

# ANCHORING THE DIGITAL TWIN... IN REALITY

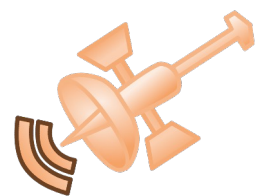


**XYZ MARKS THE SPOT**

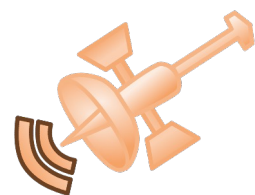
BY: NIKOLAS SMILOVSKY, PHD, GISP

# AGENDA

Introduction to Bad Elf  
Our GNSS technology  
Anchoring the digital twin  
XYZ marks the spot



# BAD ELF INTRODUCTION



Bad Elf's line of GNSS receivers empower GIS and survey professionals to collect high-accuracy field data using any phone, tablet, or laptop. Our products work with any location-based app running on iOS, Android, and Windows.

All Bad Elf's Bluetooth receivers have an integrated LCD screen and intuitive user interface to provide status information and perform standalone data collection when needed.



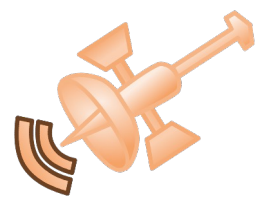
# BAD ELF INTRODUCTION



Aviation



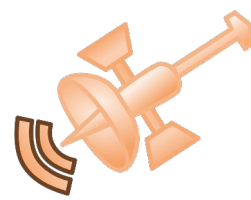
# BAD ELF INTRODUCTION



Marine



# BAD ELF INTRODUCTION



## Recreational Sports

CYCLING

- Bikemap - Cycling Map & GPS
- Cyclometer
- Strava Cycling

EQUESTRIAN

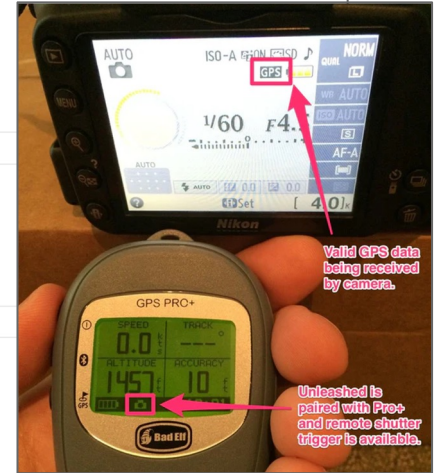
- CourseWalk
- CrossCountry

GOLF

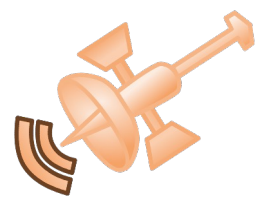
- Golf GPS & Scorecard
- Golf Logix
- Golfshot: Golf GPS

RUNNING AND WALKING

- Couch 2 5K
- Endomondo
- Map My Fitness+
- Nike+ Running
- RunKeeper
- Runmeter
- Adidas - Runtastic
- Walkmeter

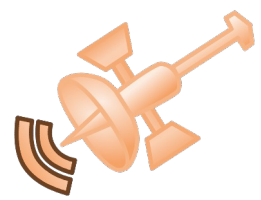


# BAD ELF INTRODUCTION



GIS / Mapping / Land Surveying / Engineering / SUE





# OUR GNSS TECHNOLOGY

the Bad Elf Flex! A low cost, alternative...  
quad-constellation, multi-frequency...  
survey-grade GNSS receiver (~1cm)!



FRONT SIDE BACK





# THE DIGITAL TWIN



## Digital twin

 22 languages ▾

[Article](#) [Talk](#)

[Read](#) [Edit](#) [View history](#) [Tools](#) ▾

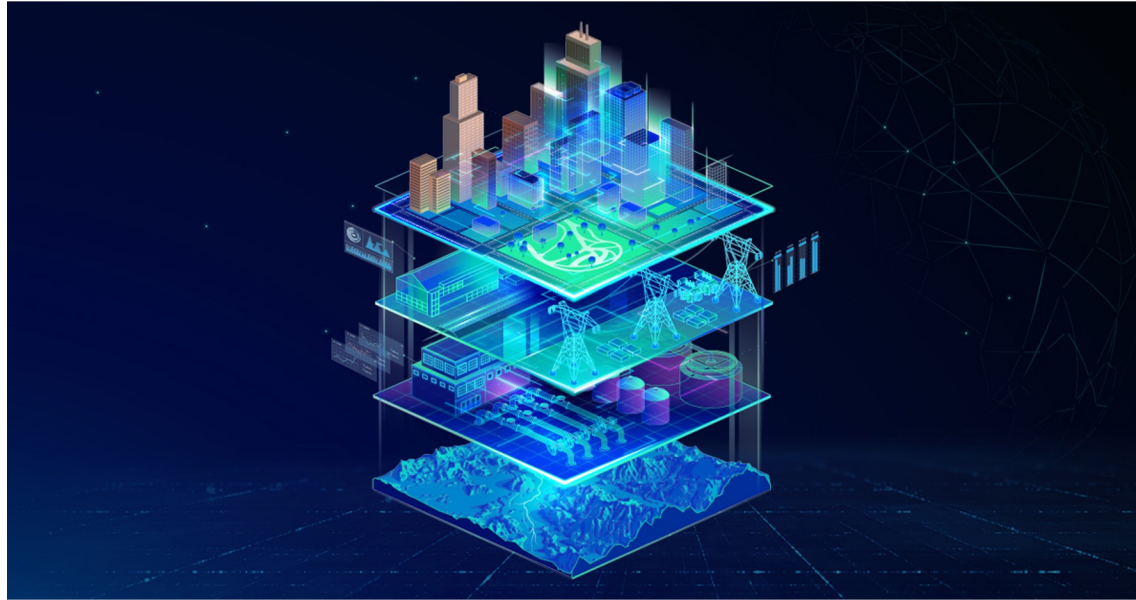
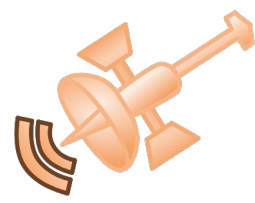
From Wikipedia, the free encyclopedia

A **digital twin** is a digital representation of an intended or actual real-world physical product, system, or process (a *physical twin*) that serves as the effectively indistinguishable digital counterpart of it for practical purposes, such as [simulation](#), [integration](#), [testing](#), [monitoring](#), and [maintenance](#). The digital twin has been intended from its initial introduction to be the underlying premise for Product Lifecycle Management<sup>[1]</sup> and exists throughout the entire lifecycle (create, build, operate/support, and dispose) of the physical entity it represents. Since information is granular, the digital twin representation is determined by the value-based use cases it is created to implement. The digital twin can and does often exist *before* there is a physical entity. The use of a digital twin in the create phase allows the intended entity's entire lifecycle to be modeled and simulated.<sup>[2]</sup> A digital twin of an existing entity can, but must not necessarily, be used in real time and regularly synchronized with the corresponding physical system.

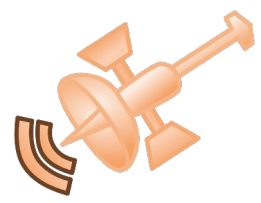
Though the concept originated earlier, the first practical definition of a digital twin originated from NASA in an attempt to improve physical-model simulation of spacecraft in 2010.<sup>[3]</sup> Digital twins are the result of continual improvement in the creation of product design and engineering activities. Product drawings and engineering specifications have progressed from handmade drafting to computer-aided drafting/computer-aided design to model-based systems engineering and strict link to signal from the physical counterpart.



# THE DIGITAL TWIN



# THE DIGITAL TWIN



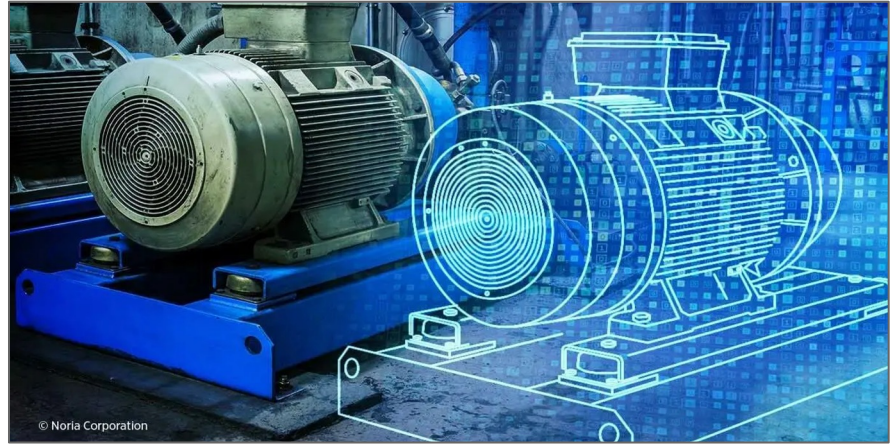
2D - plans / maps

3D - visualizations

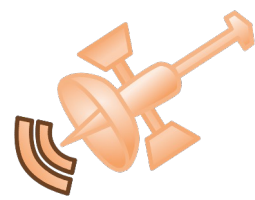
4D - time

5D - cost

6D - project life cycle



# SUBSURFACE UTILITY ENGINEERING (SUE)



## What SUE Level Do You Need?

### A

#### Locating

- Highest level of accuracy
- Full use of SUE services
- Nondestructive exposure of utilities
- Provides specific type, size, condition, and material of existing underground utilities
- Precise plan and profile mapping

Subsurface utility engineering is divided into four quality levels. Our professionals will help you decide the correct accuracy for data collection to build your project safely.

### B

#### Designating

- Most common
- Provides close approximate locations of existing utilities
- Correlated with existing records
- Electromagnetic locating/ground penetrating radar
- Surveyed to project control

### C

#### Visual Confirmation

- Visual survey of utilities (manholes, valve boxes)
- Data compared to existing utility records

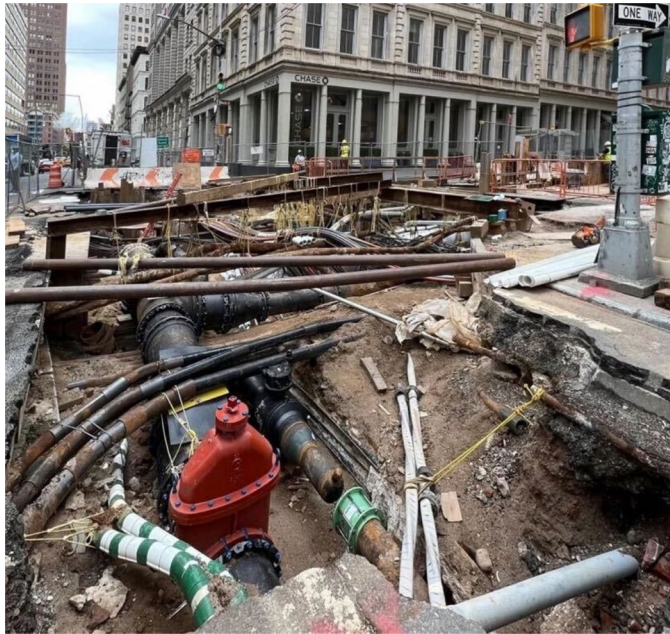
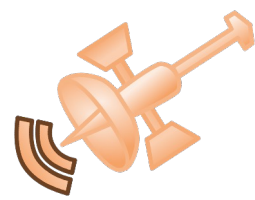
### D

#### Records Research

- Reviewing existing utility records and as-built plans
- Limited accuracy



# ANCHORING THE DIGITAL TWIN



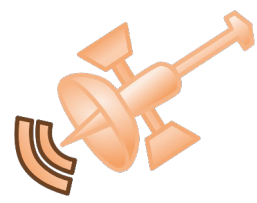
New York City Street Cut



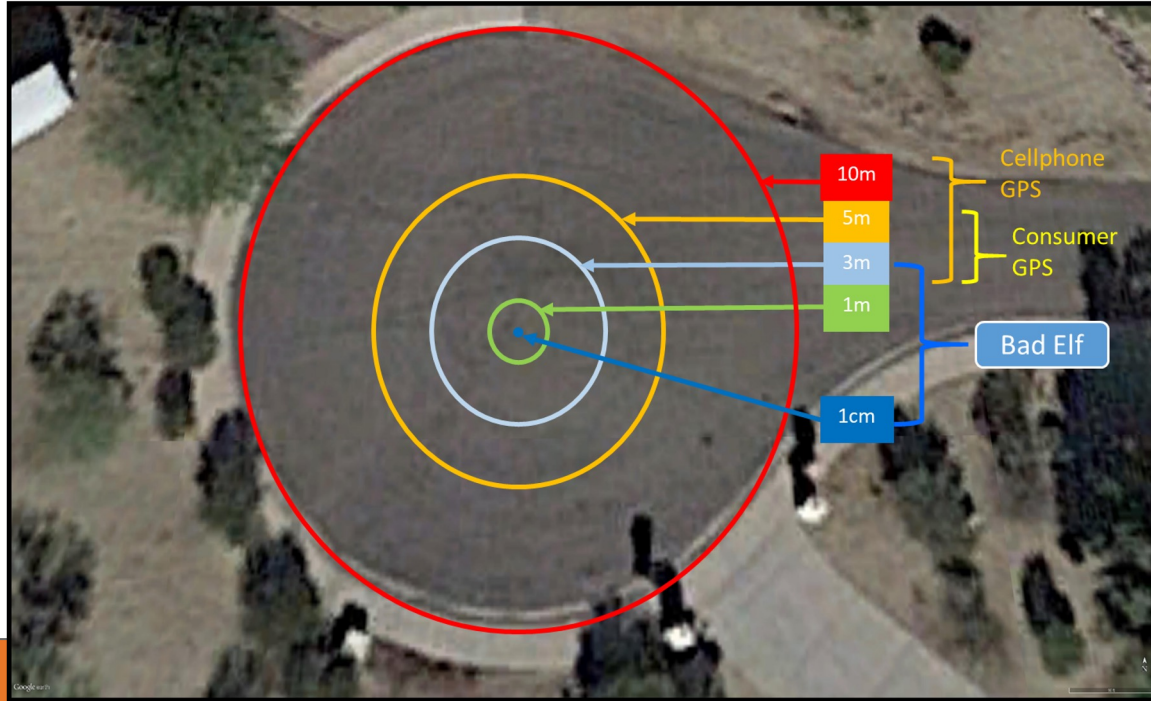
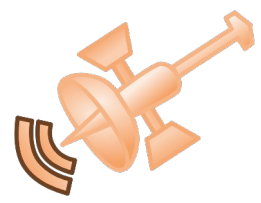
Royale Oaks, MI Pipe Strike



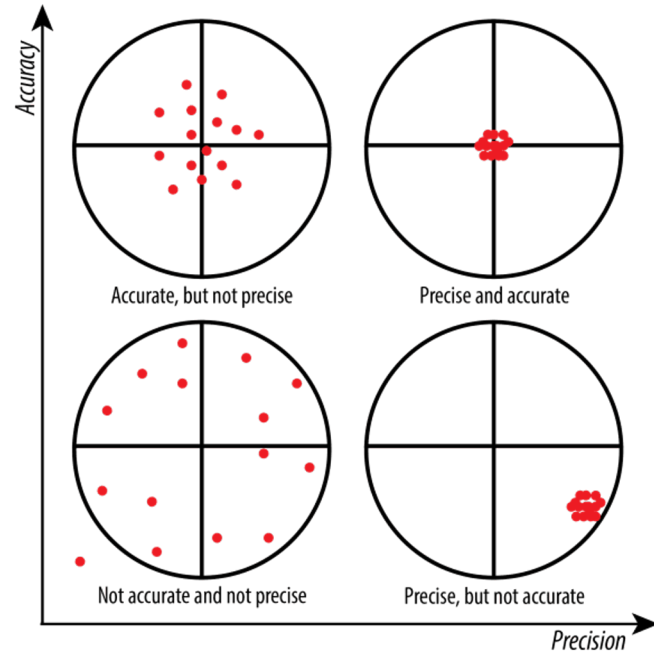
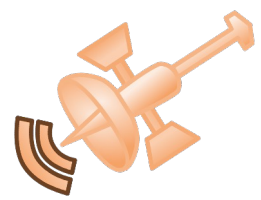
# ANCHORING THE DIGITAL TWIN



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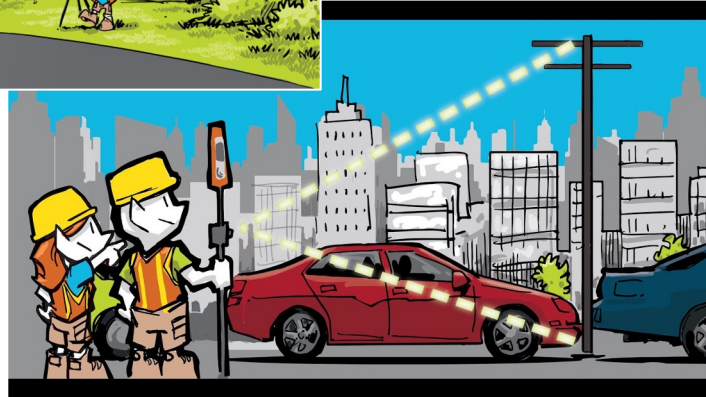
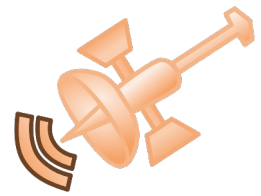


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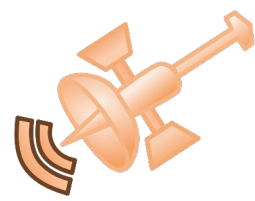


Base/Rover  
Drone Mapping

Laser Offset



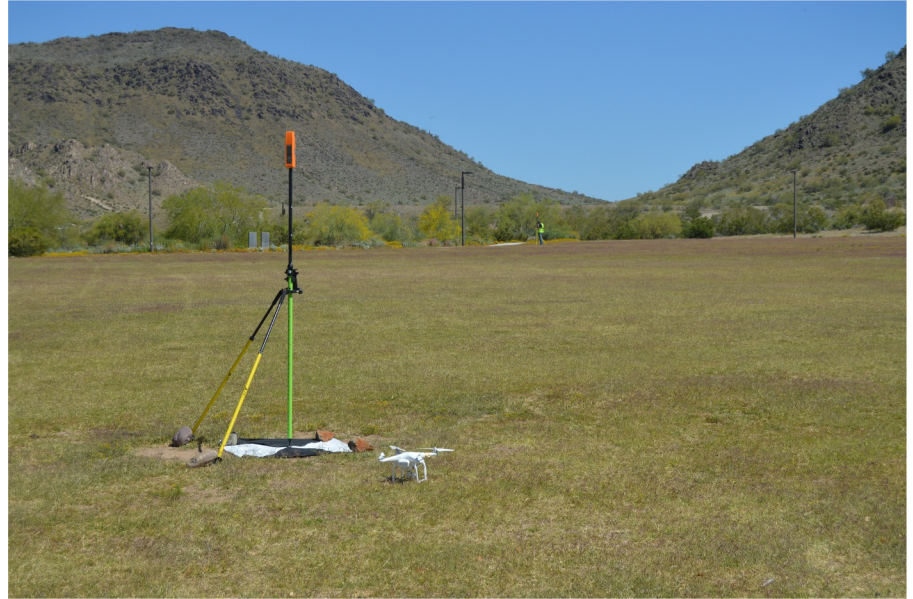
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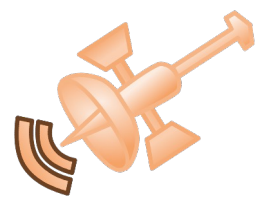
Base/Rover



Laser Offset  
Drone Mapping



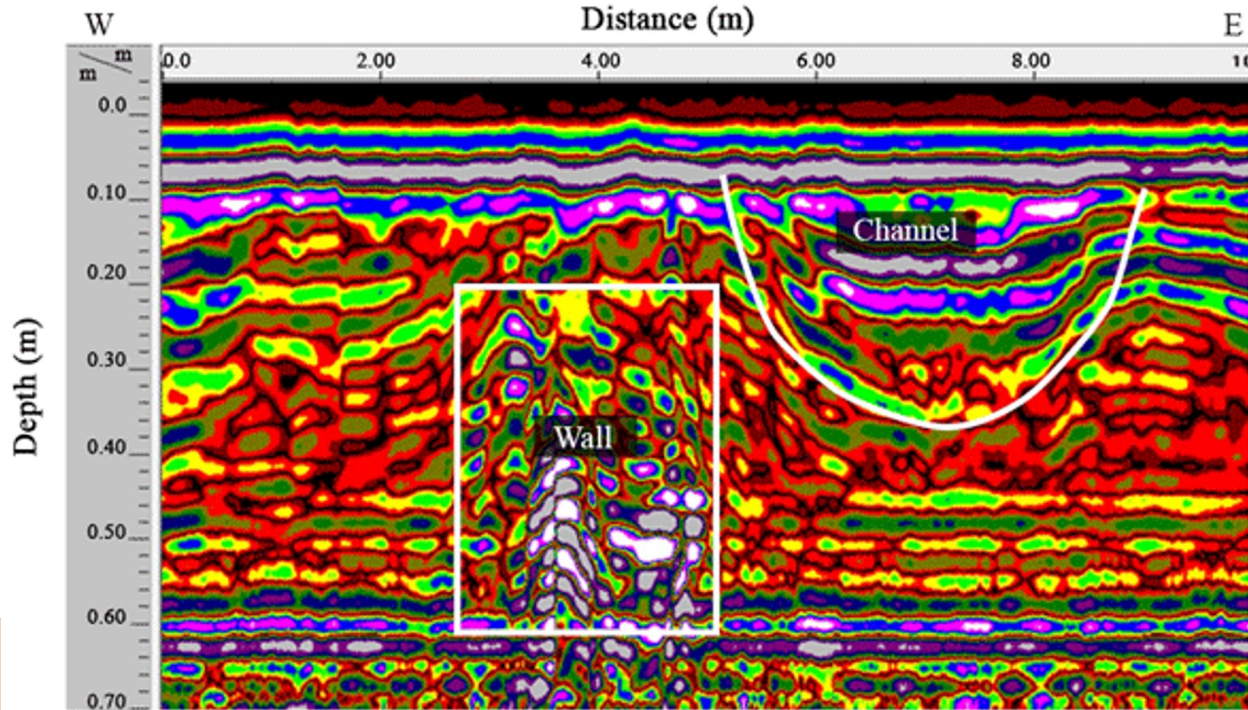
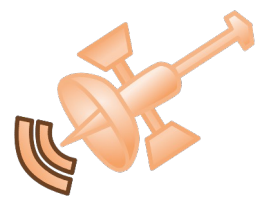
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Ground Penetrating Radar (GPR)



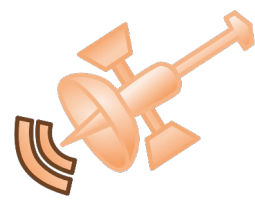
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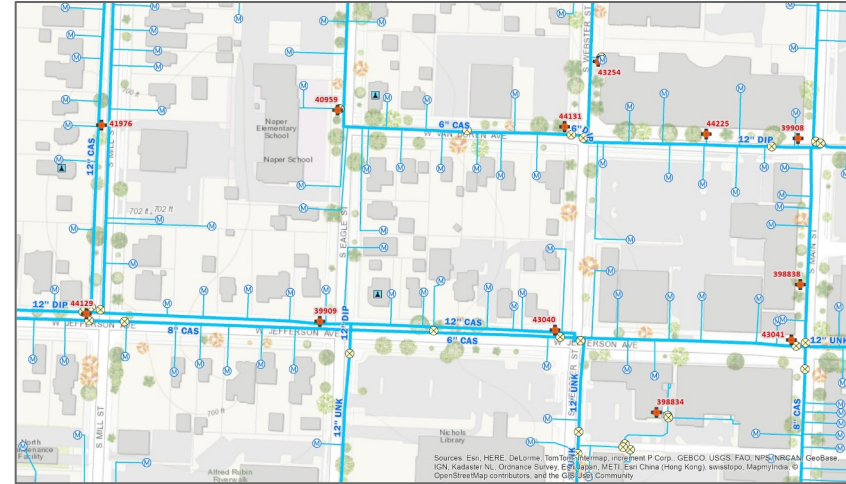
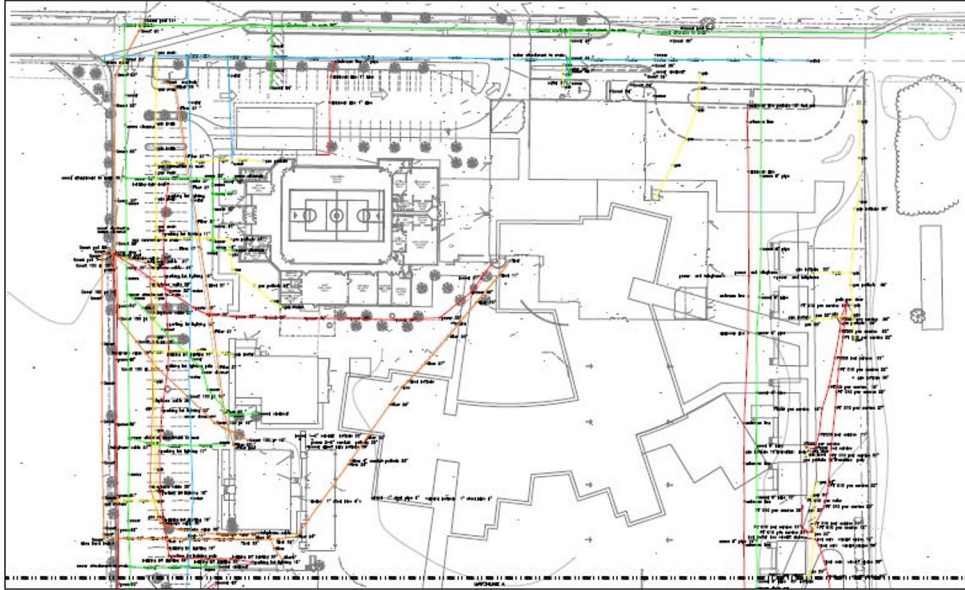
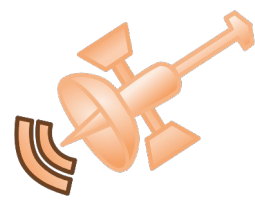
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BikeRAC, Queen Creek Case Study



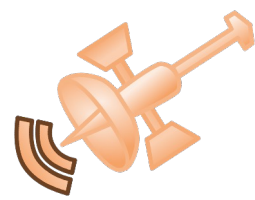
# ANCHORING THE DIGITAL TWIN



Utility Maps

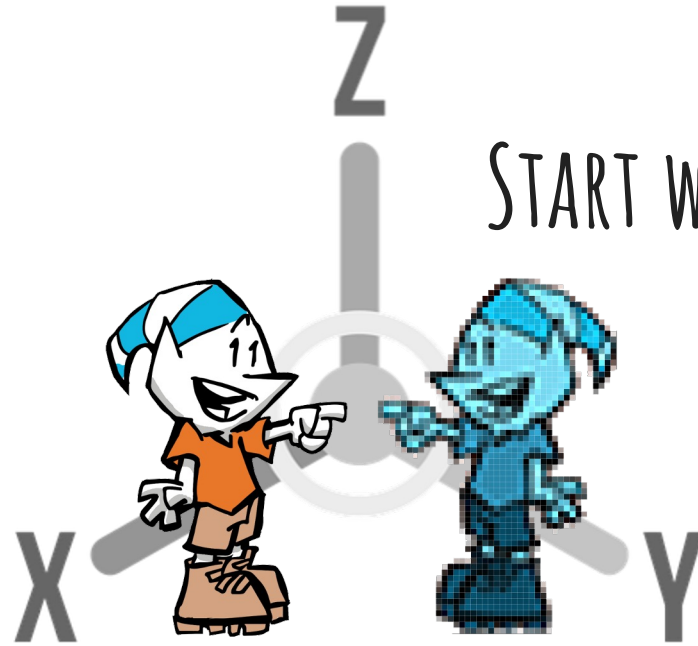


XYZ MARKS THE SPOT!



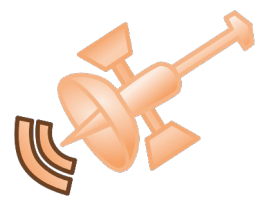
START WITH A GOOD POB!

CRUD IN, CRUD OUT!



THE DIGITAL TWIN BEGS YOU!





THANK YOU

