

3D Subsurface Utility Engineering (SUE) and Underground Utility Data into AutoCADD Civil 3D



with

Craig A. Smith & Associates

Subsurface 101

Underground utilities
Subsurface Utility Engineering (SUE) then and now

3D Radar Tomography

What is it?
How does it work?
Why do I want (NEED) it?
What does it cost (SAVE)?

Benefits of 3D RT

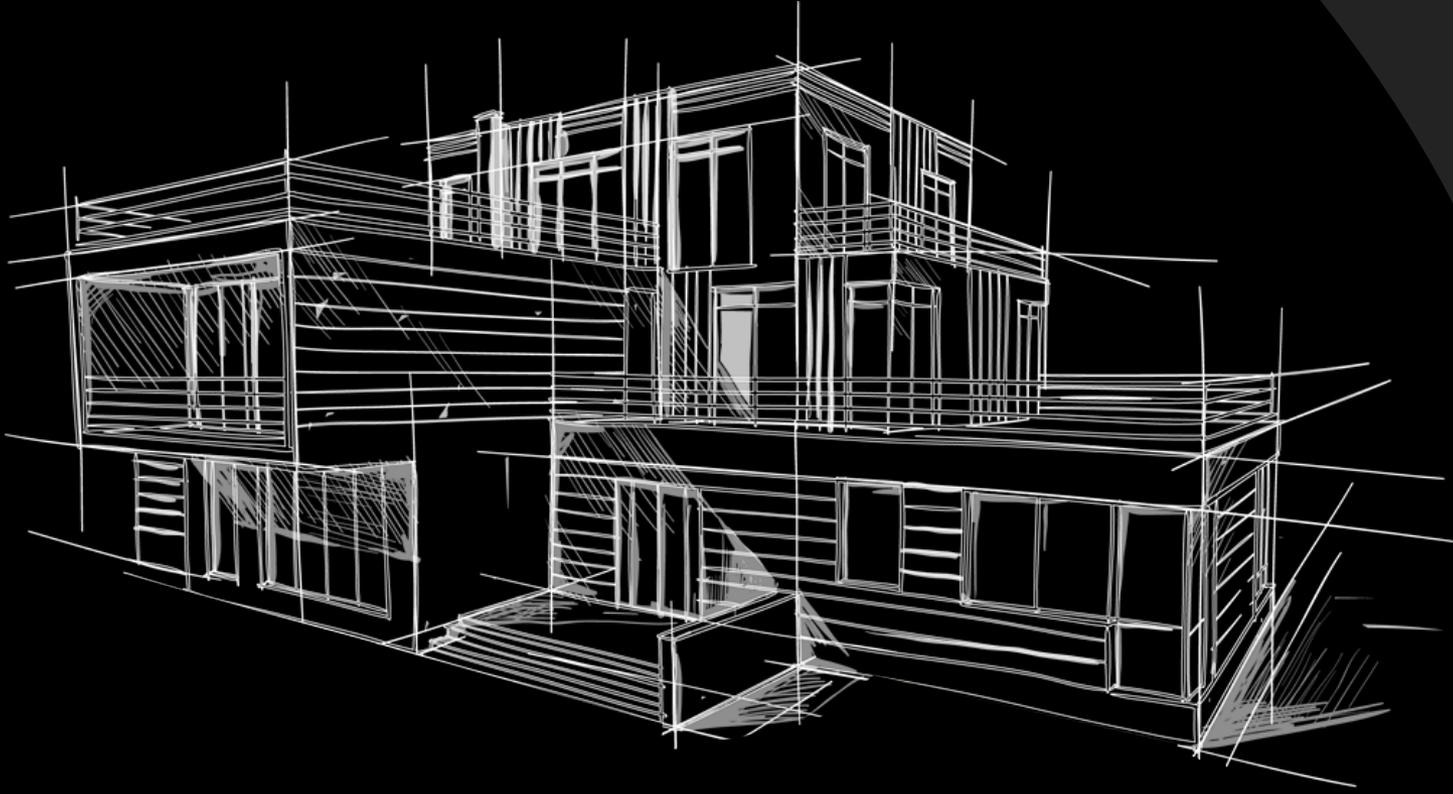
Value Added
Cost Savings



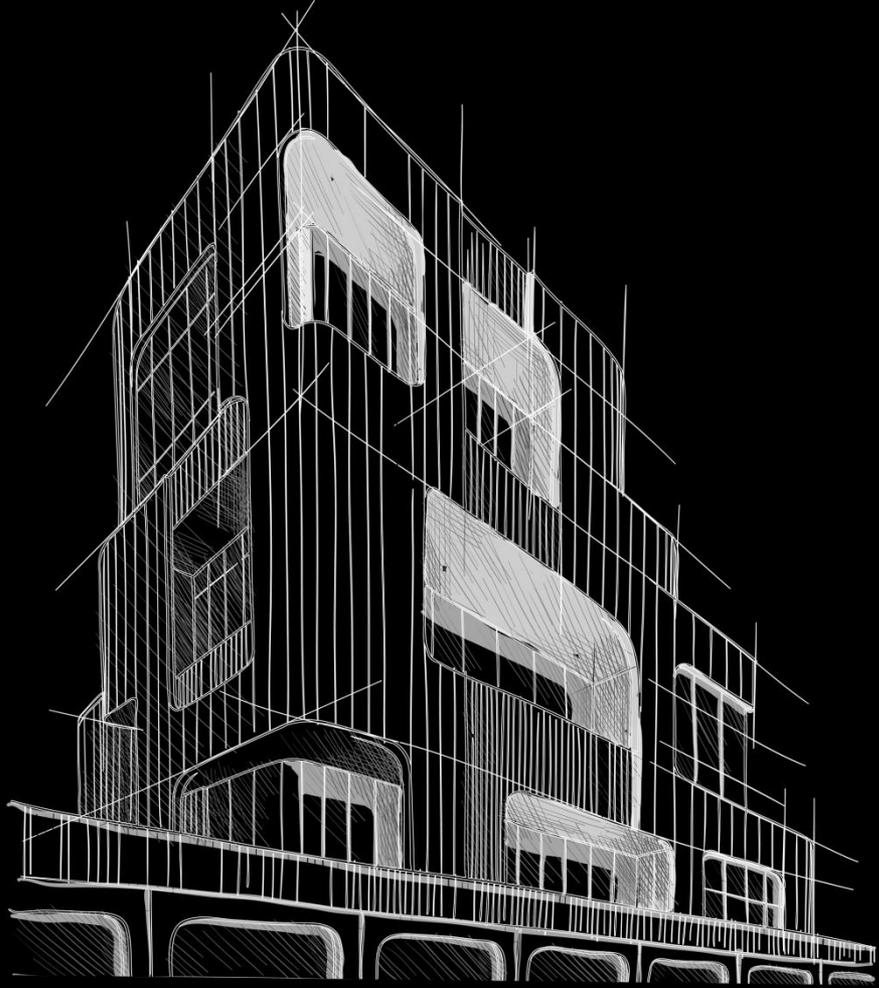
Subsurface 101



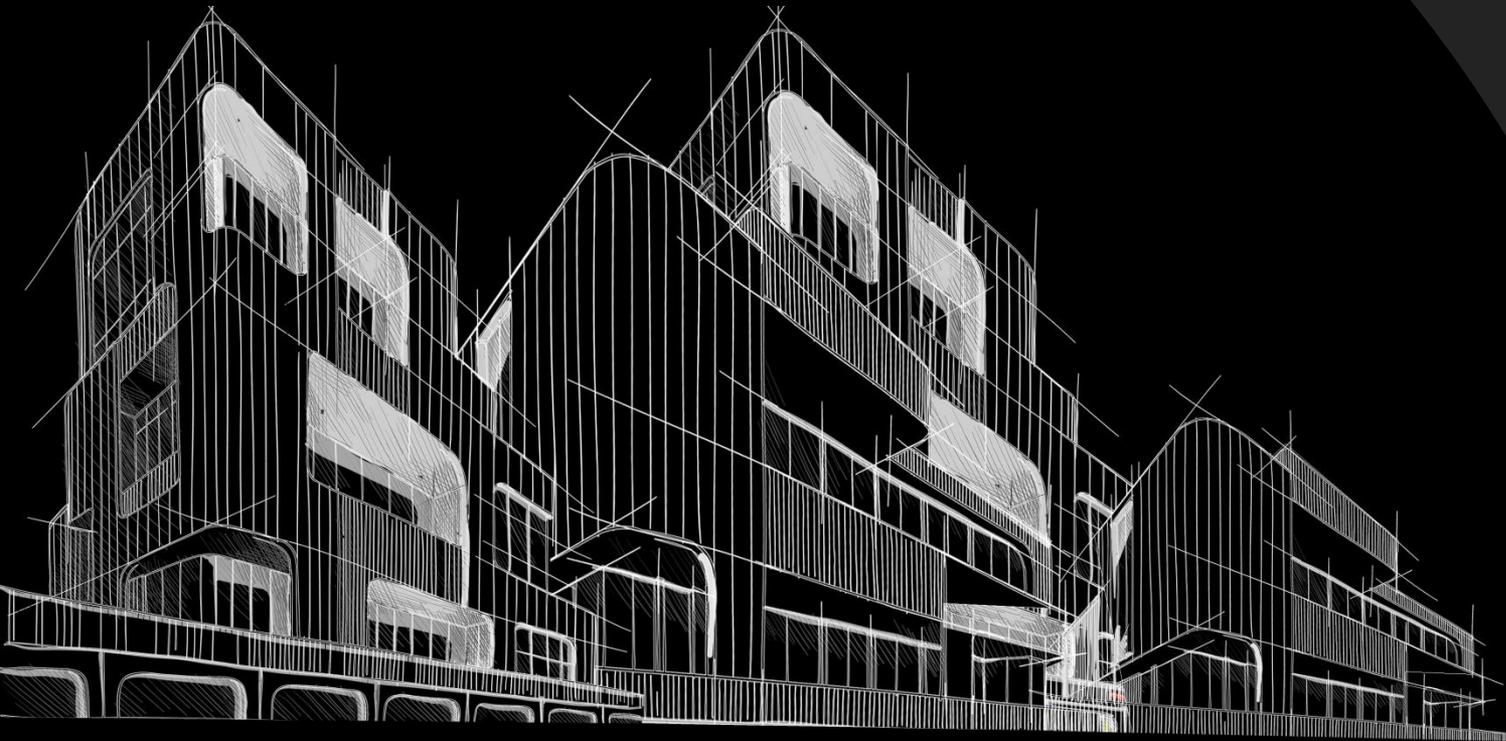
Subsurface 101



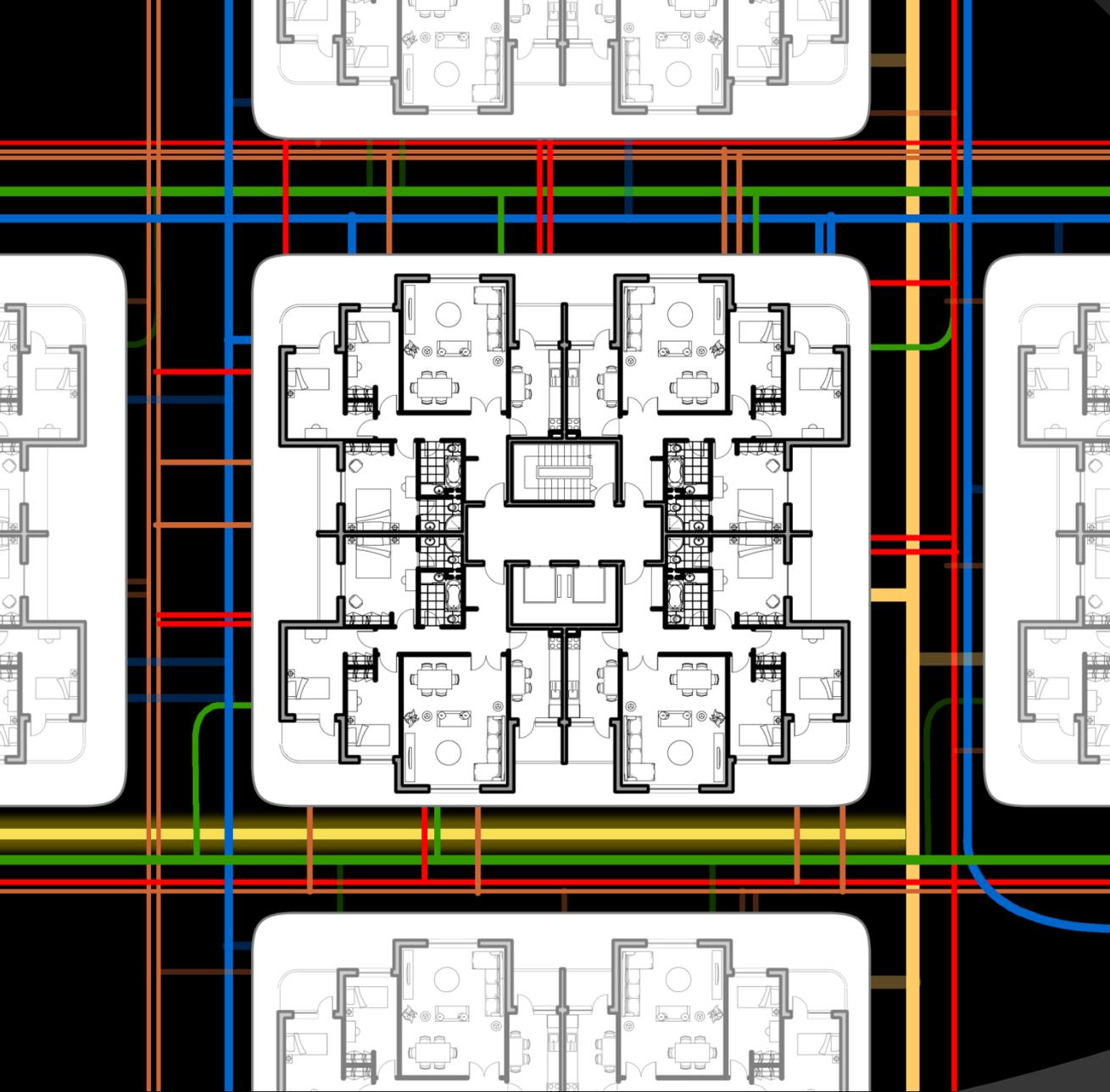
Subsurface 101



Subsurface 101



Subsurface 101



Subsurface 101

Subsurface Utility Engineering (SUE)

a **THOROUGH** mapping of the underground facilities and utilities in an area of concern (construction, excavation, exploration, etc)



Divining (Dowsing) Rod

(yes, he's *really* using a wooden tree branch to find a water line, and yes, the guy behind him is laughing, too.)

Subsurface Utility Engineering (SUE)

Current Technology and Methodology

Electromagnetic Designation (EM)

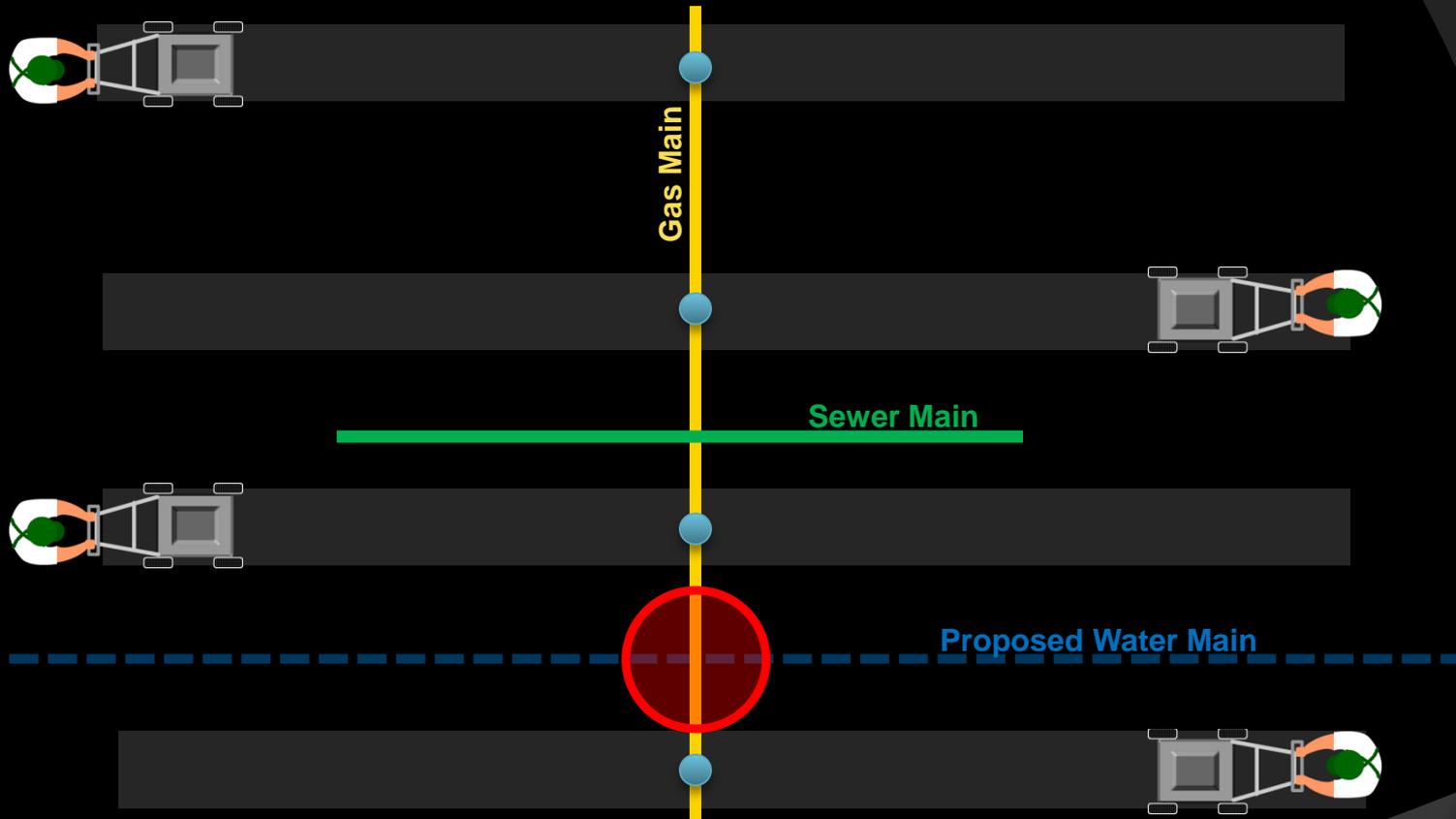
- Most common method of location
- Inexpensive & easily deployed
- Only viable on CONDUCTIVE facilities
- Prone to signal bleeding / ghosting

2D Ground Penetrating Radar (GPR)

- Non-destructive
- Rapid data acquisition
- Geo-referenced data
- Viable on non-conductive facilities
- Accurate horizontal & vertical positioning



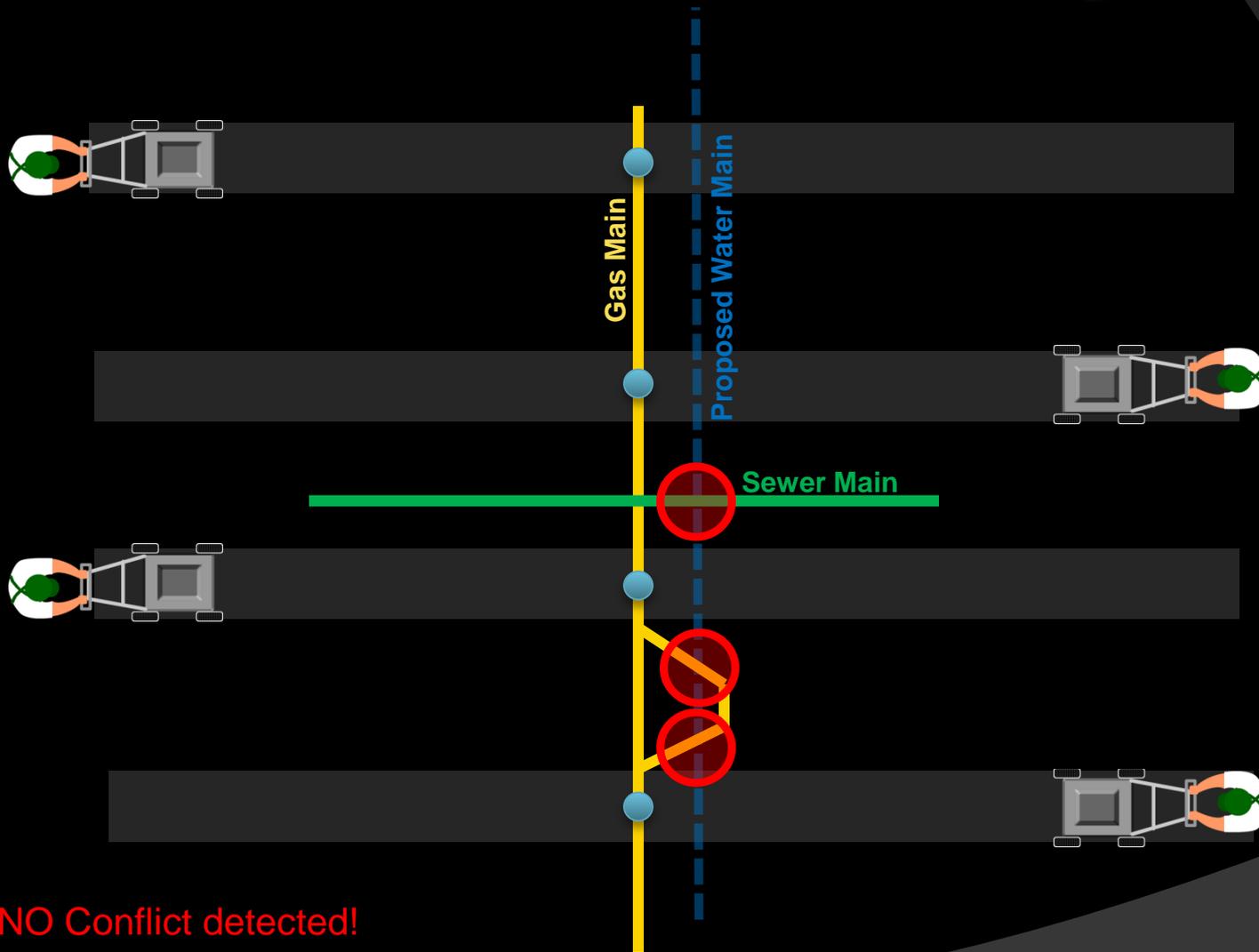
2D Ground Penetrating Radar



Conflict detected.

Course of Action: excavate to expose depth

2D Ground Penetrating Radar



3D Radar Tomography

2D Ground Penetrating Radar



3D Radar Tomography

Subsurface Utility Engineering (SUE)

3D RADAR TOMOGRAPHY

precise 3-dimensional subsurface imaging

3D Radar Tomography

3D Radar Tomography

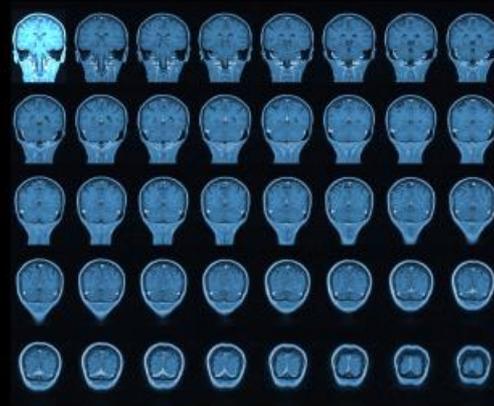
It's not brain surgery, but...



Digging in the wrong hole
here means more than a broken water main!

3D Radar Tomography

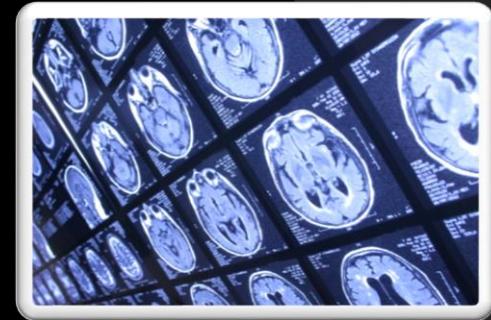
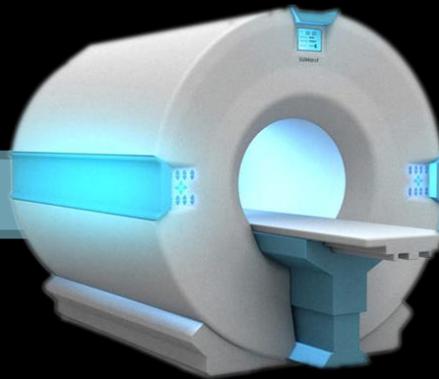
What 3DRT brings to SUE is similar in form and function to what CAT (CT) Scans did for brain surgery.



Gone are the days of guessing where to cut...where to dig.

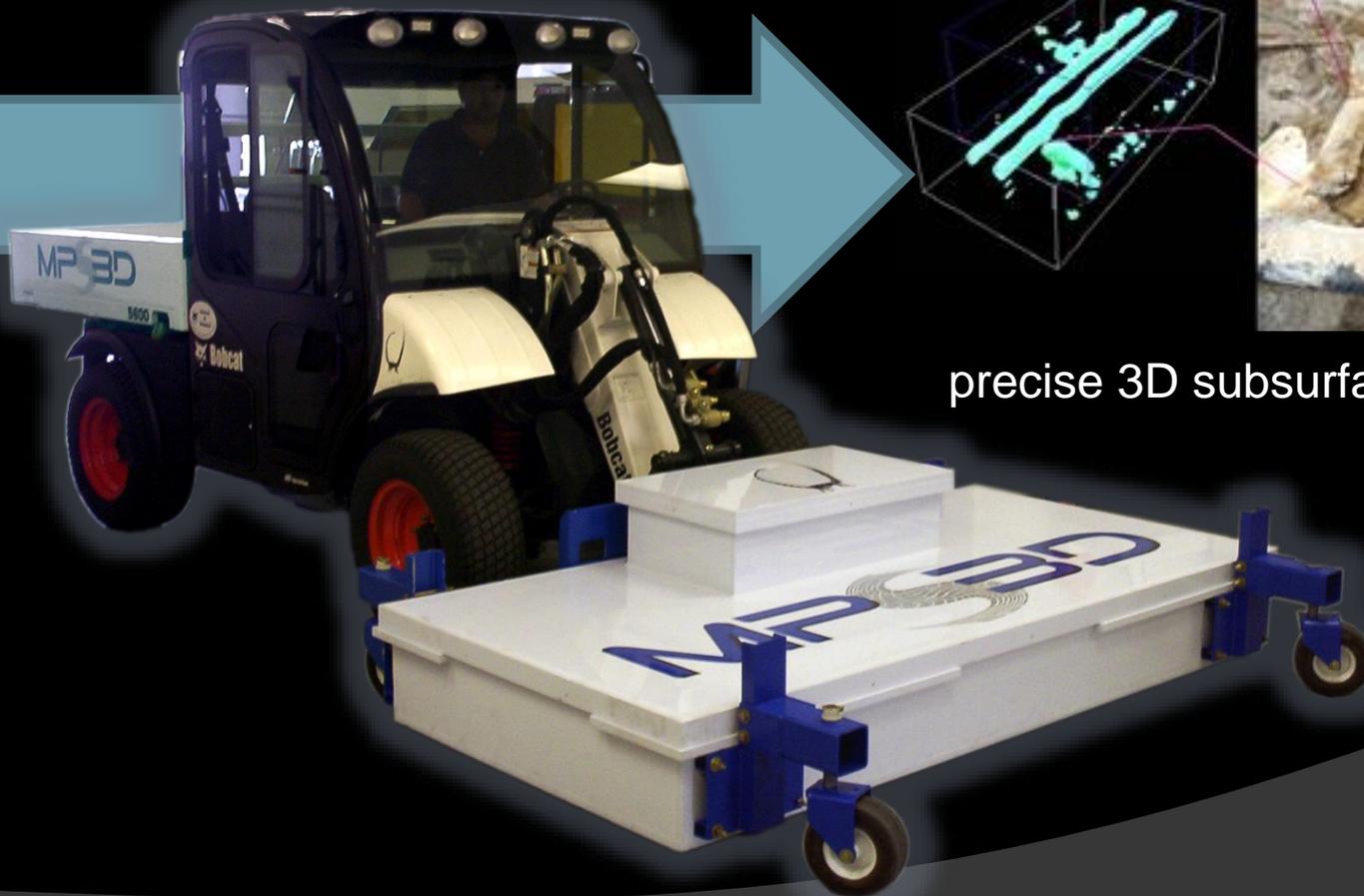
3D Radar Tomography

The right tool for every job



3D Radar Tomography

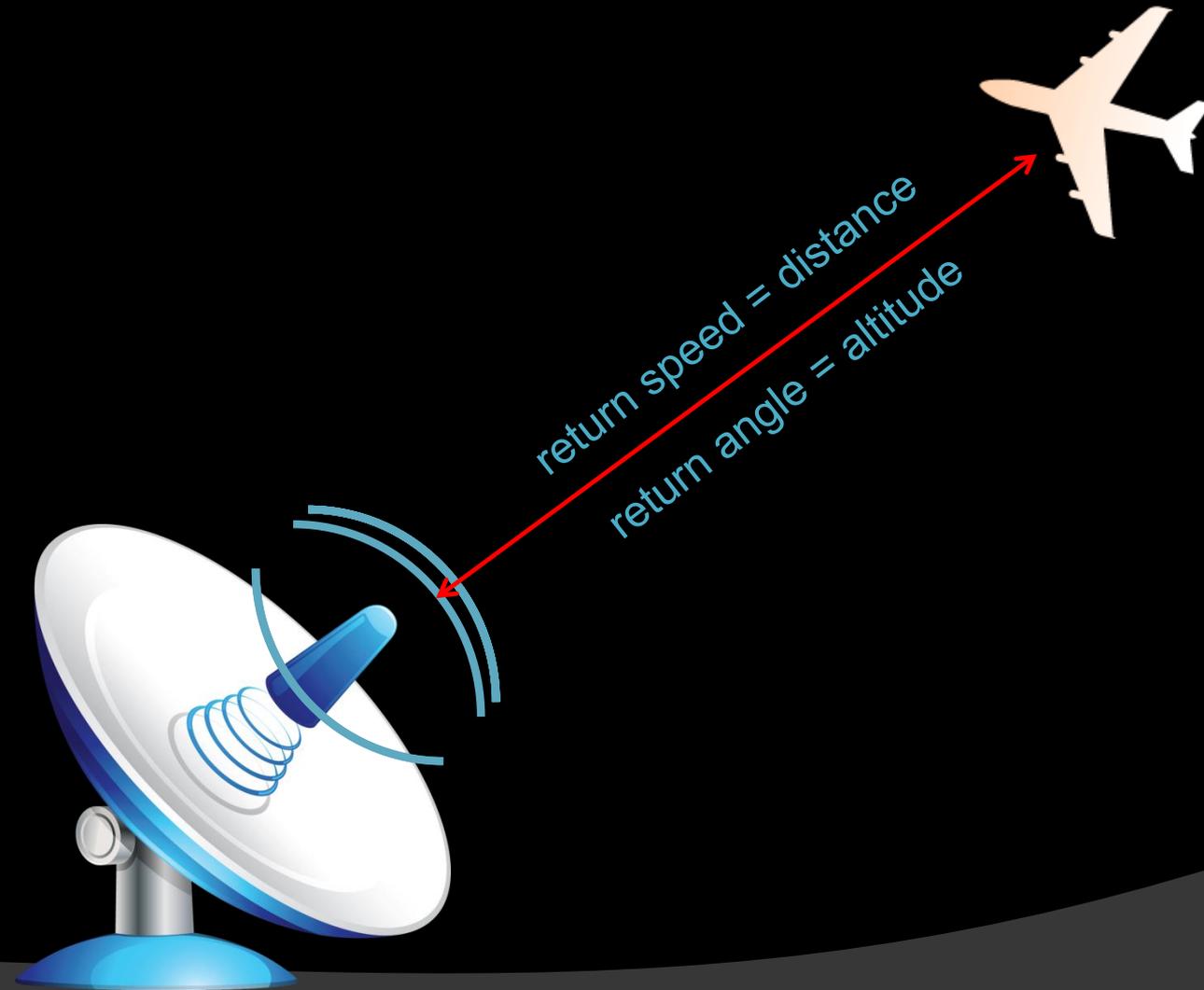
3D Radar Tomography



precise 3D subsurface imaging

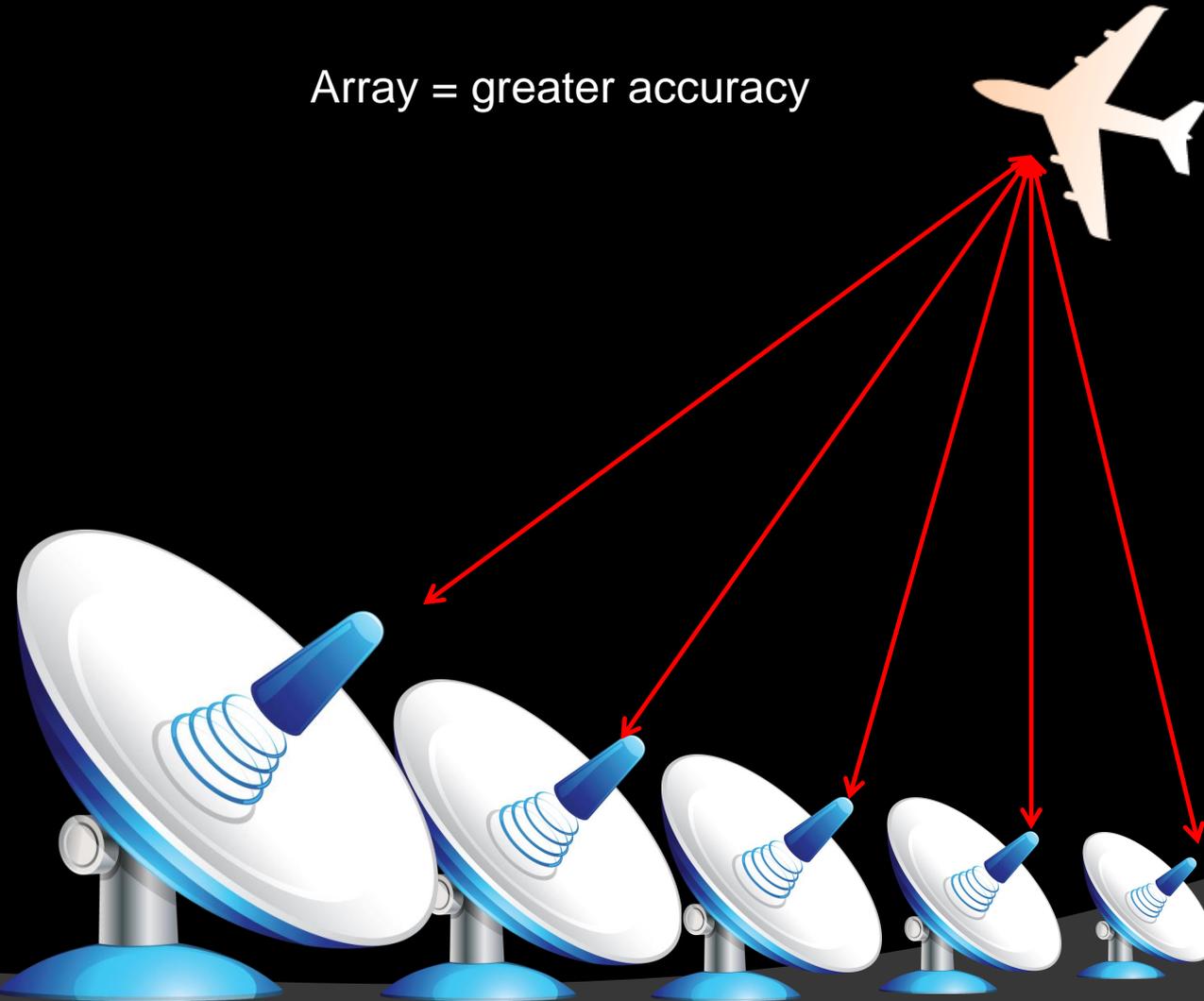
3D Radar Tomography

3D Radar Tomography



3D Radar Tomography

Array = greater accuracy



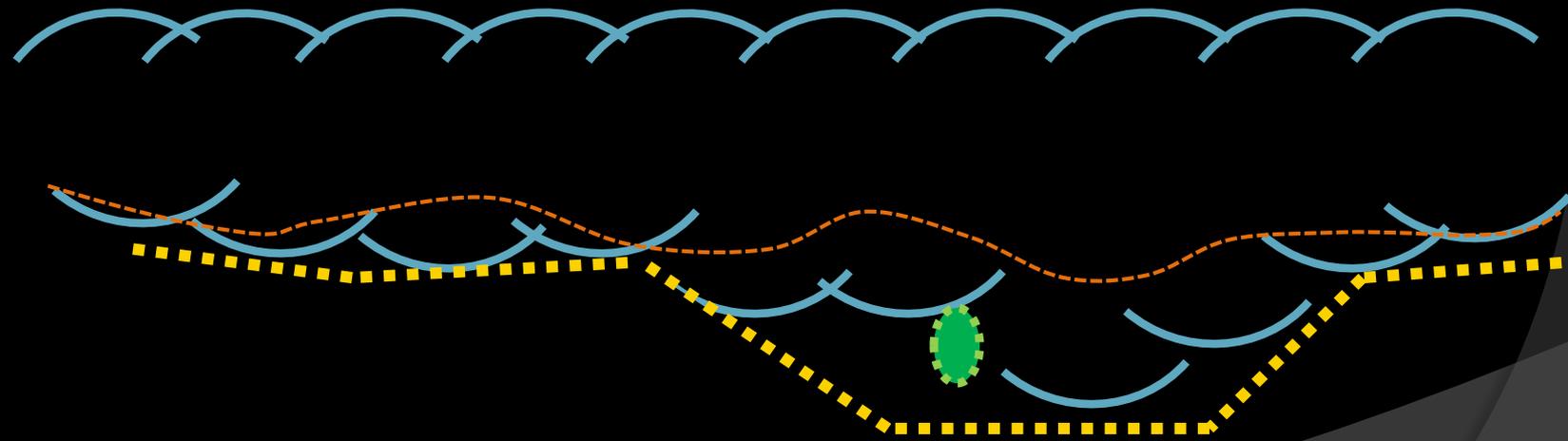
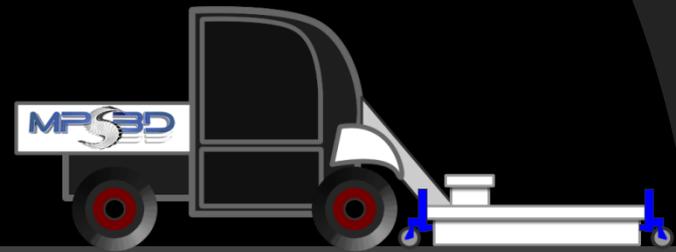
3D Radar Tomography

17 Channel Array



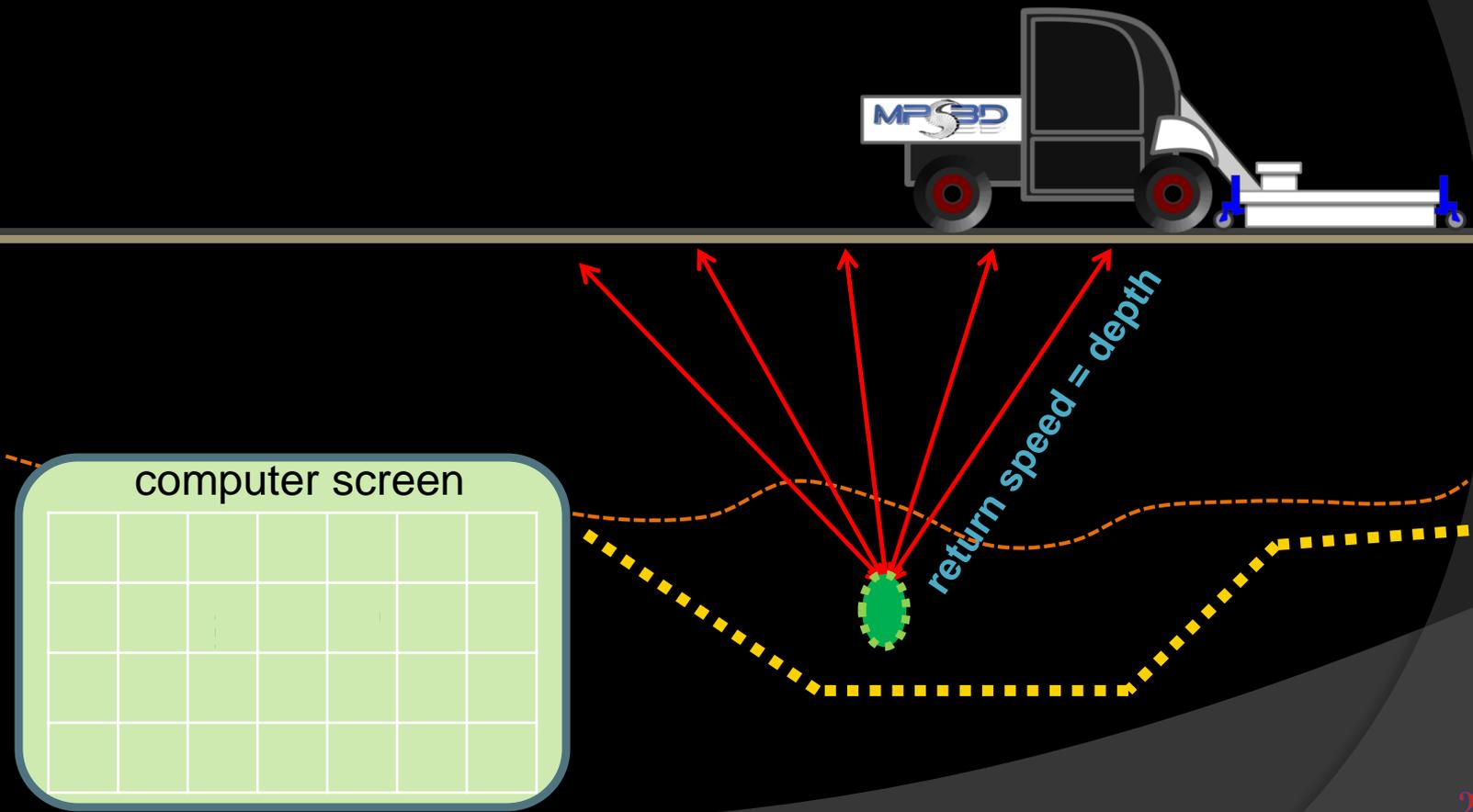
3D Radar Tomography

3D Radar Tomography



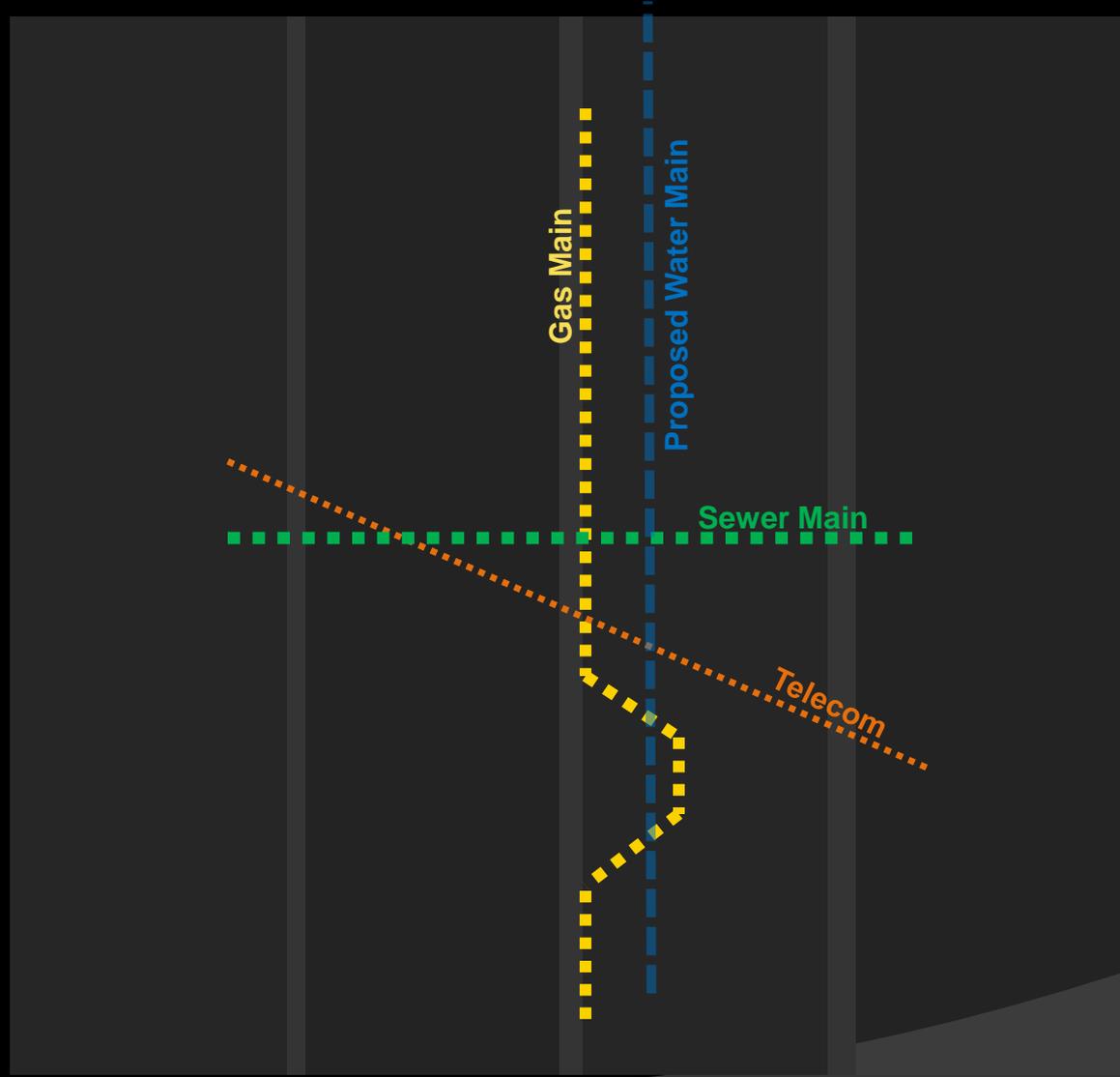
3D Radar Tomography

3D Radar Tomography



3D Radar Tomography

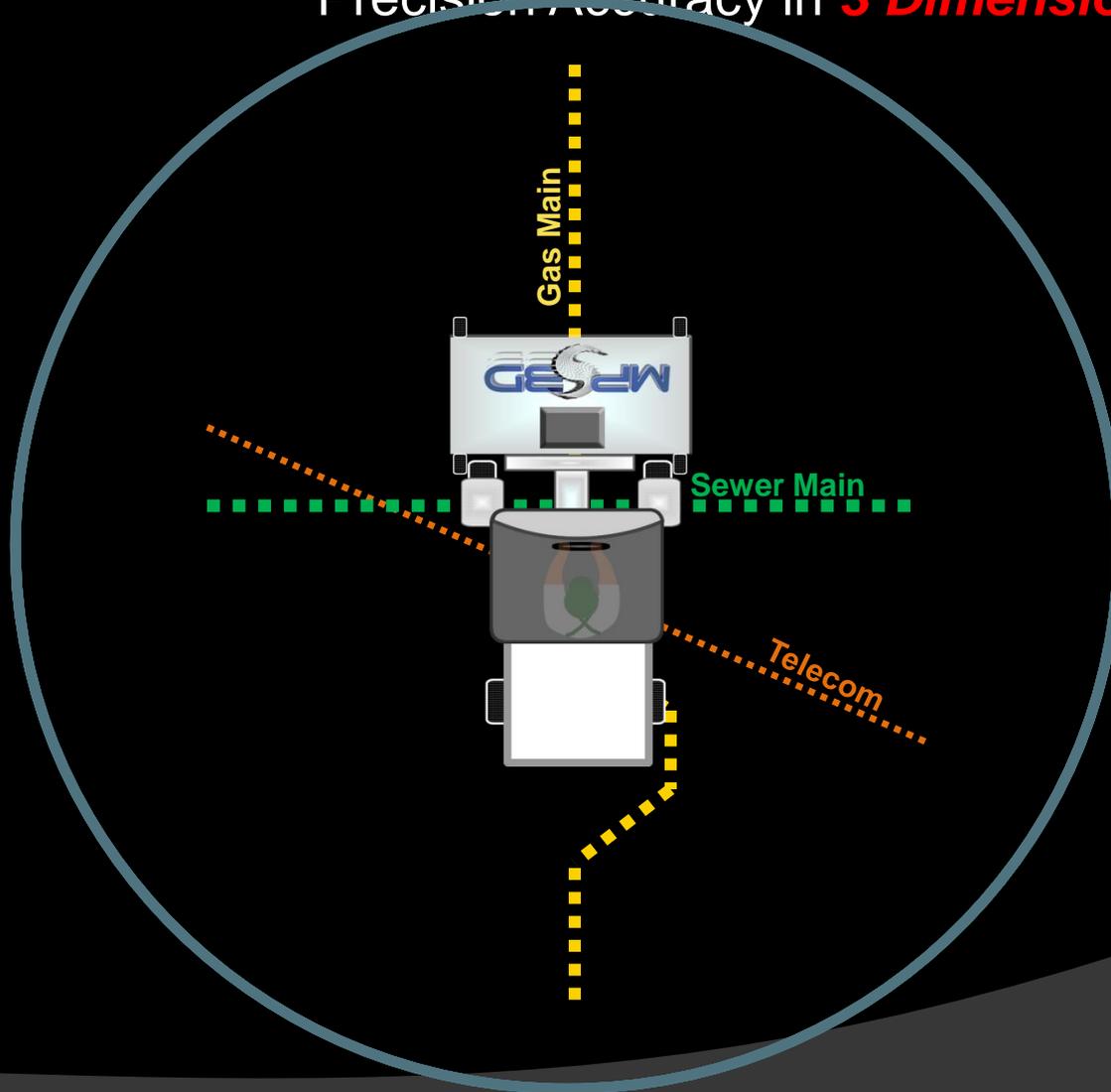
3D Radar Tomography



3D Radar Tomography

3D Radar Tomography

Precision Accuracy in **3 Dimensions**

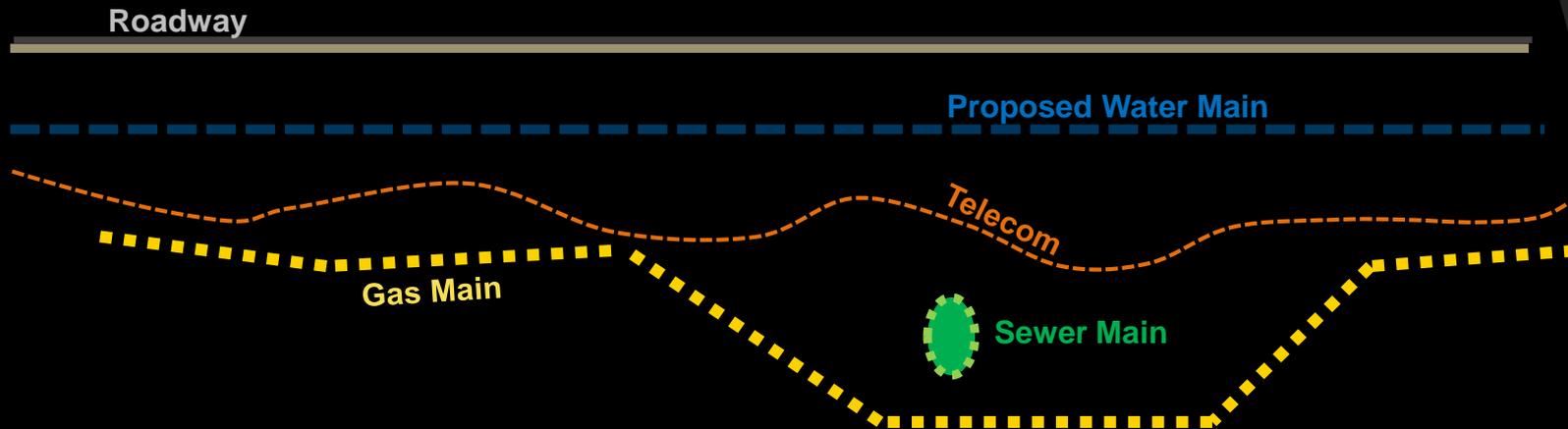


3D Radar Tomography

3D Radar Tomography

Precision Accuracy in **3 Dimensions**

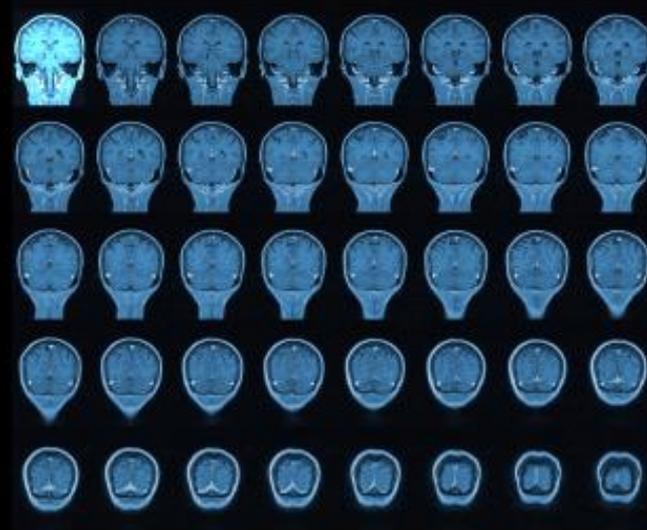
**to +/- 1"-2" in the horizontal
and +/- 4"-5" in the vertical**



3D Radar Tomography

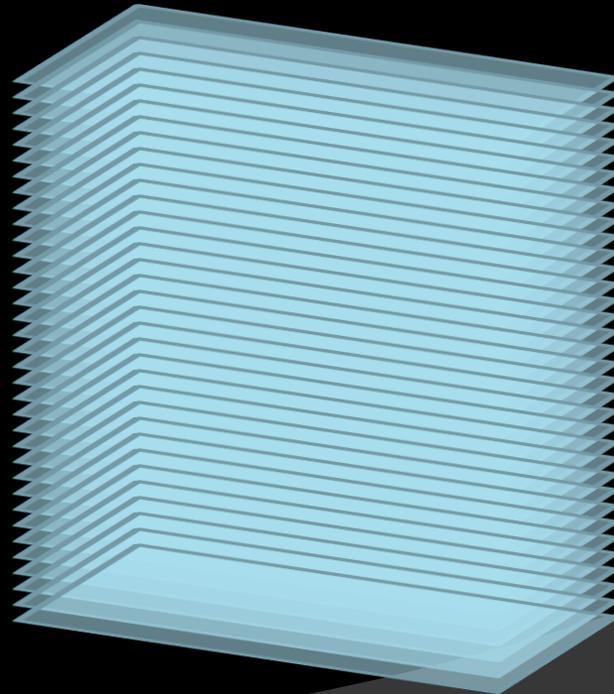
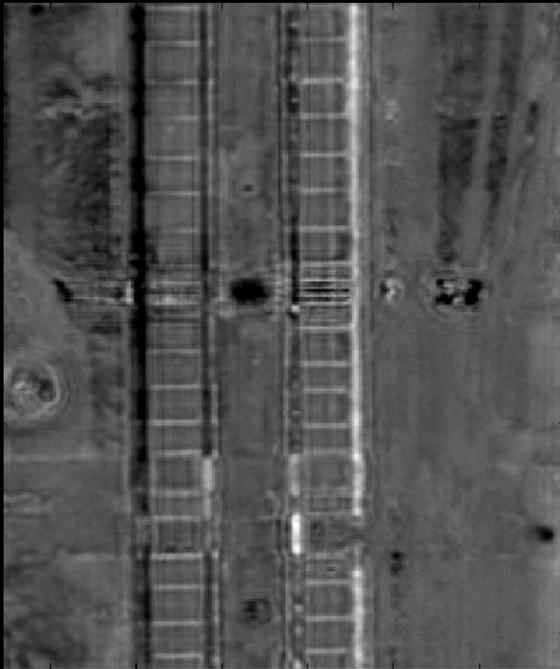
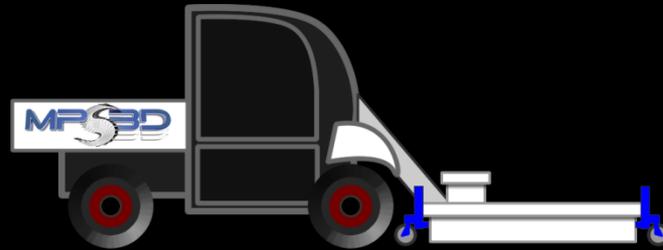
3D Radar Tomography

What 3DRT brings to SUE is similar in form and function to what CAT (CT) Scans did for brain surgery.



3D Radar Tomography

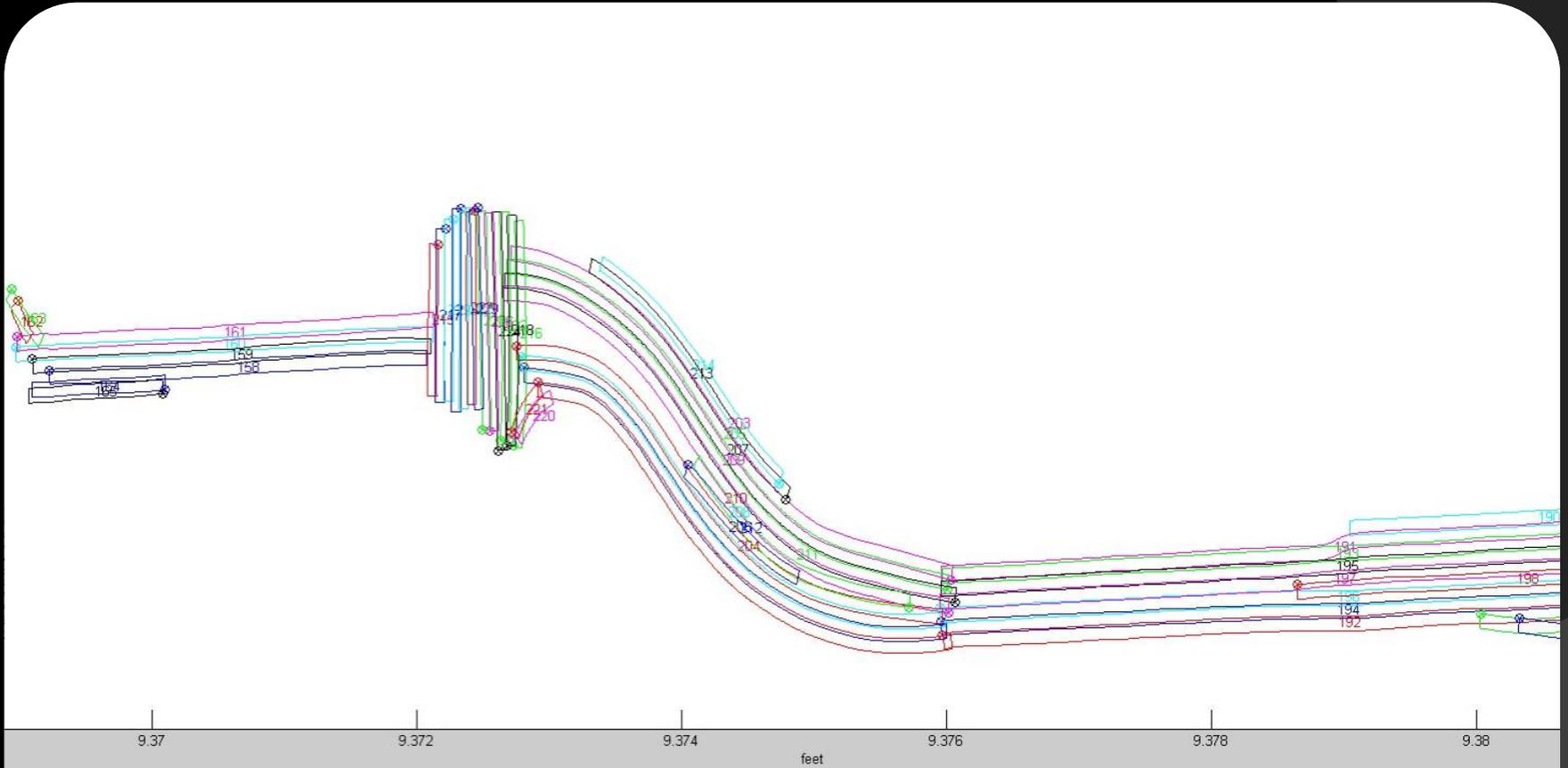
Data collected at 1" intervals



3D Radar Tomography

3D Radar Tomography

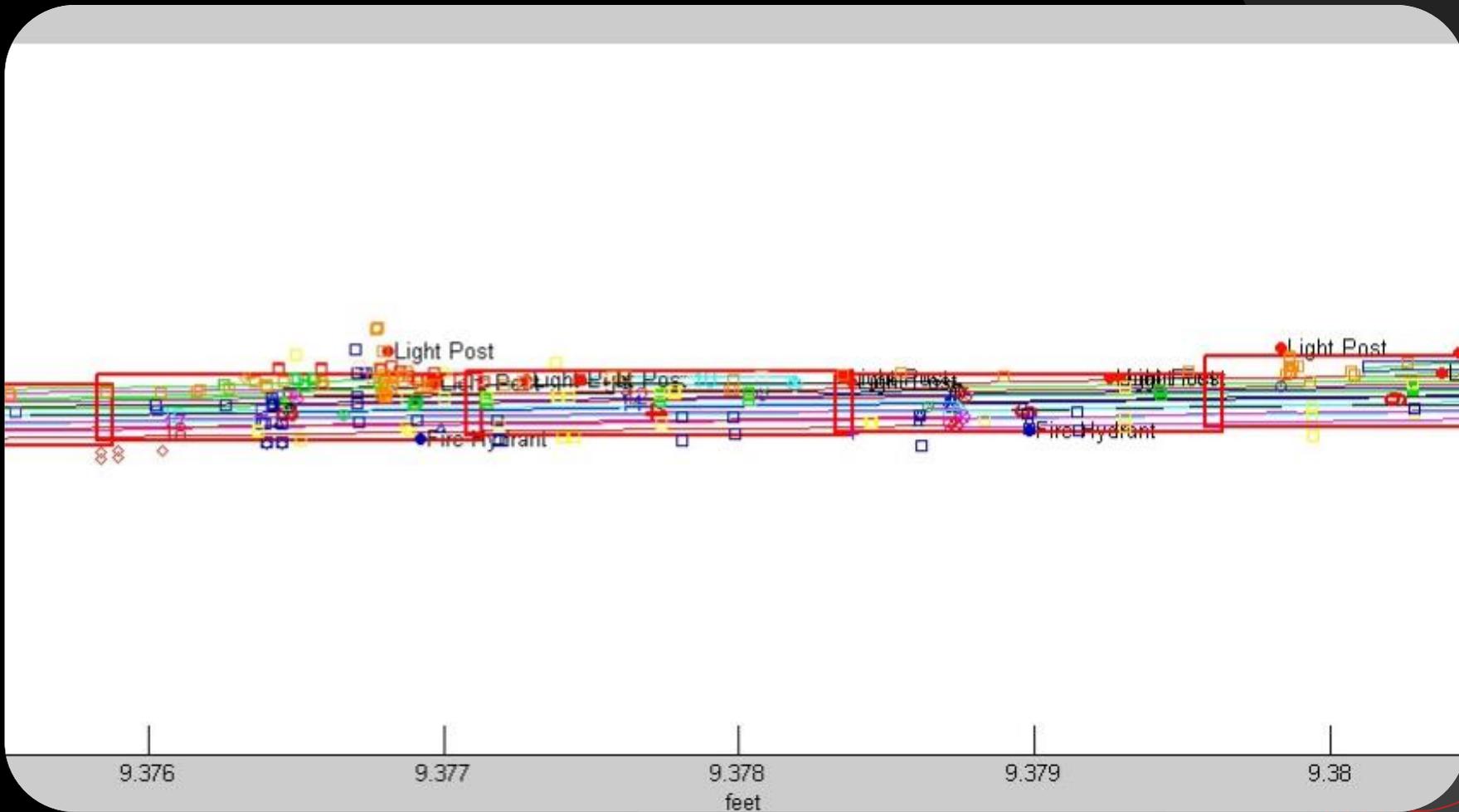
The Process : *field data collection*



3D Radar Tomography

3D Radar Tomography

The Process : *field data collection*

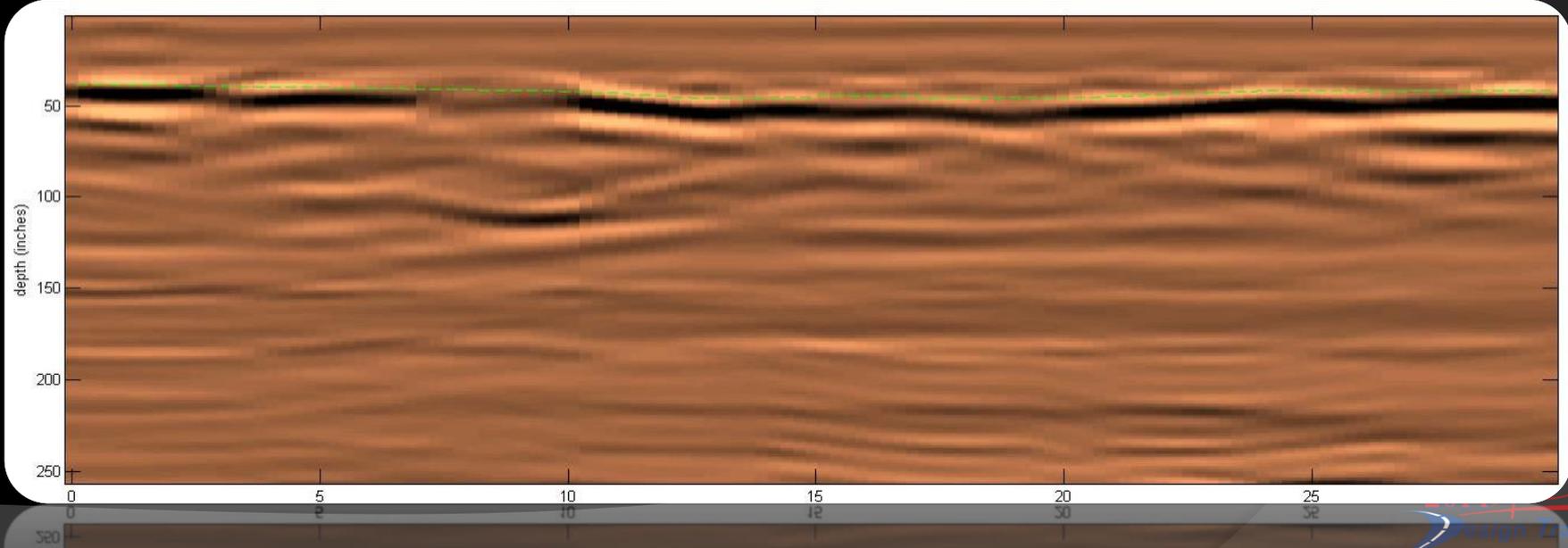
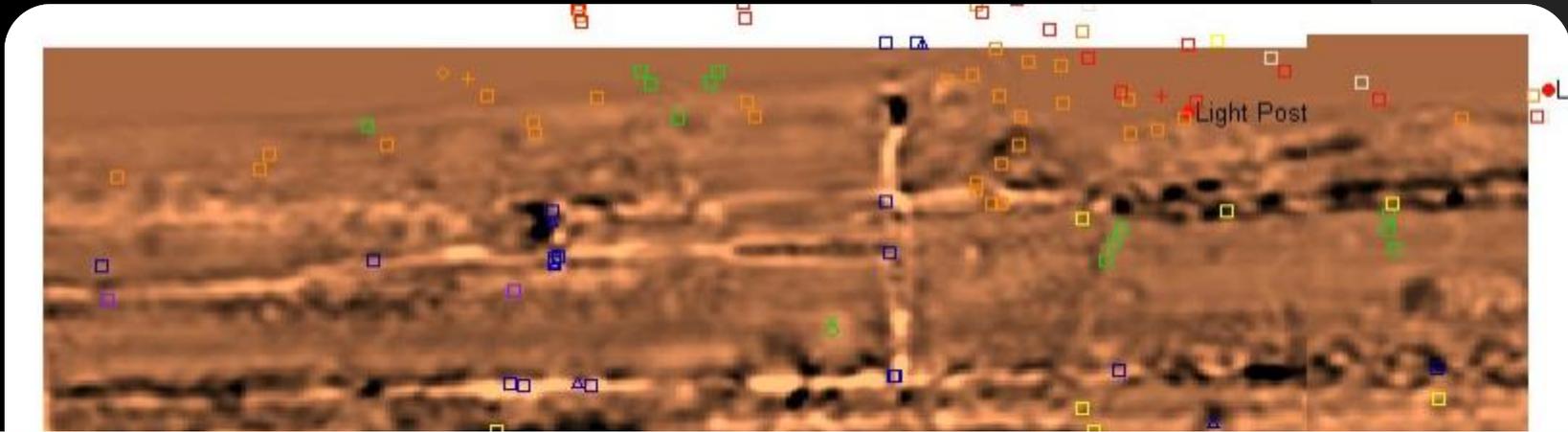


3D Radar Tomography



3D Radar Tomography

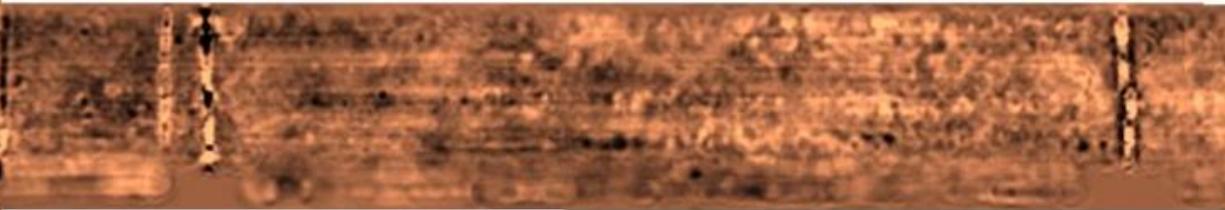
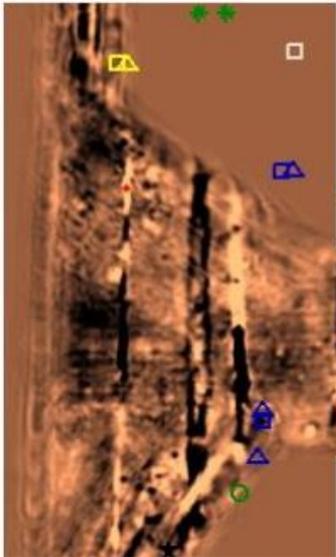
The Process : *processing*



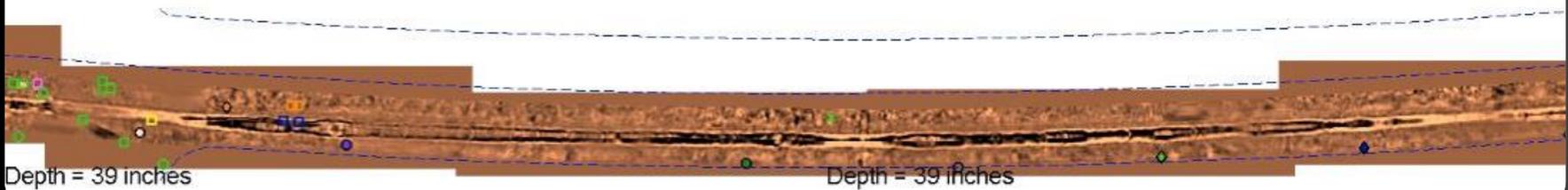
3D Radar Tomography

3D Radar Tomography

The Process : *processing*



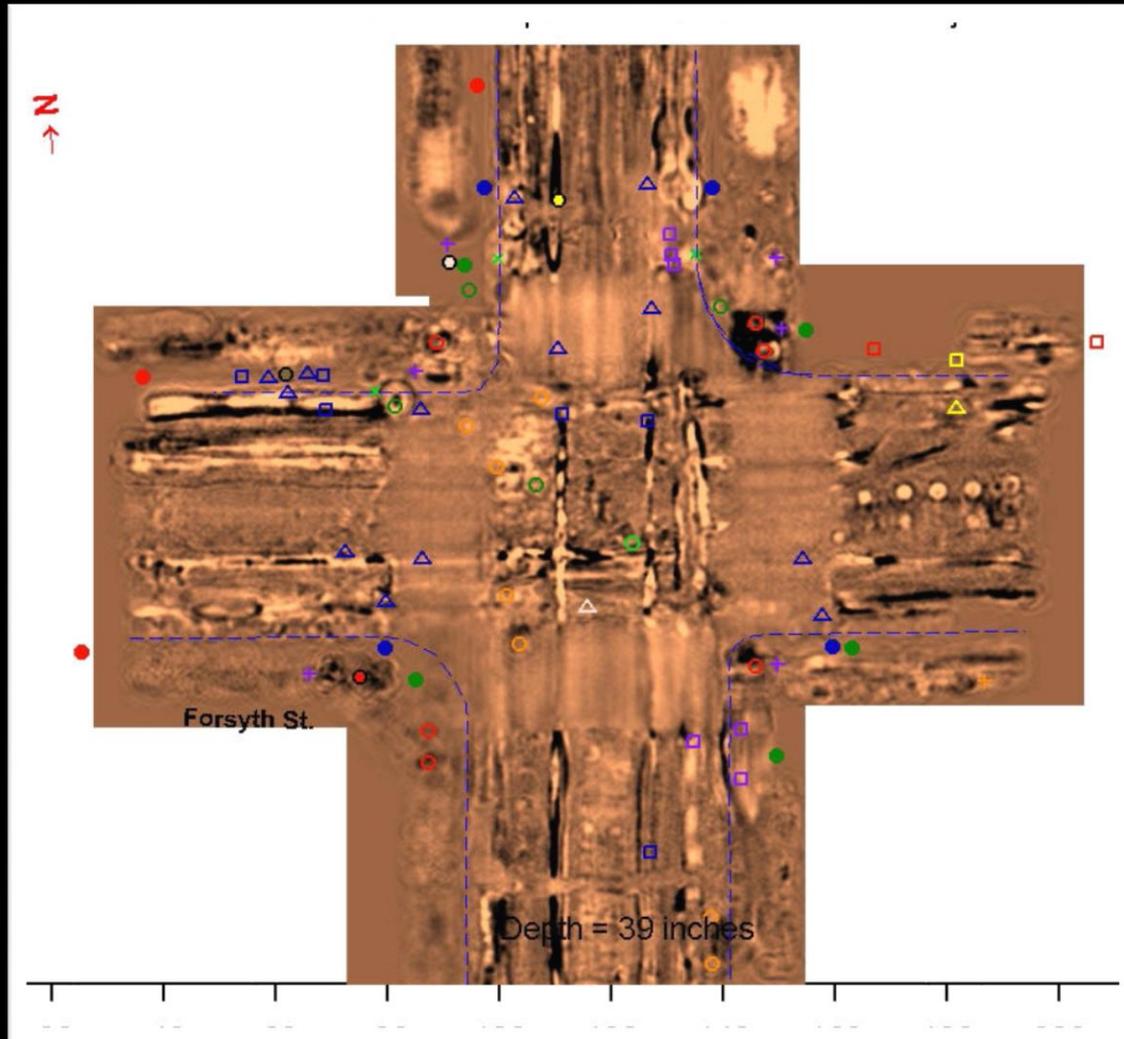
Alton, Miami Beach Raw Data Movie Slice 67 Depth = 39 inches



3D Radar Tomography

3D Radar Tomography

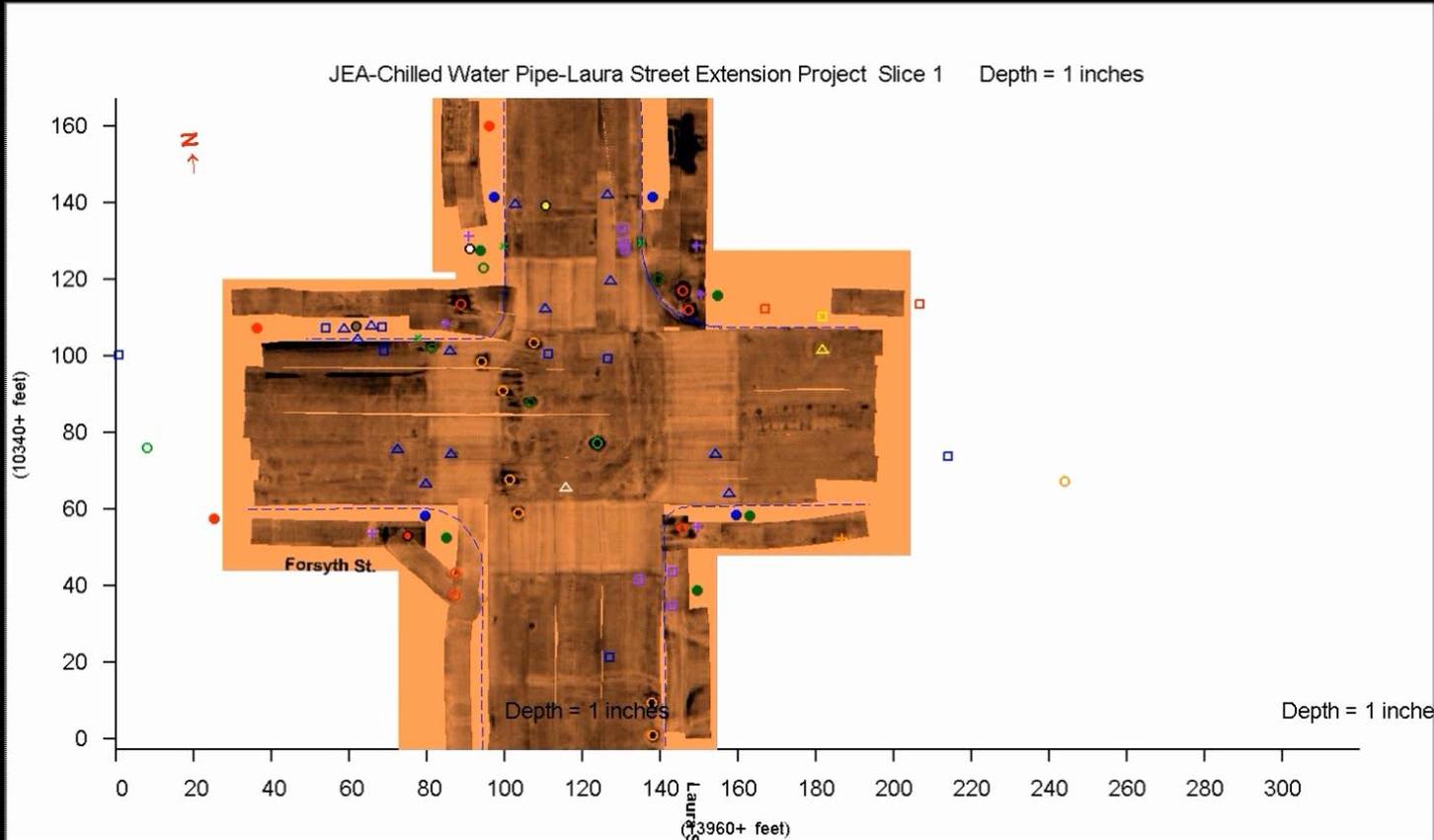
The Process : *processing*



3D Radar Tomography

3D Radar Tomography

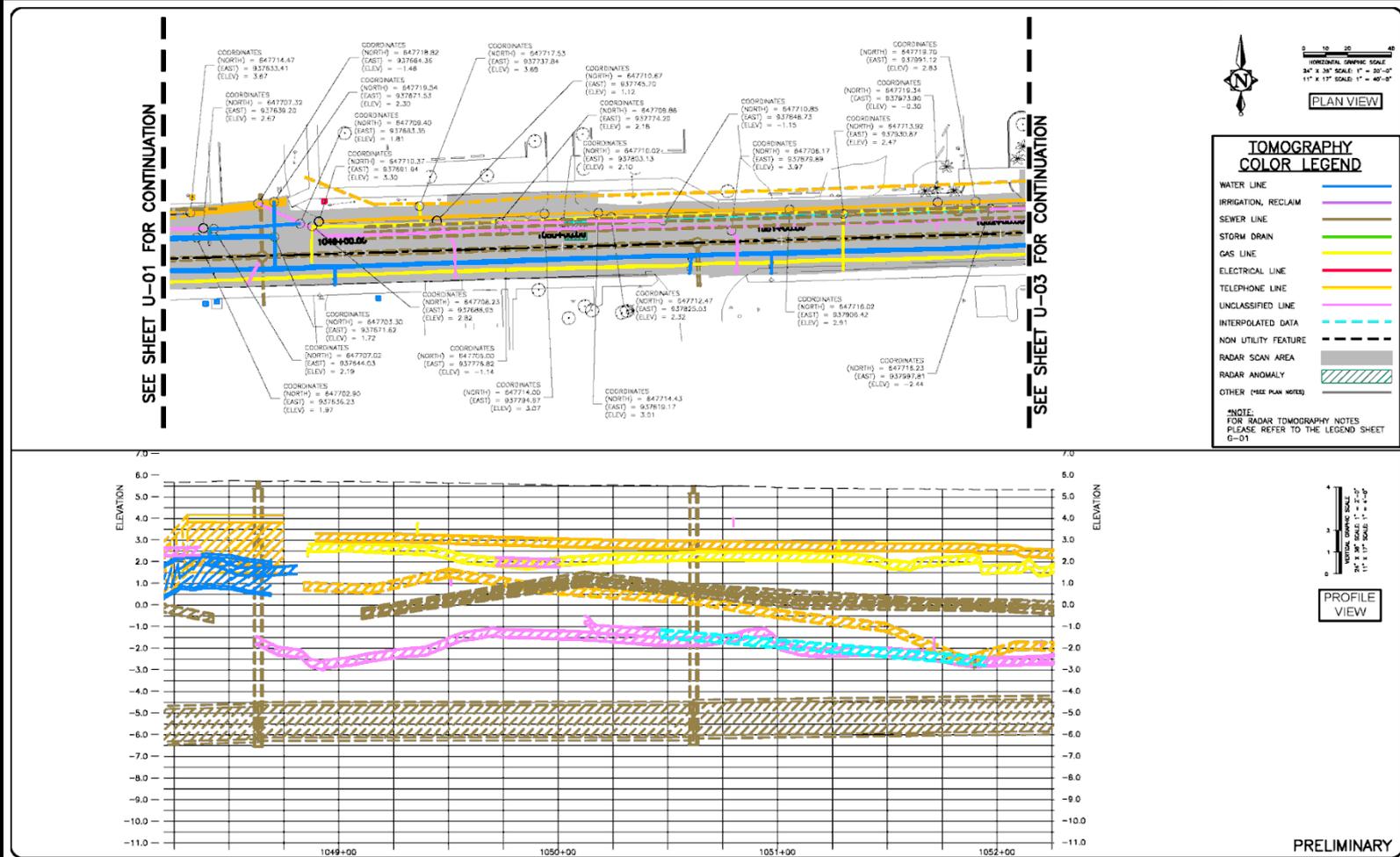
The Process : *output*



3D Radar Tomography

3D Radar Tomography

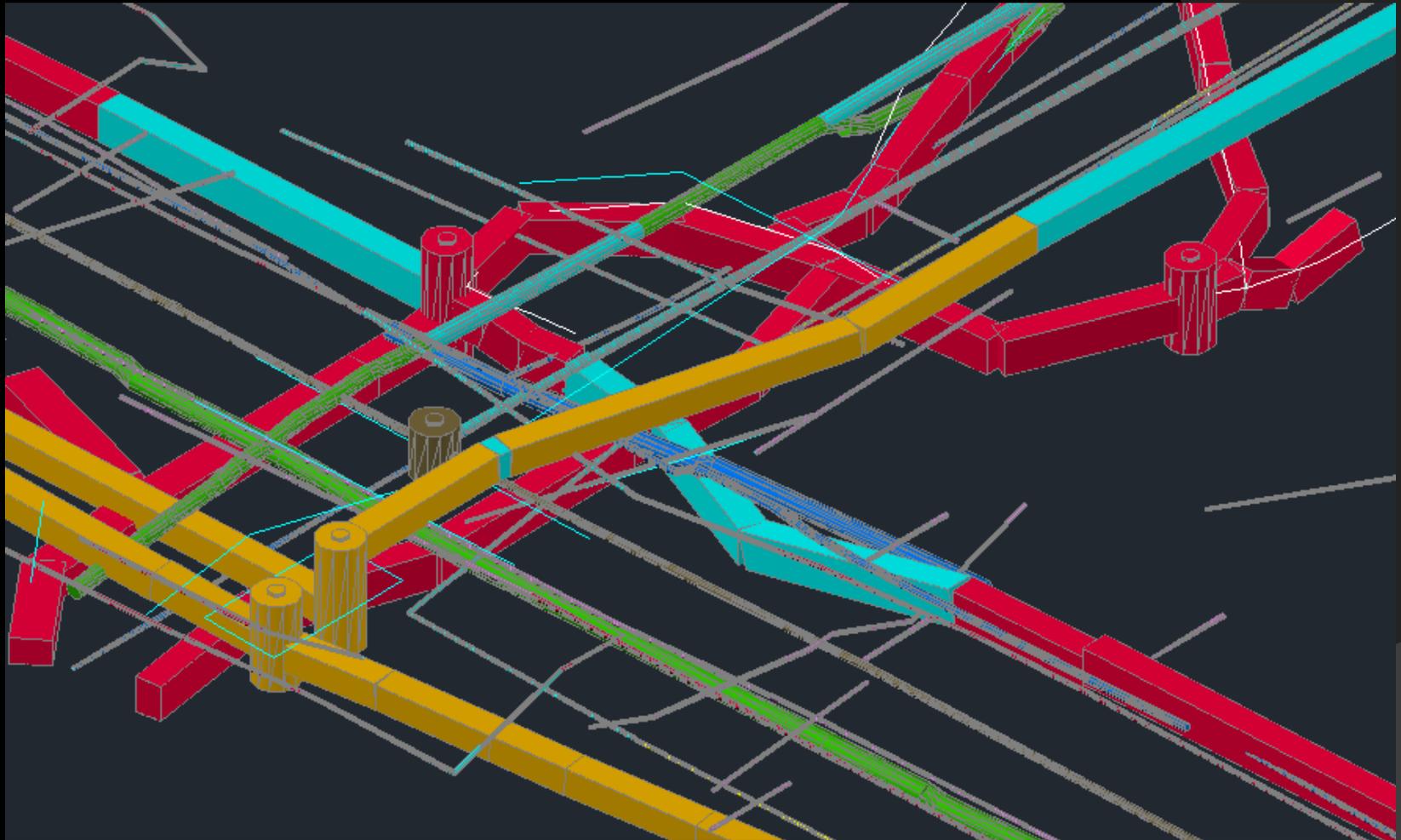
CADD – PLAN & PROFILE SET



3D Radar Tomography

3D Radar Tomography

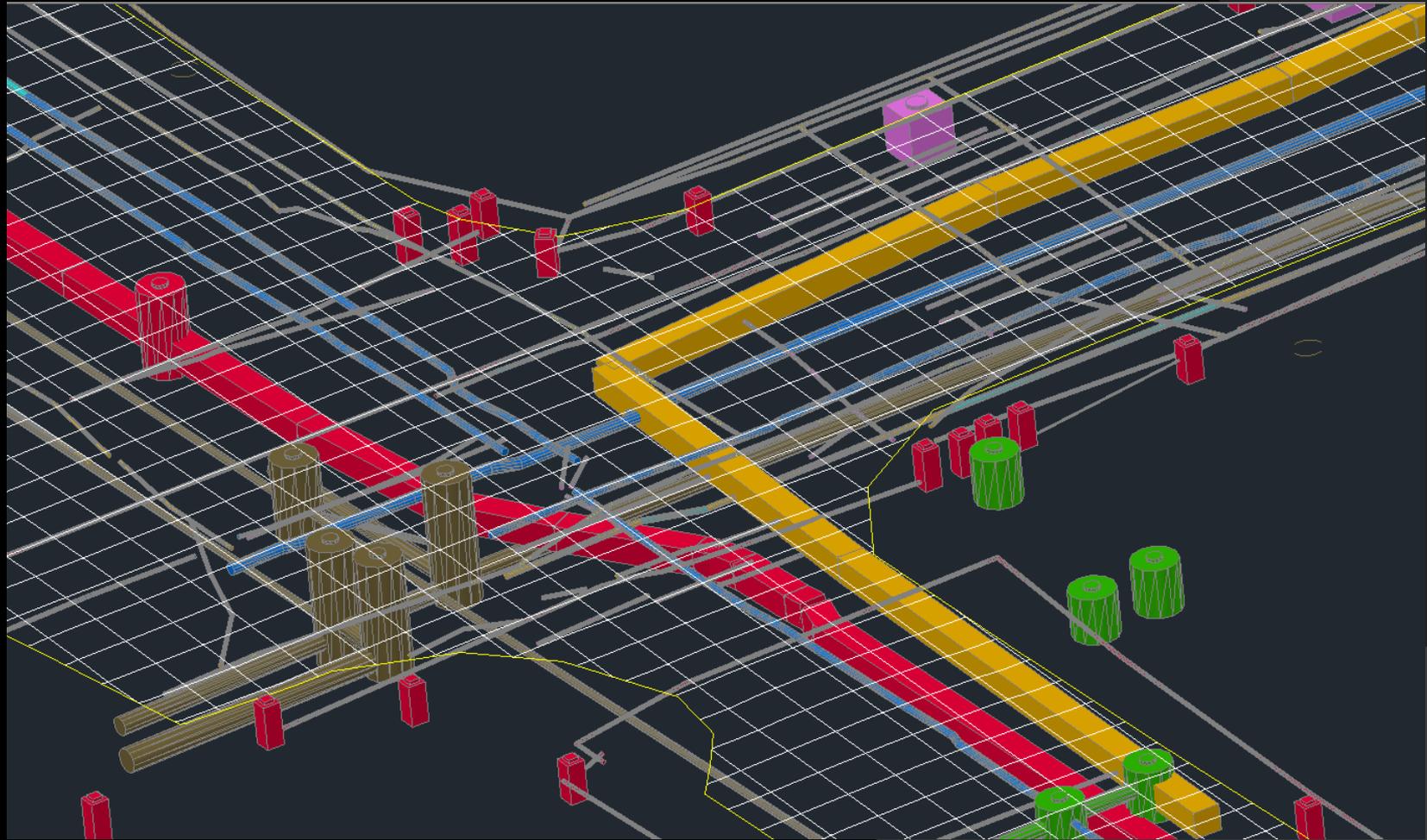
CADD – 3D MODEL



3D Radar Tomography

3D Radar Tomography

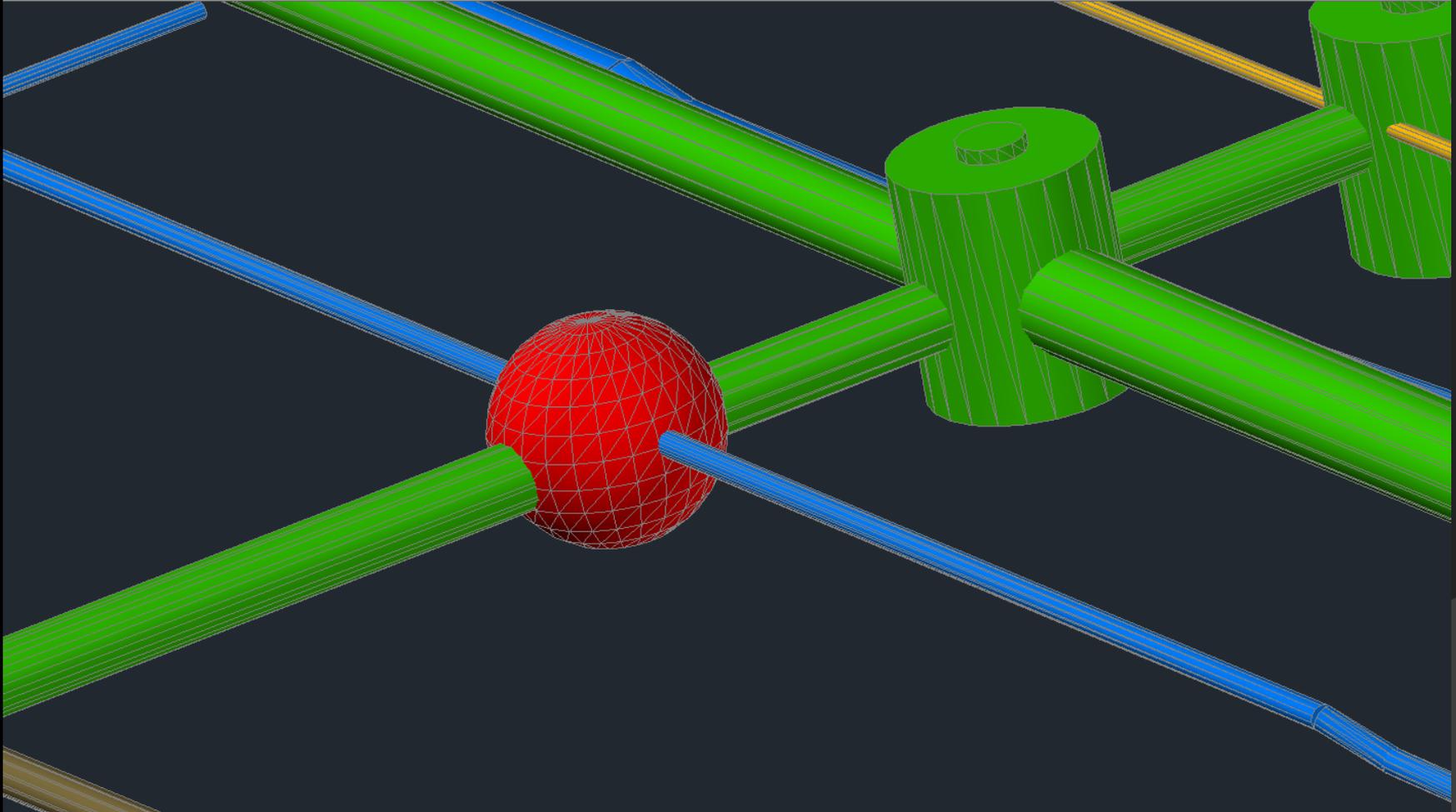
CADD – XML COMPATABILITY



3D Radar Tomography

3D Radar Tomography

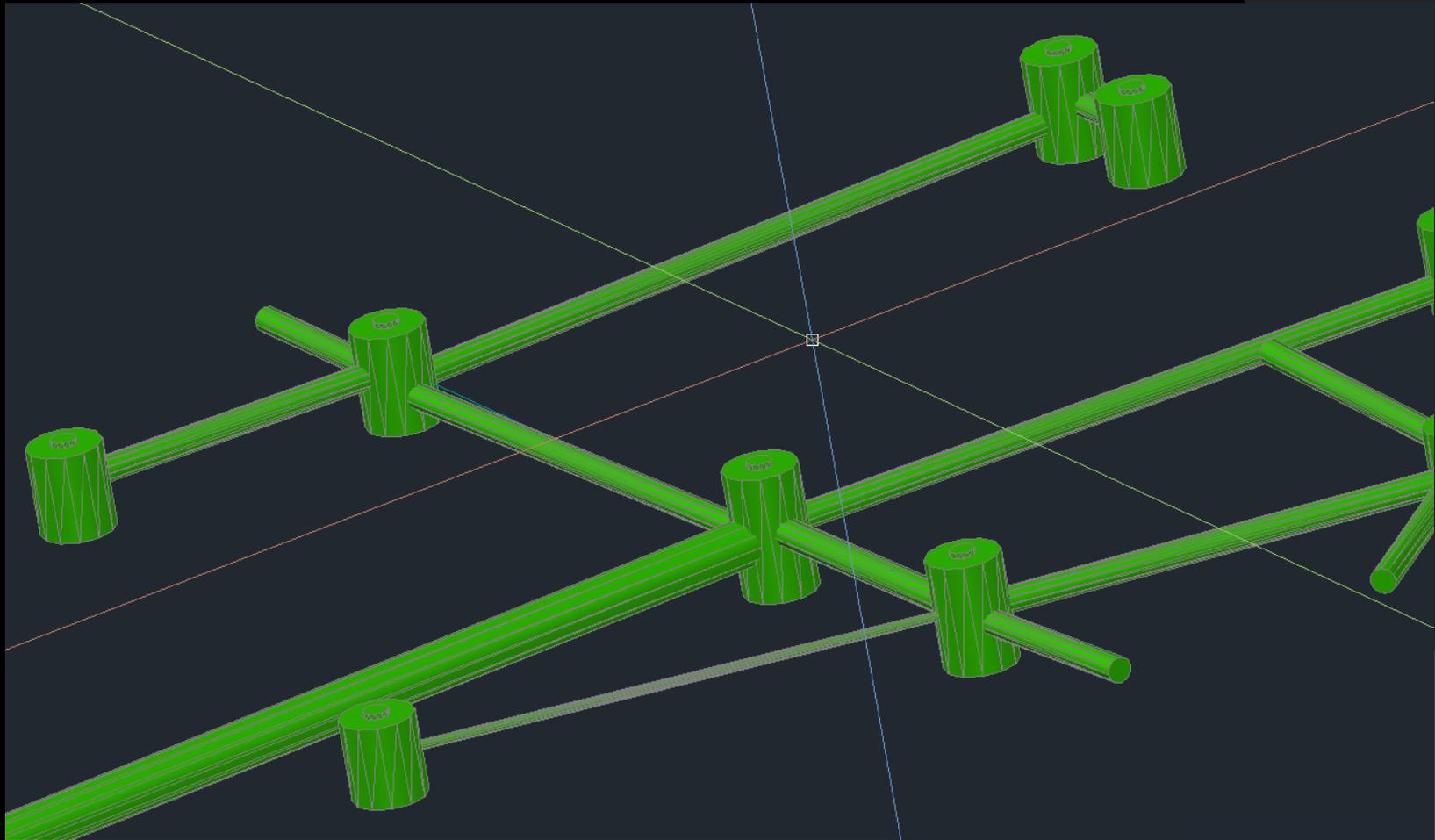
CADD – CONFLICT RESOLUTION



3D Radar Tomography

3D Radar Tomography

CADD – HYDRAULIC MODELING



3D Radar Tomography

3D Radar Tomography

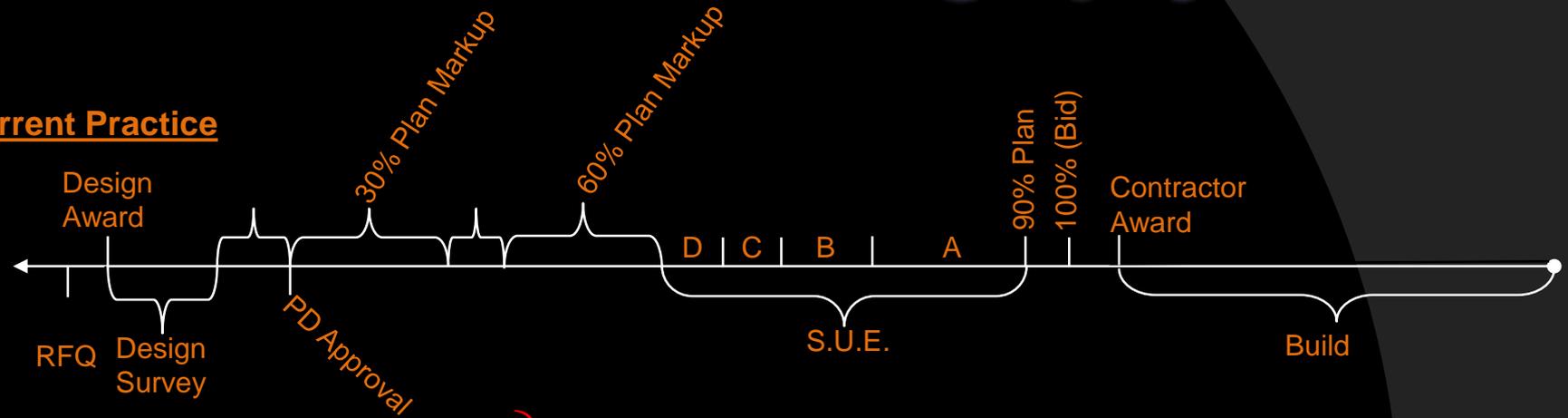
CADD – BIM / SIM

CAS

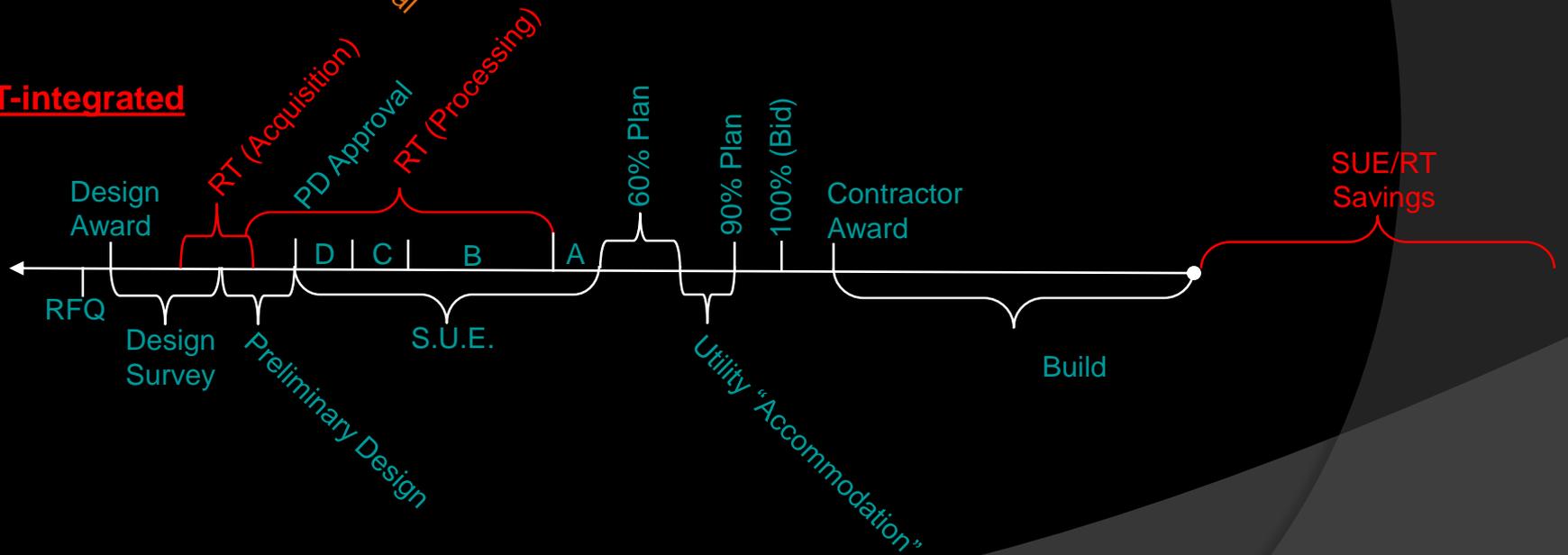
3D Radar Tomography

3D Radar Tomography

Current Practice



RT-integrated



3D Radar Tomography

3D Radar Tomography

~~Traditional~~
~~Survey Style~~



Tasks & Deliverables

Control Survey

Topographic Survey (50' grid)

Level D : Information Gathering

Utility/Brower/Grain Identification

Owner Requests

Level B : Utility Designation (2D)

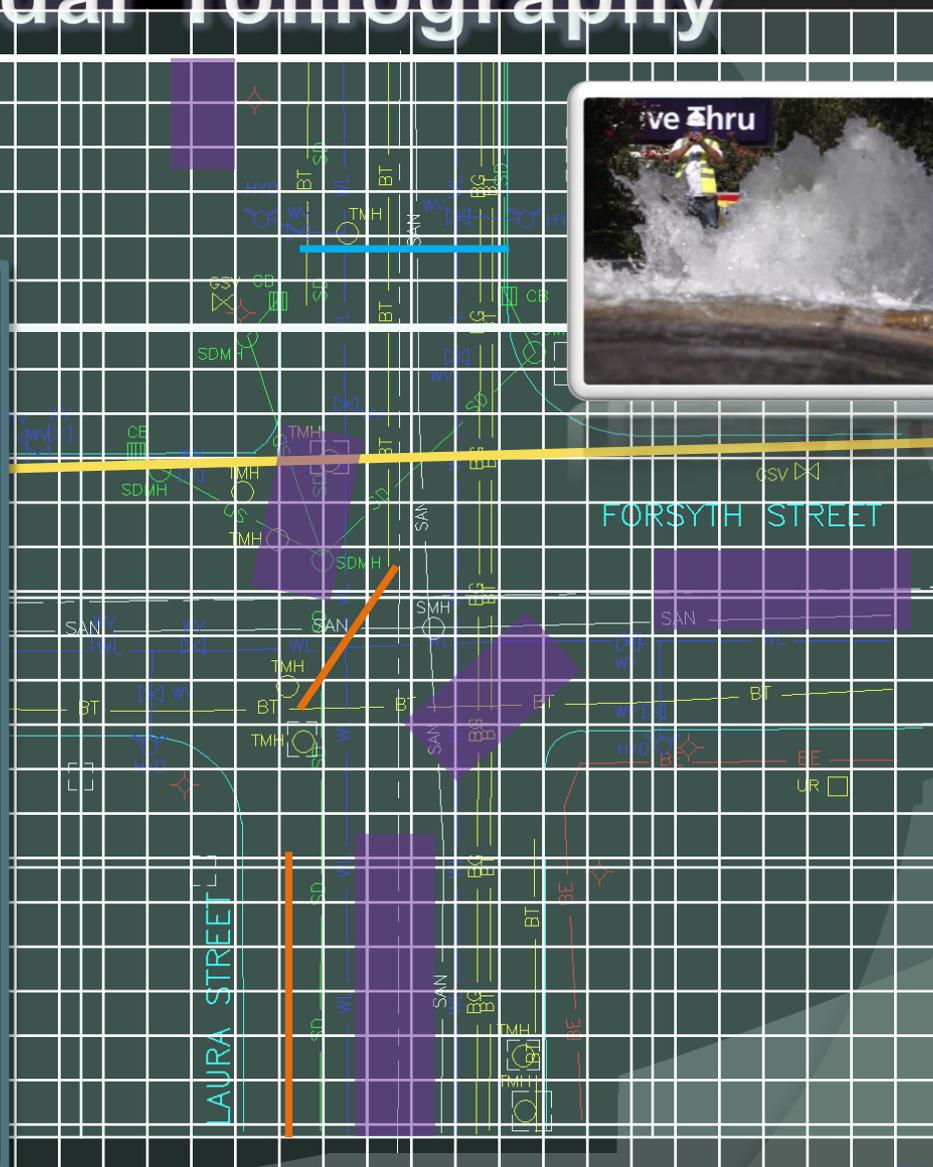
Level A : Softdig
(Utility Exposure)

Total Costs:

\$14,038

(<\$2300 difference)

(coverage 100%)



3D Radar Tomography

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Traditional SUE

FHWA / Purdue University study documents a
\$4.62 return on every \$1 invested

Laura Avenue project projected claims avoidance:
\$67,655

3D Radar Tomography

FDOT study documents a \$12.00 return
on every \$1 invested

Laura Avenue project projected claims avoidance:
\$203,256

3D Radar Tomography



EXTRAORDINARILY precise in all 3 dimensions
to +/- 1"-2" in the horizontal & +/- 4"-5" in the vertical

VERY rapid data acquisition and turnaround
Able to collect upwards of 250,000 sq' / day

Metallic and non-metallic structures
Iron, PVC, concrete...

Geophysical anomalies

Previously unknown structures
Abandoned utilities
Leaks, voids, etc.



3D Radar Tomography

3D Radar Tomography



Dramatically speed up the overall design process

Design staff “designs” with virtually all the subsurface utility data in-hand

Reduces “unforeseen conditions” claims & delays

Significantly fewer redesigns and change orders

Yields faster project completion times

Faster completion = reduced public nuisance

SAVES MONEY!

Squeezes the bid prices by decreasing the “risk factor” applied to contractor bids...saves upwards of 14% on construction costs alone.



3D Radar Tomography

Value Added



3D Radar Tomography

- Continuous Coverage in Scanned Areas
- Minimize Interpolated Data
- Reduce Soft Digs by 90%
- Discovery of Unknown Facilities & Anomalies
- Reduce Subsurface Investigation Time & Cost
- Reduce Potential Construction Claims
- Reduce Liability
- Increased Confidence in Subsurface Facilities
- Reduce Design & Construction Time
- Save Money

Cost Benefits



3D Radar Tomography

- Significantly higher levels of accuracy reduce potential hits and resulting claims
- Return on Investment (ROI) using 3D RT documented at \$12:1 (FDOT) and \$4.62:1 (Purdue Nationwide Study)
- Expedited design, delivery, and compressed schedule

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