# Increasing Stormwater Utility Revenues Without Increasing Rates: A Win-Win Proposition

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Municipalities across the United States measure their impervious surface area to determine the stormwater runoff generated from each residence or business parcel and often support their stormwater utilities by assessing an impervious surface area fee. An impervious surface is any material, natural or manmade, that prevents the infiltration of surface water to the underlying strata.

For years, impervious surface area has been collected using a manual digitization method throughout the municipality, applying a standard rate to residential parcels, and charging nonresidential parcel owners based on an average residential parcel impervious area. More recently, technology has emerged that allows municipalities to more accurately assess impervious surface and charge fees specific to each parcel, without raising that standard applied rate.

These more-accurate assessments ensure that residents and businesses are charged appropriately and that all impervious surface area is measured, which yields greater revenues for municipalities.

## Manual Digitation Method

The manual digitization of impervious surface area uses a statistically valid, random number of residential parcels and develops an equivalent residential unit (ERU) based on the average impervious surface area of residential parcels. The same-rate structure is applied for residential parcels and to nonresidential ERUs.

Manual digitization, as the name implies, is labor-intensive, and therefore, expensive. It allows for human error, making the data collected subject to debate and the results inconsistent and unreliable.

Florida, like other states across the U.S., has multiple municipalities that have relied on collecting impervious surface data via manual digitization. Florida is consistently among the fastest growing states, reportedly expanding at a rate of 1 percent per year—that's the equivalent of adding a city the size of Jacksonville every five years. Jacksonville has about 850,000 residents, and is the largest city in area in the continental U.S.

On its 2016 Report Card for America's Infrastructure, the American Society of Civil Engineers (ASCE) gave Florida an overall grade of "C" and a stormwater grade of "D." The ASCE noted that monthly stormwater utility rate averages in Florida were $5.68, which, according to the organization, "is slightly less than the cost of a Big Mac meal at McDonald's."

At the same time, the Florida Stormwater Association's 2016 Stormwater Utility Report found that the state's capital improvement needs for stormwater management are estimated to be $1.1 billion through 2019. This illustrates that utility fees were not keeping up with demand, and only the most urgent needs were being met.

The state's stormwater utilities utilized a user fee of 71 percent of the time, and 70 percent of those utilities fees were based on percent impervious surface: 12 percent were based on gross area and impervious surface, 4 percent were based on gross area with intensity of development, and 14 percent other. The average-size ERU was listed at 2,842 sq ft, and the fee was standardized to $2.78 per each 1,000 sq ft per month.

To evaluate this more specifically, consider a community the size of West Palm Beach. The impervious surface area was calculated via manual digitization to be roughly 11.6 sq mi, or 323 mil sq ft. If the impervious surface delineation error was only 5 percent, which is at the lower end of manual digitization error most often seen, that would equal 7,439 ERUs, or about $153,000 per month in lost revenue.

## Feature Extraction Method

Fortunately, there is technology available to appropriately assess impervious surface area and accurately support stormwater needs.

By employing a semi-automated feature extraction method to digital ortho-imagery and lidar (light detection and ranging), municipalities can determine the exact impervious surface area to support a fair and consistent stormwater fee structure. This feature extraction method employs the precision of four-band, near-infrared imagery, with 6-in. or higher resolution, and lidar at 1 meter or denser point spacing. Technicians then fuse available data, perform segmentation, conduct analyses, extract features, and refine and prepare that data for delivery.

The benefits of this method directly address the challenges of the manual digitation method, such as:

- The accuracy of the data makes assessments fair and defensible.
- The results significantly reduce the human error associated with manual digitization and provide reproducible results, which support consistency and accountability.

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- For large numbers of parcels, this method provides a streamlined and cost-effective process.
- By using analyses from multiple data sources, this method provides a redundancy of data and further supports that accuracy.

This allows assessors to determine exactly how much impervious surface each resident or business has, and to charge fees appropriate to that site's potential stormwater runoff.

There have been additional uses found for impervious surface data generated via feature extraction, as well, which include change detection and the delineation of multiple surfaces, such as asphalt, paving, concrete, roof tops, etc.

## Returns on Investment

Municipalities across the country have analyzed this updated method of impervious surface area collection to determine whether it's financially beneficial.

The city of Springfield, Ohio, has a population of about 60,000 people and a service area of roughly 30 sq mi. The city has analyzed residential and nonresidential parcels, with residential parcels on a tiered system.

With the previous method of manually digitizing impervious surface data, the city calculated 141,930,800 sq ft of impervious surface data, 78,473 equivalent service units, and a monthly revenue of $100,537.

By using the feature extraction method, the city found it had 162,659,093 sq ft of impervious surface area and 85,697 equivalent service units, which generated a monthly revenue of $112,094. This more-accurate assessment was an adjustment of 11 percent, and meant $11,557 more each month for the city.

In Indianapolis, the percentage difference was smaller, but the money reaped was greater due to the size of the city. Indiana's capital has close to 850,000 residents across 400 sq mi, and performed an analysis of nonresidential parcels.

The previous manually digitized calculation yielded 1,446,468,367 sq ft of impervious surface area, with 1,470,935 base billing units and a monthly revenue of $1,618,028. The feature extraction method ascertained that there were 1,517,728,074 ft of impervious surface area in the city, with 1,525,640 base billing units, which would generate $1,678,204 monthly.

This was a difference of 4 percent, and produced an additional $60,175 for the city each month. Indianapolis invested $235,000 to employ this updated feature extraction method and earned $722,100 annually. This yielded a net revenue of $487,100 the first year and $722,100 in each additional year.

This color infrared image taken of Columbus, Ohio, illustrates digital ortho-imagery collected to determine accurate impervious surface area during the feature extraction method. *(photo: Woolpert)*

Lidar, or "light detection and ranging," is a powerful tool in the semi-automated feature extraction method of collecting precise impervious surface area data. The data were collected in Columbus, Ohio. *(photo: Woolpert)*

## Conclusion

Comparing the feature extraction method of collecting impervious surface data to its manual digitization predecessor is a classic example of how technologies are evolving to improve and refine processes and applications.

Stormwater utilities are becoming more crucial to increasingly built-up environments, and budget-strapped municipalities can use all the help they can get to fund needed programs.

Ensuring that residents and businesses are charged impervious surface area fees accurately, without needing to raise their rates, while also increasing the revenue yielded from these assessments, is a win-win for the municipality and the constituent.

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