

# IN 3: Urban Engineering

*CTB3300WCx: Introduction to Water and Climate*

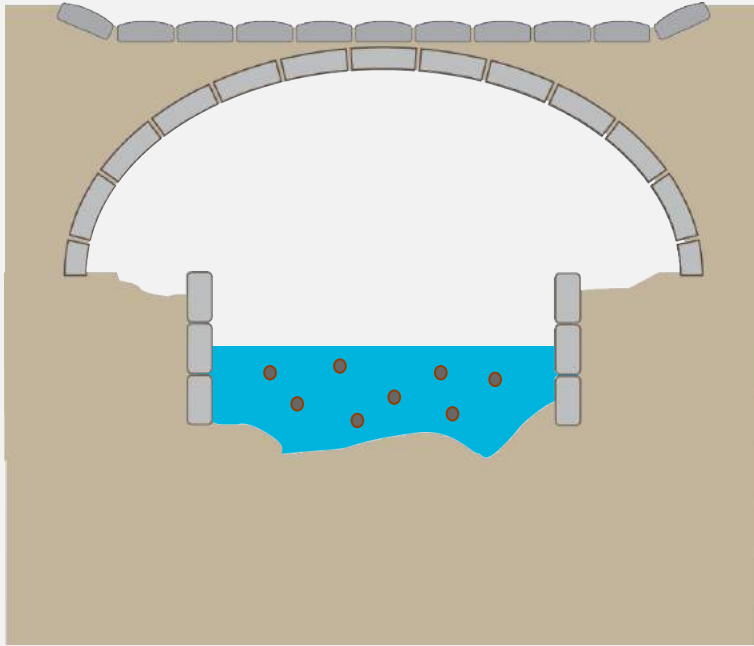
Dr.ir. Marie-Claire ten Veldhuis





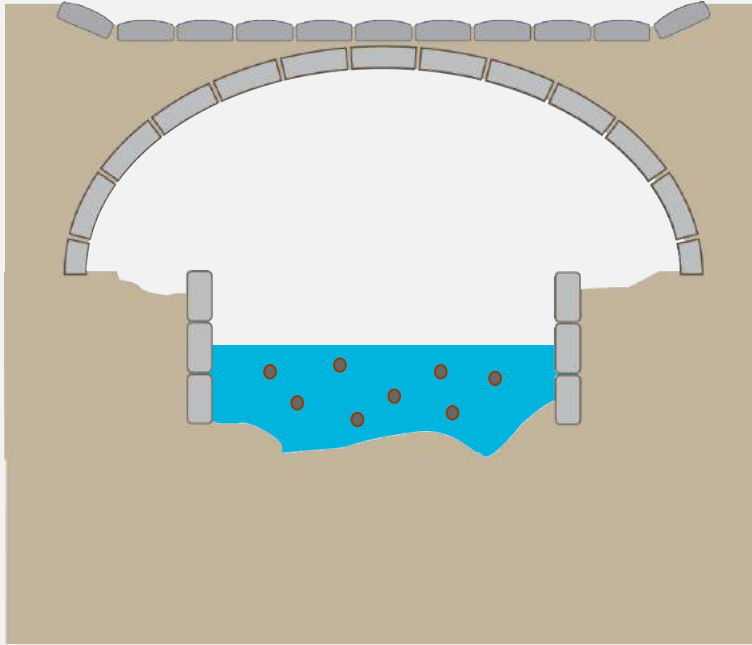


# Cloaca Maxima design



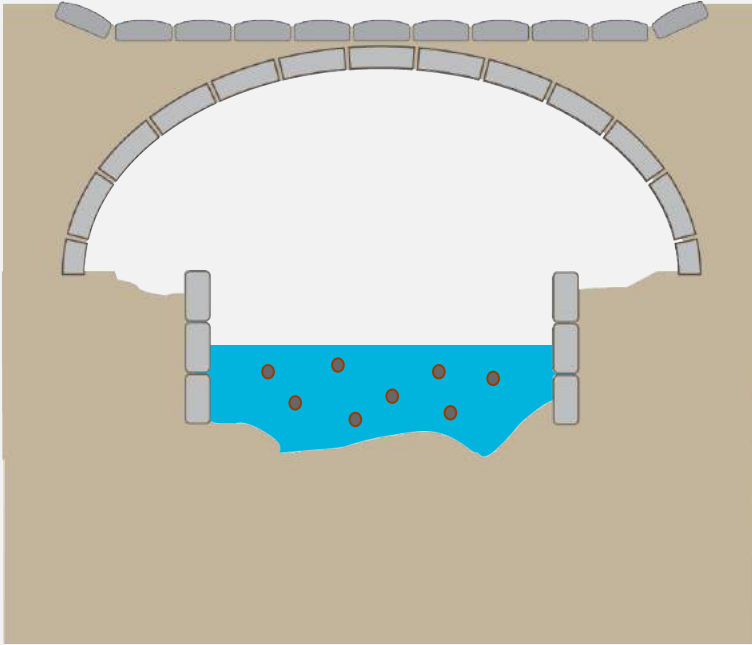
- *A channel that naturally receives stormwater from the city*
- *Gradually covered and transformed into an underground tunnel*

# Cloaca Maxima design



- *A convenient solution to drain stormwater..*
- *while life above ground could continue undisturbed*
- *But wastewater was dumped too, which flowed out through the sewer system into the Tevere river.*

# Cloaca Maxima design

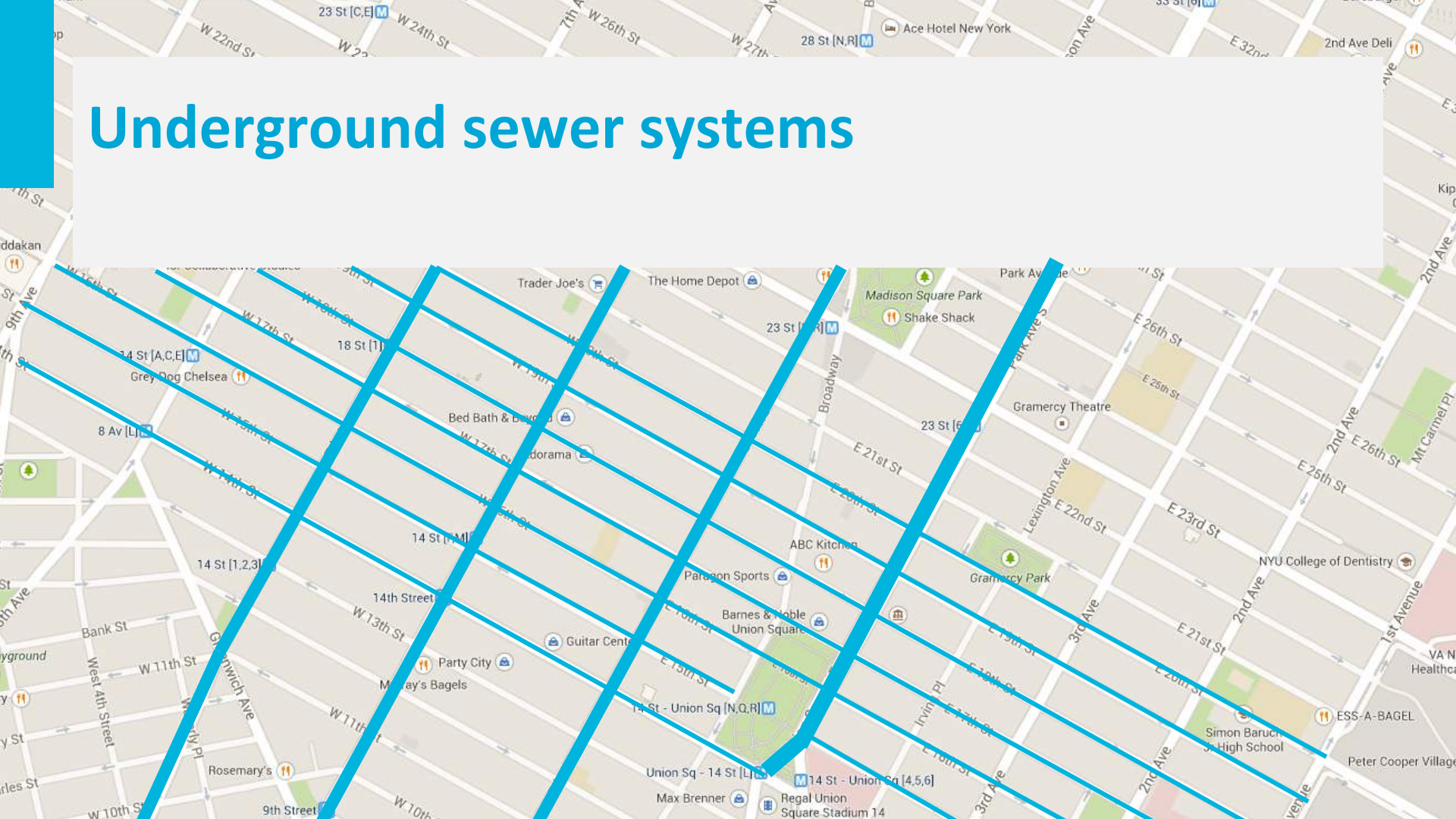


## *Combined sewers:*

- *Collect wastewater during dry weather conditions*
- *Fill up with stormwater when it rains*
- *Prevent flooding of the streets when it rains*
- *Dispose of wastewaters from the city*



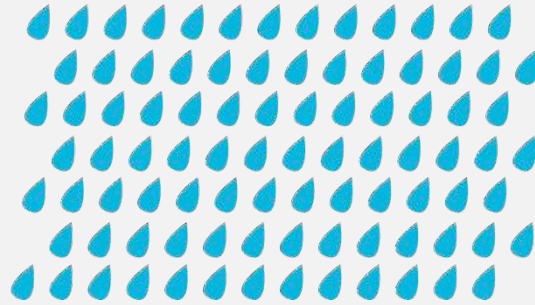
# Underground sewer systems



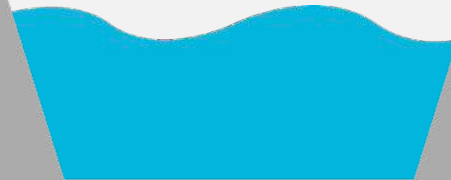




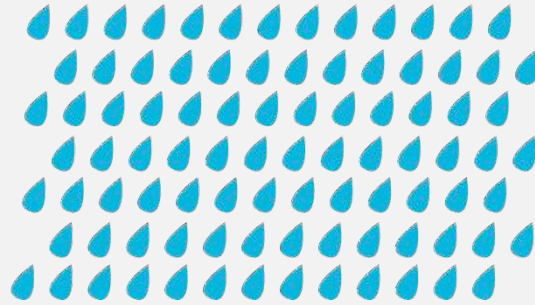
# Separate sewer



*When stormwater is collected in open channels, a separate solution has to be found for wastewater collection.*

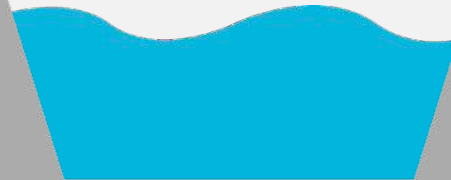


# Separate sewer

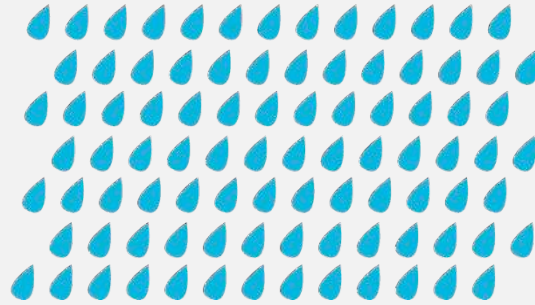


*Dumping wastewater into the open channels is undesirable:*

- Contamination
- Smell
- Health risk



# Separate sewer



## ***Separate sewer systems:***

- *collect wastewater in a separate pipe from stormwater.*

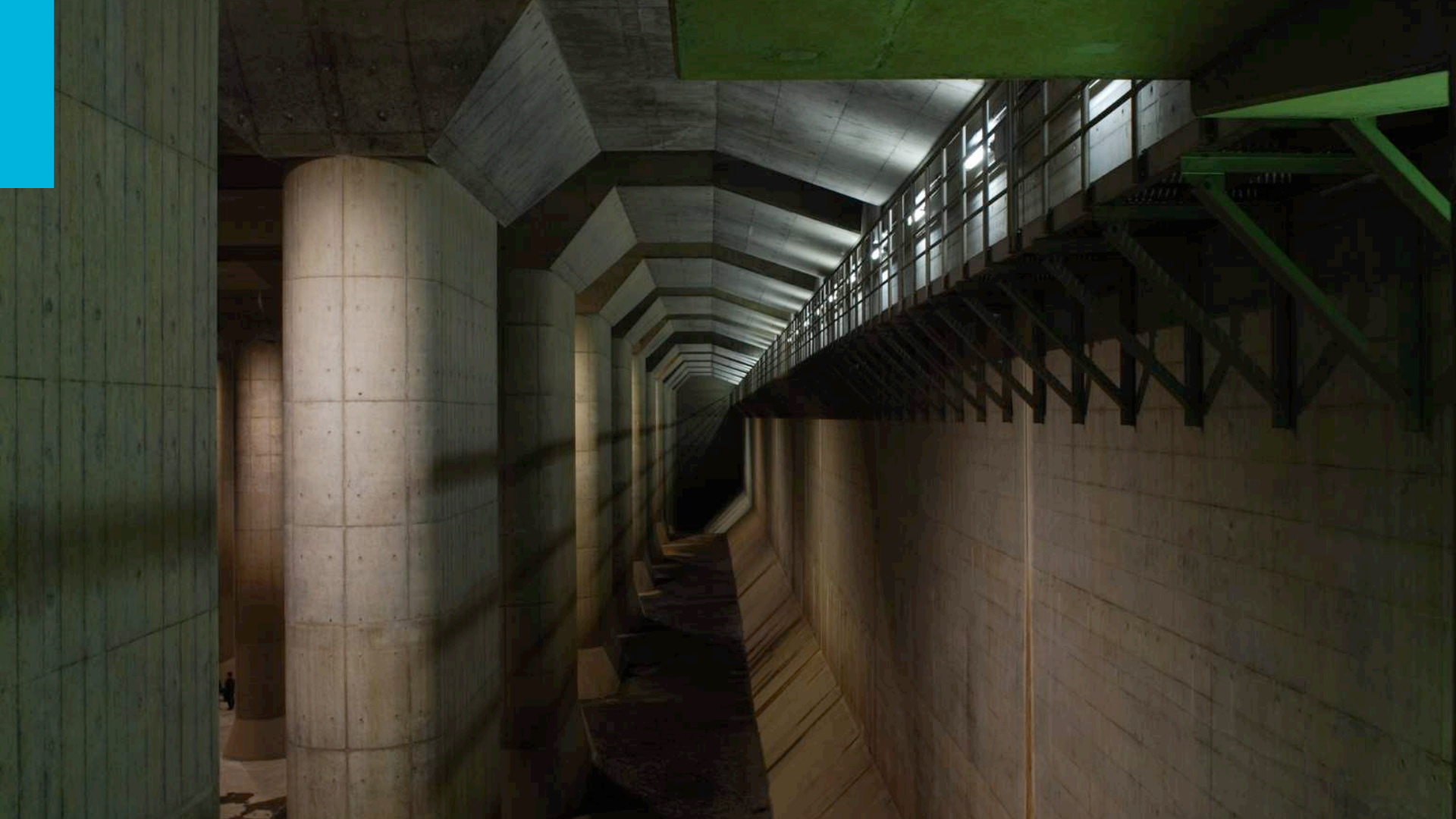




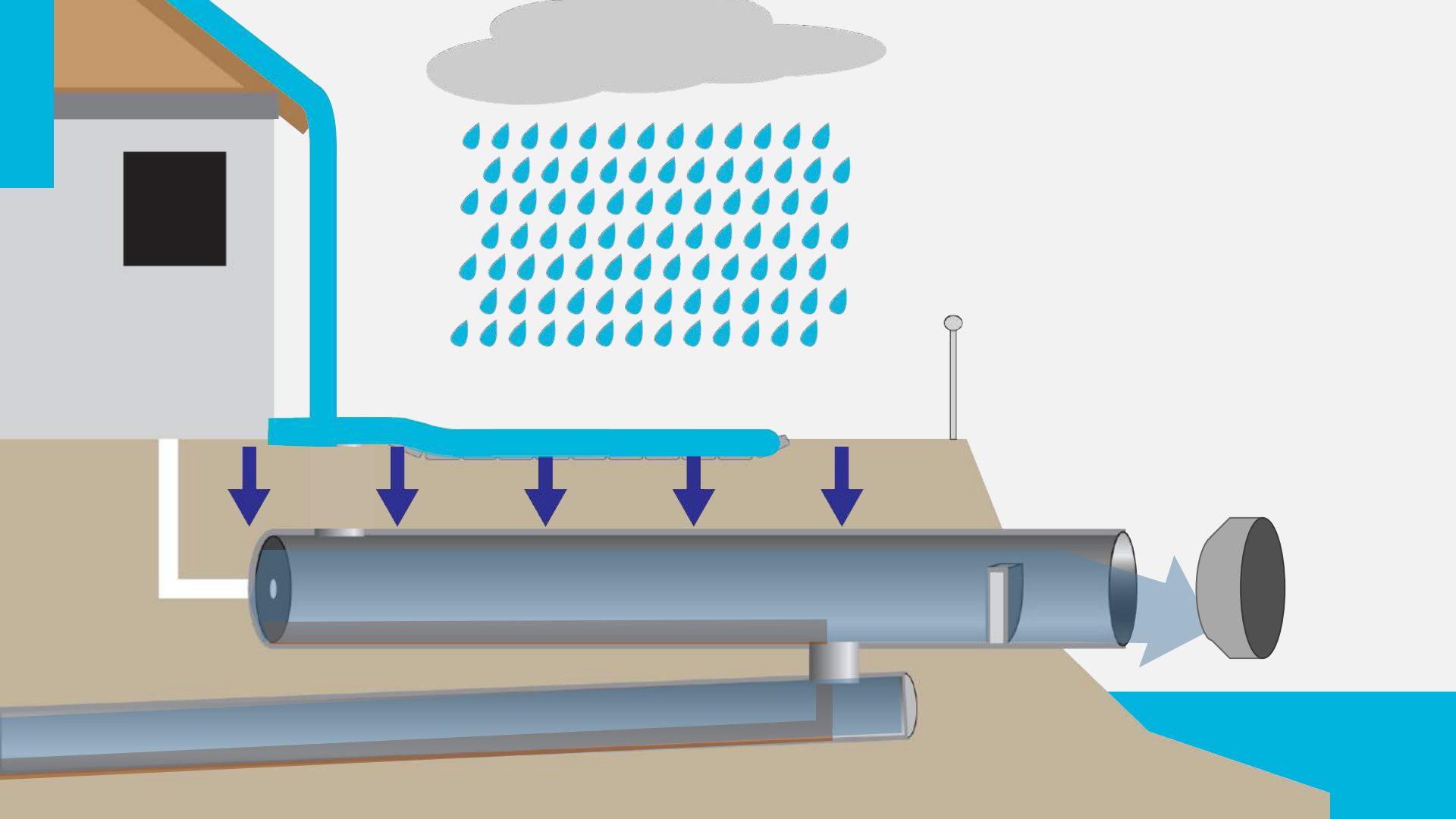
# Sataima sewer system, Japan











# Channels and Gutters



# Permeable pavement





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