3d Printed Pills to Investigate Misconnections

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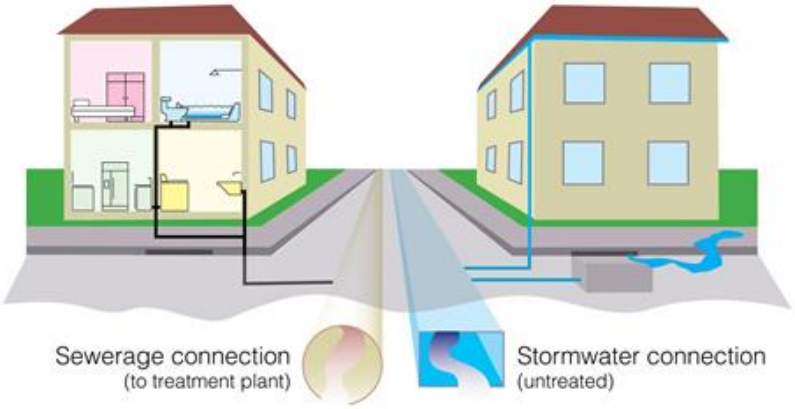
Context: Main Problem

- Separate Sewer System



- Contamination of Storm Water

- Overflow of pipes

Problems such as:

- Misconnections
- Cross connections
- Leakages

Can lead to:

Context: Methodologies

- Smoke Test

- **Time consuming**
- **Expensive**

- Dye Test
- DTS

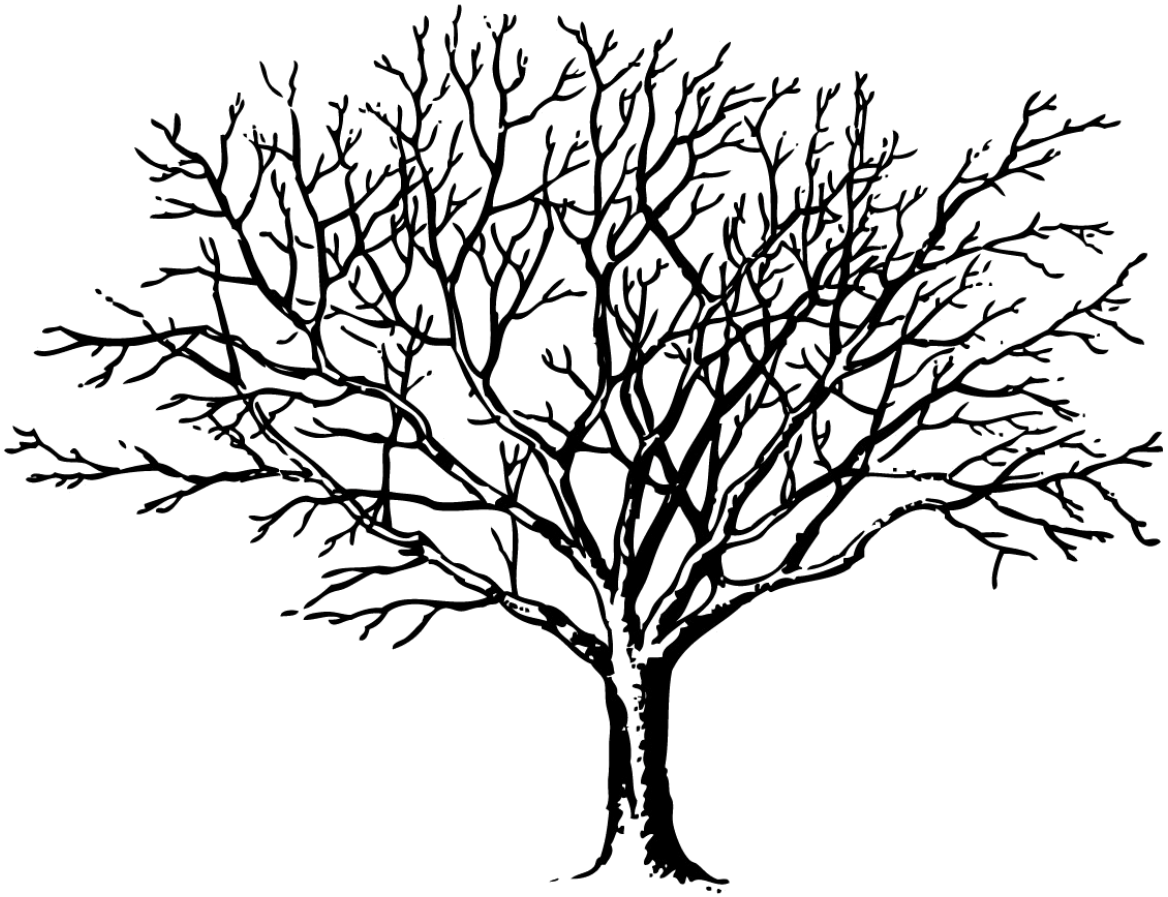
Context: Methodologies

Misconnections can happen within a building or an apartment.

Need

- A new method must be conceived. This new method must be:
  - Cheap

  - Accurate

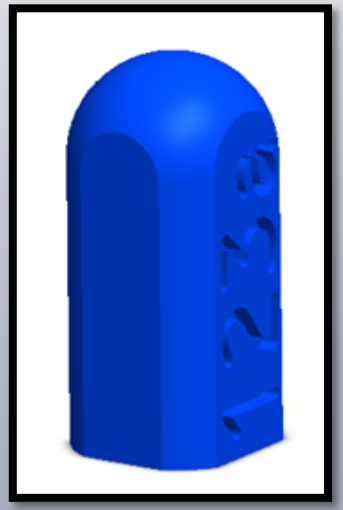


Idea

- Specifications

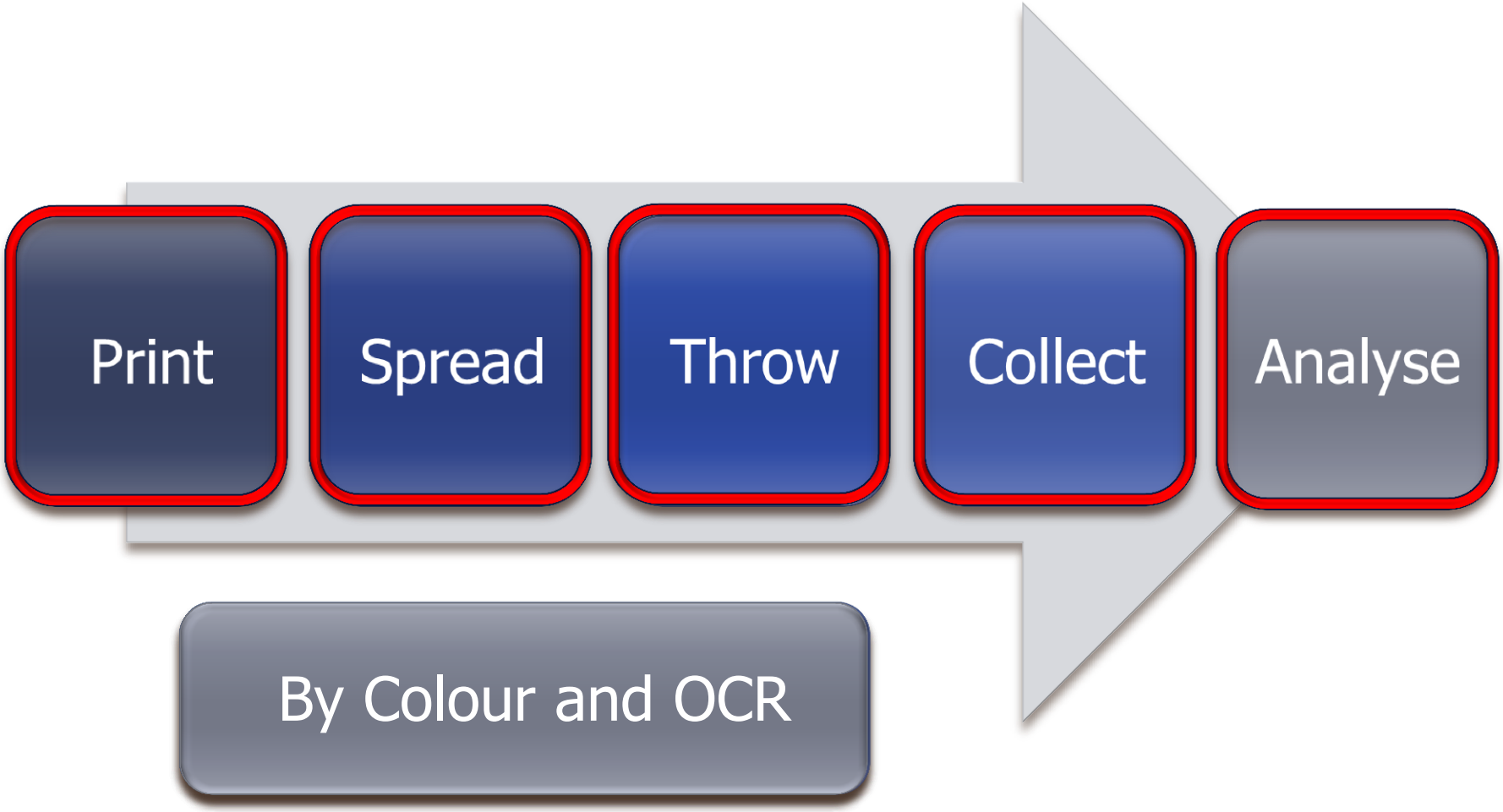
Idea: Specifications

Eco Friendly



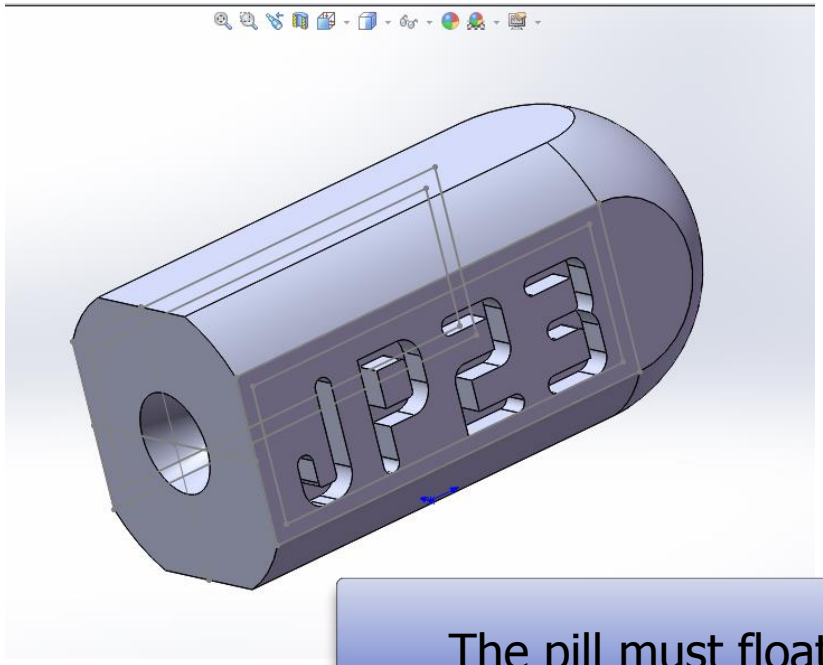
- Pills are printed with a 3d Printer, which reduces not only production costs but staff costs.
- Pills are printed with PLA plastic. PLA is biodegradable and, therefore, eco friendly.
- Pills have a bullet form to ensure they can go through sinks, toilets, showers and down pipes. Pills are 11 mm long and 5 x 3 mm wide. No knowledge is required in order to use the method due to its simplicity.

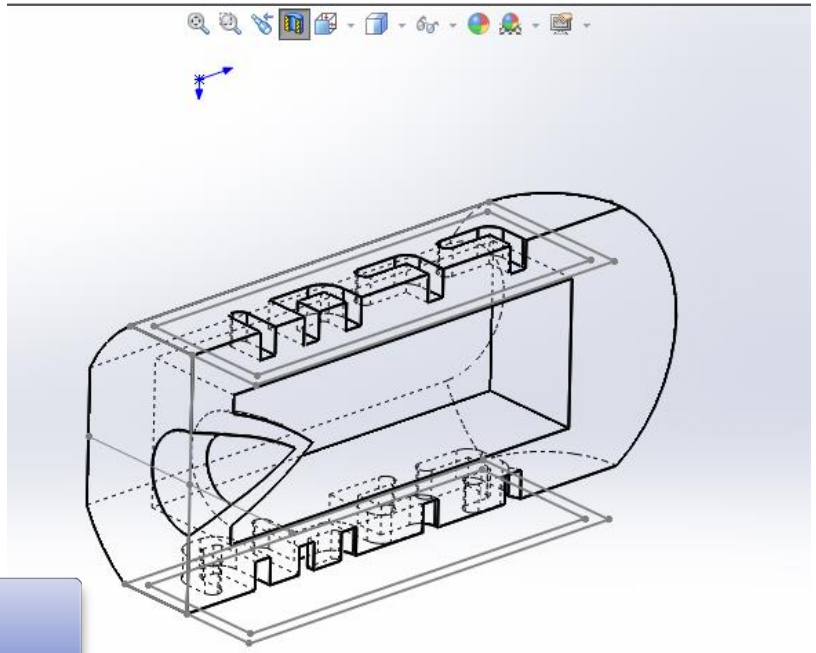
Summary



Idea: Object

- PLA density: 1,25 → Hollowing the pill → Pill density: 0,95



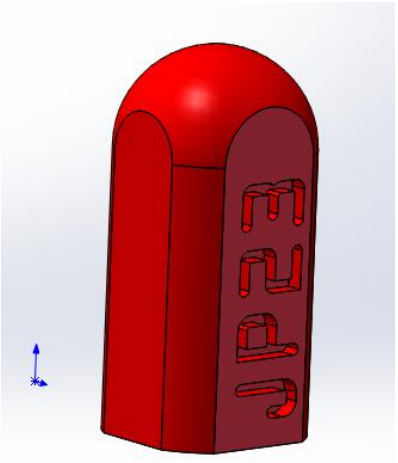


The pill must float.

Idea: Object Characteristics

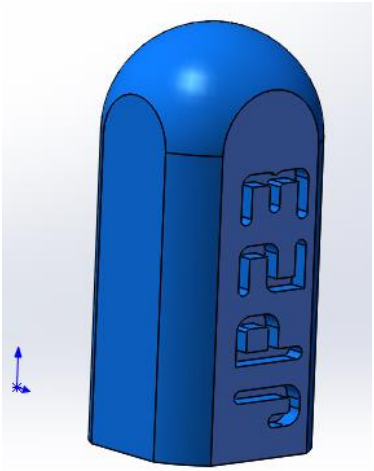
- Colour

Red



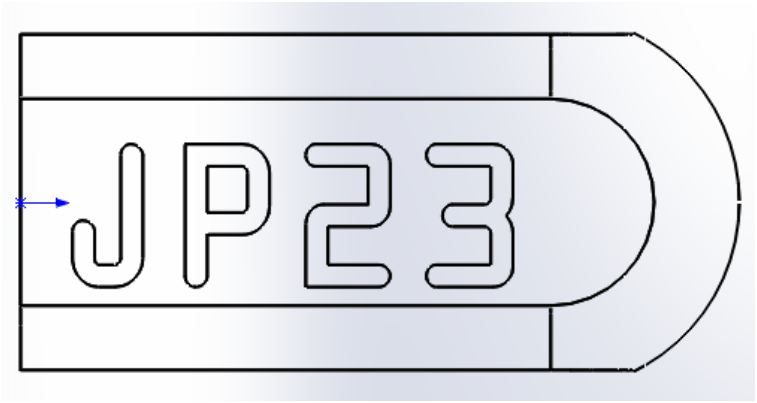
- Waste Water

Blue



- Storm Water

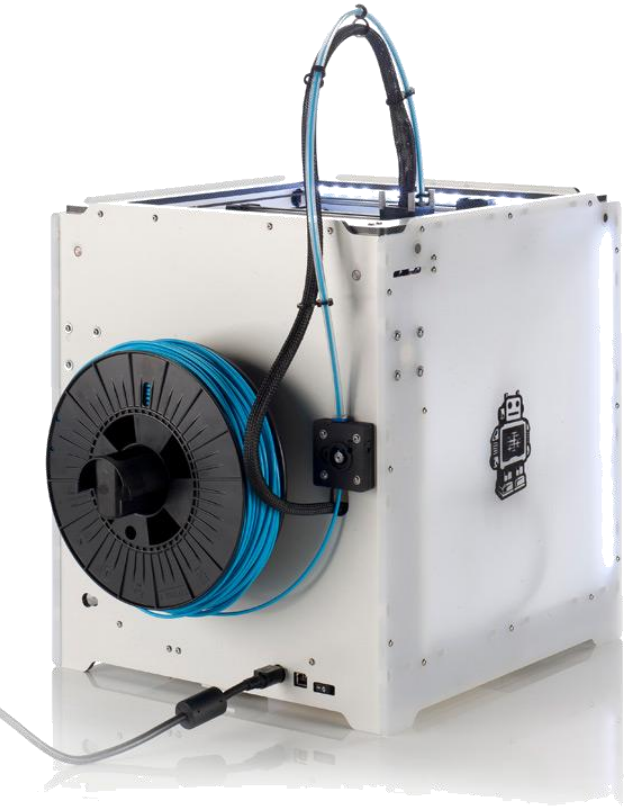
- Unique Code

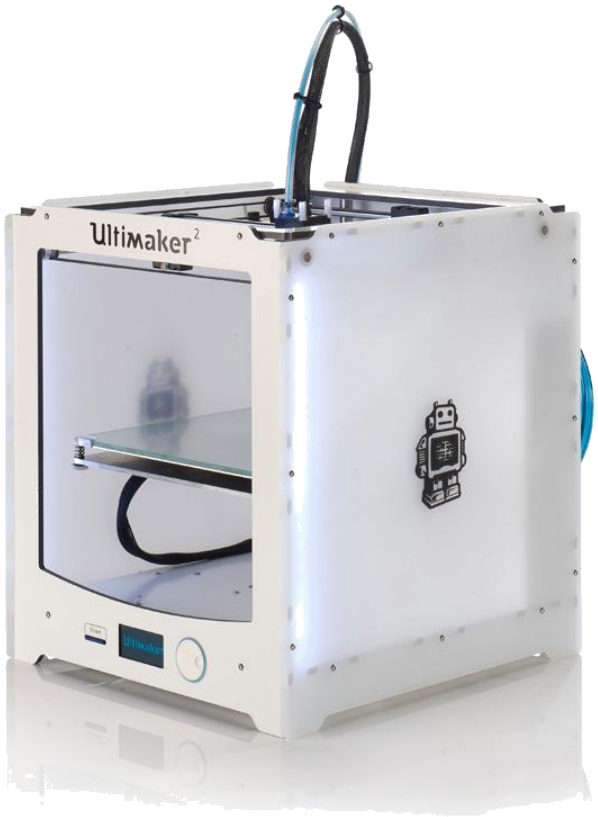


Idea: Materials

- 3D Printer

All pills can be manufactured with the 3d Printer.
The used printer is an Ultimaker 2+.





Idea: Materials

- PLA

The plastic from which the pills are made of is PLA.
PLA stands for PolyLactic Acid and it is a biodegradable.

Pill: 0,015 euro

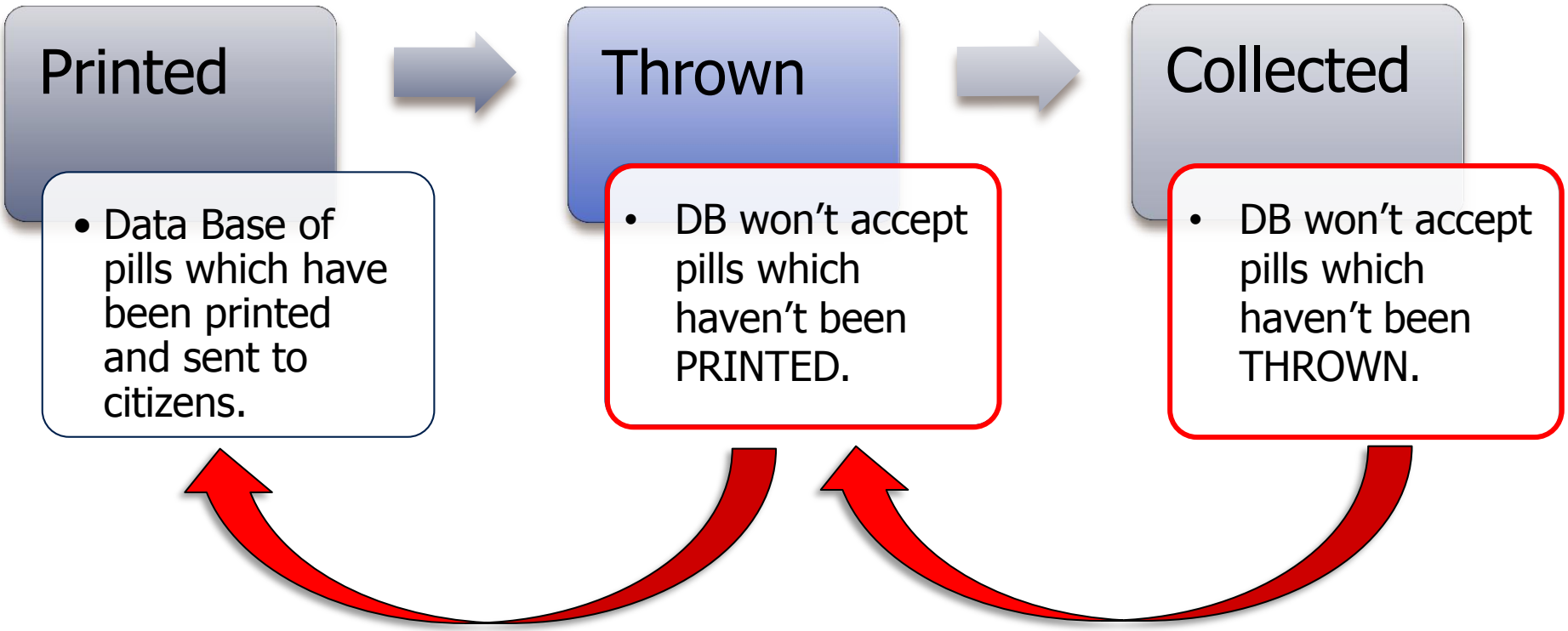
Idea: How to collect the pills

- Trials: Pills were collected with the help of a fishing net. Due to the fact that they float, they were easily spotted and, therefore, easily fished.

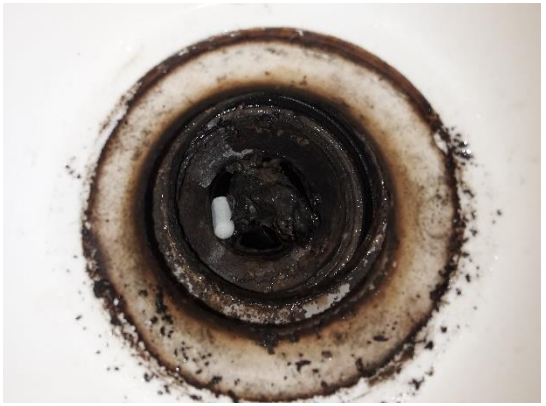
Idea: How to analyse the pills

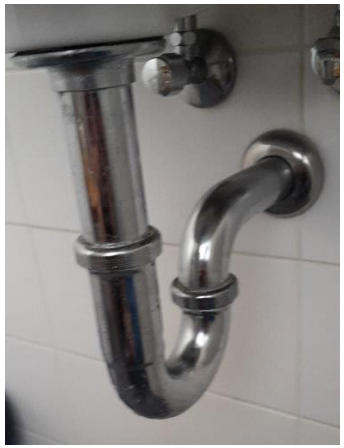
- Give a colour to the location
  - Red: pumping stations, manholes, …
  - Blue: CSO, retention/infiltration tank, …
- Identify the unexpected pills for this location
  - Blue pills for red locations and the opposite.
- Use the unique code to identify the entry point

Idea: How to derive the results



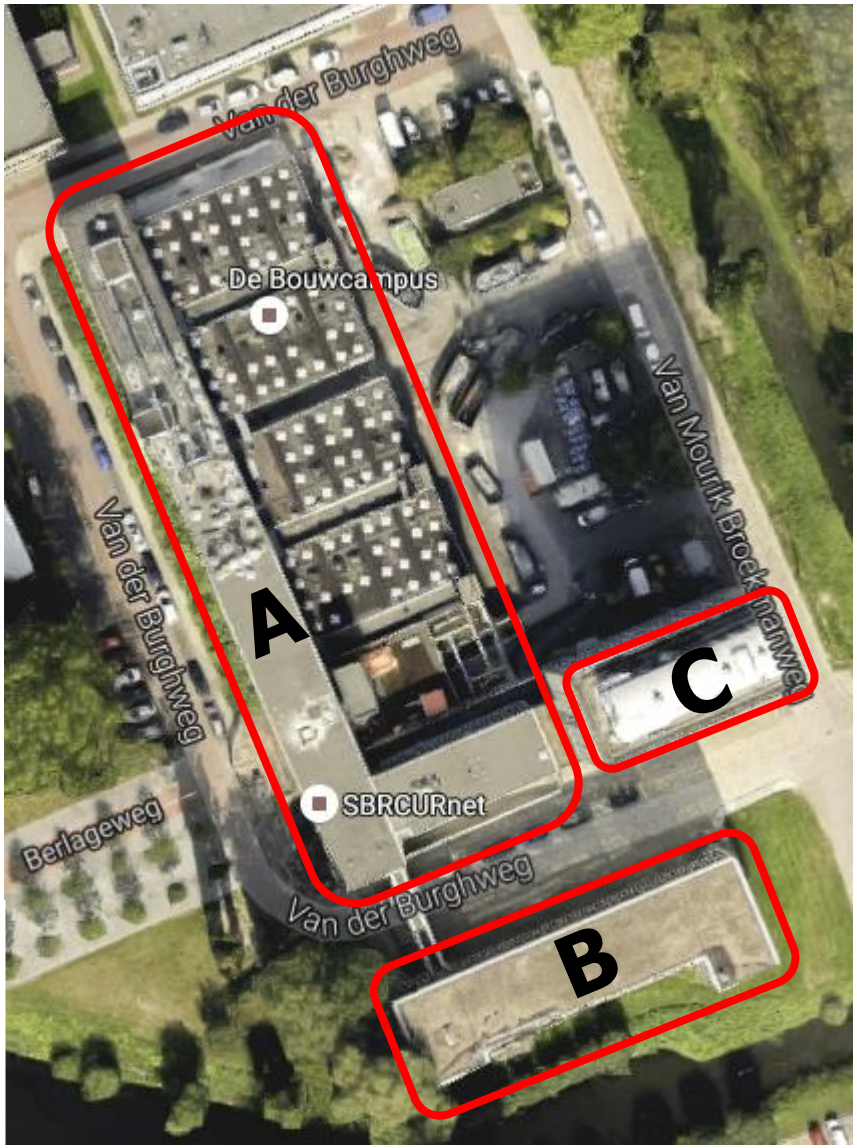
Results: Entrance to sewers





Results: First Trial

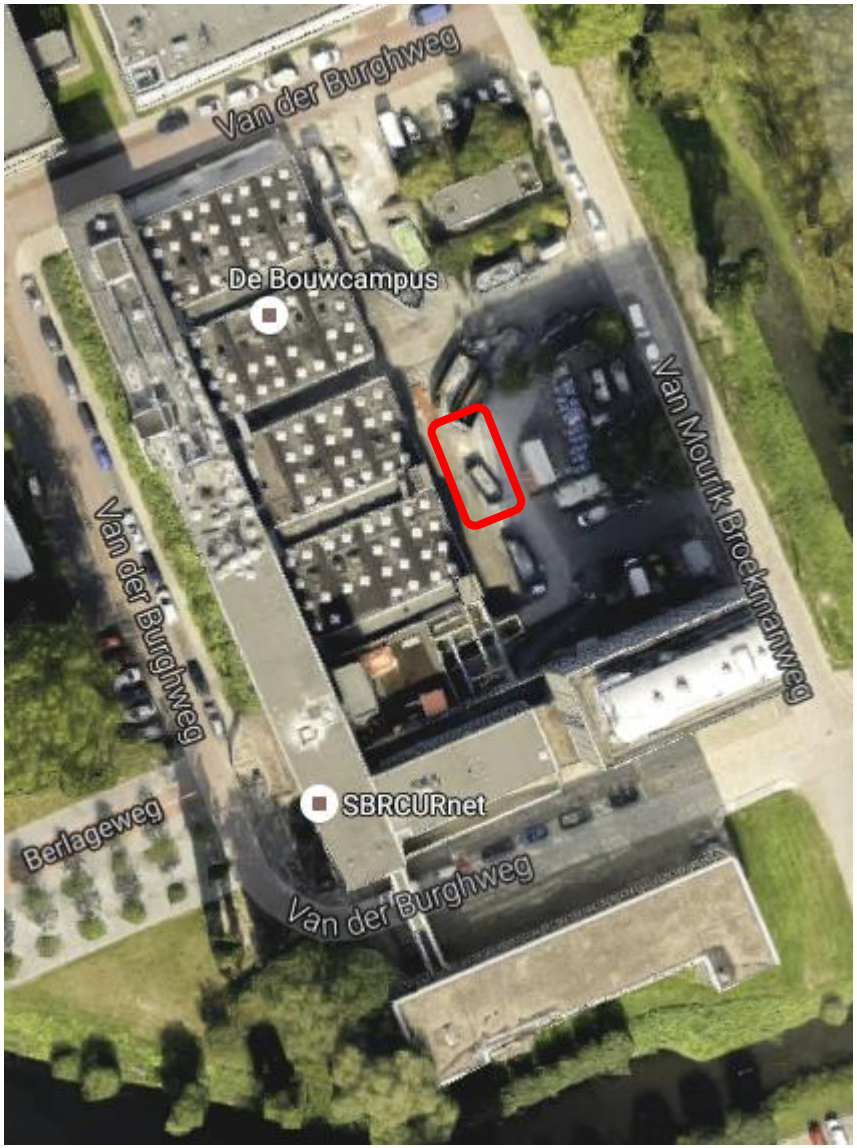
- TU Delft. Building 26
  - Building A
  - Building B
  - Building C



Results: First Trial

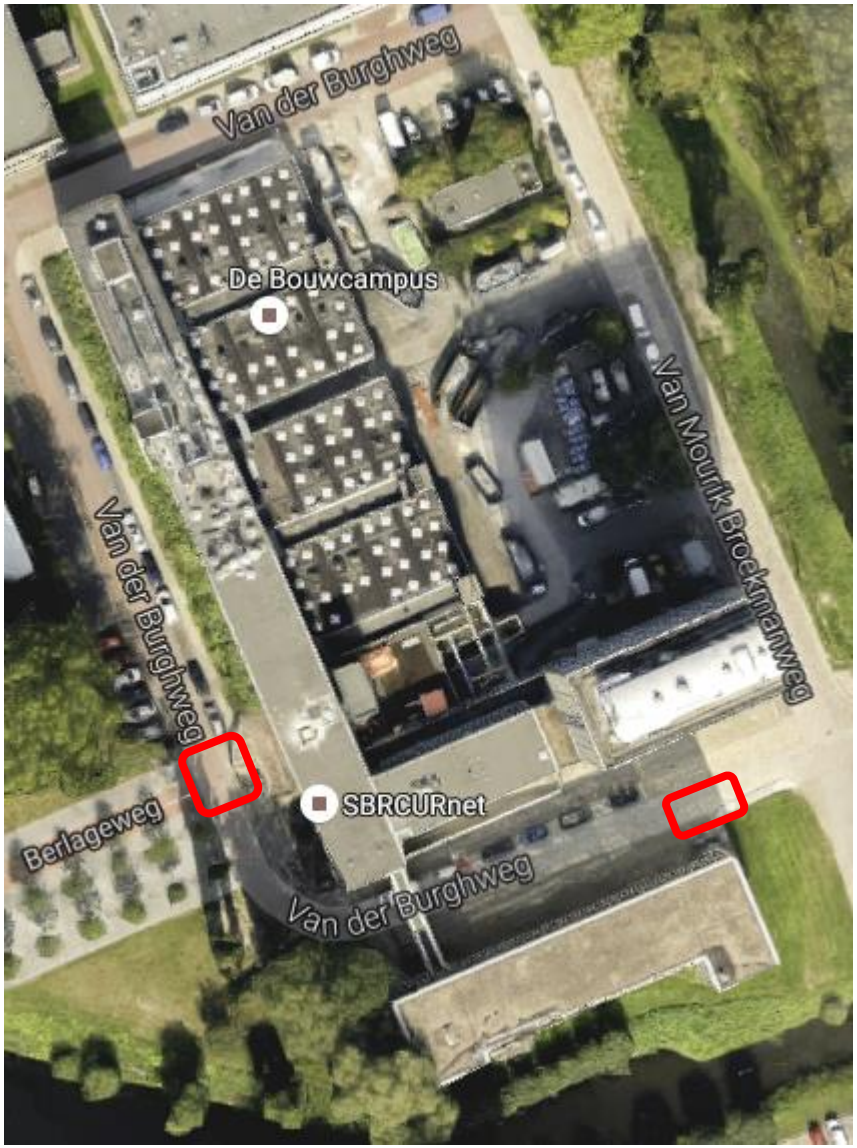
- Collection Points

- Pumping Station: Waste Water



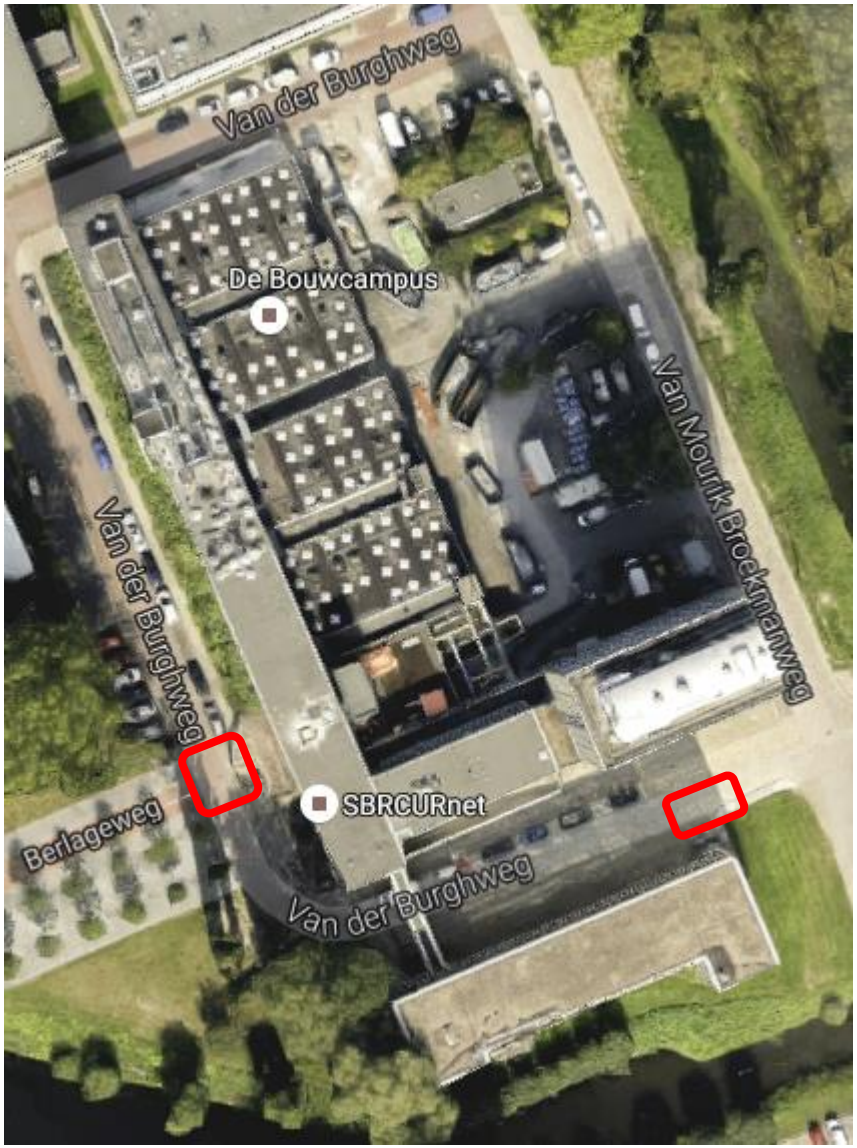
Results: First Trial

- Collection Points
  - Manhole: Storm Water



Results: First Trial

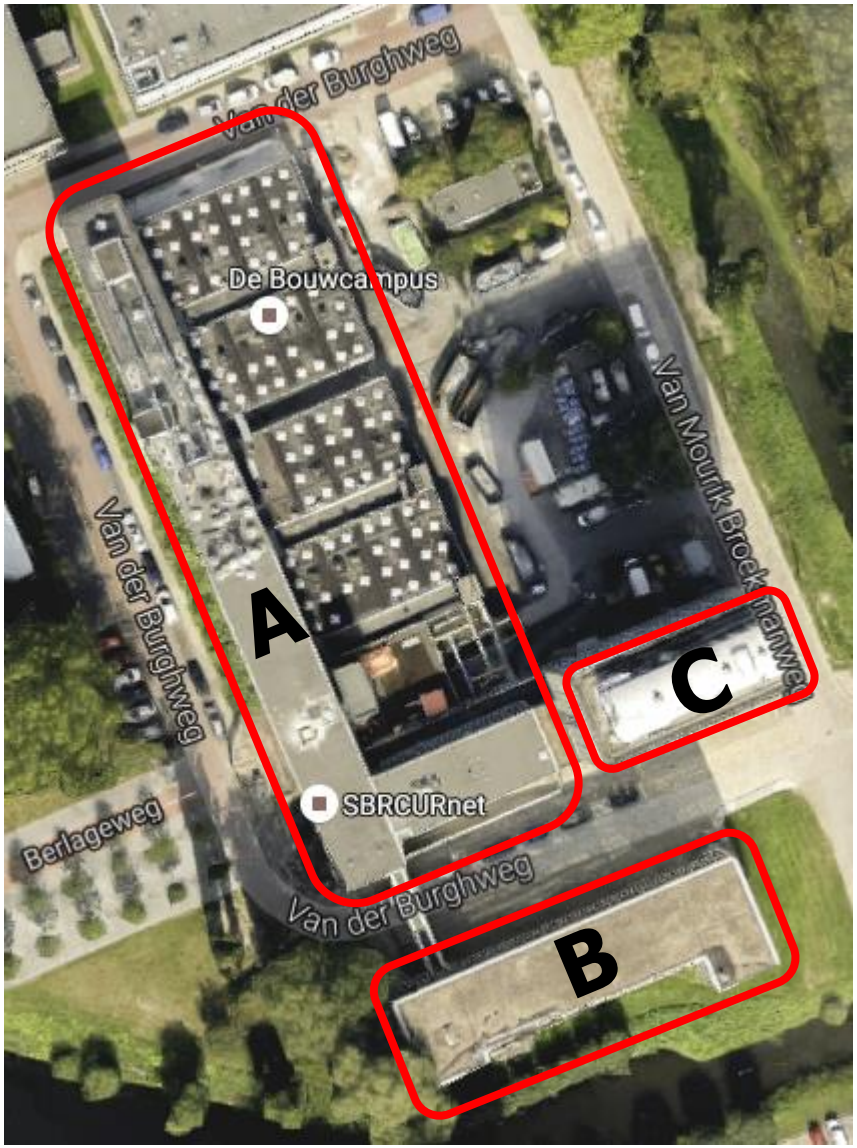
- Collection Points
  - Manhole: Waste Water



Results: First Trial

- Only 30 pills out of 490 pills were recovered at the collection points.

First Trial	Second Trial	Third Trial
Building A	Building A	Building A
• 10 red pills. • 0 blue pills.	• 12 red pills. • 0 blue pills.	• 6 red pills. • 0 blue pills.
Building B	Building B	Building B
• 0 red pills • 0 blue pills	• 0 red pills • 0 blue pills	• 0 red pills • 0 blue pills
Building C	Building C	Building C
• 2 red pills. • 0 blue pills	• 0 red pills. • 0 blue pills	• 0 red pills. • 0 blue pills



Results: Second Trial

- Individual house

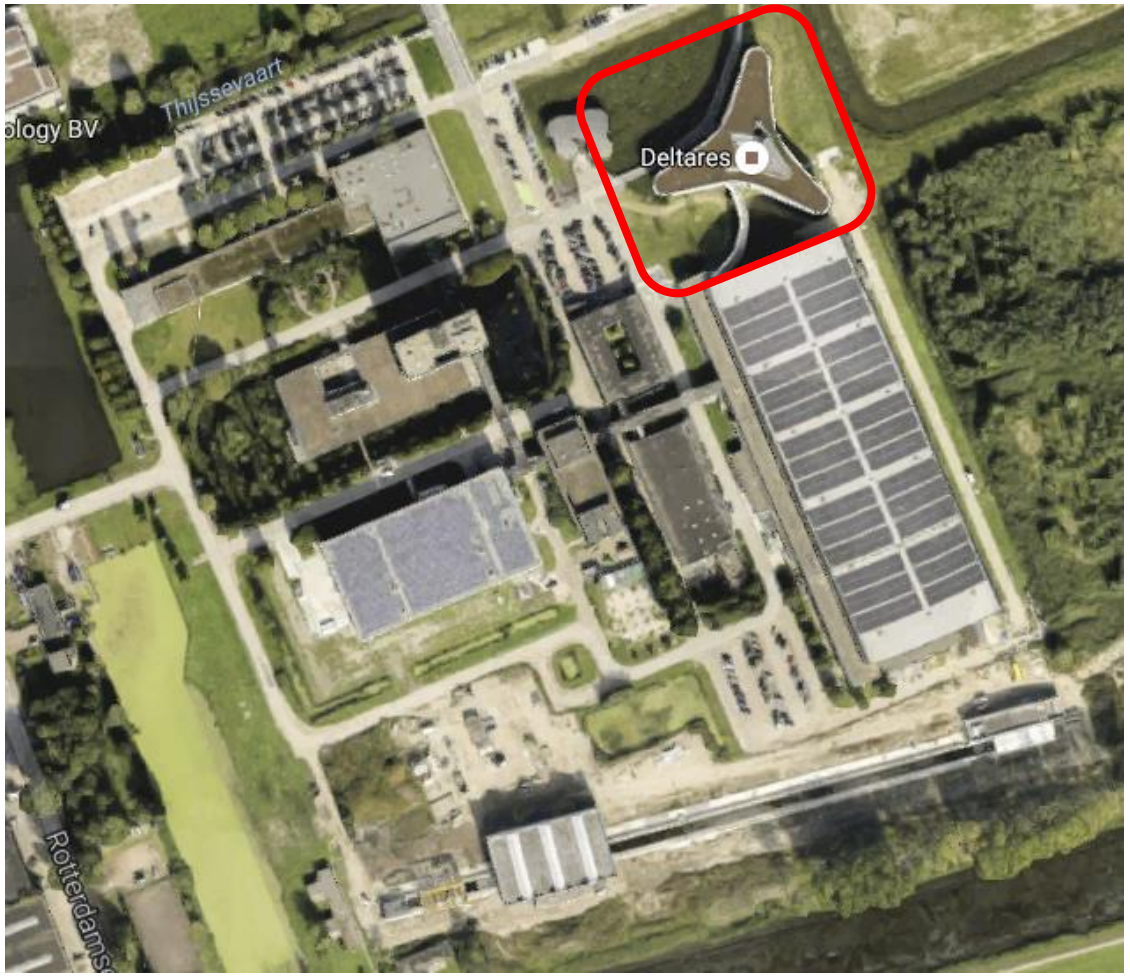
- 11 pills thrown
- 11 pills collected after a day

Results: Third Trial

- The third trial took place at Deltares.

Deltares Building

- 129 Waste Water entrances to sewer system.
- 48 Storm Water entrances to sewer system.
- A total of 177 pills were thrown into the system.
- No pills were found after a week.



Conclusions

- More experiments should be conducted, to understand the fails.
- Social acceptance should be studied.
- Larger experiments (Catchment scale).

Acknowledgement

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