Planning for Reality Capture

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Course Introduction

- Description
  - Laser scanning and flying drones can gather lots of data, but what can be done with it? Scanning for existing conditions is easy, but what about site monitoring, steel monitoring, concrete analysis, or installation comparison? Reality capture is often the fastest way to collect the information for these types of activities, but they have to be properly planned for, and strategies need to be in place so that time isn't wasted collecting data that won't be used. This session will focus on planning reality capture activities for success, and developing strategies for making sure the data can be turned into deliverables as quickly as possible.

Course Introduction

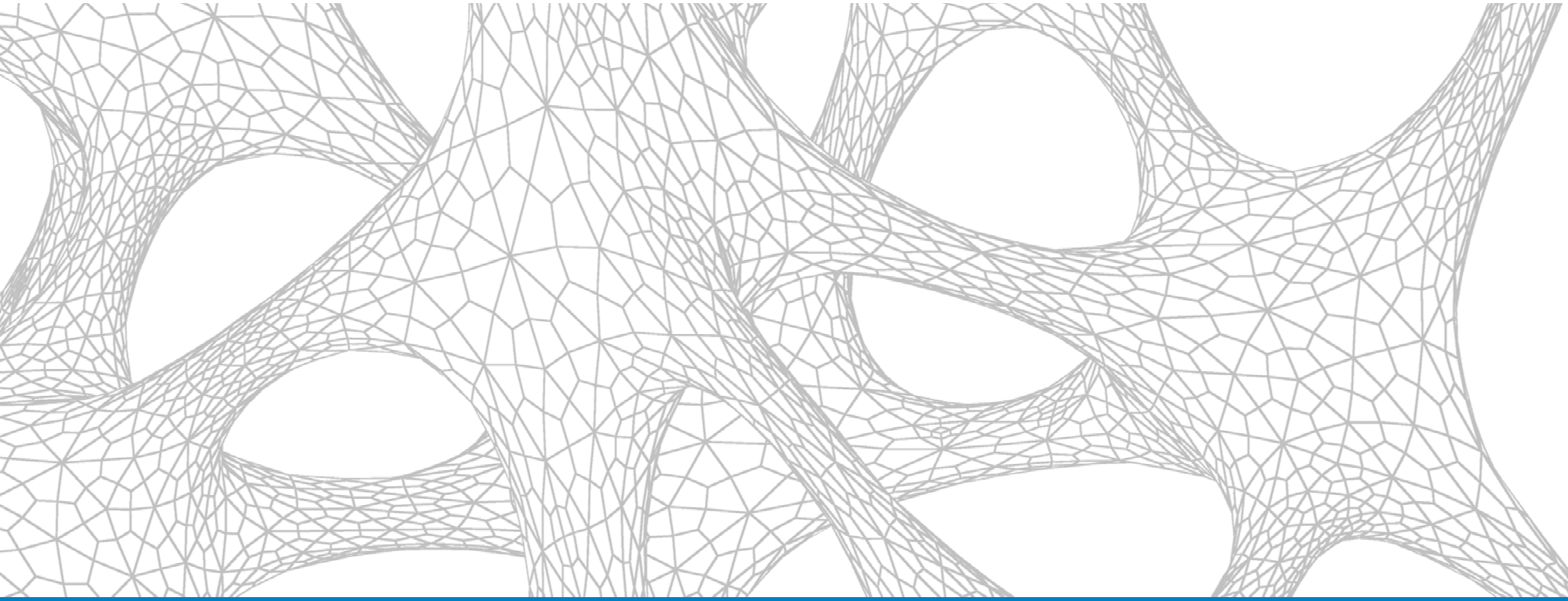
- Learning Objectives
- Learn how to create a Reality Capture Execution Plan
- Learn how to apply strategies for scheduling and planning scans
- Learn how to apply strategies for quick collection of data for deliverables
- Understand basic workflows for reality capture

Introductions

- Nick Dyer
  - I have been with Okland Construction for the past 6 years. I have been working mostly on health care and higher education projects, with some others sprinkled in-between. I have worked on projects in Utah, Arizona, Idaho, Colorado, and Hawaii.
- Okland Construction
  - Okland Construction Company was founded in 1918 in Salt Lake city, Utah. We have offices in Salt Lake City, Utah, Tempe, AZ and Boise, ID and currently have active projects in 19 states. We are a general contractor and have built or are building just about anything you can think of.

Introductions

- These are the tools we at Okland are using:
  - Laser Scanners: FARO X330 Laser Scanner
  - Drones: 3DR Solo and a Phatom 4 Pro
  - Software: FARO Scene, Recap 360 Pro, 3DR Site Scan, Rhthm Builder App, Rhthm Inspector App, Struction Site

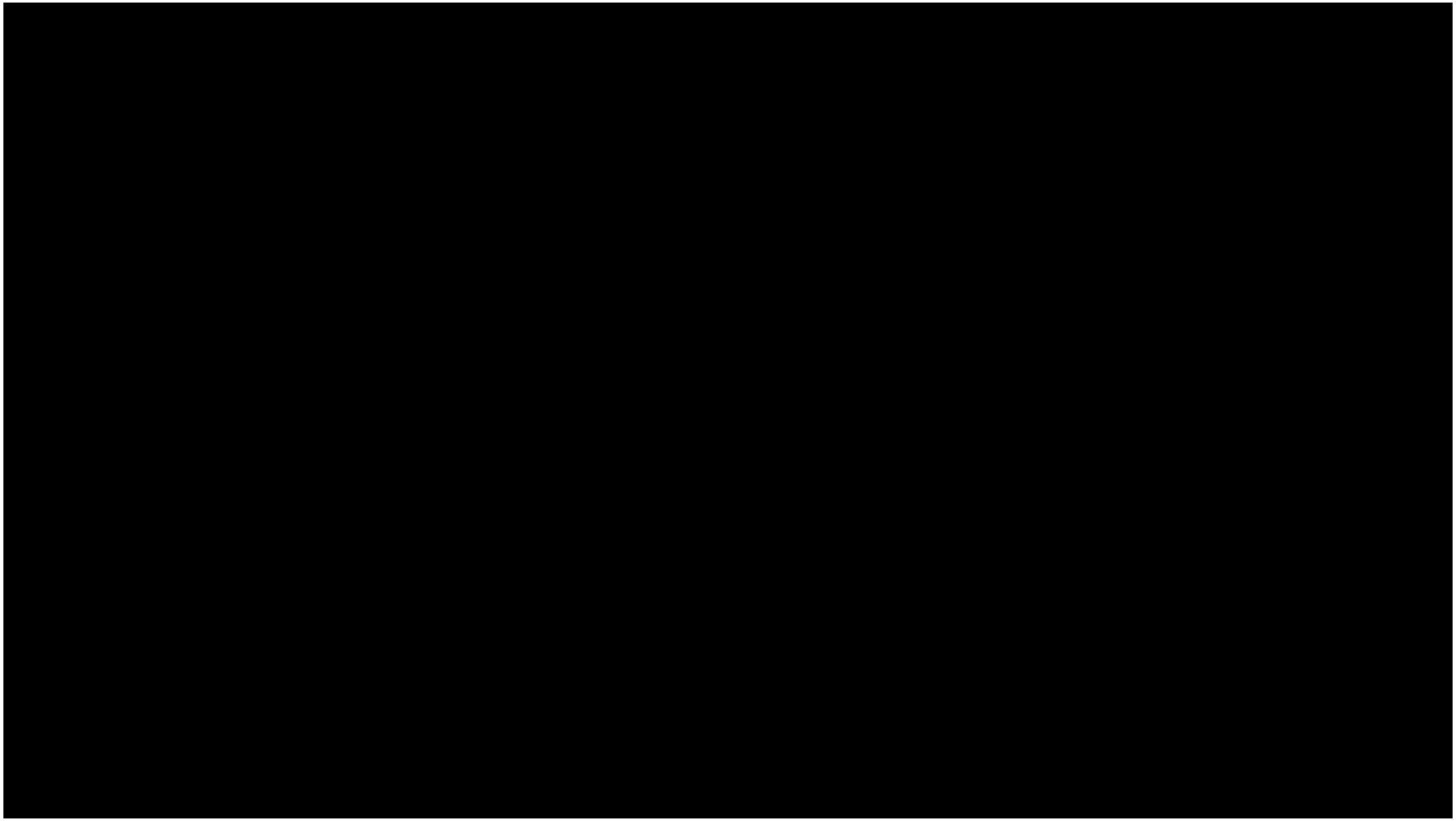


Setting Expectations

What is the purpose of a Reality Capture Execution Plan?

- Provides available services
- Sets timelines for activities and processing
- Sets expectations for all team members
- Works as a catalyst of information for communication

Dealing with Misconceptions



Lauris Beinerts “The Expert (Short Comedy Sketch)” YouTube, 23 March, 2014. Web. 2 November 2017

Dealing with Misconceptions

- We scanned through the foundation walls of to see what was behind them.

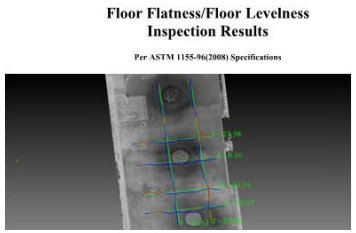
- The point cloud will automatically show you the structural problems with your parking structure

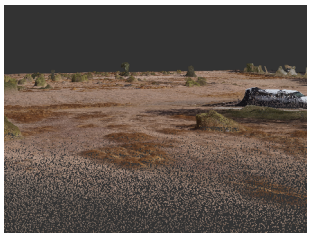
- A laser scan will create a model of your existing conditions

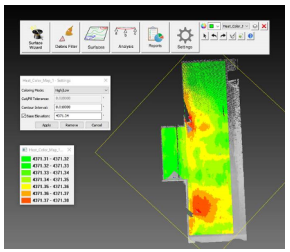
- Using a drone is more accurate than calling blue stakes

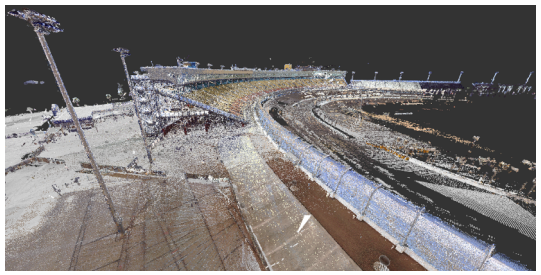
Dealing with Misconceptions

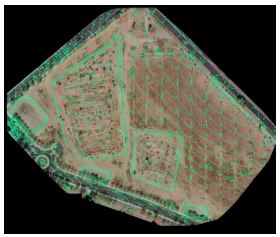
- If you don’t set the expectation, somebody else will.
- Somebody, means everybody
- Your plan or guide should promote transparent communication
- Examples speak much louder than words

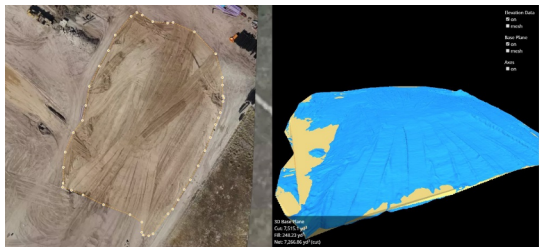


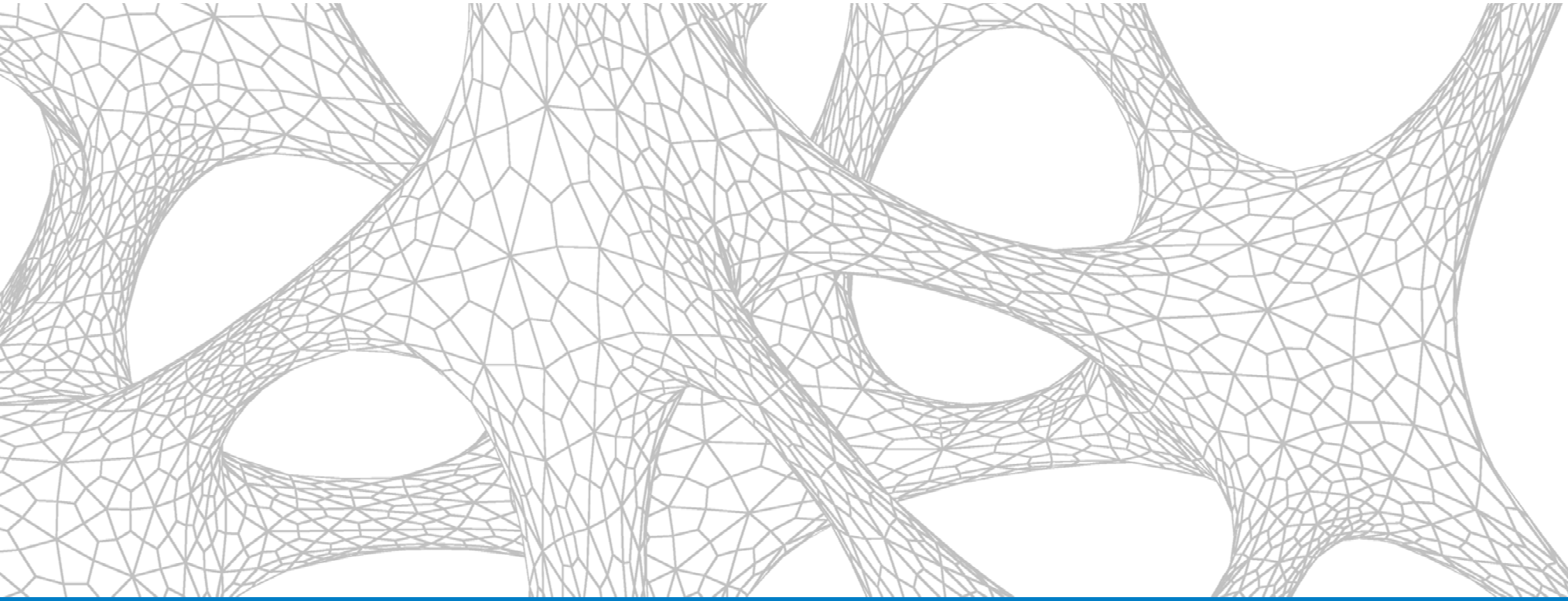












Building your Reality Capture Execution Plan

The administrative Stuff

- Straight Froward, just a few things to formalize the plan
  - Project Name
  - Owner
  - Project Address
  - Area of project to be captured
  - Airspace, if needed
  - Others?
- Questions
  - Is this an internal plan or are you contracting with an outside firm?
  - Does that change expectations?

What's on the Menu?

- Assuming you are the person in charge of providing the service, creating a menu will force you to think about 2 major points:
  - 1) It will force you to think through your internal process so you are asking the correct questions
  - 2) It will force you to standardize your deliverables so they can be easily repeated on multiple projects

What's on the Menu?

- As the project team, a menu provides and forces you to think about:
  - What kind of deliverable is valuable to my project
  - What is the correct timing
  - What is the correct time table
- It will also force project teams to start asking questions. Thus, kicking off the conversation to a complete execution guide.

Menu Items

- At a minimum, your menu items should address the following items.
- Can you think of other items that may be important?
  - To you?
  - Your company?

- Equipment Cost
- Labor Cost
- Time Estimating
- Schedule
- Permits or Documents
- Survey Control
- Deliverable
- Software to read deliverables
- Limitations

Menu Items

- Equipment Cost
  - Do you need to rent? Do you own the equipment?
  - Usually a straight forward cost just to cover equipment
- Labor Cost
  - Usually just the hourly rate charged for you and your counterparts to perform the work.
- Time Estimating
  - Estimating the time it will take to perform the work, so you have a transparent cost of the work

Menu Items

- Schedule
  - Is the activity recurring?
  - Is this just a one time deal?
  - When will the activity take place?
- Permits or Documents
  - FAA?
  - Laser permits?
  - Public Notifications?

Menu Items

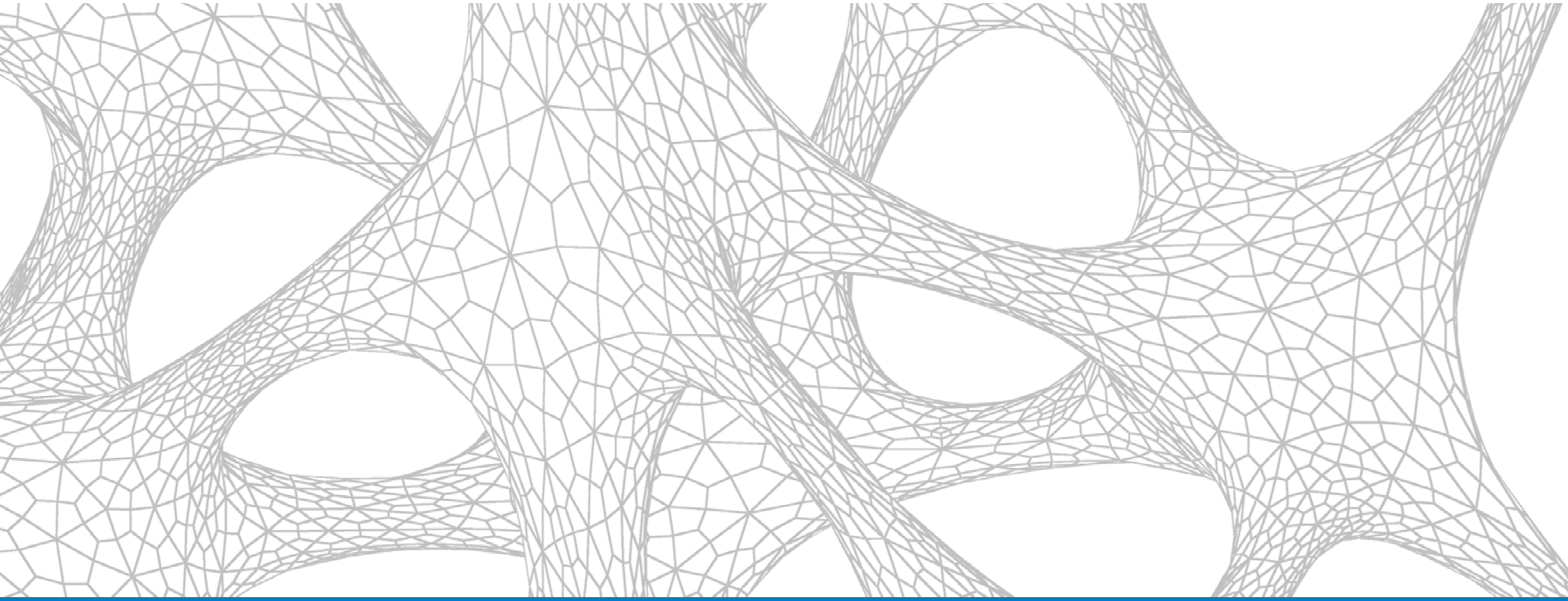
- Survey Control
  - Most activities will be made exponentially better by use of control points.
  - Targets are the best practice.
- Deliverable
  - Explain in text what the final deliverable will be
  - ALWAYS provide examples and/or step the project team through an example deliverable so they can experience it before you perform the work.

Menu Items

- Deliverable file types
  - This may or may not matter to your project team, but if you are providing your data to a subcontractor, it will be important to them.
- Required Software
  - Unless the deliverable is a PDF, it probably requires a viewer or some kind of special software to be viewed. Just make sure everyone involved has the software before you perform the work.

Menu Items

- Limitations
  - This section will probably evolve as you become aware of more misconceptions.
  - Some easy ones to place here are:
    - If something is not exposed, it will not be captured
    - Files size can get large and difficult to share.
    - Areas of interest need to be free of people and moving vehicles as much as possible.
    - Too much noise will provide inaccurate results

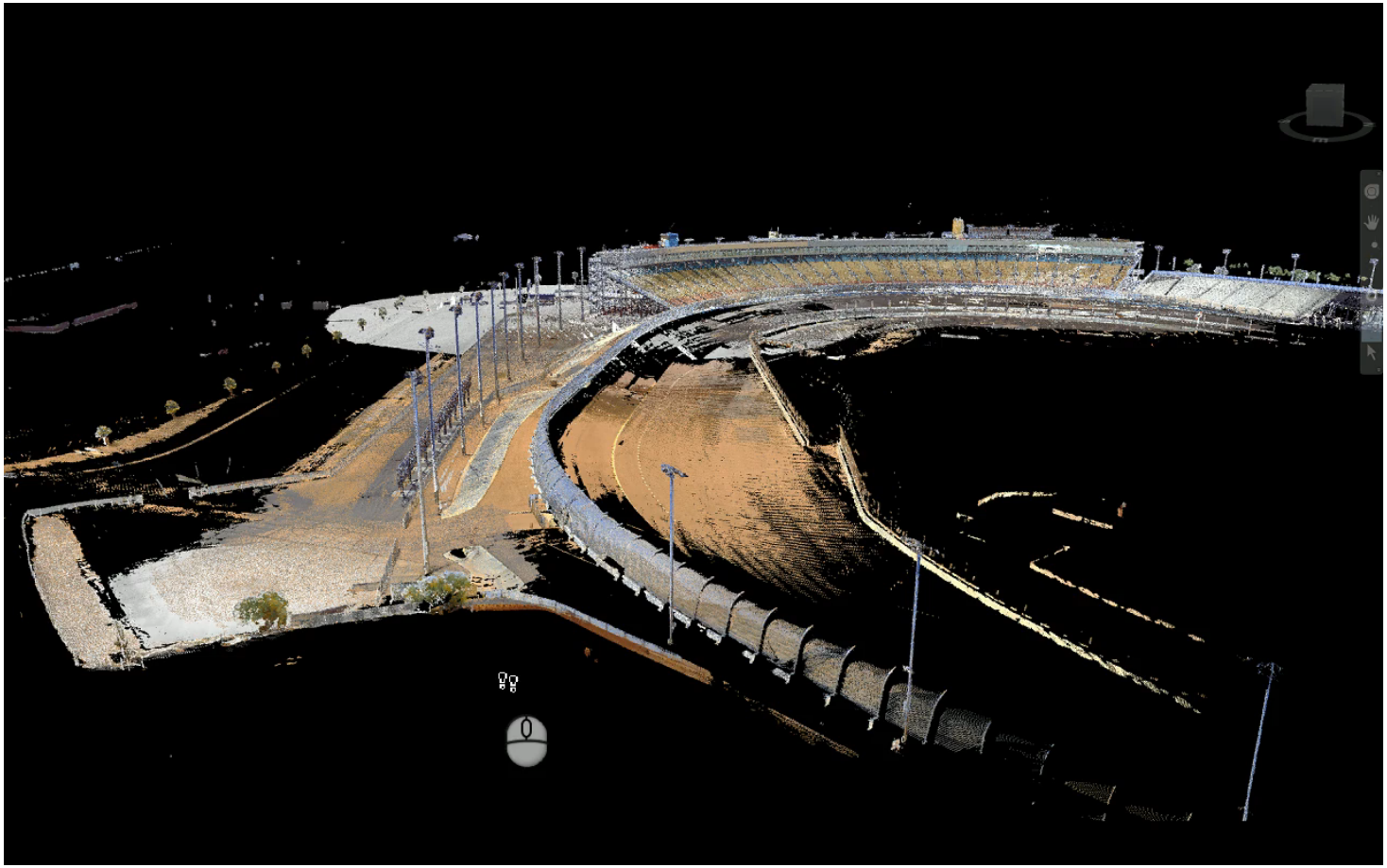


Example Menu Items

Laser Scanning an Existing Facility

- **Equipment Cost:** $100/Half day, $200/Day, $600/Week
- **Labor Cost:** $95/Hour
- **Time Estimate:** Varies per building, consult ICT
- **Schedule:** Dates based on time needed for scanning and processing
- **Permits or Documents:** are any needed?
- **Control:** GC provided targets, data provided by?
- **Deliverable:** Registered point cloud provided an external hard drive
- **Deliverable File Types**: .fls, .pts, .rcs, .rcp,
- **Required Software:** Faro Scene LT, Recap 360, Navisworks, Revit, AutoCAD
- **Limitations:** If something is not exposed, it will not be scanned. File types can get very large.

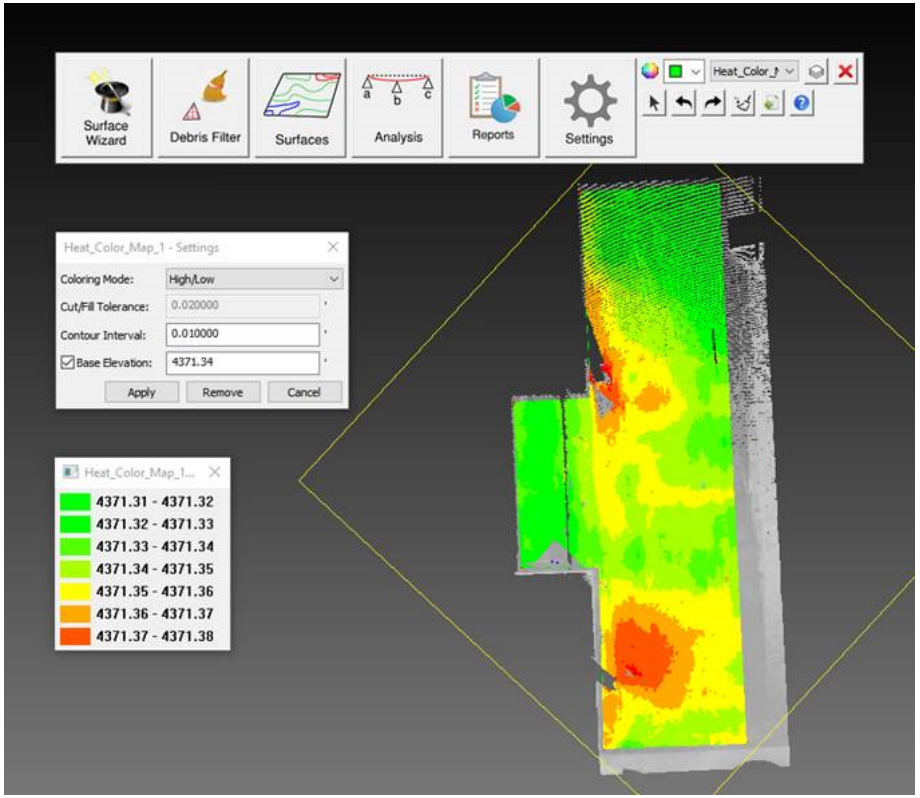
Laser Scanning and Existing Facility

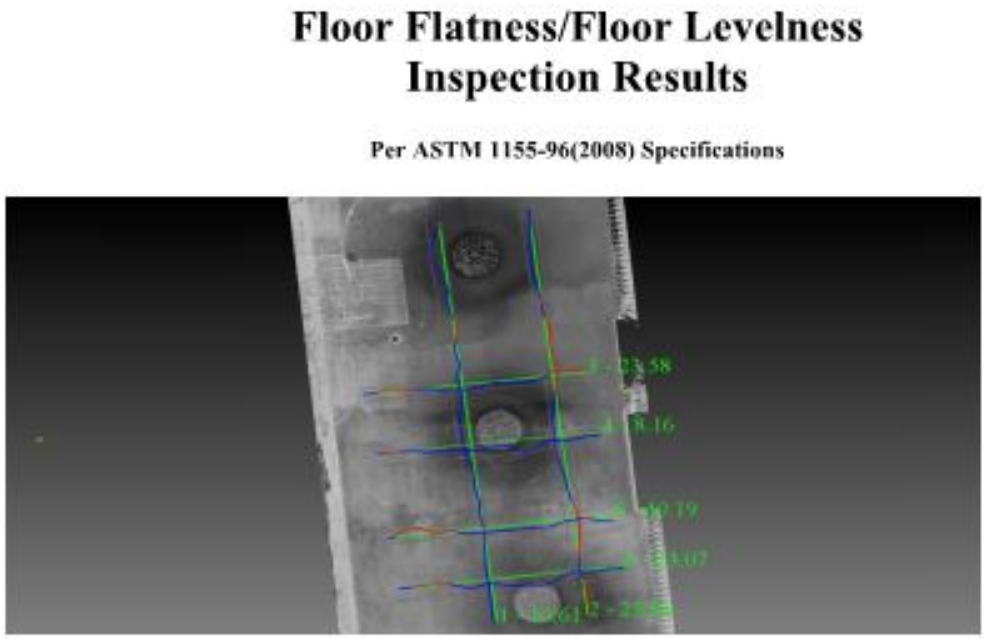


Floor Flatness/Floor Levelness (FF/FL)

- **Equipment Cost:** $100/Analysis
- **Labor Cost:** $95/Hour
- **Time Estimate:** Plan for travel + 2 hours for each data collection +3 hours for each analysis
- **Schedule:** Needs to be scheduled for same day as each slab on deck pour
- **Permits or Documents**: are any needed?
- **Control:** GC provided targets, data provided by?
- **Deliverable:** PDF report of analysis, electronically delivered via e-mail or download link.
- **Deliverable File Types:** .pdf
- **Required Software:** Bluebeam or Adobe
- **Limitations:** In order for results to be accurate, the concrete must swept and free of obstacles.

Floor Flatness/Floor Levelness (FF/FL)

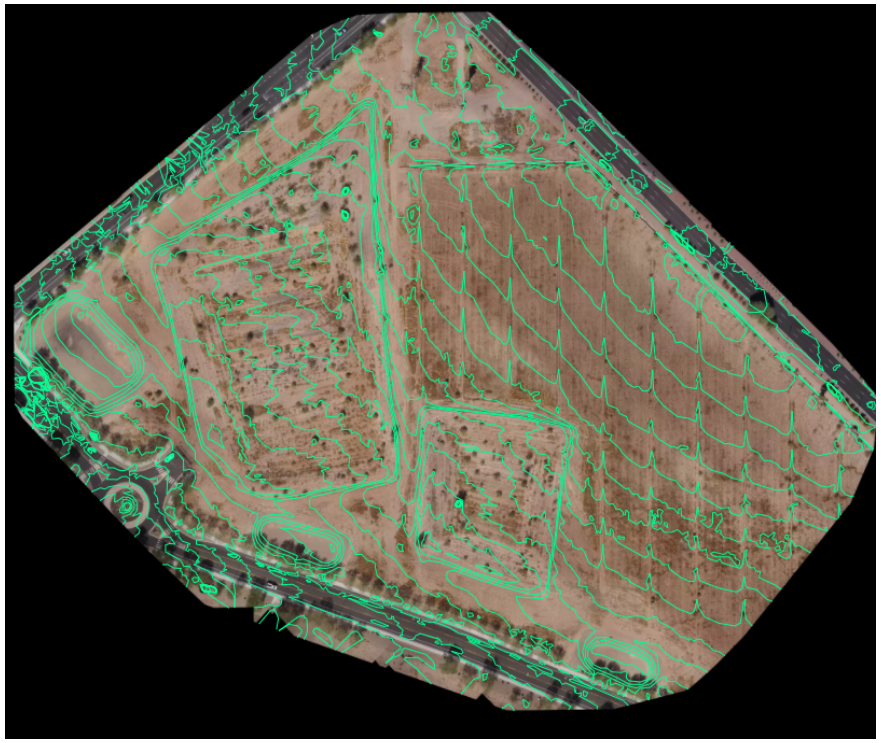


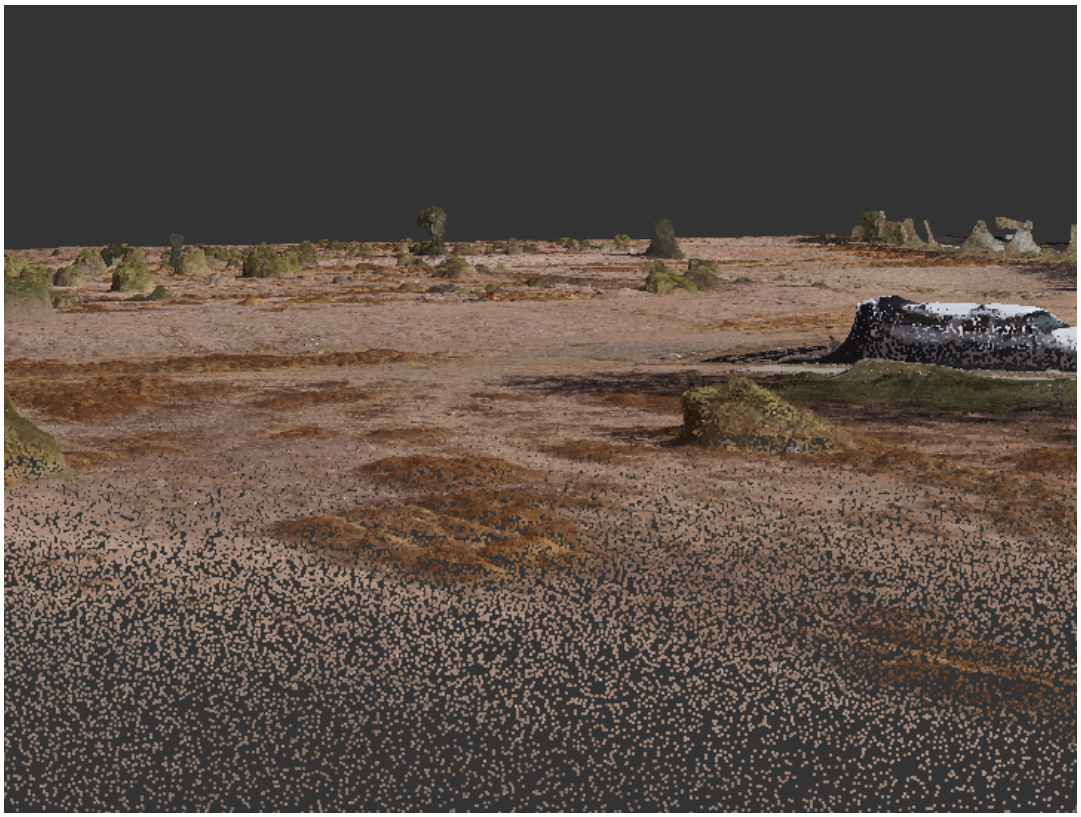


Aerial Survey

- **Equipment Cost:** $100/Day
- **Labor Cost:** $95/Hour
- **Time Estimate:** Plan for equipment + Travel + data collection time + 3 hours for processing data + additional time based on desired deliverable file type.
- **Schedule:** recurring once/weekly/monthly?
- **Permits or Documents:** FAA documents? airspace?
- **Control:** GC provided targets, data provided by?
- **Deliverable:** Images, Image Map, Contour Lines, and/or Point Cloud, items can be sent via download links or on an external hard drive.
- **Deliverable File Types:** .jpeg, .tiff, .shx, .dxf, .rcs, .rcp, .las, or .pts
- **Required Software:** Image Viewer, Recap 360, AutoCAD, Revit, or Navisworks
- **Limitations:** If something is not exposed, it will not be scanned. File types can get very large.

Aerial Survey

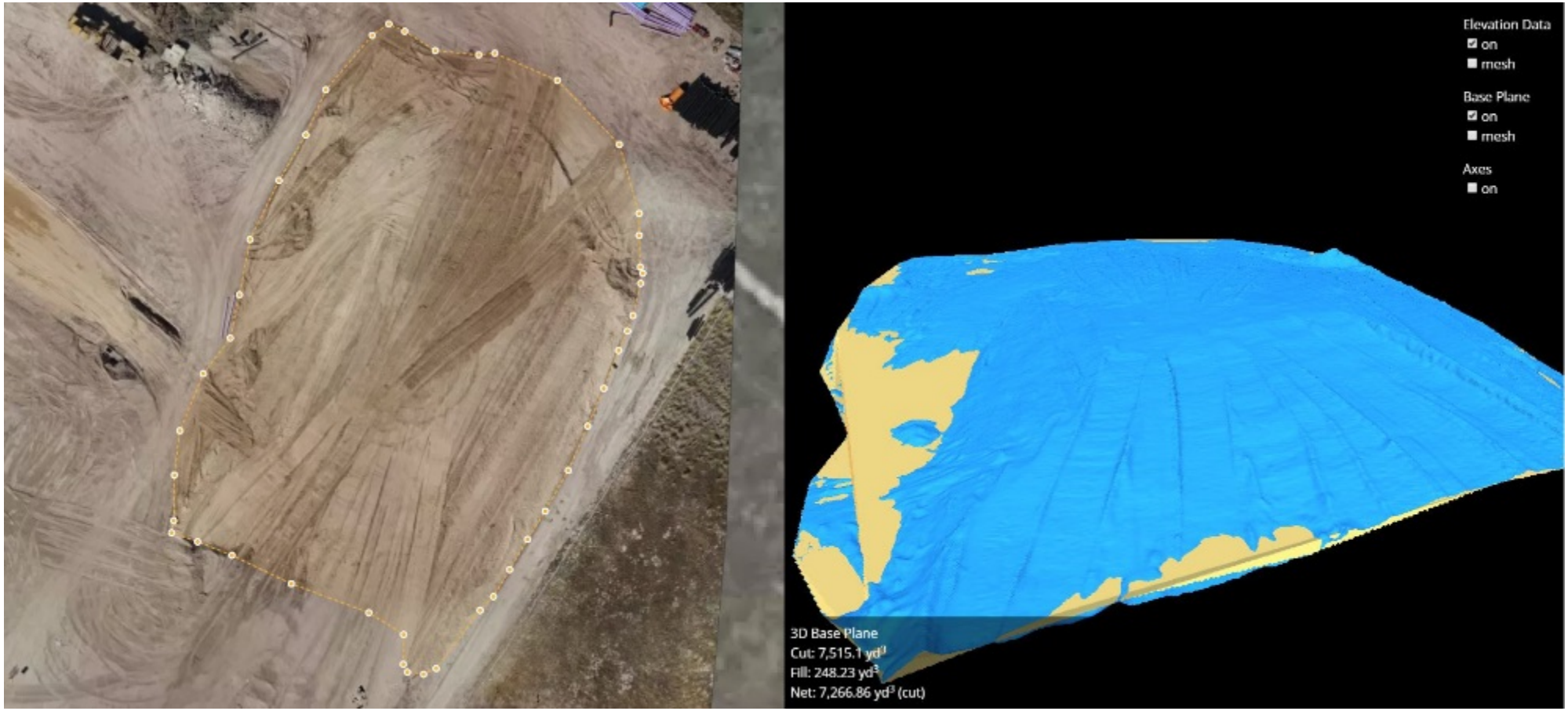




Soil Monitoring

- **Equipment Cost:** $100/per day
- **Labor Cost:** $95/Per Hour
- **Time Estimate:** Travel + 3 hours data collection and processing data
- **Schedule:** recurring once/weekly/monthly?
- **Permits or Documents:** FAA documents? airspace?
- **Control:** Okland provided targets, data provided by?
- **Deliverable:** PDF of analysis report delivered electronically via e-mail or download link.
- **Deliverable File Types:** .pdf
- **Required Software:** Bluebeam or Adobe
- **Limitations:** Areas of interest need to be free of people and moving vehicles as much as possible. Too much noise will provide inaccurate results. If the soil is dark, direct sunlight is needed to provide accurate results.

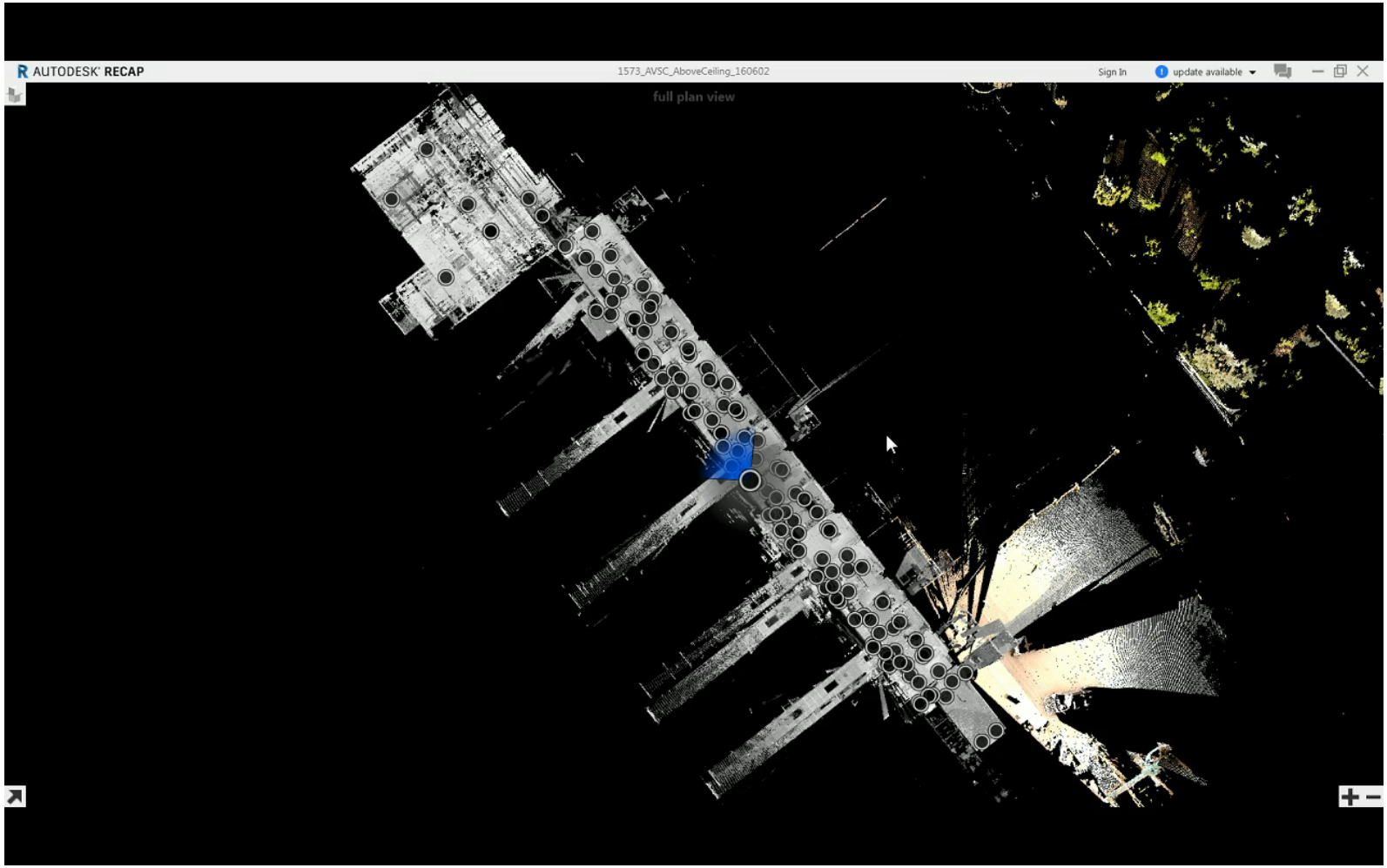
Soil Monitoring



360 Map: Measurable Photos

- **Equipment Cost:** $100/Half day, $200/Day, $600/Week
- **Labor Cost:** $95/Hour
- **Time Estimate:** Plan 15 images/half Day, 30 Images/day + Travel + 1 additional days' worth of labor per day of data collection.
- **Schedule:** recurring once/weekly/monthly?
- **Permits or Documents:** are any required?
- **Control:** Not Needed
- **Deliverable:** Recap file with linked 360 photographs delivered electronically via a download link if the file size is small enough. If the file size is too large it will be delivered on an external hard drive.
- **Deliverable File Types:** .rcp or .rcs
- **Required Software:** Recap 360
- **Limitations:** If something is not exposed, it will not be captured. Files size can get large and difficult to share.

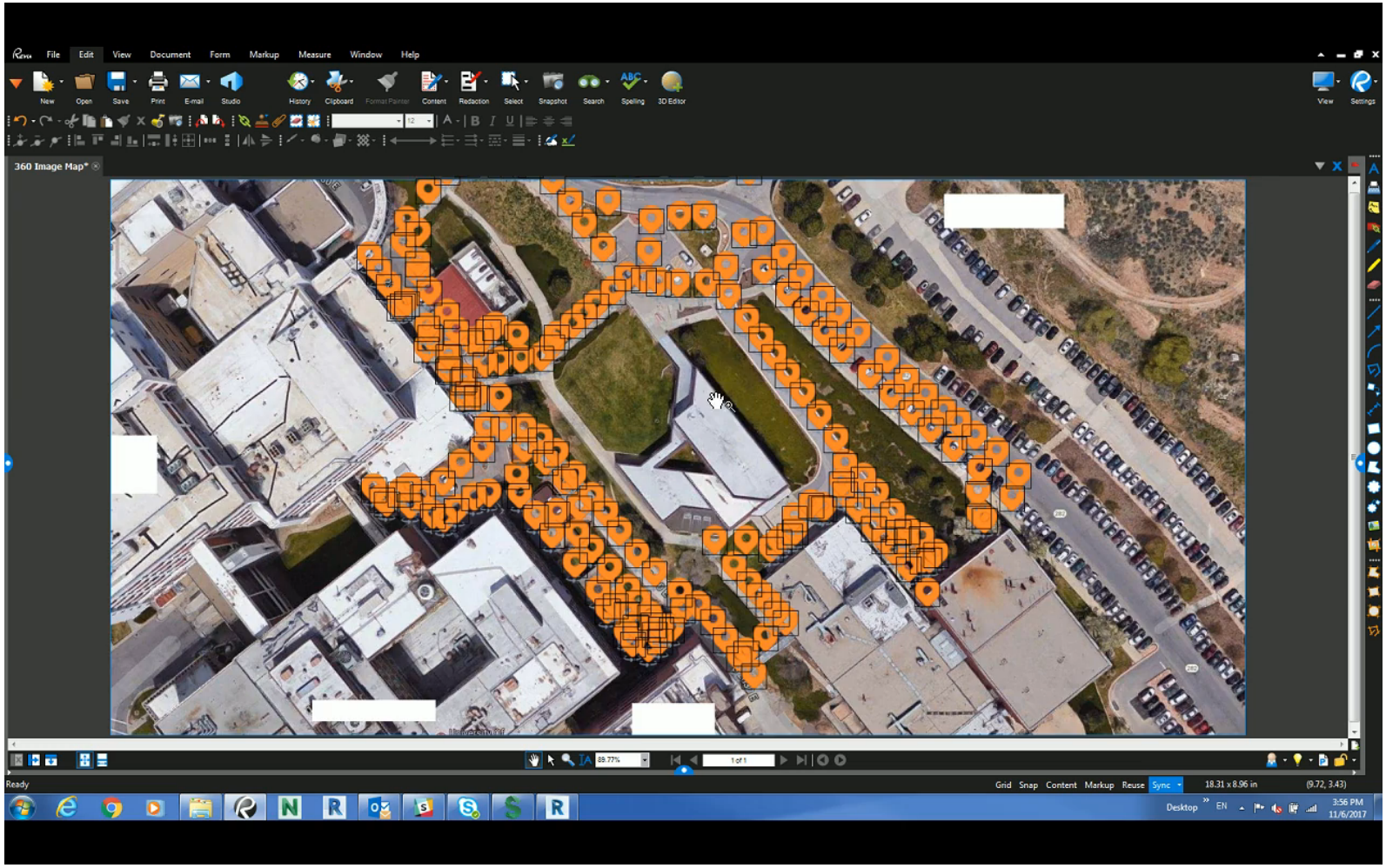
360 Map: Measurable Photos



360 Map: Photographs

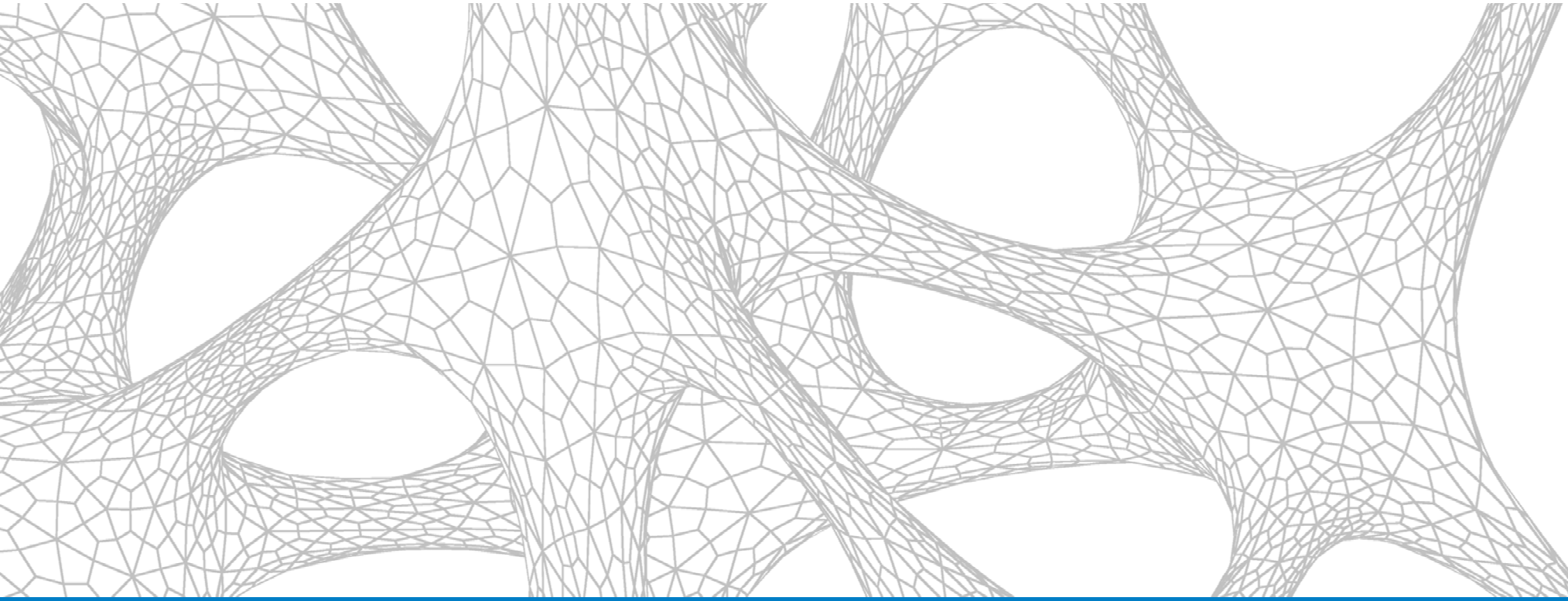
- **Equipment Cost:** $10/day
- **Labor Cost:** $95/Hour
- **Time Estimate:** Plan 100 images per day + travel + 3 hours of processing time
- **Schedule:** recurring once/weekly/monthly?
- **Permits or Documents**: are any required?
- **Control:** Not Needed
- **Deliverable:** PDF with hyperlinked 360 images delivered electronically via e-mail or download link.
- **Deliverable File Types:** .pdf
- **Required Software:** Bluebeam or Adobe
- **Limitations:** If something is not exposed, it will not be captured. Must be connected to the internet in order to be usable.

360 Map: Photographs



Menu Items don’t and shouldn’t tell the whole story

- The purpose of putting together the menu is:
  - To provide enough information to start a conversation
  - Formalize deliverables



Example Scenarios

Laser Scanning an Existing Facility

- The Scenario
  - You need to scan an existing facility that is mostly doctors' offices and exam rooms and totals about 3,000 square feet.
    - Estimate
    - Workflow
    - Finding the Efficiencies

Laser Scanning an Existing Facility: Estimating

- First, you need to determine how many scan stations you need
  - 3 Options for doing this
    - Best: Use a floor plan and plan your scan station locations
    - Good: Use a formula to determine a how many scan locations
    - Worst: SWAG your number based on personal experience

Laser Scanning an Existing Facility: Estimating

- SWAG
  - Not worth discussing
- Formulas
  - Formulas like these are good when you don't have anything else to use.
    - Office Building: 1 scan per 350 Sq. Ft. + 1 scan per room
    - Warehouse: 1 Scan per 700 Sq. Ft. + 1 Scan per room
    - Manufacturing: 1 Scan per 350 Sq. Ft. + 1 scan per room
    - Building Perimeter: 1 Scan per 60 linear Ft. + 1 Scan per building corner
  - Combining a Formula with a site visit before the day of scanning can help you refine your estimate.

Laser Scanning an Existing Facility: Estimating

- Using a Floor Plan
  - Create a stamp in Bluebeam, Revit, or AutoCAD
  - Place your Scan Locations
  - Also lets you pre-plan your scan path, decreasing your registration time
  - Each Scan will take 8 minutes plus 2 minutes/scan for setup between stations
  - 58 Scans Total = 9.667 hours for data collection, so 10 hours

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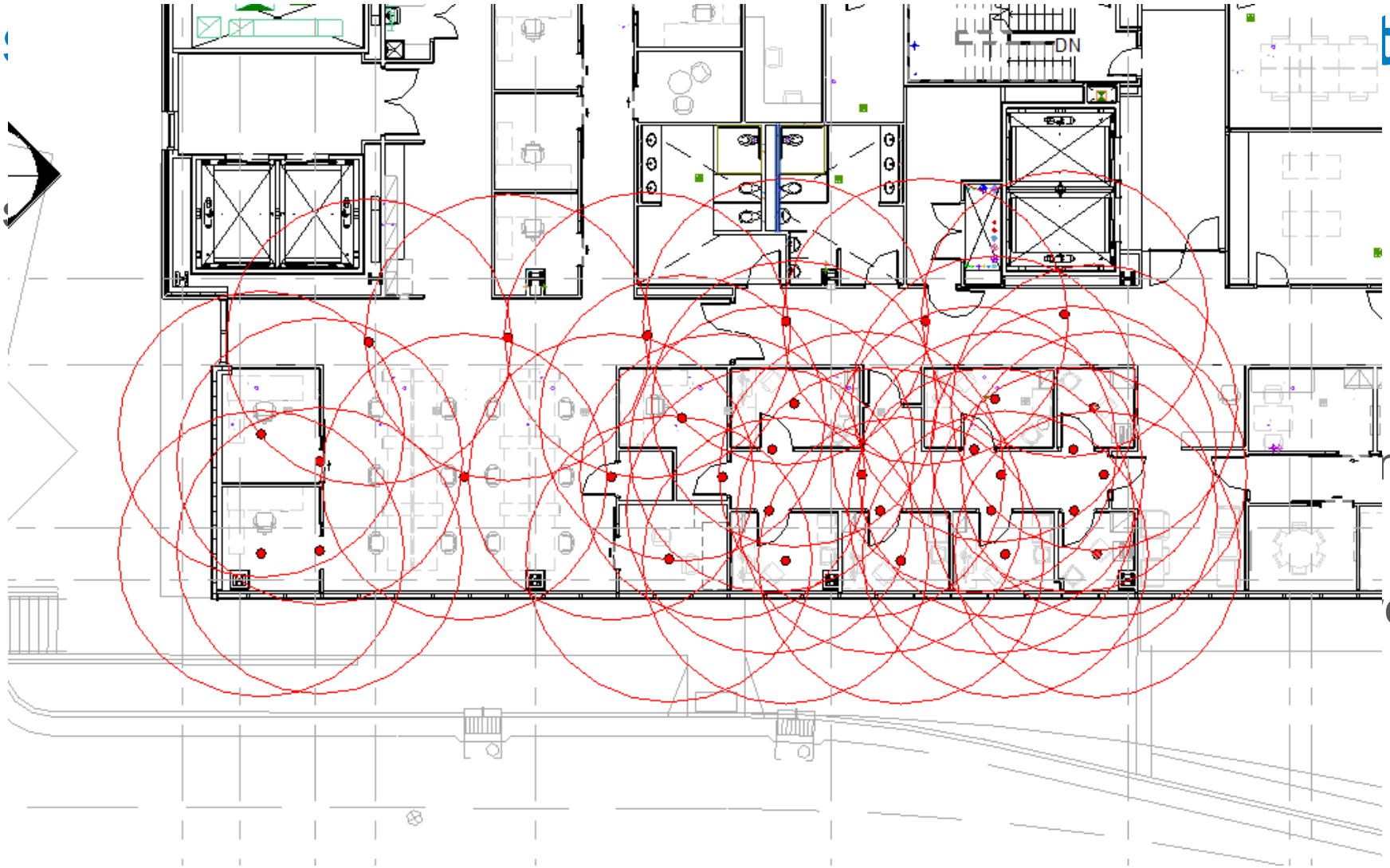


Laser Scanning an Existing Facility: Estimating

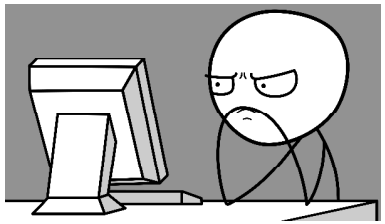
- Other Things items that add time
  - Setup & Cleanup
    - 30 Min. + 5 Min./Room
  - Registration
    - Same Amount of time as data collection from scan stations
  - Preparing Hard Drive
    - 2 Hours
  - Travel: 1 Hour per day
- Setup @ 20 Rooms = 2 Hours
- Data Collection = 10 hours
- Registration = 10 Hours
- Preparing drive = 2 hours
- Total less travel = 22 hours
  - Nearly 3 working days
- Travel = 3 hours
- Total = 25 hours

Laser Scanning an Existing Facility: Estimating

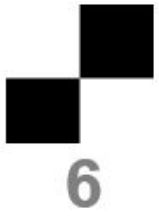
- Now Adding Costs
  - Equipment Cost: 1½ Days of data collection = $300
  - Labor & Travel: 25 hours @ $95/Hour = $2,375
  - Total: $2,675

Laser Scanning an Existing Facility: Workflow

Basic Workflow for this scenario



Estimating



Setup

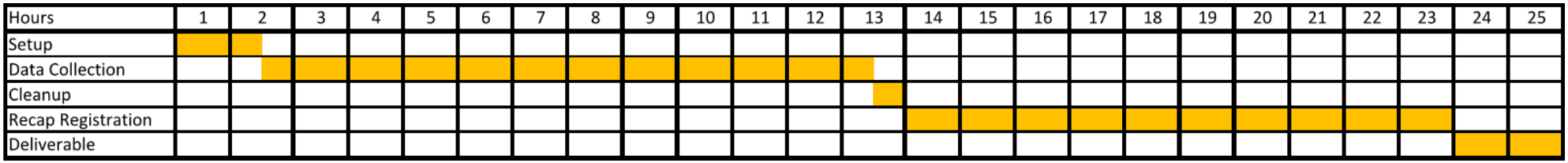
Data Collection

Cleanup

Recap Registration

Deliverable

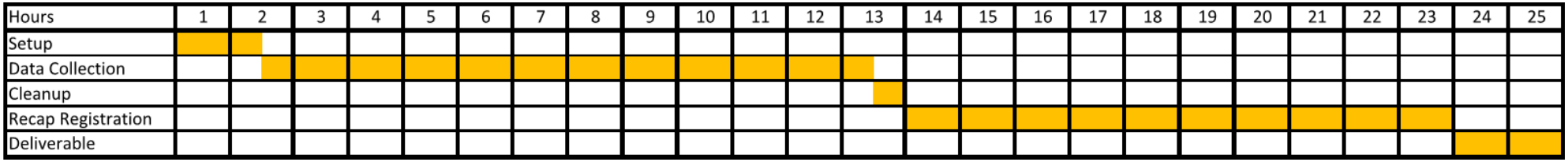
Laser Scanning an Existing Facility: Workflow



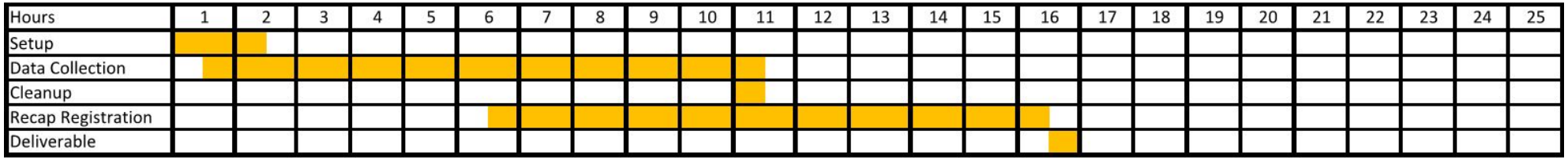
Laser Scanning an Existing Facility: Finding the efficiencies

- Estimating: Floor Plans always decrease overall number of scan stations needed and taken as opposed to the other estimating options
- Setup: Do some initial setup, then start scanning while you finish setup
- Data Collection: Nothing to be found, scans take the same amount of time at each station
- Cleanup: Start cleaning up before scanning is finished
- Registration: starting registration on a laptop with “data dumps” allows for some concurrent registration with data collection.
- Deliverable: have a stock of flash drive or hard drives to limit trips to Best Buy.

Laser Scanning an Existing Facility: Workflow



Linear Workflow



Workflow with Efficiencies

Aerial Survey

- The Scenario
  - You need to fly over a jobsite totaling 8 acres of land. You happen to be in class G airspace and there are no obstacles over 100 feet tall
    - Estimate
    - Workflow
    - Finding the Efficiencies

Aerial Survey: Estimating

- You need to know your drone
  - Battery life Vs. Elevation Vs. Area
  - Most efficient when you can fly 150-200 Ft. AGL, and will cover an area of ±20 acres in 1 hour
    - Flying higher covers more area in about the same amount of time, but your battery life decreases exponentially
    - Flying lower decreases the amount of time spent, but covers less area.

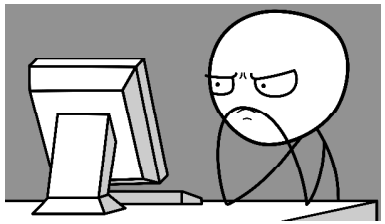
Aerial Survey: Estimating

- This scenario is really straight forward.
- Travel time = 1 hour
- Data Collection = 1 Hour
- Processing Data = 3 Hours
- Deliverable = 0 hours
- Total = 5 hours

- Equipment Cost = $100
- Time = 5 hours @ $95 = $475
- Total = $575

Aerial Survey: Workflow

Basic Workflow for this scenario



Estimating

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Setup

Data Collection

Cleanup

SiteScan

Registration

Deliverable

Aerial Survey: Finding the Efficiencies

- Aerial drone workflows are usually all or nothing. Thus a lot of the work cannot be done concurrently.
- The trick getting information into the cloud for processing as fast as technologically possible.

360 Images: Estimating

Measureable Photos

- Its identical to laser scanning an existing facility with 1 small change
  - You don’t have to set up target

Non-Measureable Photos

- Technically not a reality capture activity, but you may want to:
  - Use the laser scanner for 360 images
  - Include your laser scans as part of your 360 image map

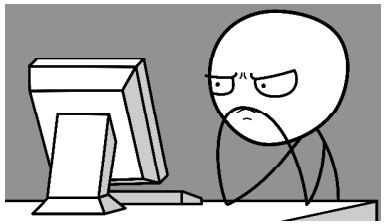
360 Images: Estimating

Non-Measurable Photos using a laser scanner

- Equipment = $300
- Data Collection = 40 Stations @ 10 min. ea. = 6.667 hours or 7 hours
- Travel time = 1 hour
- Processing time = 1 hour
- Creating Deliverable = 2 hours
- Total Time = 11 hours
- Total Cost = $300 + (11 hours @ $95/hour) = $1,345

360 Images: Workflow

Basic Workflow for this scenario



Estimating

Data Collection

FARO SCENE

Import Scans

FARO SCENE

Apply Pictures

FARO SCENE

Export Images

Upload Map/Drawing

Upload Images to map

360 Images: Finding the Efficiencies

Measureable Photos

- Identical to laser scanning as existing facility

Non-Measureable Photos

- The workflow is really linear, you can’t really do much concurrently so its just determining if you really need or want a laser scanner to take the images.

Monitoring Activities: Estimating

Floor Flatness/Floor Levelness

- Equipment
- Setup & Cleanup Time
- Data Collection Time
- Data Processing Time
- Deliverable Time

Soil Stockpile Monitoring

- Equipment
- Setup & Cleanup Time
- Data Collection Time
- Data Processing Time
- Deliverable Time

Monitoring Activities: Estimating

Floor Flatness/Floor Levelness

- Setup & Cleanup Time: 30 Minutes usually covers it. However the key to make sure the project team know you need the area swept and obstacle free so you don't waste time sweeping
- Data Collection Time: Most only need 4-5 stations so about 1 hour
- Data Processing Time: Same amount of time as collection, 1 hour
- Deliverable Time: since we are using the Rthmn plug-in, we just need to plan about 15-20 minutes, but rounding to 30 minutes keeps the math simple

Monitoring Activities: Estimating

Soil Stock Pile Monitoring

- We are using a drone; would it be different if we used a scanner?
- Data Collection: most flights are 1 hour, but if the area is smaller, we can plan for less time.
- Data Processing Time: Really just upload time, if your internet is good, 30 minutes?
  - What if you connection is bad
  - Plan for the time for processing (6-8hours) but that's all in the cloud
- Deliverable Time: 30 minutes keeps the math simple

Monitoring Activities: Estimating

Floor Flatness/Floor Levelness

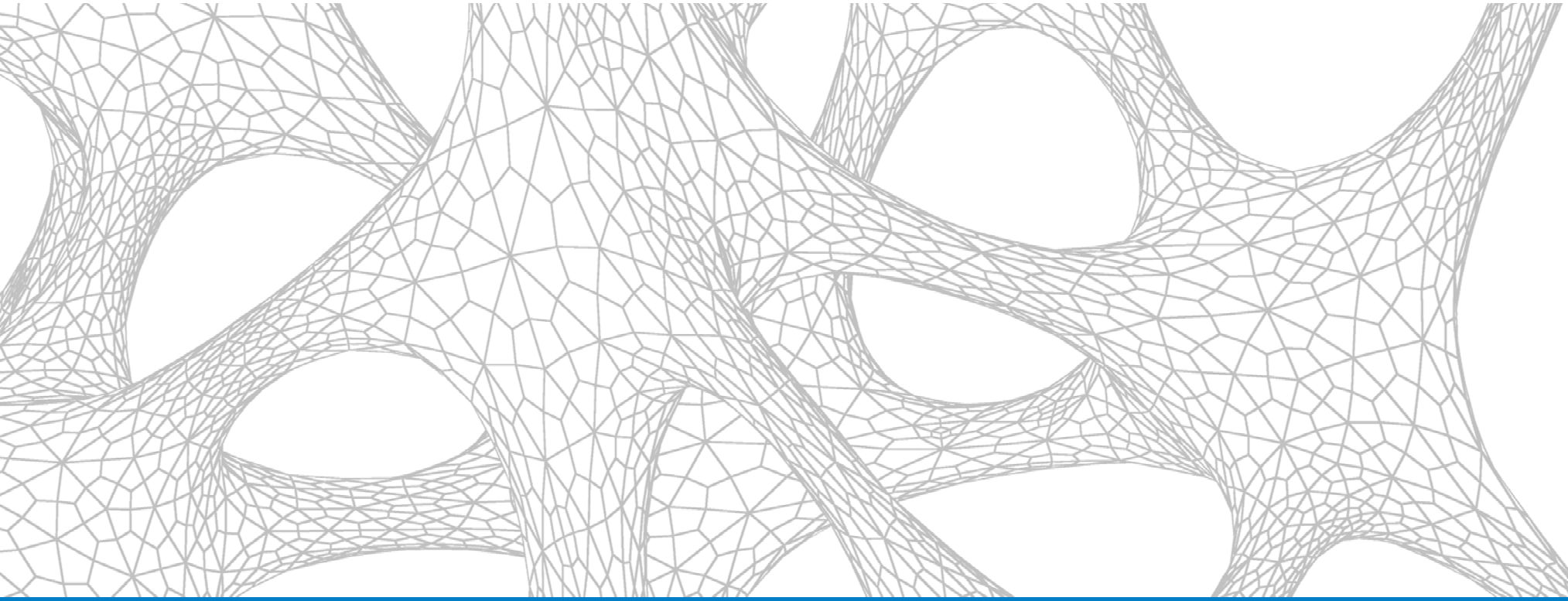
- Equipment: $100
- Time: 3 hours @ $95/hour = $285
- Total = $385

Soil Stockpile Monitoring

- Equipment: $100
- Time: 2 Hours @ $95/hour = $190
- Total = $290

Monitoring Activities: Finding the efficiencies

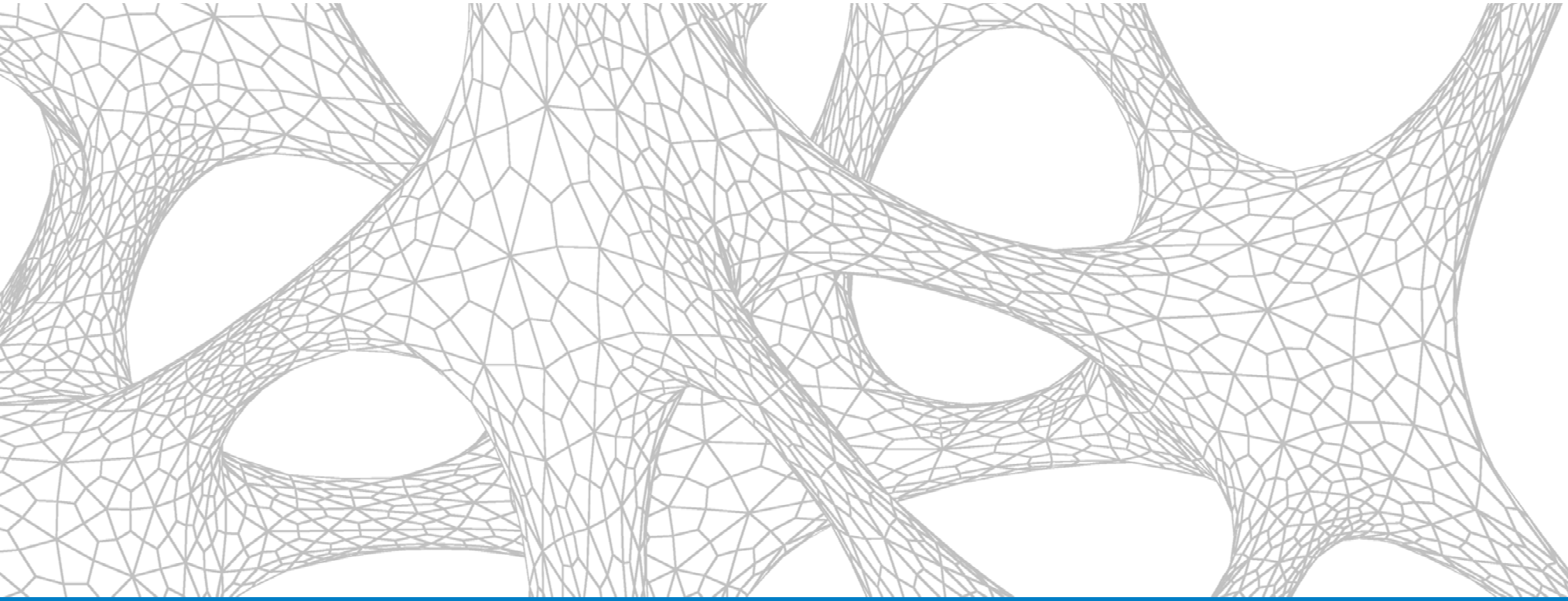
- Most monitoring activities can be completed in less than 1 day. However there are a few tips to making these quicker:
  - Collect your data during lunch or at the end of the day
  - Visit your jobsites before you are scheduled to collect the data
  - Try to convince your project team to have the areas prepped for you so you don’t loose time cleaning up after others.



Getting on the Schedule

Getting on the Schedule

- Don’t let your project team’s get onto your calendar without first getting on theirs.
  - Reminds the team about the plan to collect and analyze the data
  - Keeps reality capture activities from turning into emergencies
  - If the project schedule changes, your activity time will adjust appropriately



Summary

Create a Reality Capture BIM Execution plan

- Menu sets up the template for reality capture services
- Menu leads to discussions that fill in the gaps of the plan
  - Formalizes when the activity will happen
  - Formalizes deliverables

Apply Strategies for scheduling and planning scans

- Estimate against your workflow
- Start keeping track of your own productivity rates
- Find the efficiencies in your workflow

Apply Strategies for quick collection of data for deliverables

- Plan your scanning routes by
  - Visiting the site before you scan
  - Plan scan stations on a floor plan
- Leverage the automatic features in your software and plug-ins.
  - Don’t put anything on the Menu that you have not done before

Understand basic workflows for reality capture

- Because we are estimating against our basic workflow, it forces us to scrutinize our processes
- Nothing substitutes for experience
- Workflows change based on deliverables

Q/A

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