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SMART CITY WATER INC.

10 ESSENTIAL ELEMENTS OF A SUCCESSFUL FLOW MONITORING PROGRAM

01 REAL-TIME INTELLIGENCE

It should almost go without saying – your flow and rainfall monitoring should be telemetered, hosted on a cloud solution, and alarmed to provide alerts and reports on an event-by-event basis.

02 PLACEMENT OF RAIN GAUGES

in order to correctly assess the relationship between rainfall and flow, you must ensure that your rainfall data takes into account the spatial variation so typical of precipitation events. Too many flow surveys are rendered invalid because data from only one or two rain gauges are used, often placed far from the actual monitored area. Depending on the size of the catchment, you may need to plan for three (3) or more rain gauges to be placed within 2 km (1.24 miles) of the center of a monitored area in order to generate a distributed rainfall model which will accurately extrapolate rainfall at any non-gauged point in the sewershed.

03 PRIMARY DEVICES STEP UP WHERE A/V FALLS SHORT

The doppler velocity sensor in Area/Velocity (A/V) meters fails miserably in low flow conditions (depth under 5 cm [2 inches] or velocity under 25 cm/s [0.82 ft/s]) – in these conditions, false zero readings, random spikes, and continuous debris-related drift confounds the data. Flumes and ultrasonic depth sensors in combination will produce high quality readings even in low flow conditions.

04 ENSURE ACCURACY THROUGH CALIBRATION

Every flow monitor, no matter how well made, is susceptible to inaccuracy. Before each lengthy deployment, your flow monitor should be calibrated at an accredited flow lab, and during implementation (every two to four [2-4] weeks) manual velocity and depth measurements should be taken. One to three (1-3) points of velocity should be taken in a cross-section of flow and taken together to calculate the final velocity measurement.

05 REGULAR QA/QC OF DATA

On at least a monthly basis, desktop quality assurance and quality control should be undertaken to validate that your data is usable. Two reliable indicators of data quality are (1) the scatter graph, which compares the relationship between the sensor readings and a fitted Manning's "n" curve based upon pipe dimensions, and (2) mass balance, which compares the measured volume of flow at the incremental catchment area between the upstream and downstream monitoring sites to the expected volume of flow.

06 CORRECTLY LEVERAGE YOUR ULTRASONIC SENSOR

Placement of non-contact ultrasonic sensors is key – often the maximum range advertised by the manufacturer is rendered null by the presence of maintenance hole benching (the width of the ultrasonic beam should not exceed the width of the open channel being monitored), and every ultrasonic has a minimum distance within which the level reading will flatline (the "deadband"). Specialized devices are affordably available which minimize the sensory deadband of a mounted ultrasonic unit. Furthermore, when using ultrasonic with A/V sensors, the ultrasonic depth measurement location must be positioned in the same place as the velocity measurement (flow depth and velocity can be wildly disparate within a short distance).

07 CONSIDER THE IMPACT OF ANTECEDENT MOISTURE CONDITIONS (AMC)

Many flow monitoring providers consider only peak intensity over time of concentration (especially theoretical Tc) when characterizing rainfall events, but this is insufficient for projecting design storm responses, often leading to negative or poor correlations. Every catchment area is made up of a combination of fast and slow responding inflow and infiltration (I/I) sources. A high volume, low intensity rainfall event can often have a higher I/I response than a low volume, high intensity event. Each network and catchment area is unique, and the fast/medium/slow-responding sources need to be understood and characterized by advanced unit hydrograph methods such as the continuous API (antecedent precipitation index) method. This can result in a high level of predictability in flow monitoring data, design storm projections, and excellent coefficient of correlation values.

08 PREDICT THE NEXT ISSUES BY NORMALIZING FLOW DATA

A season or two of flow data may not be representative of typical or future conditions. Also, many important metrics of drainage system performance are benchmarked against design storms with return periods unlikely to be captured during a typical flow monitoring period. System response to storm events can be normalized, however, to predict how the system will respond in a design storm, by relating the intensity of measured rain events to the inflow and infiltration measured. The correlation between these two factors is further enhanced when providing for antecedent moisture conditions. While this analysis can begin after five (5) storm events, it is recommended that eight to ten (8-10) data points be captured for prediction confidence.

09 EVENT-BASED REPORTING

The effectiveness of many flow monitoring programs is obstructed by the weeks that elapse between a significant storm event and the moment that the key decision maker finally gets to see the data, which leads to windows of opportunity being missed. Preference should be given to contractors and/or solutions that guarantee comprehensive and validated event-based reporting within three (3) business days of a significant storm.

10 PLAY THE LONG GAME

Sewers are high-wear, dirty, hostile environments for electronic devices - look for flow monitoring manufacturers that emphasize quality and longevity. And don't forget about maintenance costs! For example, for high-resolution monitoring (5-minute sample rates), most flow monitor batteries will last for approximately six (6) months before replacement is needed. If these batteries are replaced, you may spend more than 20% of the original purchase value of the unit to simply power it over a five (5) year lifespan. Some manufacturers offer rechargeable batteries, which will reduce both operating costs as well as replacement efficiency and being environmentally friendly stewards.

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