LiDAR- How Southern California Edison Visualized Success

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Class summary

- Southern California Edison (SCE) uses light detection and ranging (LiDAR)-equipped aircraft to identify overhead lines with clearances that don't comply with local and federal requirements. This involves many units, including transmission, distribution, and telecommunications.
- In this class we will discuss a 4-step approach: Identify, Evaluate, Design, and Remediation.
- The LiDAR results show occurrences where man-made encroachments occur, as well as revealing environmental encroachments that involve vegetation management.
- We will look back at lessons learned to date, and we'll take a look forward at the future of advanced surveying and design systems.
- This all happens within the framework of SCE's enterprise level workflow management system.

Key learning objectives

At the end of this class, you will be able to:

- Understand the benefits and challenges of LiDAR
- Discuss how to use design data to solve business problems
- Learn how LiDAR can integrate into Design Solutions
- Learn how to apply lessons learned and look forward from these processes

Class Summary

- Light Detection and Ranging (LiDAR) technology uses ultraviolet or near infrared light to image objects and map physical features.
- Southern California Edison (SCE) uses aircraft equipped with LiDAR equipment to identify locations throughout SCE's service territory that do not meet the minimum required clearances for overhead lines established in General Order (GO) 95 for resolution.

Disclaimer

Any similarity with real events or characters is purely coincidental

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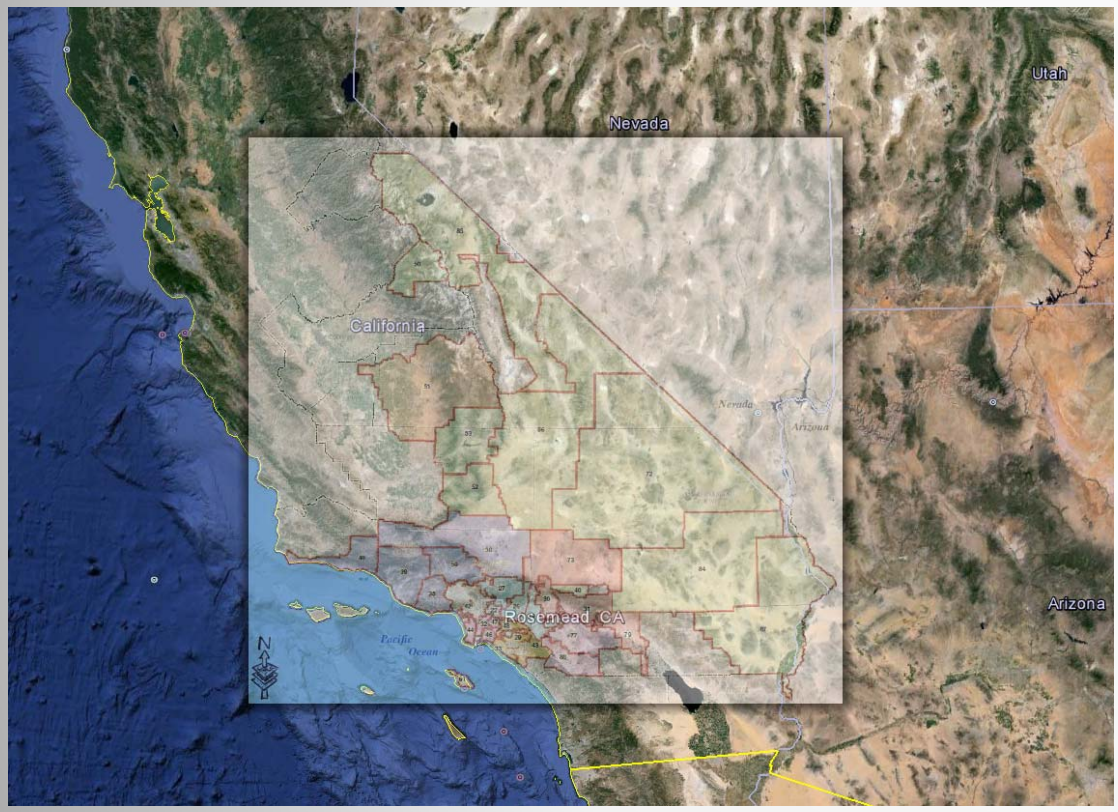
Southern California Edison

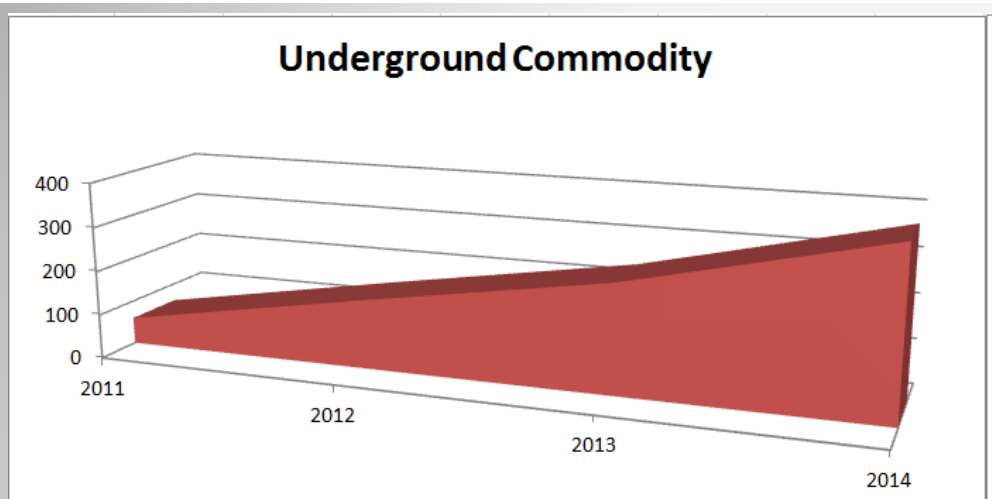


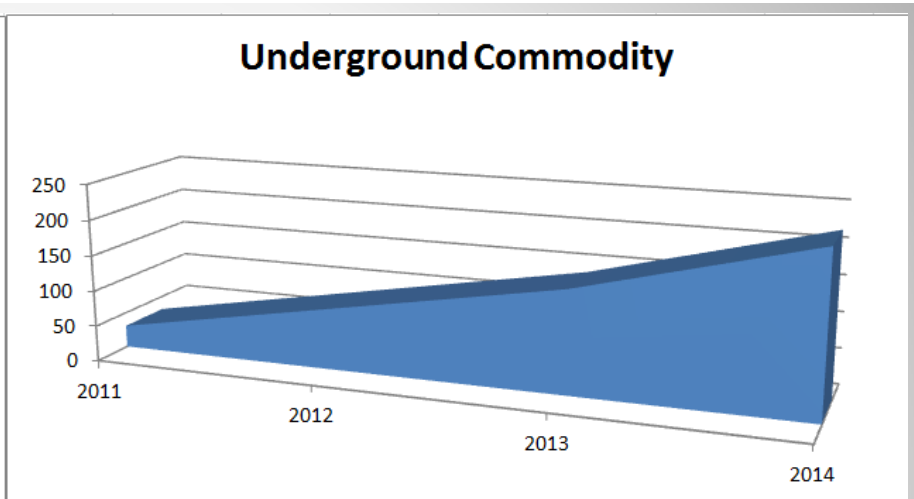
One of the Largest U.S. Electric Utilities

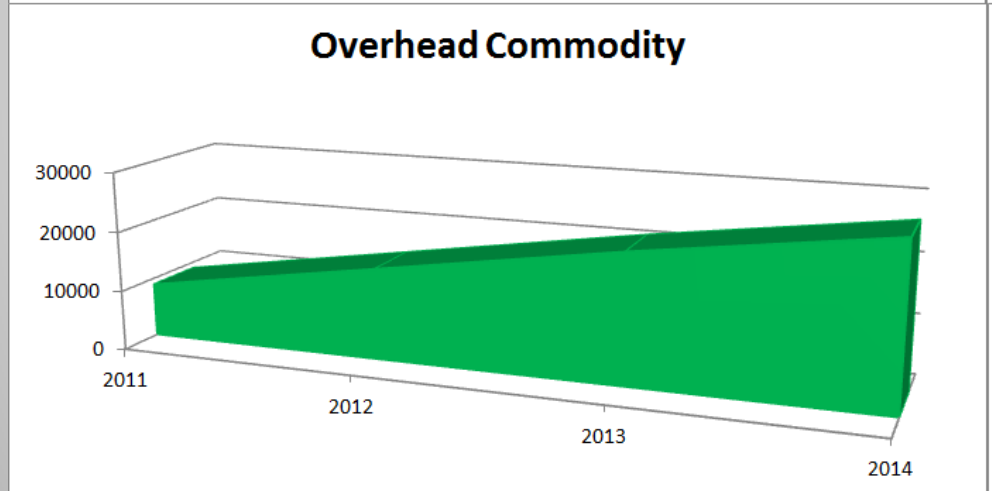
- 50,000 square-miles of service territory
- 14+ million people served
- Providing electric service for more than 125 years
- Delivers 87.34 billion kWh of electricity annually

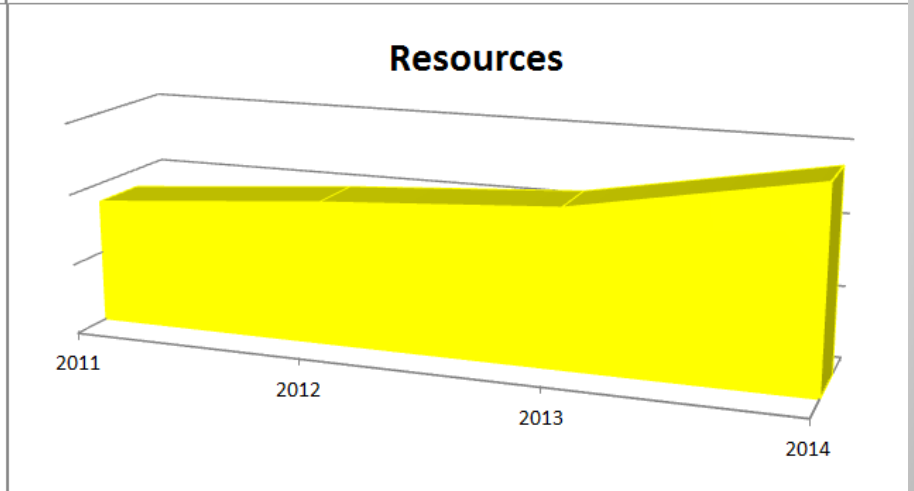
Delivering Service Takes

- 16 utility interconnections
- 4,900 transmission and distribution circuits
- 365 transmission and distribution crews
- 88,000+ miles of distribution lines


Underground Commodity
400
300
200
100
0
2011
2012
2013
2014


Underground Commodity
250
200
150
100
50
0
2011
2012
2013
2014


Overhead Commodity
30000
20000
10000
0
2011
2012
2013
2014

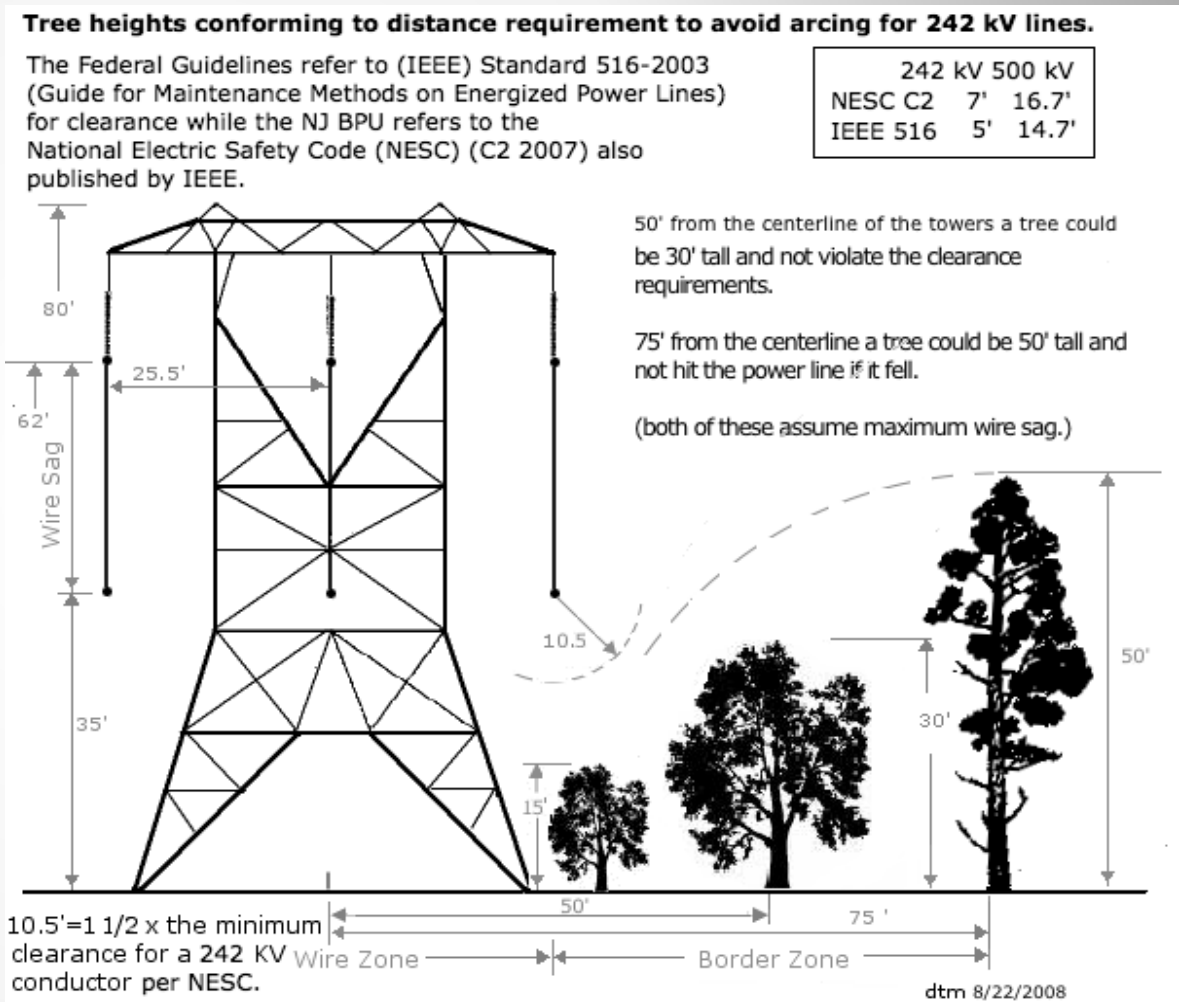

Resources
2011
2012
2013
2014

PROBLEM STATEMENT

- Increasing regulatory pressure in the U.S. electricity transmission industry as a consequence of large-scale blackouts during the past decade has prompted the North American Electric Reliability Council (NERC) to create reliability standard FAC-003

IEEE 516-2003 EXAMPLE

- Ground Clearance
- Blowout
- Border Zones
- Rule Definitions for conditional data



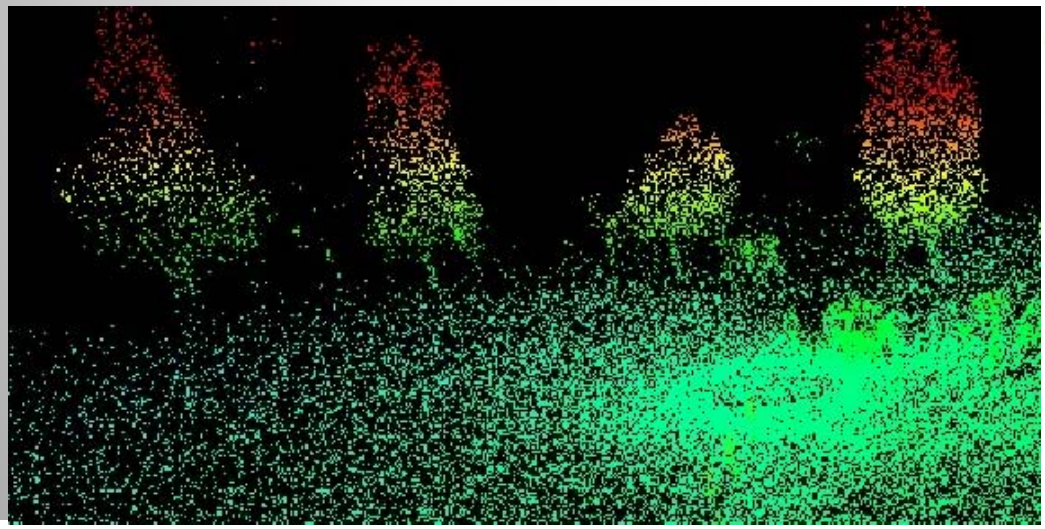
PROCESS

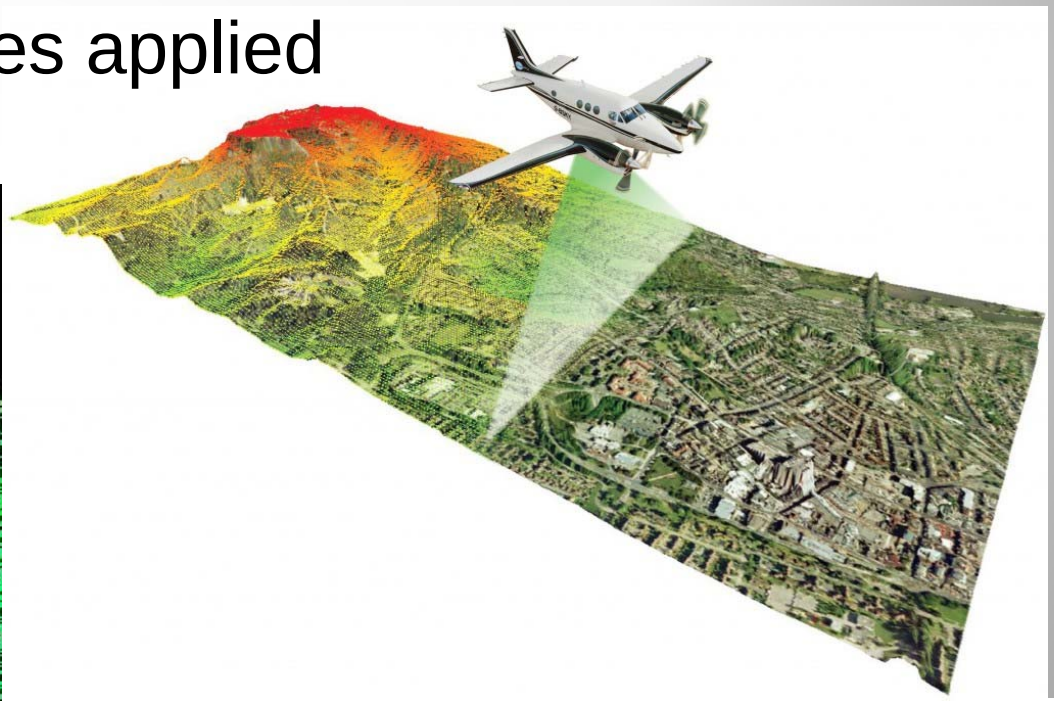
Identify, Evaluate, Design, and Remediation

- ***Identify*** – LiDAR Scanning
- ***Evaluate***- Data Classification (Many file formats, many viewers, many translators, many toolsets, many needs)
- ***Design***- AutoCAD driven Work Order (IPSEC model)
- ***Remediation***- Field crew changes to assets, Vegetation Management, Address 3rd Party Attachments

LiDAR

- LiDAR- Light Detection and Ranging (RADAR with a laser)
- Creates point cloud data sets
- Relatively fast, accurate, data driven
- Each point can have attributes applied





LiDAR Approach

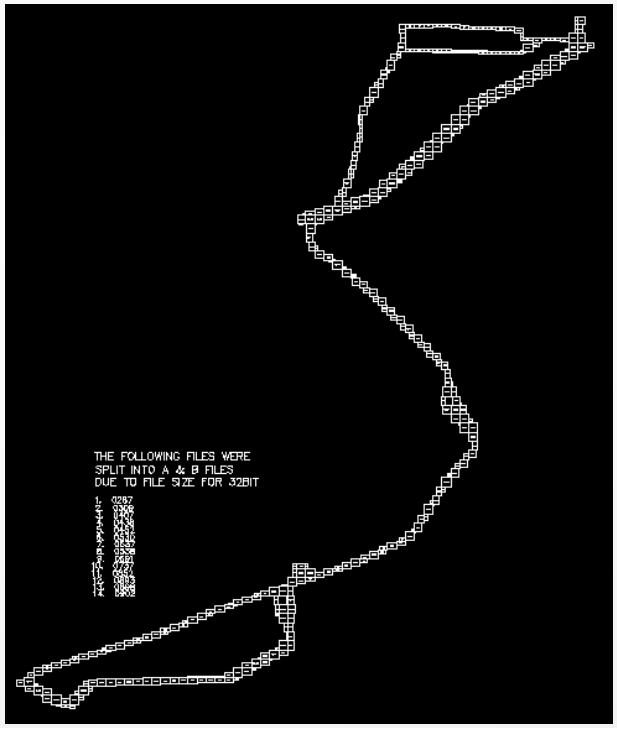
We analyzed the entire identification strategy, and decided to outsource the LiDAR collection

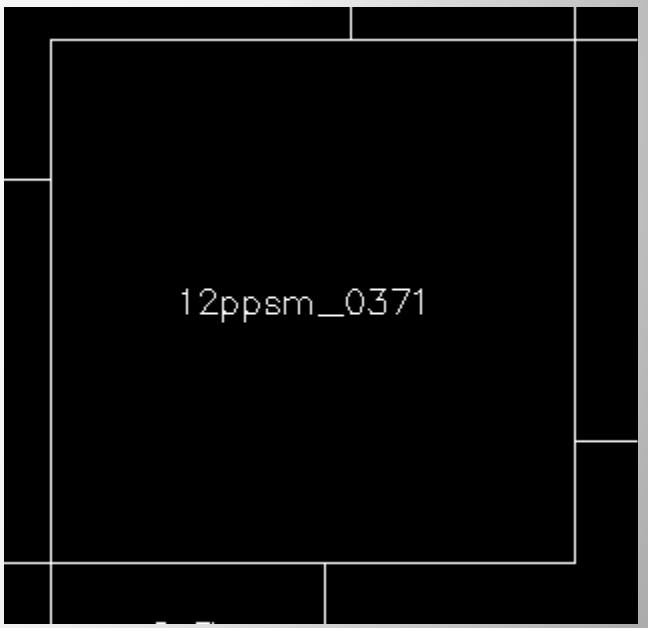
Identify

- Work with vendors who provide LiDAR services
- Provide job scope
- Set parameters of accuracy
- Phased approach to meet program requirements
- Perform scans

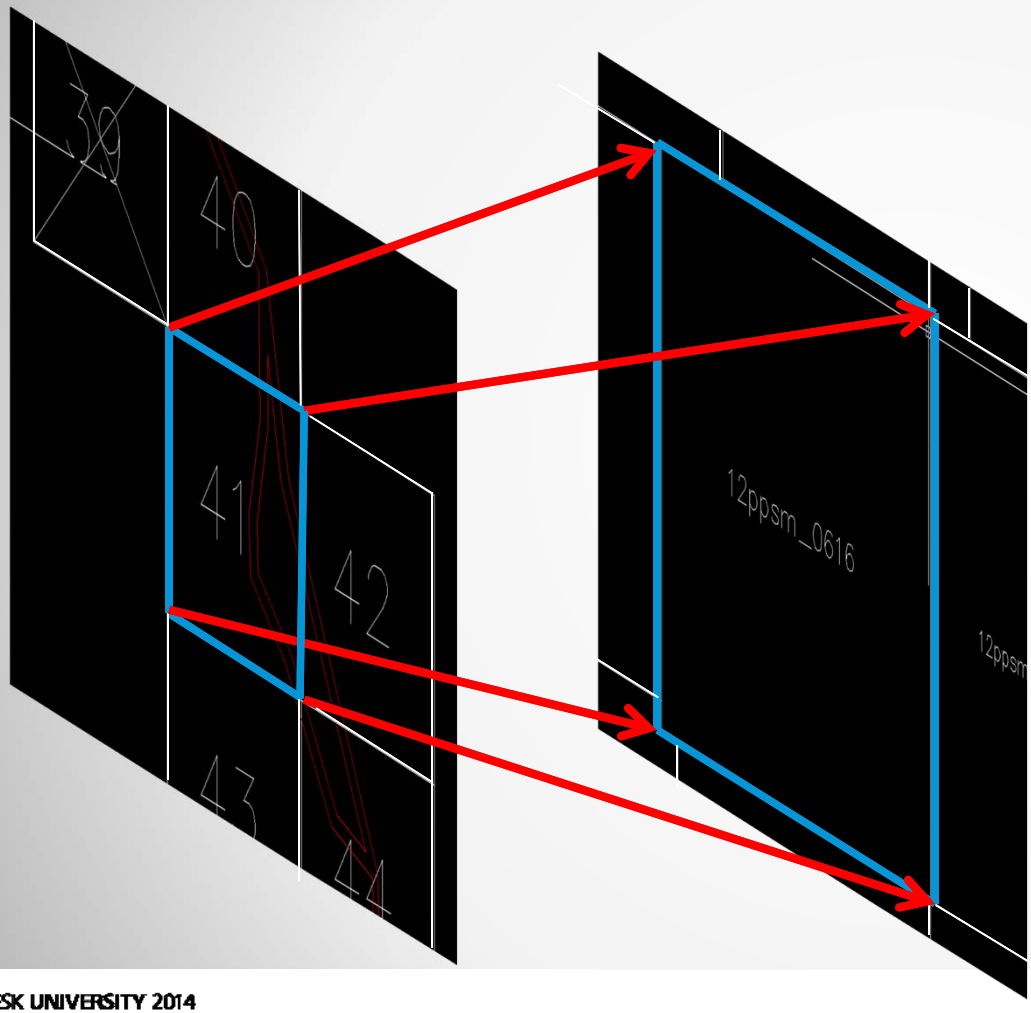
Identify – More detail

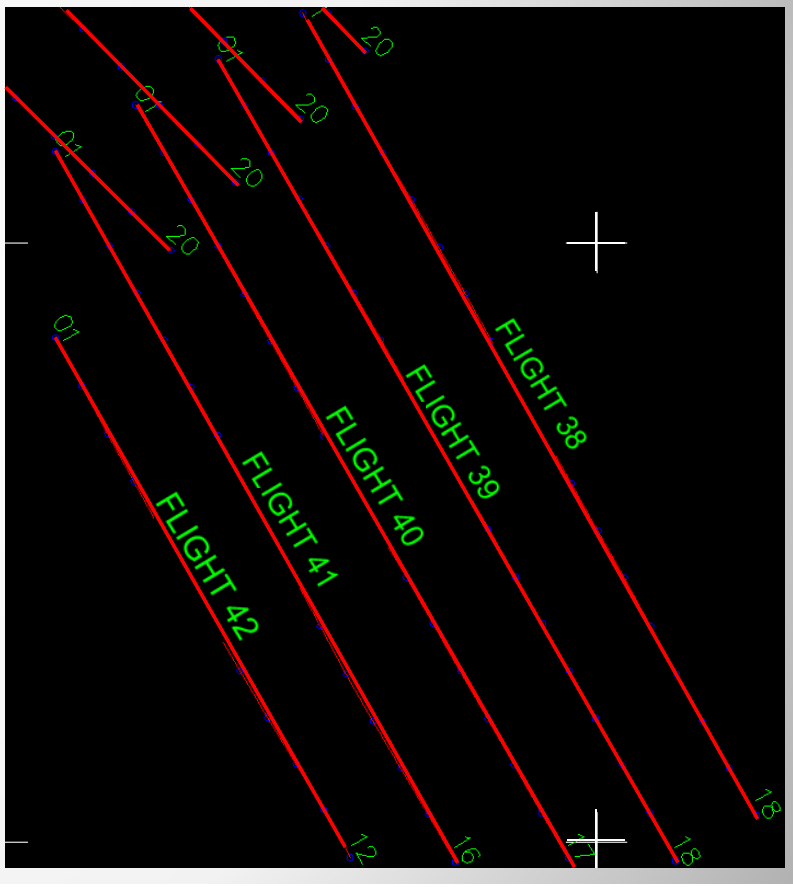
- Take a large project split up into manageable parts
- Index the job by parameters
  - By Grid
  - By LiDAR file
  - By Topography
  - By Flight path / Scans





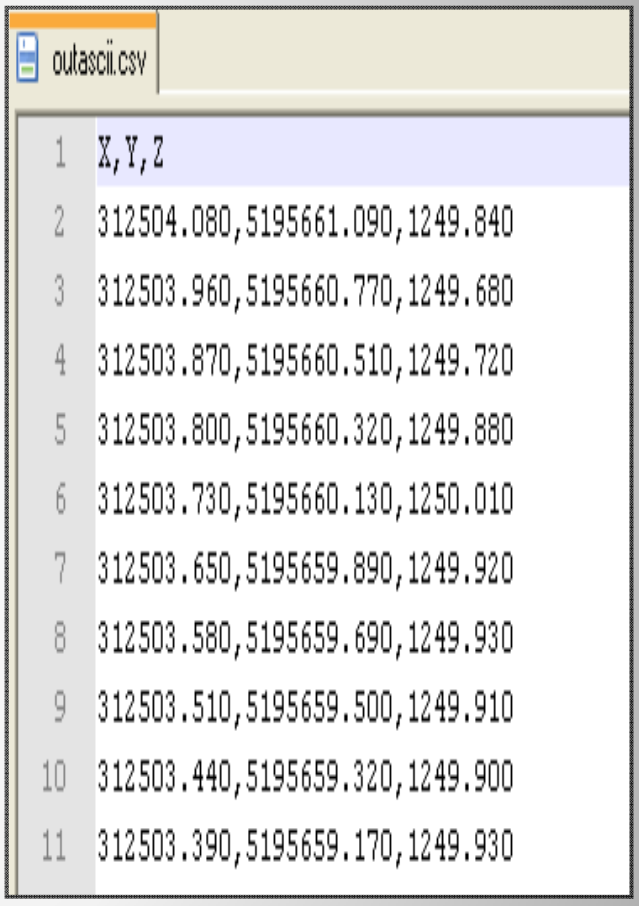
GRID / LAS FILE / FLIGHT PATH (SCAN)





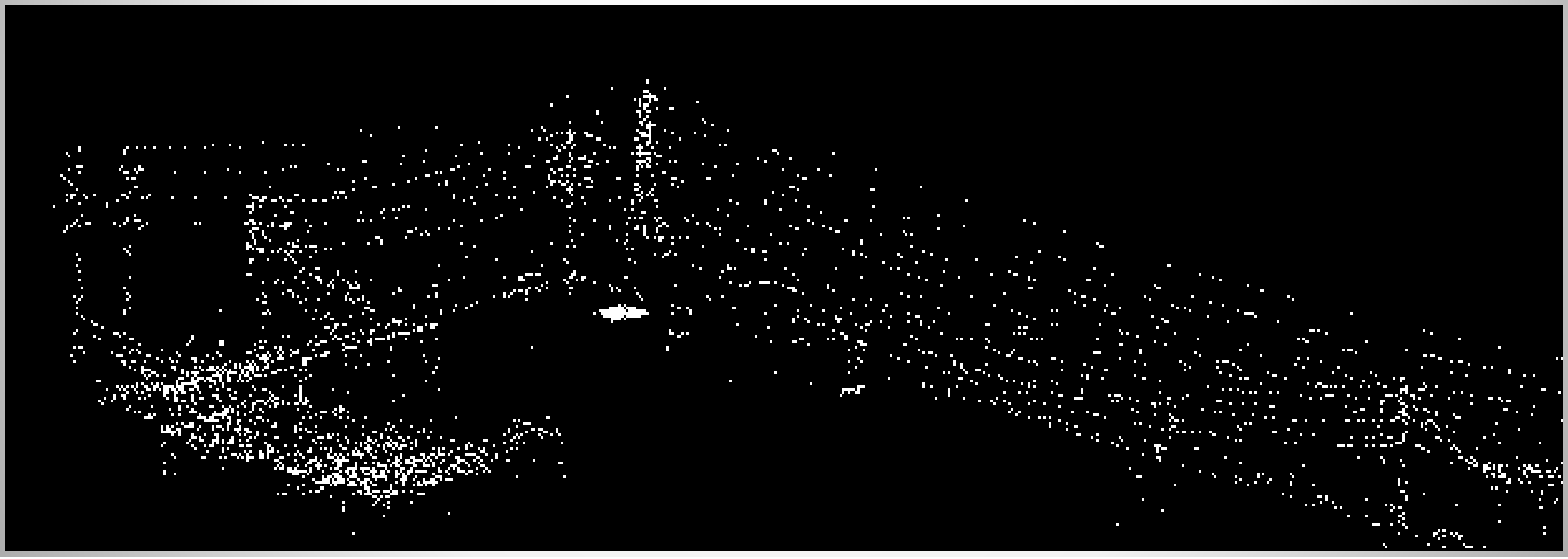
.LAS

- Each point in the cloud is assigned an XYZ value
- These points can be geo-referenced
- The data points are typically highly accurate in reference to each other
- Placing each one of these points within an XYZ coordinate system is the process of indexing the data into point cloud data
- In this case transferring a flat ASCII file into MAP3D



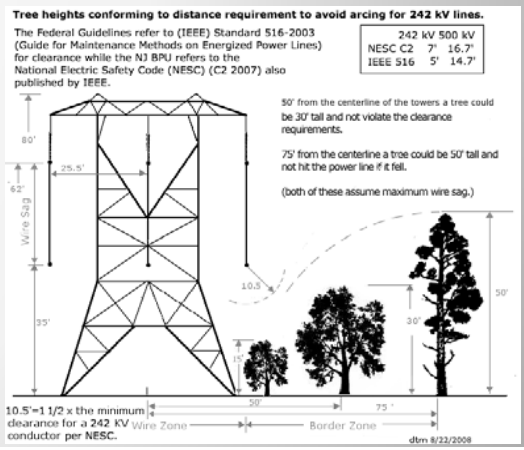
Identify- Point Cloud Data

- Indexed, unclassified, raw point cloud data
- Paints a clear, but “unintelligent” picture



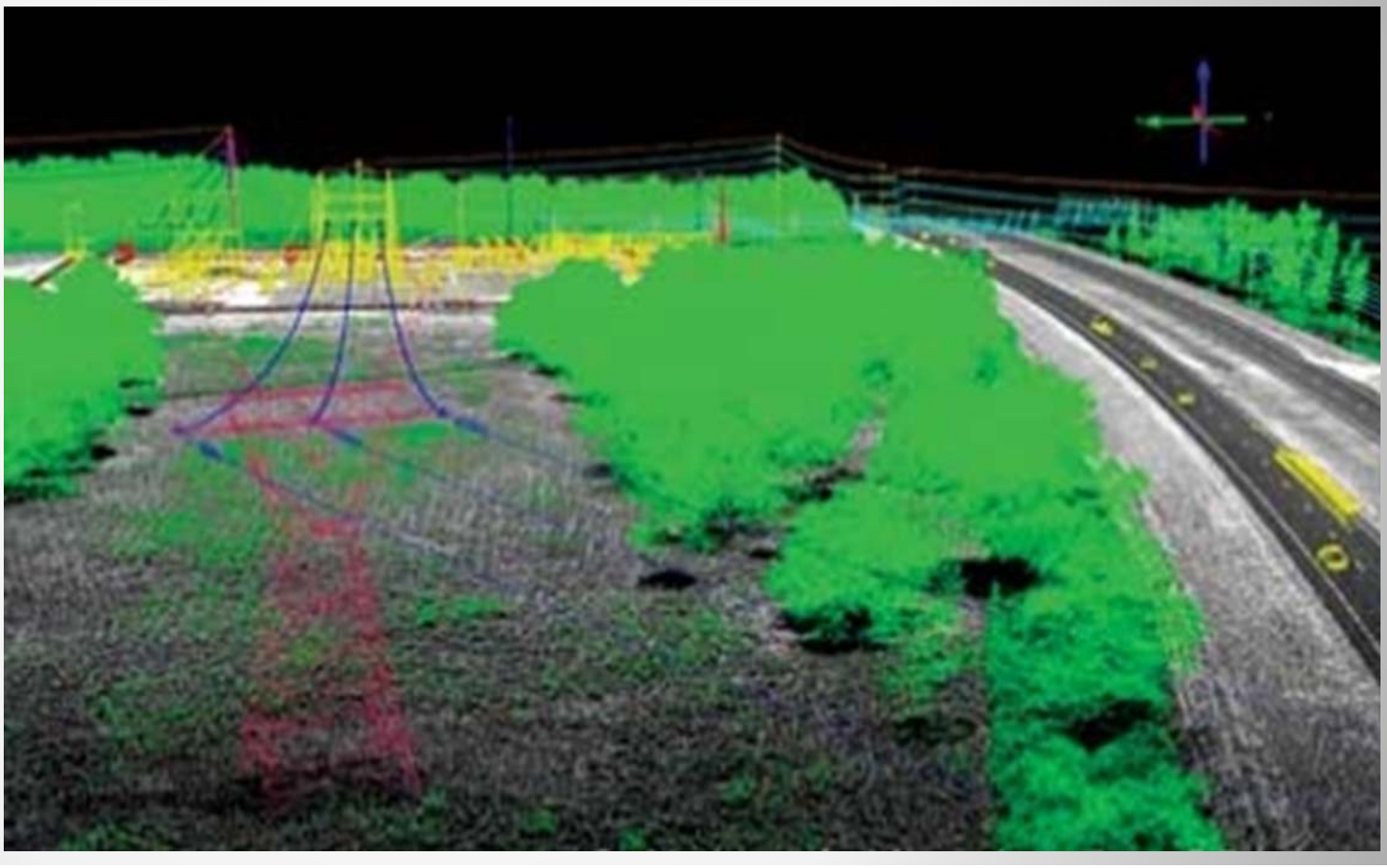
Feature Coding/ Classification

- Each point in the cloud gets assigned attributes
  - Point = Tree = Green
  - Point = Wire = Red
  - Point = Bare Earth = Brown
  - Structure, etc…
- Rules based on IEEE Standard 516-2003, can be applied to data points, with attributes
  - Wire to Ground > 35’ = No Infraction
  - Wire blowout Tree < 10.5’ = Infraction
  - Tree : Ground (If tree = True) then = Infraction
  - Etc…



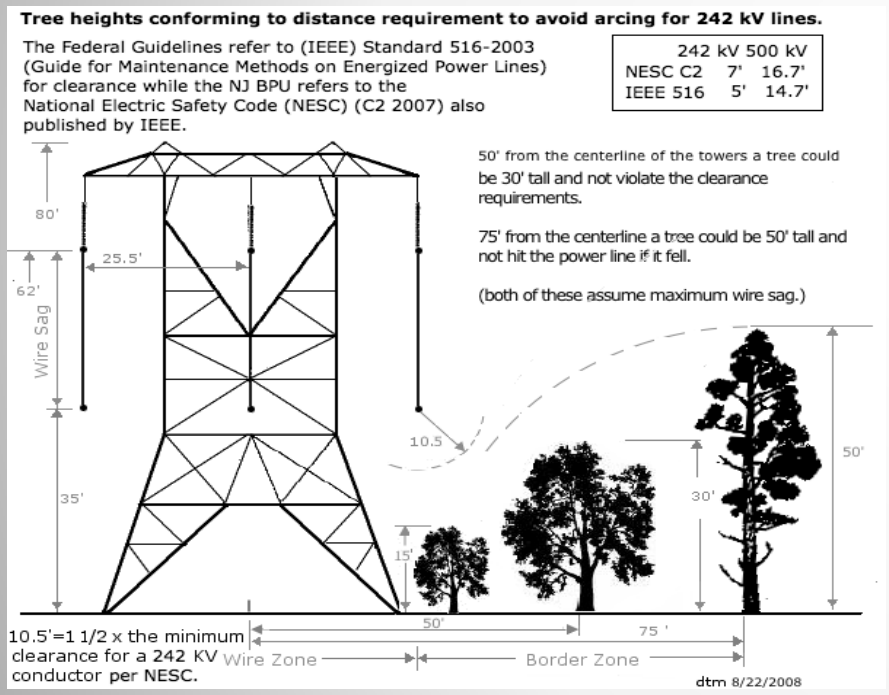
Classified Point Cloud Data

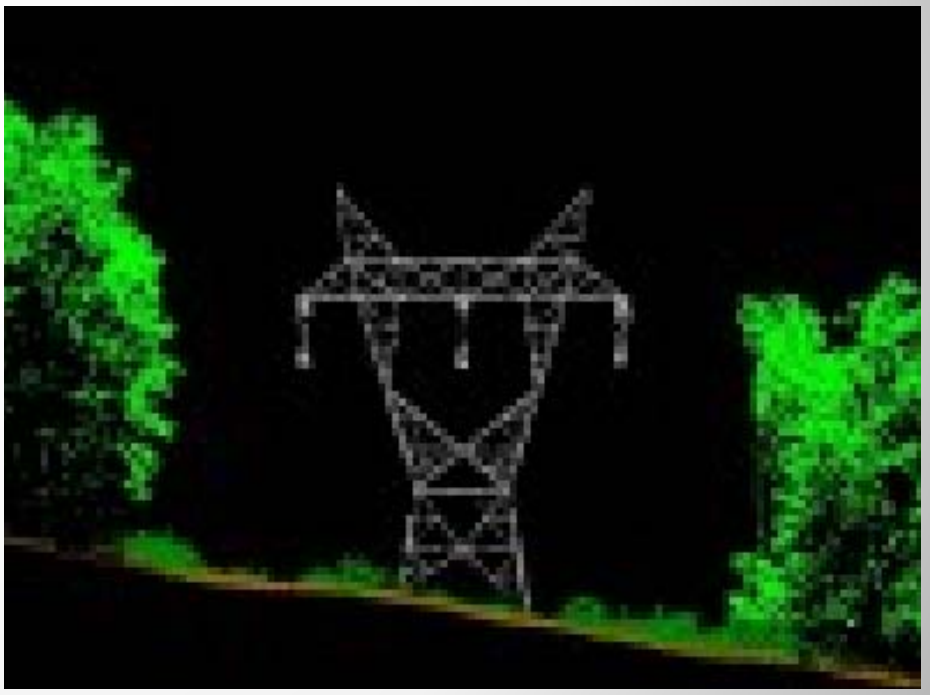
- Intelligence behind the points in the cloud
- Predictive analysis based on existing conditions



Infraction!

- Based on the IEEE 516 standard, two data points are:
  - Out of spec
  - Predicted to go out of spec





Is there a problem?

1. A “fast growing” Ash tree is identified 20’ below a structure

Table 1: Tree Species Names and Growth Rates

Species Name	Growth Rate	Species Name
Ash	Fast	

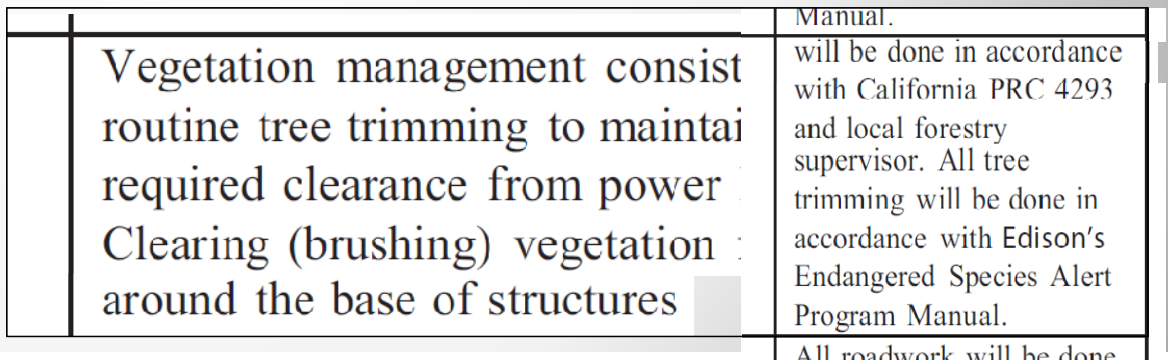
3. “356” condition < 3 years

356	Vegetation grown into Line
360	Tree or tree limb/palm frond contact
363	Falling tree or limb
370	Tree cut into line

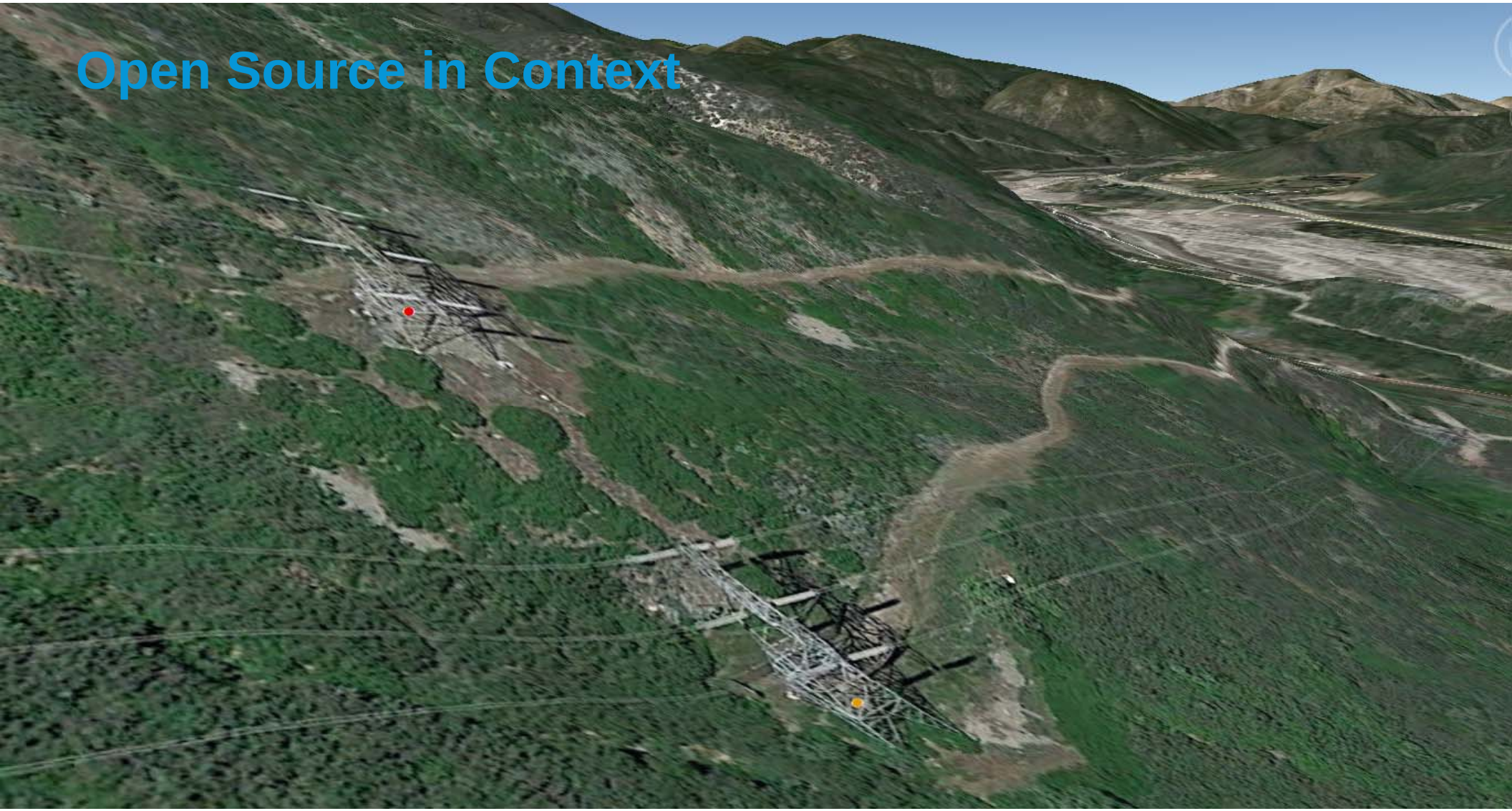
2. (F) Fast is > 6’ annually

Approximate Growth Rate:
(S) Slow: 0 to 3 feet annually
(M) Medium: 3.1 to 6 feet annually
(F) Fast: More than 6 feet annually

4. Vegetation Plan put into effect



Open Source in Context

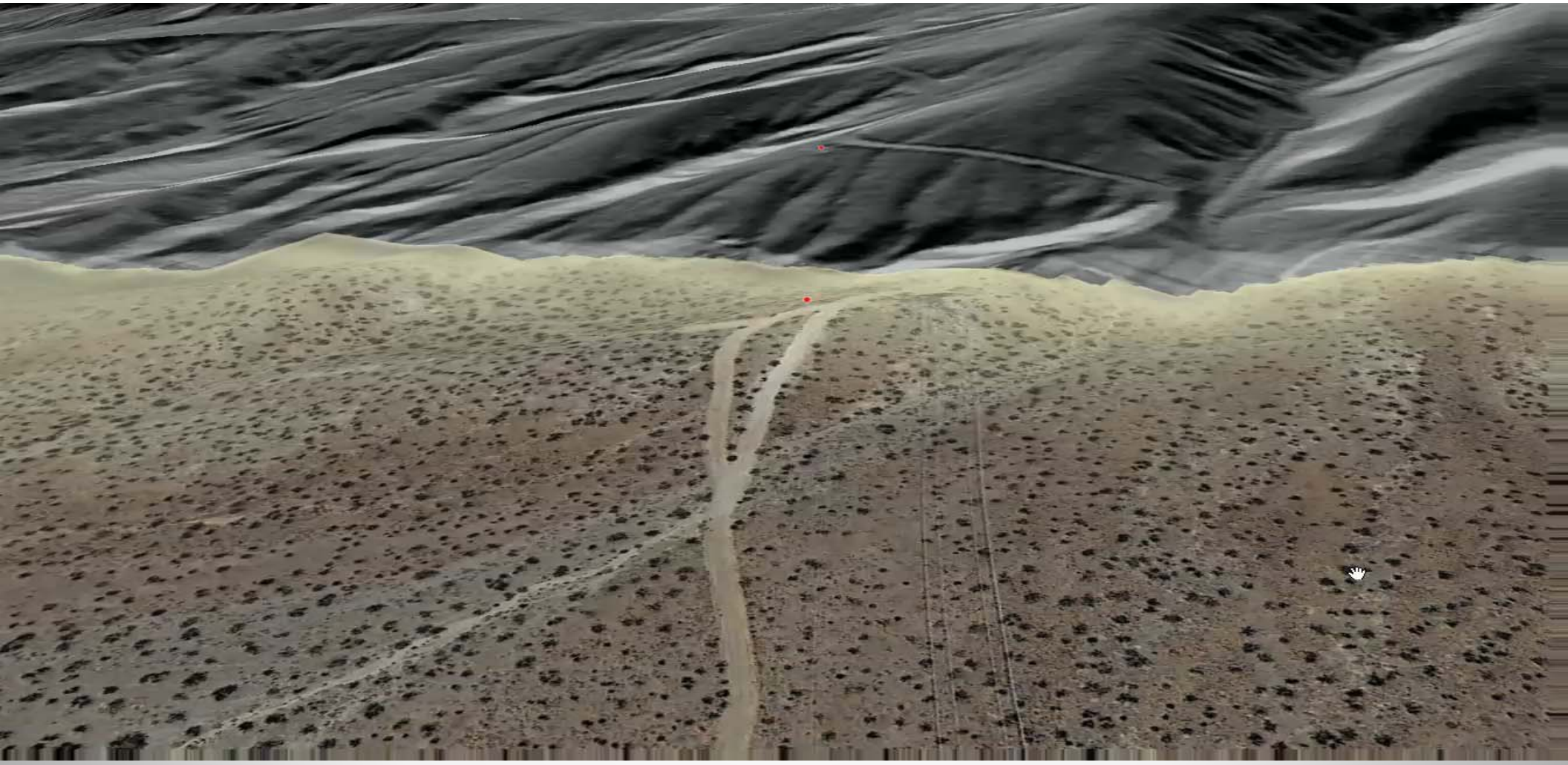


Placing the Data in Context

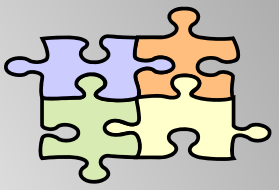
EI , A2

EI	, A2
SHAPE	Point
TWNRNGSEC	
Pedestrian_Access	
SCEGovtLands_Admin1	Unclassified
SCEGovtLands__Admin2	
Acres	1213403
Critical_Habitat	
SCE_District_Number	44
SCE_District_Name	SOUTH
Status	In Progress
InfractionID	44
priority	A2
NUMBER_	4
Discrepancy_No	44I
FLOC_No	ET-I
Voltage_1	220
Line_Name	EI
From_Structure	M1-
fromLat	33.!
fromLong	-118.4
To_Structure	M1-T8
toLat	33.
toLong	-118.
Feature	Existing Structure
Pri	A2
Grid	Metro
Priority_Letter	A
District_Name	SOUTH
Name	EI
Eng_Name	

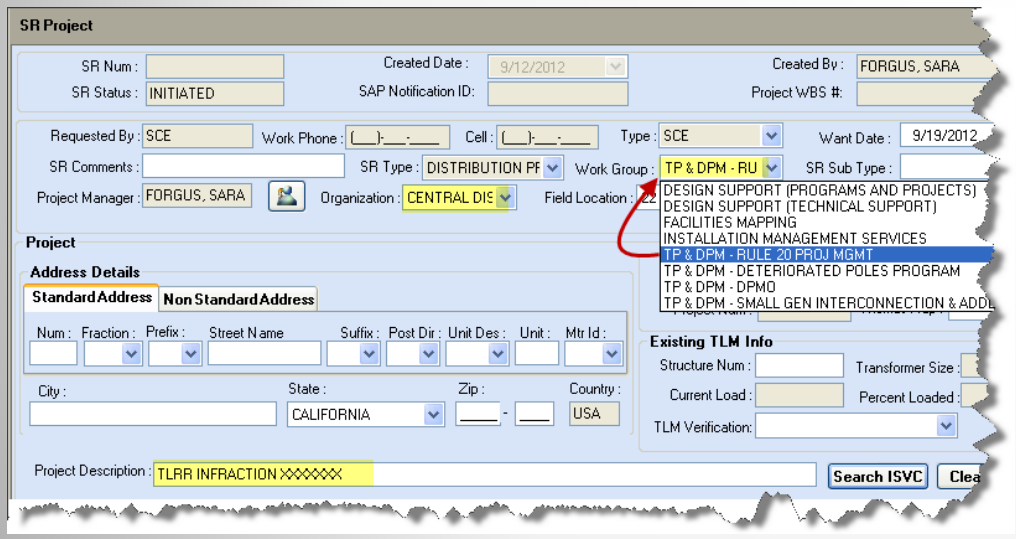
Directions: To here - From here



Mitigation

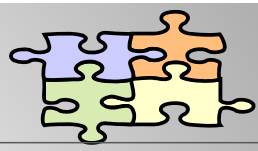


- Collecting and classifying laser based data is relatively easy compared to processing the Work Order



- Multiple systems, departments, forms and processes are involved.

Planning Process



Planning:
Forward the email received to the Planner selected to complete the design
If Capital distribution work is associated with the TLRR, consult with Field Engineering
Approve the prepared work order in SCE Design Manager
Create the work order using the entries for all ***Capital*** Distribution work associated with the TLRR program
Deadline to have the design complete, approved, and scheduled
Review the prepared packages once received back from the assigned Planning office
If incomplete, notify the assigned Planner and return the package If complete, proceed to next step

Schedule the approved work order through the Distribution Resource Planning Performance Manager (RPPM) following established scheduling procedures	Field work will be assigned to SCE or contract crews depending on resource availability

Solve the Problem Repeat Process

After 125 years, some things don't change

Lessons Learned

173 miles of new and upgraded transmission lines, with the capacity of 4,500 megawatts, power for 3 million homes

In July the PUC redirected Edison to construct first of a kind 500-kilovolt transmission lines underground through 3.5 miles of the city

“Edison begins to dismantle massive power line towers in Chino Hills”

Lessons Learned

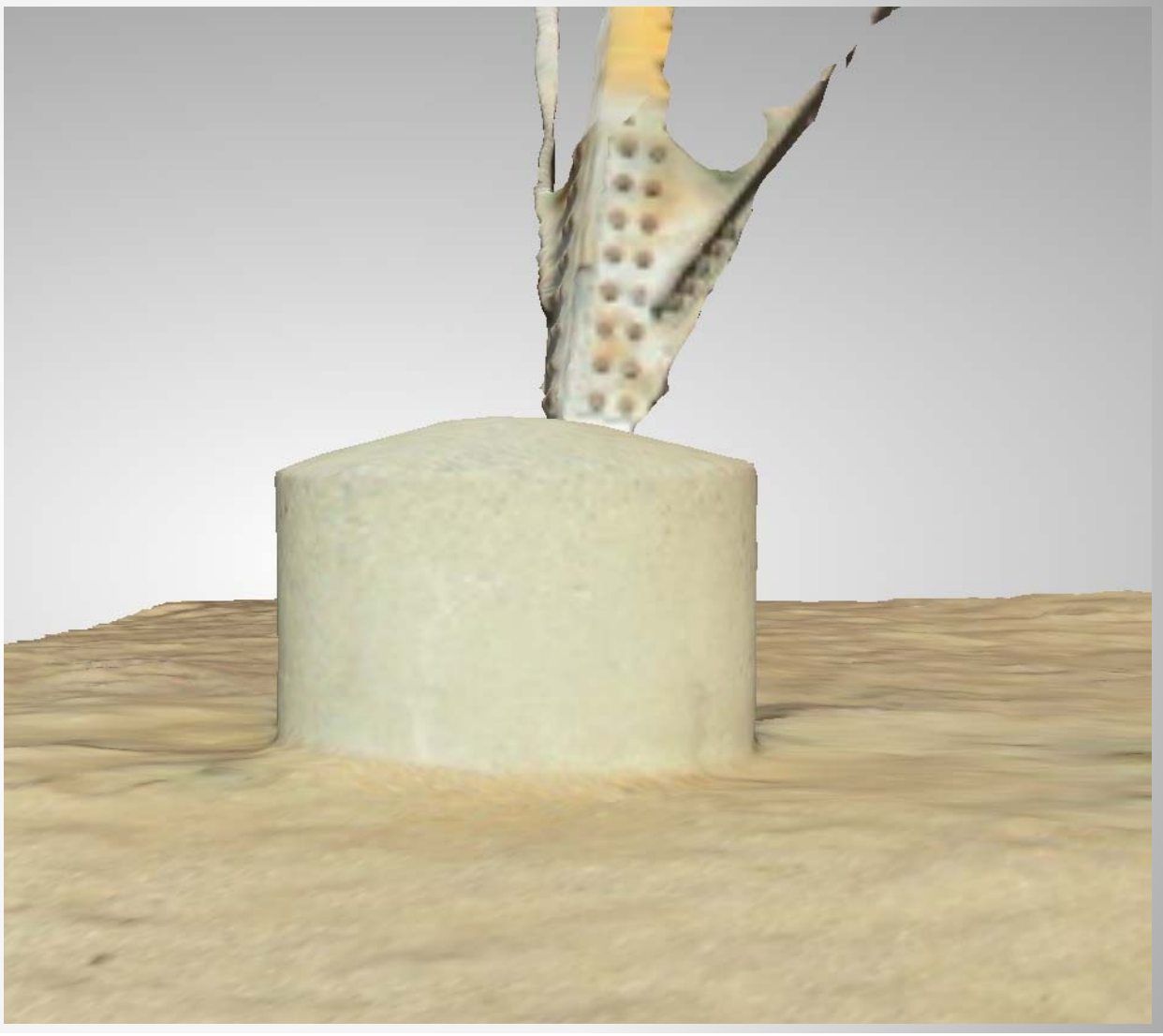
- Is there a better way to present anticipated changes to stakeholders?
- Show each stakeholder the proposal from the perspective that matters to them?
- Can we put these changes into a context that matters to the affected organizations?
- How to work better with other organizations
  e.g. Joint Utilities, Municipals

Putting detailed design data into a visual context

Tower Footing-

Means the world to me

- Concrete footing
- Soil conditions
- Bolt pattern



However, that same imagery…

Shows stakeholder:
Proximity
Impact
Involvement

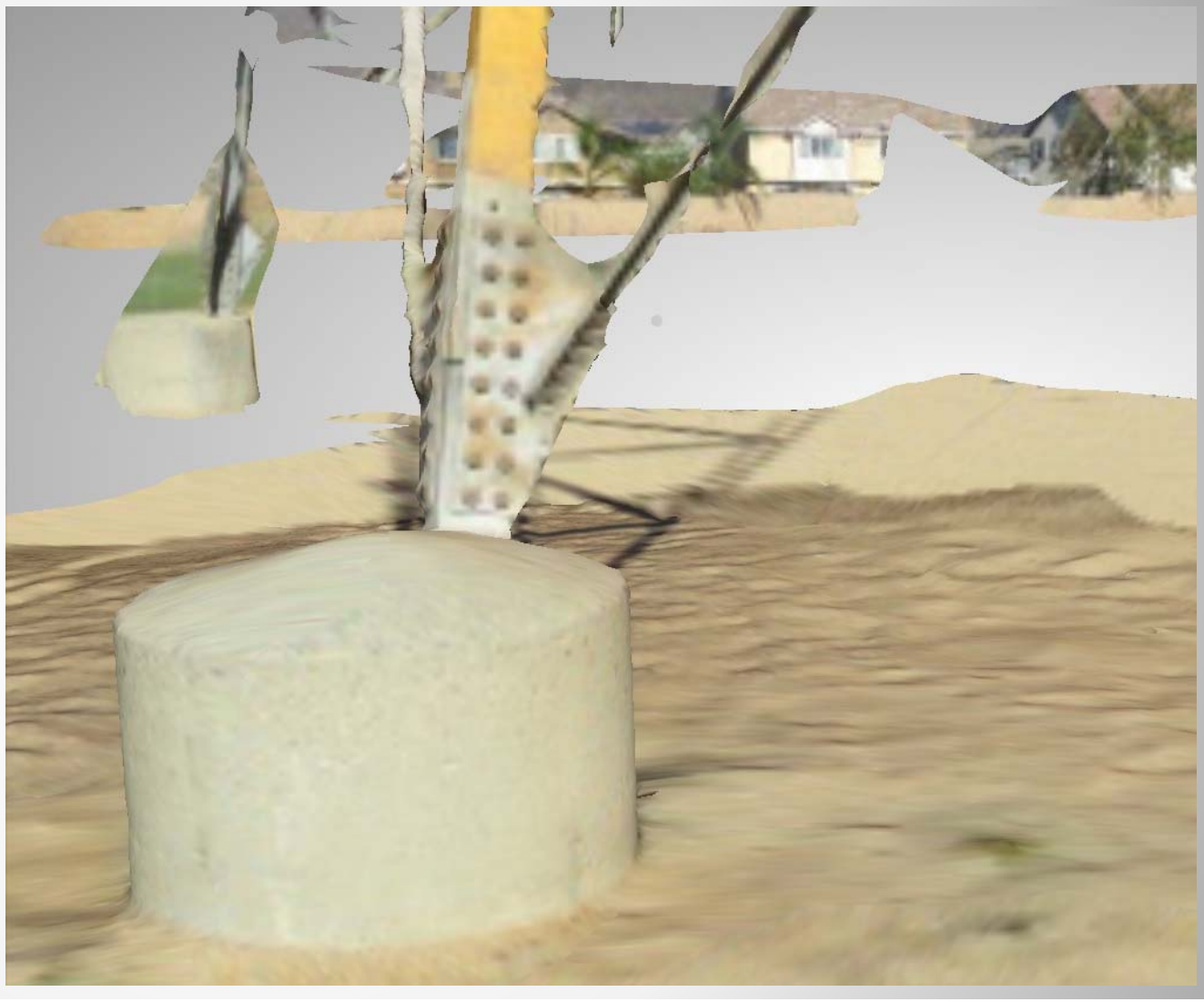


Photo-realistic wire frame information model- Recap

LiDAR, Infraworks, Recap, Internal Spec's

Autodesk
InfraWorks

Conclusion

- LiDAR – High quality, low cost, accurate
- This data used in context, to create compelling visuals
  - Reduce false starts
  - Engineering / Pre-engineering level of data accuracy
  - Involvement for stakeholders, from their perspective:
    - Regulators, environmental groups, legislation, other utilities, agencies, and internal departments
  - Turning data into information

Final

- Questions/ Suggestions/ Thoughts/ Concerns