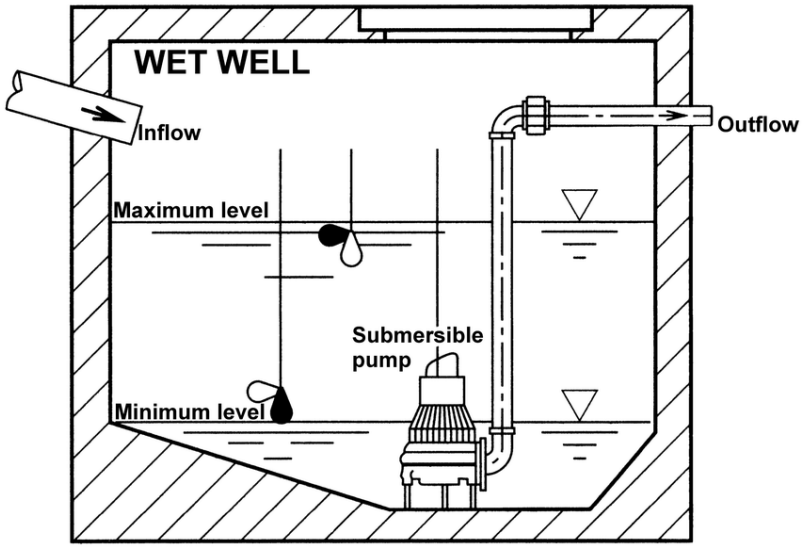
Water Pumping Automated System

Context

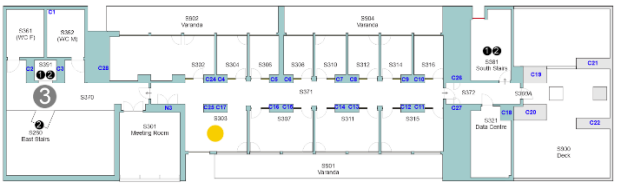
The goal of this project is to design and implement a prototype automated control system for CISTER's building **water pumping system** (WPS) for **two rainwater water wells**. A high-level scheme of each pumping system is provided in the picture below.

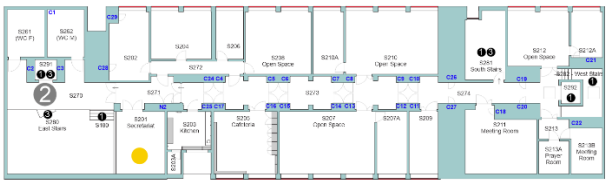


Each of the 2 WPS is composed by 3 parts: a **wet well** (that is, the container for the water that flows in), a **submersible pump** (responsible for pumping water into the outflow pipes that connect to the public water network), and a **water level sensor** (that measures the amount of water that is present in the wet well). These 2 WPS differ on the reading rate of the sensors, on the minimum and maximum values, and on the pumping power.

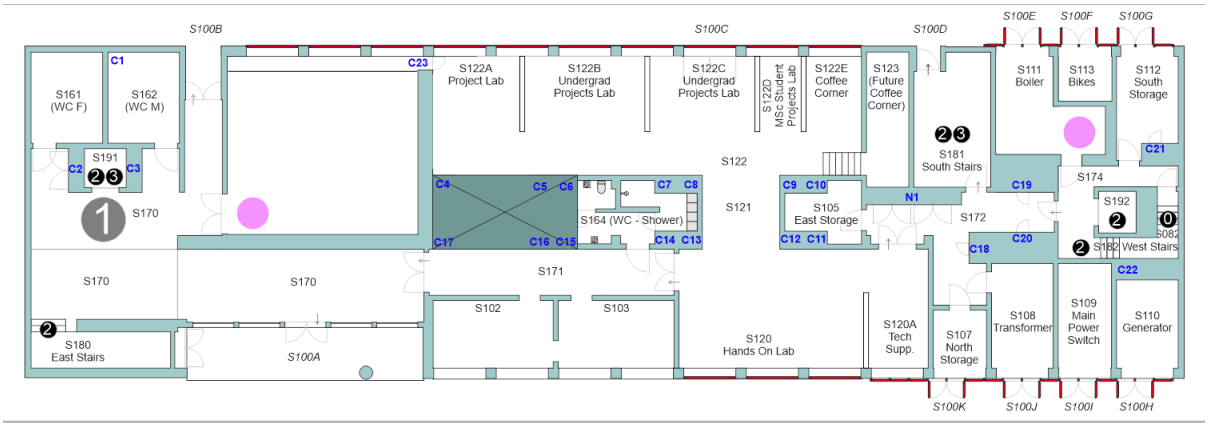
The pump is on when the water is above a minimum level, and an alarm will sound if the water is above a maximum level. The current water level of each system is given by two (for redundancy purposes) distance sensors that measure the distance from the ceiling of the wet well to the water and transmit the current value via wireless communication. The well and pumps are in the basement (level 0). There are remote status stations in Room S201 and Room S303 with information about the water levels (LED), pump status (LED) and alarm (LED + Siren), and a local sounder disable control (push button). Status information should also be available on a WWW server (read only).

Approximate location of the remote status stations (at level 2 and 3)





Approximate location of the pumping systems (at the basement level, below level 1 presented)



Tasks

The goal of this project is to automate the WPS by controlling the power of the pumps and exchanging the status of the systems. Furthermore, being a critical system, this WPS should be enriched with measures to prevent or mitigate failures. More concretely, the core tasks of this project are:

- **T1: Hazard analysis.** A list of potential hazards should be produced, indicating how each of these could be mitigated. This list could include hazards that are only identified but not addressed by your implementation. An initial list is included in the next subsection.
- **T2: Embedded components.** There should be embedded components to (1) read the sensor data, and (2) the control specific devices (the component's software should use code written in assembly).
- **T3: WSN network.** Each WPS should send wireless all sensed data to a remote status station via MQTT, and the remote station should be able to send instructions to both WPS.
- **T4: Hazard mitigations:** Extra components used to mitigate hazards, e.g., the use of two pumps instead of one for each WPS, should be properly implemented and validated.

These 4 tasks may be carried in parallel, could have intersection points, and are not meant to be carried sequentially.

Initial Hazard Analysis

An initial list of hazards and mitigations can be found in the table below. All the listed hazards should be addressed in this project. You should complete this table and extend it with new hazards and mitigations, even if you do not plan to address these.

Hazards	Mitigations
One of the pumps may stop working due to a mechanical problem.	Use 2 pumps, and raise an alarm to the maintenance team if one stops reacting