SMART DRAIN INSPECTOR

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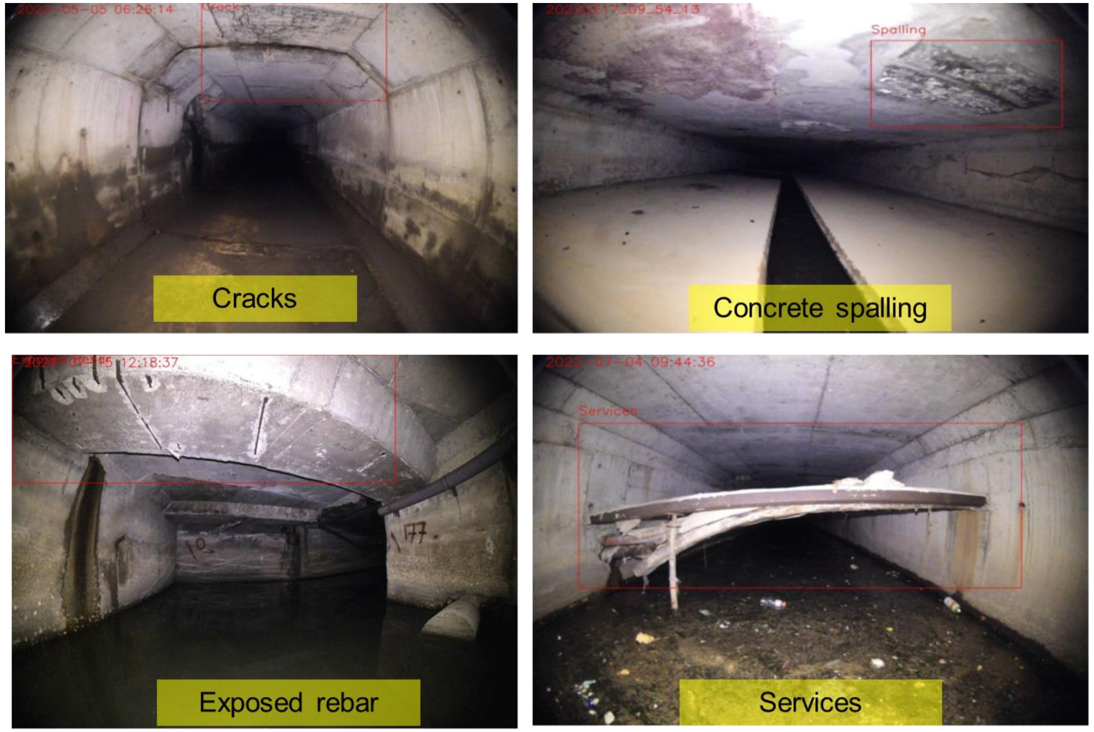
Background & Current Practice

- Manual inspection of public drains are conducted once every 5 years to check for defects and abnormalities
- PUB is exploring autonomous inspection to eliminate the need for man entry into confined space, improve productivity and enhance work safety



Limitations of Current Drone being Explored

- **Relatively big size**
  - Unable to inspect drains that are less than 2m wide
  - Unable to maneuver around any underground services present within the drains
- **Water-phobia**
  - Needs to be tailed via man access for retrieval in a wet environment (e.g. partially submerged drains)

Smaller drains <2m width

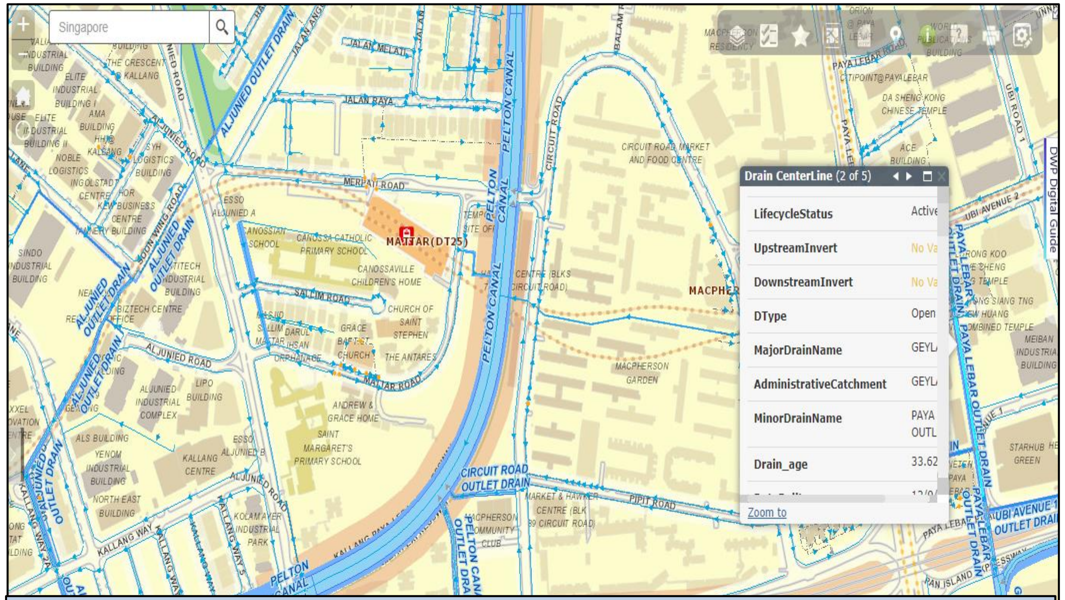
Services crossing drains

Partially Submerged drains

Other Gaps to be Addressed

- **Manual intervention for identification of defects from inspection**
  - ➢ AI to be utilized to automate defects identification

- **Updating drainage network database**
  - ➢ Drainage network details are currently verified through manual inspection and updated manually into geospatial database, which however is not able to cover the drain alignment
  - ➢ Need to map out the drain alignment and dimensions into a geospatial database automatically



Drain asset data in Geospatial database

Areas of Opportunity

To develop solutions that can autonomously:

Inspect drains as small as 0.6m width and in different environmental conditions (e.g. partially submerged conditions, submerged conditions)

Identify defects and abnormalities of drains without the need for manual post-processing

Map out the alignment and dimensions of drains to an accuracy of +/- 0.1m for horizontal and vertical displacement for **upload into a geospatial database**

Key Considerations & Challenges

The proposed solution shall be:

a. Able to enter drain access openings (min 0.70m x 0.85m) that are spaced at varying intervals depending on the sizes of drains (refer Table 1)

b. Agile to avoid localised obstructions and adapt to sudden rise in water level within drains

c. Able to eliminate the need for personnel to access into the drain

d. Able to automatically and accurately detect and identify defects, ideally providing measurements to determine the extent of the defect.

e. Able to automatically generate inspection reports with location data, images and video timings to support subsequent investigation and rectification works.

f. The inspection and data processing methods, e.g. data transfer and report generation should adopt innovative methods that require minimal manual interventions in order to achieve smarter operations.

g. Cost effective to enable large scale implementation across the drainage network in Singapore (i.e. 8000km of drains)

Drain access openings

Table -1

Internal Width of the Drains	Distance Between Next Access Openings
W > 4m	50m
750mm < W < 2m	6m (for drain <1m deep) or 18m (for drain >1m deep)
W <750mm	6m

Expected Outcomes

If the pilot is successful, the solution would be provided to PUB through a service model where the equipment is owned, operated, and maintained by the company

Expected Autonomous Solution

1 A cost-effective site-tested prototype system that can autonomously inspect drains of various types and dimensions

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2 Identify drain defects automatically without manual interventions

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3 Mapping out the drain alignment and dimensions to an accuracy of +/- 0.1m for horizontal and vertical displacement for upload into a geospatial database

Proposals should clearly indicate how [1] ,[2] and [3] are being addressed

PUB SINGAPORE'S NATIONAL WATER AGENCY

Thank You

MAKE EVERY DROP COUNT