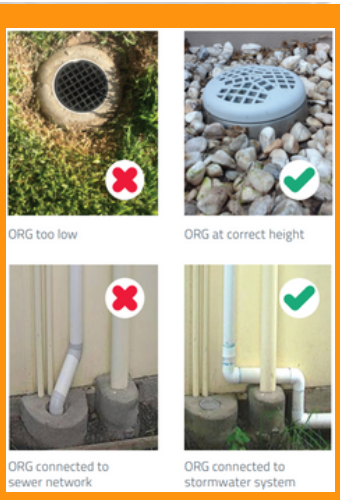
CASE STUDY 6:
UNITYWATER – PRIVATE PLUMBING INSPECTION PROGRAM



Over the last 10 years, Unitywater has implemented an extensive inflow and infiltration (I-I) investigation program of 70,000+ properties. A comprehensive defects rectification program (on private drainage and Unitywater assets) followed to reduce the risks associated with uncontrolled sewer network overflows to properties during wet weather events. With help from the community, the number of overflows has been controlled with public health and environmental risks being mitigated.

Management approach
Asset (Flow Reduction- I/I Removal)

Receiving environment principles considered/met/achieved
Ecosystem, Community, Property, Economic

Background
Unitywater provides essential water supply and sewage treatment services to residents and businesses in the Moreton Bay, Sunshine Coast and Noosa regions in South-East Queensland.

It manages approximately 6,100 km of sewer mains, 800 Sewage Pump Stations (SPS) and 17 Sewage Treatment Plants (STP).

During recent La-Nina event and during higher rainfall events in 2010-2012 some of the sewerage catchments have recorded overflows during moderate wet weather events (50-100mm of rain), impacting private properties and, in some instances, temporarily closing Caloundra beaches. Unitywater needed to mitigate overflows to help avoid customer complaints, adverse media attention and environmental impacts.

The main cause of the sewage overflows is the rainfall dependent Inflow and Infiltration (I/I). The rainfall enters the sewerage network from many minor defects contributing small amounts of ingress dispersed widely throughout the network. According to Management of Wastewater

Modelling approach
System Infiltration and Inflow (I/I), Good Practice Guideline, Volume1 (Background and Theory) and Volume 2 (the "How to ") (Nov-2011), up to half of the rainfall dependent I/I can be from the private property plumbing.

Unitywater adopted its first Sewage Overflow Abatement Plan (SOAP) in 2011, which led to the successful reduction of 90 hot spot overflow locations, and hydraulic model calibration for four catchments for controlled overflow location identification. One of the key initiatives of the SOAP was to undertake private plumbing inspection using smoke testing for approximately 65,000 properties in the following five years. The private plumbing inspection program was kick-started again in 2021, after the revision of the SOAP. Approximately 4,200 properties have been smoke tested and inspected in 2021-22 and another 12,000 are planned for inspection in 22-23. Sewerage manhole condition assessments and corresponding sealing of manholes are also part of this inspection program.

Investigations and Program Objectives
Unitywater's main goal is to actively manage sewer overflow abatement within its regions to minimise overflow frequency and impact. The related goals for the plan are summarised below:

- reduce the impact on the sewerage system during wet weather events and minimise uncontrolled overflows
- mitigate risks to the environment, public health and community amenities

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- decrease the number of illegal or inappropriate connections throughout the region
- reduce sewage pumping and treatment costs in wet weather
- optimise the capacity of the sewer network and defer the need for expensive upgrades.

Unitywater developed screening KPIs for prioritising inspections at STPs and SPSs that indicated stormwater inflow issues. These KPIs are based on data that is already being collected as opposed to further investment in the collection of additional data. This aligns with WSAA guidelines that SOAP should be based on simple measures relating to the sources of I/I rather than more sophisticated approaches which would require additional data and resources. Figure 1 shows the priority matrix developed for the SPS catchments based on Unitywater's data available in Maximo, SCADA, GIS, rainfall and hydraulic models.

An I/I community education and awareness program was also developed in parallel to achieve optimum results. The objectives were as follows:

- Educate the community and key stakeholders on the effects of stormwater I/I on the sewerage system.
- Engage and partner with various external stakeholders to ensure we are all working towards a common goal i.e. working with local councils, environmental regulator, plumbing associations and community groups.
- Ensure communications with customers regarding I/I are strategic and considered to avoid potential backlash when requesting rectification works.

The I/I community education and awareness program included information on the identification of private stormwater inflow sources (defects) to sewer systems and how they contribute to wet weather sewage overflows and the consequent impacts on neighbours and the environment. The educational initiatives included notices in local newspapers, pamphlets, social media posts, educational segments on Unitywater's website and presentations to the interested stakeholders and community groups.

Following the identification of defects, rectification programs were implemented for private plumbing issues, sewer mains and manhole repairs.

FIGURE 1
Screening KPIs for Prioritising the sewerage pump stations for inspection

SPS	SPS1* – No. SCADA Overflow Triggers	No. Overflow Complaints	SPS2* – No. Overflow Complaints/ 100 km	SPS3[1] – Average Daily Run Hrs Per Pump (Hrs/	SPS4[2] – Wet Weather Pump Run Hrs Per Pump (Hrs/d	GWI_2[3] (L/EP/d)	SWI_1[4] (PWWF/AD WF)	RDII[5] (%)	Overall Score	Priority Ranking
SPS-CAL010	0	1	125.4	1.9	3.9	540.3	8.8	17.5%	37	1
SPS-CAL011	13	1	23.3	2.5	10.5	286.9	7.2	8.5%	35	3
SPS-CAL008	0	4	59.6	6.8	15.0	296.0	4.2	3.7%	35	3
SPS-LMT006	0	0	0.0	0.3	0.7	443.6	171.9	7.0%	33	5
SPS-LMT001	0	4	8.2	8.0	23.1	192.3	3.4	10.2%	32	6
SPS-GLD002	0	2	69.0	4.0	14.1	164.8	5.2	22.6%	31	7
SPS-GLD005	0	1	56.2	5.7	14.0	346.4	5.5	1.7%	31	7
SPS-CPK003	0	0	0.0	3.2	7.6	440.1	26.9	10.4%	31	7
SPS-CAL001	8	2	4.3	3.1	11.9	211.1	7.5	7.0%	30	10
SPS-LMT005	0	0	0.0	6.1	18.7	486.1	3.6	1.4%	30	10
SPS-CKS030	7	2	9.9	3.5	8.8	134.1	7.8	5.2%	29	12
SPS-CAL004	2	5	44.4	2.8	10.5	85.3	24.3	3.2%	29	12
SPS-PWS014	1	1	62.9	3.4	5.2	466.0	8.2	0.0%	29	12
SPS-CPK007	14	4	33.3	3.3	8.2	348.1	5.9	3.3%	27	16

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Stakeholder Involvement

Throughout the program, officers from the environmental regulator were very interested in the I/I program and its planned outcomes to reduce sewer system overflows and mitigate risks to the environment and were kept up-to-date with quarterly meetings. Unitywater management was also kept up-to-date with progress with papers to the Infrastructure Strategy Committee.

Table 1 details the extent of the smoke testing program and the success of private property rectifications.

TABLE 1
Screening KPIs for Prioritising the sewerage pump stations for inspection

Timeframe	Inspection Program		Private property defects identified	Private property defects currently referred to Council	Private property defects rectified
	Properties	Manholes			
2011 to 2016	66,775	26,525	2,926	181	2,745
2021 onwards	4,547	2,508	415*	94	204

*about 100 property owners are still in the process of responding to Unitywater notice

In the first phase of the inspection program, the majority (87%) of private property defect rectifications were resolved by the property owners (at their expense) through a three-notice process by Unitywater. In the second phase of the inspection program, only a single notice for rectification is sent with a success rate of 60% of defects rectified by the owner. The notices also include information on educating the customer about the cost and effects of wet weather sewage overflows and the importance of keeping stormwater out of the sewer system.

If the defect(s) is not rectified by the property owner, it is referred to the Local Council which has regulatory power (under *Plumbing and Drainage Act 2018 - Qld*) to enforce rectification at their discretion. Unitywater has recently signed a Memorandum of Understanding (MoU) with Sunshine Coast Regional Council to streamline the process of communicating the defect handovers and the status of the rectification work.

Outcomes

In the second phase of this program the percentage of properties with plumbing defects has increased to 9.1% compared with 4.4% in the first phase. Ignoring the sample size, it can be attributed that a refined KPI screening process (refer Figure 1) has been adopted in the second phase to target the poor performing catchments.

As shown in Table 2, the predominant private property drainage defect type found throughout the investigations was low Overflow Relief Gullies (ORG) at 61%. During wet weather, a low ORG can drain large areas (paved and unpaved) and contribute to wet weather sewer system overflows.

TABLE 2
Screening KPIs for Prioritising the sewerage pump stations for inspection

Defect Type	Number per Type	Percentage of Total
Overflow Relief Gullies – low.	1,785	61%
Inspection Openings - cap removed, damaged etc.	478	16%
House drainage pipes - displaced joints, cracked, etc.	341	12%
Roof-water pipes connected to sewer	247	8%
Rainwater tank overflows connected to sewer	37	1%
Wash-down bay draining to sewer	20	1%
Private Service Pit	18	1%
Uncovered sink or shower	12	<1%
TOTALS	3,341	

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Table 3 shows the types of defects found during manhole inspections. It is concerning that approximately 10% of the manholes displayed on GIS either could not be located or could not be opened by the contractor in the field. These account for 54% of total defects observed. All these manholes have been added to the maintenance schedule for rectification work.Approximately 25% of the manhole lids were sealed during the inspection program, if signs of the pounding of water were evident.

TABLE 3
Summary of Manhole Defect Types

Defect Type	Percentage of Total
Manhole to be accessed/raised	54%
Signs of gas attack	4%
Defective copping rings	2%
Signs of infiltration	18%
Tree roots	22%

A reduction in the number of sewer network overflows and internal sewage surcharges was noted after the first phase of the inspection program. Two significant wet weather events impacted the Unitywater region in early 2015. Both events severely affected the sewerage network due to the volume of rainwater in the sewer network. The first event saw a prolonged period of continuous rainfall, while the second had a more intense short period of high-volume rainfall:

- Between 19 and 23 February 2015 as a result of two weather fronts, former tropical cyclone Marcia and a tropical low, 451mm of rainfall fell in 56 hrs, 253mm in 24 hrs.
- Between 30 April and 02 May 2015, a more extreme wet weather event occurred, predominantly affecting the Moreton Bay region, with over 433mm of rainfall in 46 hrs, 312mm of which fell in just 4 hrs from 2pm 1 May 2015, a 1 in 50 year ARI.

The ability of the sewer network to cope with the extreme wet weather events in early 2015, and the reduction of internal sewage surcharges in comparison to similar rain events in 2012 (from 42 down to 17) highlights its success.
Unitywater is developing an automated process as part of its Intelligent Customer and Network Operation project to calculate screening KPIs (refer Figure 1) for all pump stations. This will help in measuring ongoing monitoring of the effectiveness of the inspection program.

Costs/benefits

A cost/benefit analysis for the Nambour STP catchment is presented here. Nambour STP catchment comprises a large fragmented geographical area surrounding Nambour, Palmwood, Yandina and Eumundi townships. A 10km long 150mm diameter duplication of the pressure main is planned from Eumundi to the STP in the year 2023 with an estimated cost of $6.5M. A smoke testing and manhole inspection program was carried out in the Eumundi catchment involving approximately 2,500 properties. Every 7th property was identified with a plumbing defect and 80% of which were rectified by the owner. The assessment of the actual reduction in the rainfall dependent flow has not yet been carried out. This cost-benefit analysis is based on the assumption of three scenarios: 2.5% reduction, 5% reduction and 7.5% reduction in the I/I. A delay in the construction of the pressure main for six-month, one year and two years is calculated respectively with the above reduction scenarios.

The total cost of the project includes project management, smoke testing and manhole rectification. The economical benefits are achieved with a reduction in cost for; STP consumables, power and overflow management. The major benefit is achieved by saving the interest payment by delaying the construction of the pressure main. Figure 2, shows that a 7.5% reduction in I/I can achieve cost-benefit within a year.

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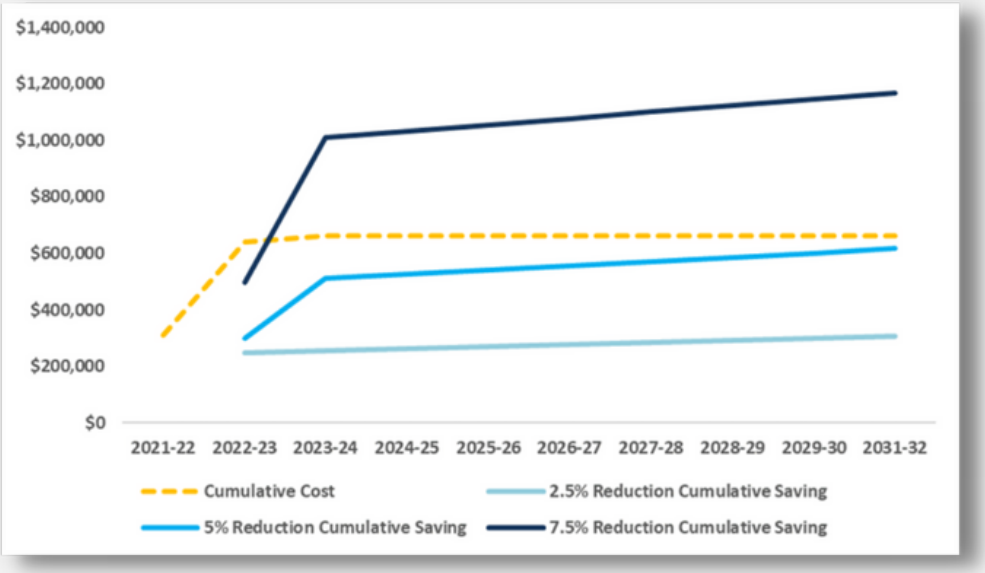
FIGURE 1
Screening KPIs for Prioritising the sewerage pump stations for inspection



It is to note that, the above cost-benefit does not include environmental and social non-economical benefits.

Project Timing

The first phase of the project was carried out during 2011 to 2016. The private plumbing inspection program was kick-started again in 202. Approximately 4,200 properties have been smoke tested and inspected in 2021-22 and another 12,000 are planned for inspection in 22-23.