

BISCUIT RUN PARK PHASE 2 DEVELOPMENT

(Technical Report)

**BALANCING SAFETY AND SURVEILLANCE: OPTIMIZING WEARABLE
TECHNOLOGY INTEGRATION IN CONSTRUCTION WHILE ADDRESSING
PRIVACY AND TRUST CONCERNS**

(STS Research Paper)

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Abstract

These two research efforts explore how civil engineering and construction technologies can better serve communities by prioritizing safety, accessibility, and trust. Both projects address environments where individuals interact directly with systems intended to protect them—through either physical infrastructure or digital monitoring. The technical capstone focused on sustainable public infrastructure, while the STS project investigated the ethical implementation of wearable safety devices in construction. Together, these studies emphasize that engineering solutions must not only be technically effective, but also socially responsible and ethically grounded. Each demonstrates that successful engineering is not just about what we build, but how thoughtfully we build it and for whom.

The technical portion of my research addressed a lack of accessible recreational space in the rapidly growing southern region of Albemarle County, Virginia. To respond to this need, my team and I designed a section of Biscuit Run Park that included two athletic fields, a multi-use trail network, and stormwater best management practices (BMPs) such as a bioretention basin and an underground retention system. The design followed a “living with nature” theme that reflects community goals and environmental guidelines. Using Civil 3D, VRRM modeling, and DEQ stormwater guidelines, we created detailed construction drawings, a phasing plan, a construction schedule, and a cost estimation for implementation. The park’s layout was intentionally designed to reduce runoff, minimize impervious surface area, and provide a welcoming and accessible recreational space for all users. These decisions reflected the broader understanding that technical design must also improve user experience and long-term environmental impact.

Similarly, my STS research focused on how technological implementation must be guided by ethical and human-centered thinking. It examined the adoption of wearable safety technologies—such as smart vests, helmets, and biometric monitors—within the construction industry. Despite the life-saving potential of these tools, many workers remain skeptical due to concerns about surveillance, data privacy, and employer misuse. Using the Technology Acceptance Model (TAM) as a theoretical framework, I expanded the analysis to include privacy, trust, and data transparency—key social factors that shape adoption. Interviews with construction professionals revealed that workers are more willing to accept safety technology when they understand how data is collected and used, and when they are assured it will not be exploited. Clear data policies, opt-in procedures, and hands-on training emerged as essential strategies for building trust and improving acceptance on job sites.

Together, these projects reinforce the importance of aligning technical innovation with social responsibility. Designing sustainable infrastructure in a public park is only effective if it is

usable, inclusive, and safe. Likewise, introducing advanced safety equipment on job sites is only meaningful if workers trust the systems behind it. Whether shaping a landscape or embedding digital tools, engineers must consider how technologies intersect with real people's lives. When viewed as a whole, the capstone and STS research demonstrate that engineering problems rarely exist in isolation. These problems require integrated solutions that account for technical performance, ethical implementation, and human impact.