately installed by the outlet, or as close as possible to the outlet, to maximize the storage capacity of stormwater networks.

There are many different types of WaStop valves with several different possible attachments, but the WaStop valve with a standard membrane in one of the existing dimensions between NPS3"- NPS80" (DN75-2000mm), is most often used.

IMPORTANT THINGS TO KEEP IN MIND WHEN IMPLEMENTING THE SOLUTION

It's important to ensure that sufficient head pressure is present upstream for water to flow through the WaStop inline check valve. The WaStop valve opens when the differential pressure reaches the opening pressure, determined by the dimensions of the installed valve.

You should also make sure that there are no cracks in the pipes to ensure that extraneous water cannot enter the system through entry points behind the WaStop valve.



HYDROGEN SULFIDE (H₂S) – A GROWING PROBLEM

Many municipalities are experiencing problems related to increasing levels of hydrogen sulfide. This is partly because less water is present in sewer and stormwater systems today than there used to be. It is more common today to use separate pipes for transporting stormwater and sewer water than it used to be. People also tend to use products that require less water, for example low-flush toilets, shower heads, washing machines and dishwashers. This increases the risk of water stagnating which facilitates the formation of hydrogen sulfide. A problematic amount of hydrogen sulfide thereby builds up in the system.

An odor, like the smell of rotten eggs, can then spread to unsuitable places (public squares etc.). This is an inconvenience for the people who are exposed to this smell, such as restaurant guests and people visiting cafes, shops, and parks. Bad odor penetrates manhole covers and spreads to the surrounding area. Bad smells can also be emitted via spillways and into the stormwater system and can be expelled via stormwater drains (drains in streets and squares).

Hydrogen sulfide is very corrosive to both concrete and steel. This makes it harmful to equipment in pumping stations (valves, etc.). When pipes are corroded, they become brittle and break, which shortens the service life of the pipe network. Products in cast iron, such as manhole covers, are corroded faster. This diminishes their strength, which results in increased maintenance requirements and higher costs.

Hydrogen sulfide repels oxygen, which makes it very dangerous to enter drains without breathing aids.

You can prevent hydrogen sulfide from being emitted by installing WaStop inline check valves. You can also limit the damage that hydrogen sulfide causes, since the special WaStop membranes block hydrogen sulfide from passing through.

One instance of a WaStop being utilized in this type of application is in sanitary pump stations where there is a valve vault present with a wet well. As inflow and infiltration (I & I) enters the valve vault it then drains into the sanitary sewer wet well through a drainpipe. The installation of the WaStop on the outlet of that drainpipe prevents the hydrogen sulfide from permeating back through the drainpipe to the valve vault. Preventing the H₂S from entering the valve vault prolongs the life of the equipment in it and also prevents the odor from emitting out of the wet well.



SAND, ROCKS AND SEAWEED CAUSE PROBLEMS RELATED TO WATER FLOW

Many stormwater drains are affected by sand, rocks, seaweed, and other objects being washed far into the pipes due to natural occurrences such as waves, storms, and tides. This limits the capacity of stormwater networks and, in the worst case, risks clogging the pipes and prevents stormwater from exiting the network. This occurs in many sewer and stormwater networks and is not a new phenomenon.

Sand and seaweed penetrate far into the pipes, if no barrier has been implemented, preventing stormwater from exiting the system, which results in flooding.

To avoid blockages, sand needs to be dug out of the pipes and the pipes need to be flushed out several meters upstream from the outlet. This issue thereby results in increased maintenance requirements and increased costs.

High tides or waves can push large rocks and large amounts of sand/seaweed into an outlet.

To avoid blockages supervision is required, as described above.

By installing the WaStop inline check valve by the outlet, sand, rocks, and seaweed are prevented from entering the system.

WaStop reduces the need for maintenance and above all, prevents sand, rocks, and seaweed from entering a pipe system. Any maintenance takes place at the point of the outlet.

- The WaStop inline check valve has a flushing effect that prevents sand from building up in front of the valve.
- Upstream pipes retain their capacity.
- With WaStop, the need for flushing and sludge suction is reduced.
- Operational and maintenance costs are reduced as only the outlet needs to be supervised, not the pipes.

To avoid the problems the check valves, need to be installed in the same way as described under the section "Water from seas and rivers rises and enters outlets".

SALTWATER ENTERS THE SEWER AND STORMWATER SYSTEM

The introduction to the text describes how stormwater is prevented from exiting, or gets stored in, the pipes, since the storage capacity of the pipes is reduced due to water entering the system from the outlet. Another problem is that salt water enters the system and leaks out on roads, into streams, etc. Below are a couple of potential consequential scenarios.

Saltwater leaks out onto roads through road drains.

- The road/street material is negatively affected by this and the service life is significantly shortened, which

increases the need for maintenance and increases costs.

- Grates and other iron parts of the system rust, which results in additional costs. Concrete can also be damaged by salt water.
- The traffic on the streets is negatively affected by vehicles being exposed to salt water. This results in increased costs for the owner and bad will for municipalities and cities.

Saltwater travels to green areas, parks, etc., which are normally intended to store rainwater.

- Plants die from saltwater exposure. This results in additional costs for the owners.
- Freshwater animals (fish, insects, and frogs) can be harmed if salt water enters ponds.

Saltwater enters pumping station.

- The effectiveness of the biological treatment process can be reduced by this, which leads to increased levels of pollutants in the environment as well as increased costs.
- Pumping stations need to pump much more water than usual. This leads to increased electricity consumption and wear on pumps with increased costs as a result.

By installing WaStop inline check valves (see solution problem 1) you can avoid these problems.





HOLDING BACK THE FLOOD

HOW CAN I GET HELP MINIMIZE THE CONSEQUENCES OF FLOODING?

Wapro has got a lot of experiences from what type of solutions that should be implemented depending on your specific situation. You can easily book a meeting with us to discuss high tide and stormwater related flooding in your geographical area. We can help define challenges with the sewer and stormwater network that can be solved to minimize short and long-term problems. [Visit us here.](#)

You can also watch our recorded event *"Mitigating the consequences of increased flood hazards in municipalities"*

During the event we will go through the driving forces behind increased flooding and how this will affect the sewer and stormwater systems. You will also learn the basic concepts for how modern check valves will minimize the problems in a variety of different scenarios. You can watch the recorded event [here.](#)

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LTA Engineers specializes in stormwater management systems and infrastructure solutions that improve the built environment and protect nature.

LTA Engineers has been providing sustainable, long-term solutions to coastal and island communities since 2000.

[Contact Lynn Burnett for consultation.](#)

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