LEVERAGING UAS TECHNOLOGY FOR MORE EQUITABLE AND RESILIENT COMMUNITIES

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Flooding, lack of high-quality open space, poor water quality, damage to personal property, and poor health are typically disproportionate burdens for communities in low-lying areas and areas adjacent to industrial land uses. To overcome these hydrological challenges and issues of environmental injustice, investment in green infrastructure, open space, and community-building projects are increasingly critical to achieve a high quality of life without displacing long-term residents. However, these communities often do not have access to the same levels of resources or social and financial capital as more affluent communities to quickly and effectively remediate these challenges.

For planners or designers with an eagerness to partner with communities and bridge resources to transform these liabilities into assets, uncrewed aircraft systems or UAS, also known as drones, are an important low-cost technology to consider adding to their toolkits. They can effectively help communities share their stories and perspectives with a larger audience to connect with those entities that can bolster efforts to improve hydrological conditions and connect the community to financial capital. Furthermore, UAS technology can help engage a community, especially during COVID-19, by immersing them in their neighborhood from above through video, photography, and mapping, and can take them into places that are difficult to access or view during situations such as the aftermath of large storm events.

Although drones require a moderate level of investment up front, the payback over time can be relatively quick. Most importantly, UAS can help clients, organizations, officials, and communities "see" their neighborhoods and project sites in a new light.

Not only do UAS have the capacity to offer new perspectives through photography and videography, planners can use their cameras and sensors to create base maps of existing conditions for much less than a full survey of a property typically costs. For one recent project site in southeast Raleigh, North Carolina, with wetlands, hotspots of invasive species, illegal dumping areas, and unknown drainage channels, we used a UAS to quickly map 30 acres (Figure 1.4). We used the data to create a base map with publicly available GIS data, resulting in fundraising documents that led to additional financial resources.

For this project, a standard survey would have cost around $20,000 and taken about four to six weeks to execute, whereas the UAS, associated licenses and software, and time and labor cost $2,500 and the mapping process took 15 minutes. Although a standard survey will eventually be necessary for the construction drawings, a UAS-created base map made possible an informed plan with high-quality imagery and analysis that compelled decision makers to fund and thus execute the project.

In addition to base mapping of existing conditions, drones were also used in this project to record approximate flood elevations over time after various storm events. Collecting UAS imagery is much quicker than walking or driving a watershed or drainage area and can be less expensive and more engaging to the public than water-level sensors and their associated data loggers. Additionally, UAS processing software makes these analyses quick and easy with tools that can perform rapid comparisons of elevations of features over time. With the use of software for planning autonomous

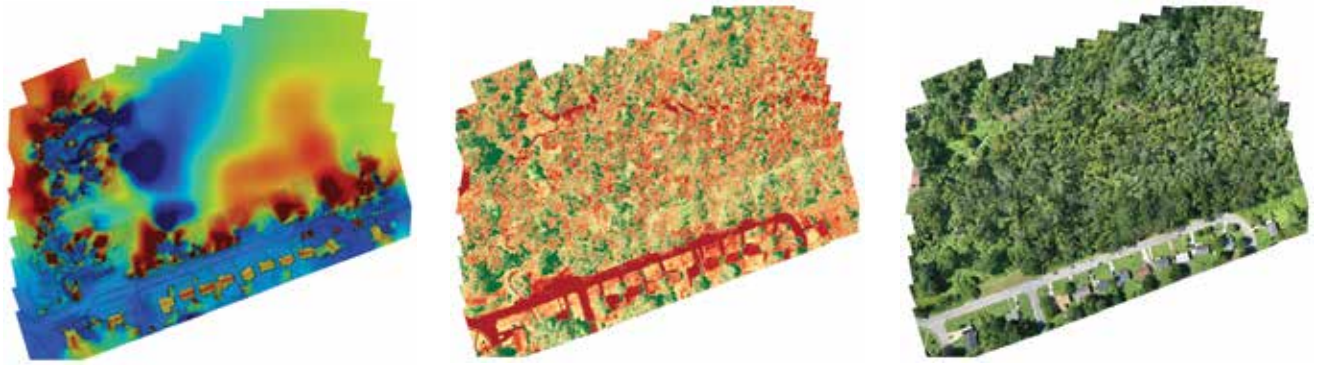

Figure 1.4. Elevation (left), Normalized Difference Vegetation Index (NDVI; center), and orthomosaic (right) views of a project site (Design Workshop)

flights, the same photograph or data collection activity can be repeated in the same location time after time.

A summary of the potential of UAS base-mapping capabilities and uses for planning and design of green infrastructure and park projects are listed below, but this is by no means representative of all the possibilities:

- Providing general topography information
- Creating 3-D models and elevations of vegetation, water, bridges, topography, buildings, etc.
- Tracking flood events, erosion and sedimentation, and water flow over time
- Analyzing vegetation health, such as identifying dead or dying trees that may be due to disease, pests, or changes in hydrology
- Balancing cut and fill grading
- Identifying different species of vegetation, particularly trees, using multispectral imagery
- Mapping the urban heat island using thermal imagery
- Tracing traffic patterns and general vehicular speeds
- Monitoring wildlife and wildlife movements
- Delineating overhead utility lines and other utilities
- Identifying damaged infrastructure in difficult-to-access areas, such as clogged inlets or other areas where waterflow is blocked
- Tracking shoreline changes over time and establishing rates of change
- Assessing existing and proposed viewsheds
- Mapping neighborhood resources such as sidewalks and crosswalks

A lack of access to capital funding, professionals with technical backgrounds, and technological tools to gather data about existing conditions can be steep barriers to overcoming issues of equity in planning and design in communities that are prone to flooding, poor water quality, and other poor environmental conditions. For planners who seek to work with communities to build much-needed high-quality and high-performing open space to provide ecological and social services, UAS technology can be an inexpensive tool that reveals the often hidden realities of a place and shares different perspectives to help catalyze change.