

NATIVE PLANT CONSERVATION ON THE PINAL CENTRAL TO TORTOLITA 500 KV TRANSMISSION LINE PROJECT

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**PART 1: SAGUARO CONFLICT ASSESSMENT
TRANSMISSION LINE (CONDUCTORS) & PREDICTED SAGUARO GROWTH**



WestLand Resources

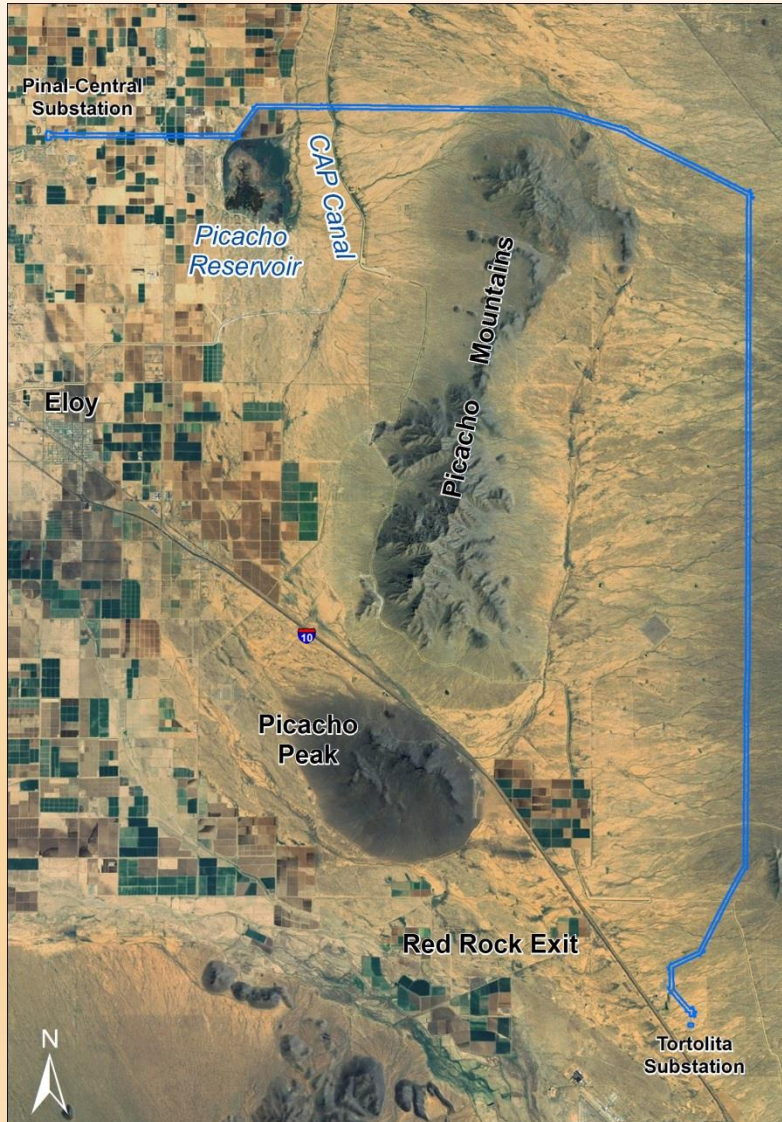
The logo for WestLand Resources consists of a stylized blue wave graphic above the company name 'WestLand Resources' in a black, sans-serif font.

OBJECTIVES FOR SAGUARO CONSERVATION

- Stewardship & Sustainability -
Reduce impacts to native plants
- Minimize Indirect Impacts to Wildlife -
U.S. Fish & Wildlife Service & the
endangered lesser long-nosed bat
- Cost Savings - Reduce certain
expenses by minimizing field survey
and vegetation removal



SAGUARO INVENTORY, GROWTH MODEL, & CONFLICT ASSESSMENT



- Remote Survey (Orthophotography & LiDAR)
- Field Sampling Verification
- Predicted Growth Rates
- Sargent & Lundy conductor line conflict assessment
- Determination of saguaros to be removed & preserved

ORTHOPHOTOGRAPHY & LIDAR

Orthophotography: aerial photographs with ground control points

LiDAR (Light Imaging Detection and Ranging): various measurements based on light travel time from laser pulse transmitter

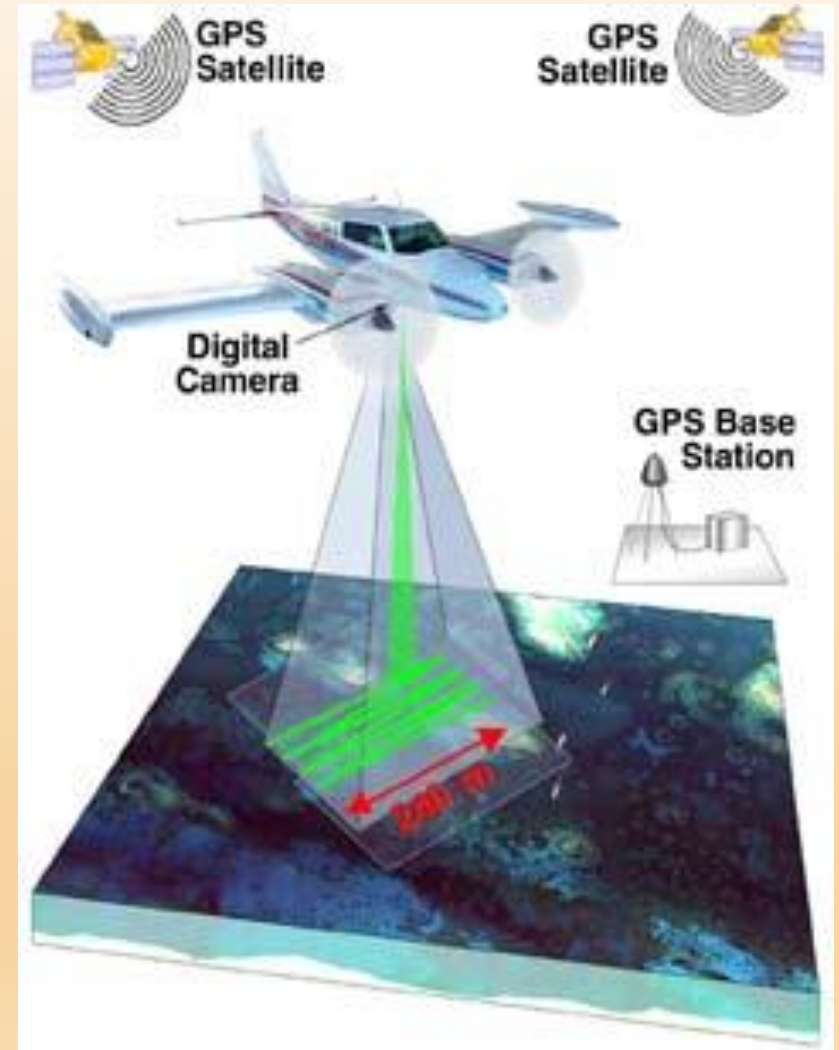


Image source: McLeod County, MN

METHODS: REMOTE SENSING

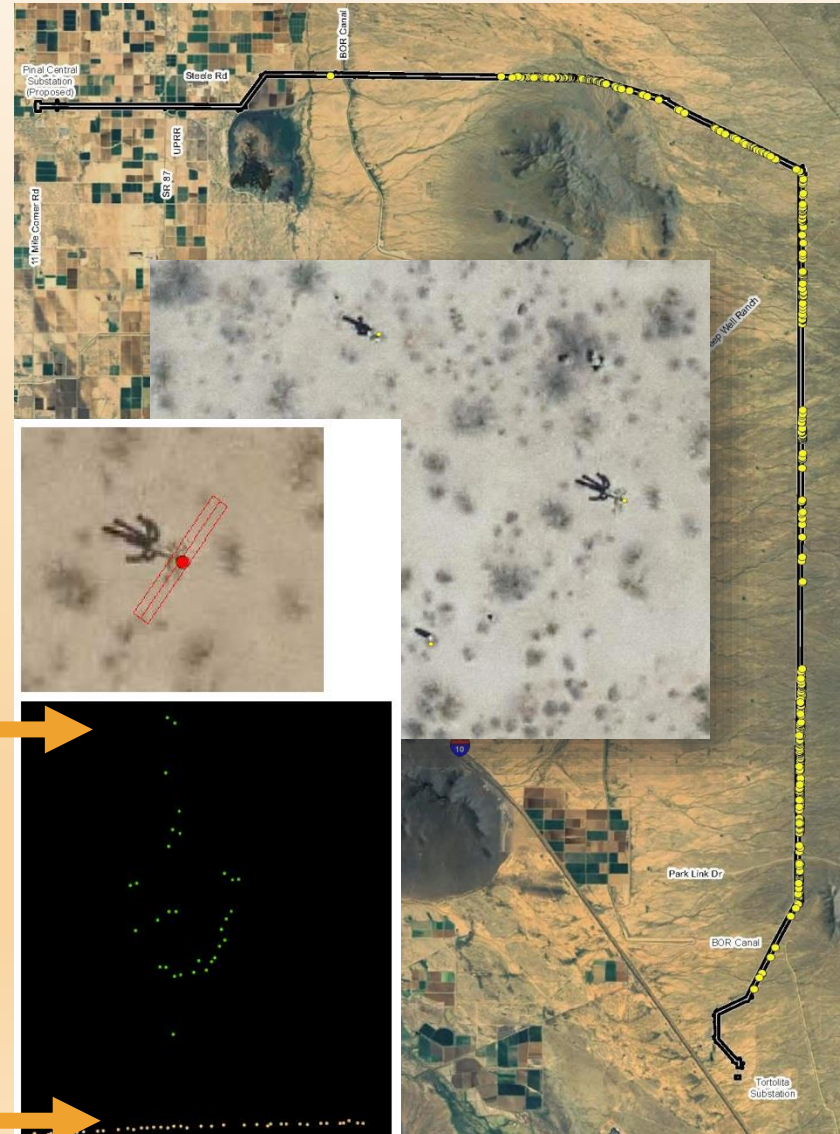
High-resolution orthophotos used to remotely identify and count visible saguaros

LiDAR classification of DEM and ground/vegetation cover used to estimate saguaro heights:

- Point data containing the X, Y, and Z coordinates
- Subtracted the elevation of points classified as ground from the maximum elevation of points classified as vegetation at each saguaro

Elevation at highest vegetation point

Elevation at ground point



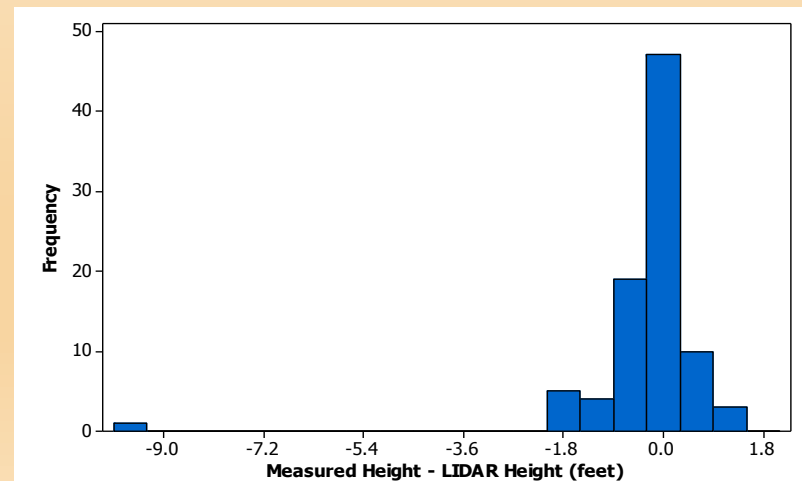
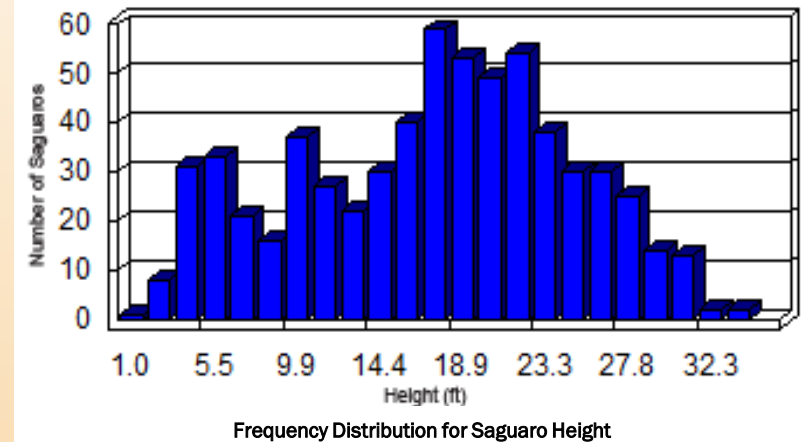
METHODS: FIELD VERIFICATION SAMPLING

- Three clusters of 30 saguaro randomly selected to sample the 635 potential saguaro
- Biologists confirmed saguaros and measured height via stadia rod or rangefinder
- Height was recorded with a GPS unit



RESULTS OF INVENTORY AND HEIGHT SAMPLING

- 86/90 sampled were actual saguaro
- Extrapolated 600/635 potential saguaro are likely actual saguaro
- LiDAR predicted saguaro heights at mean of 18 ft. (1 ft. to 34 ft)
- Saguaro less than 3 ft likely not detected
- Range of LIDAR accuracy typically within inches, clustered around 0. LiDAR over predicts saguaro height **by just 2.4 inches**



SAGUARO GROWTH RATE PROJECTIONS

Growth rates are highly age/size dependent

- 10 yrs for a saguaro to reach 2 cm and 20-50 yrs to reach 1 meter
- Height/yr ranges between 2 - 14 cm before flowering (8 ft), then declines to about 7 to 8 cm/yr
- The period of greatest growth occurs from unbranched to branched adult

Actual growth is site-specific and varies with amount of precipitation

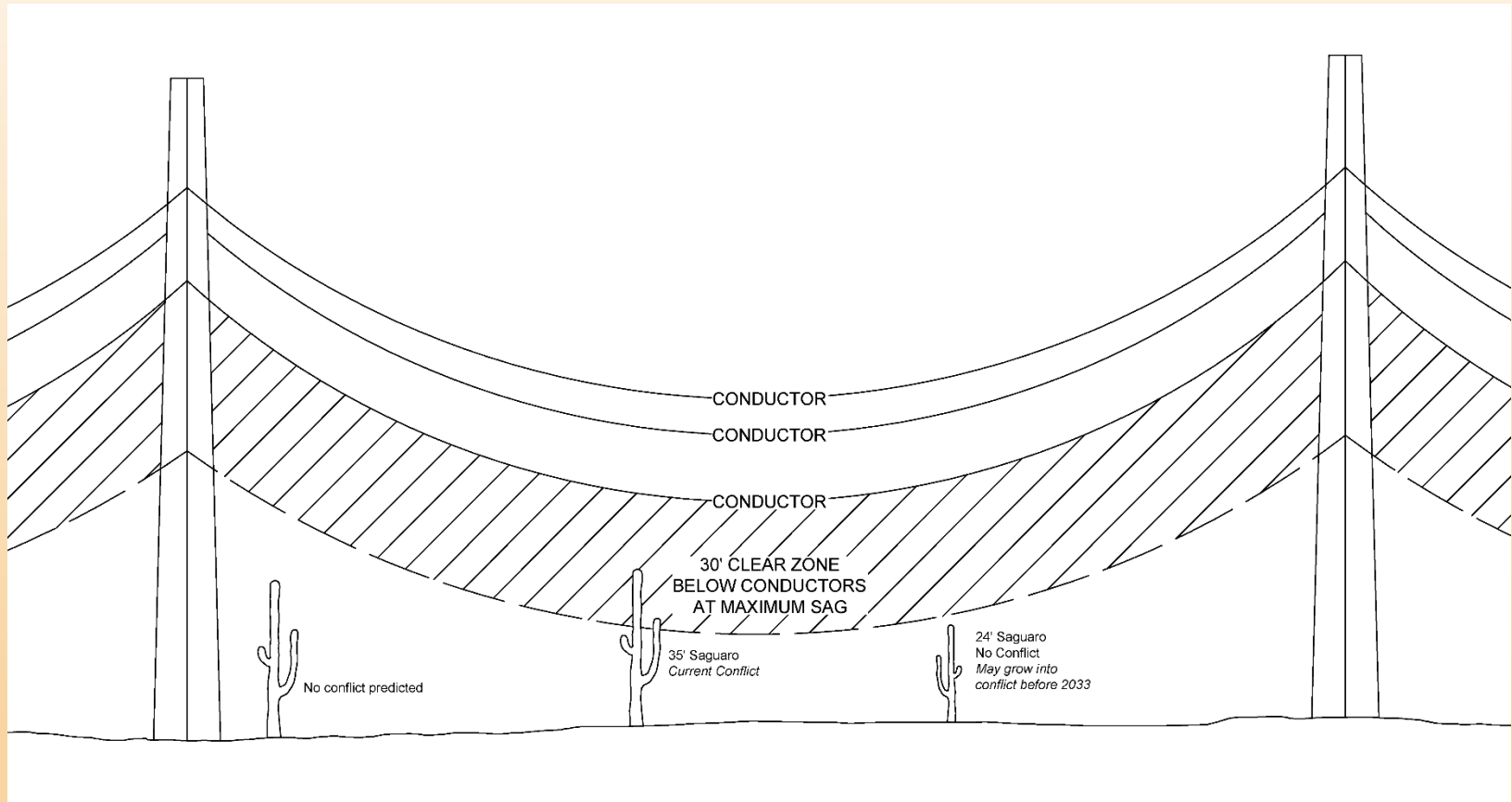
- We used an algorithm that considers growth rate, height, and precipitation (Drezner 2003) based on studies at Saguaro National Park East & West:

$$R = K \cdot 10^{-0.222287 + 0.606605 \cdot \log(h) - 0.00003534(\log(h))^9}$$

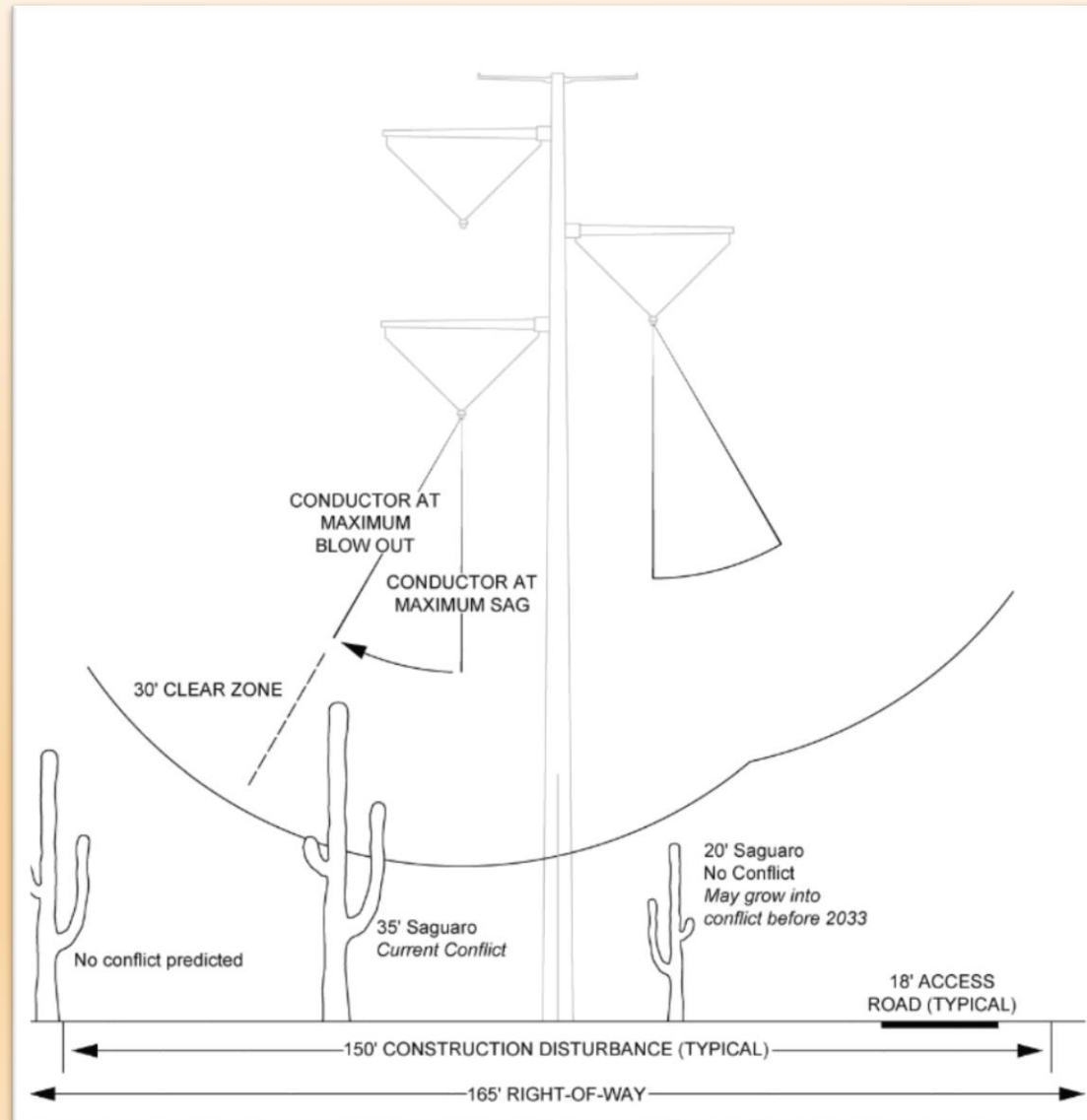
- Where R = Rate of growth (cm/year)
- H = Current height of saguaro (cm)
- K = Growth factor (1/year)

The growth factor considers annual precipitation in the vicinity

SARGENT & LUNDY CONDUCTOR LINE CLEARANCE ANALYSIS



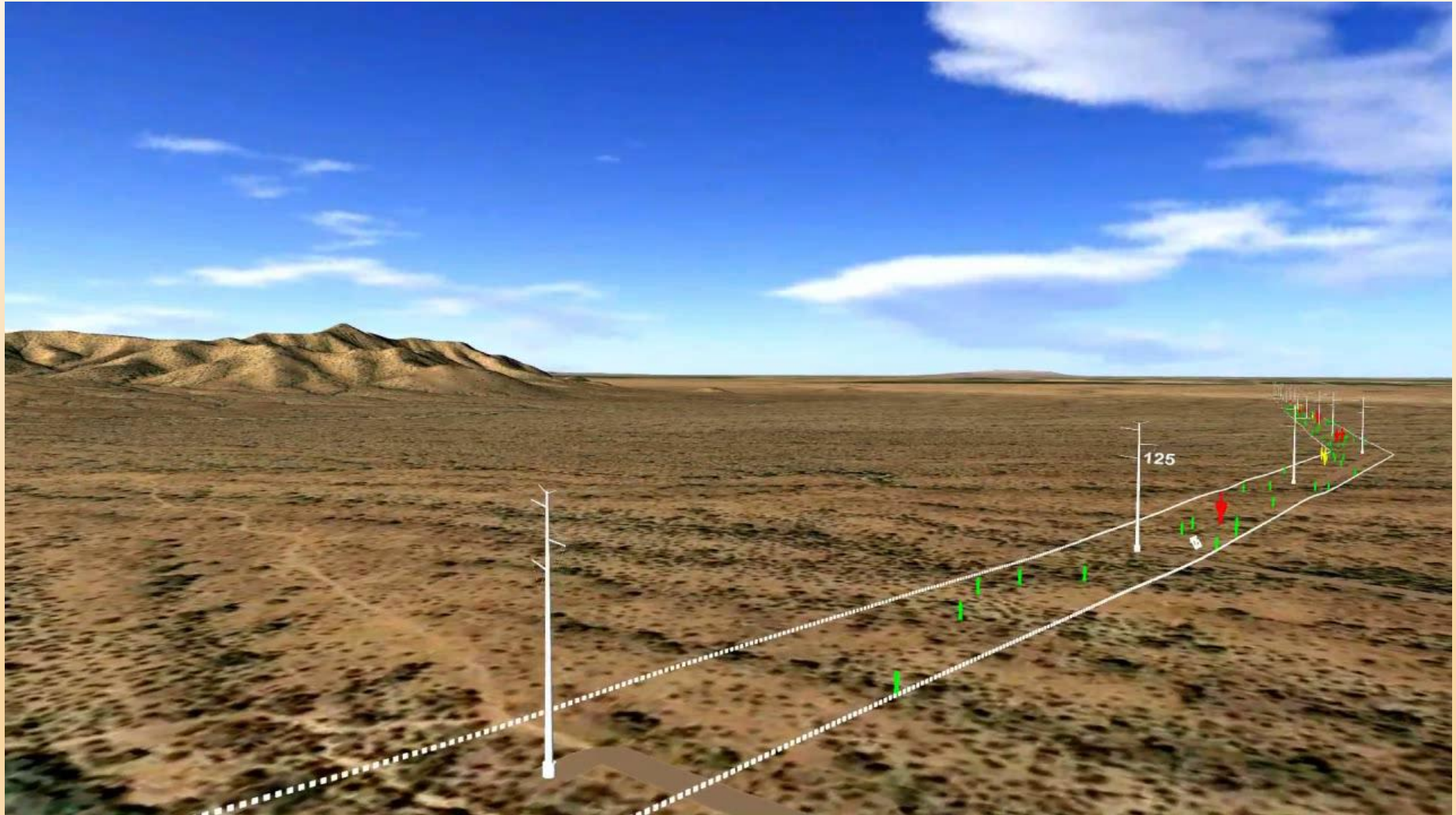
SARGENT & LUNDY CONDUCTOR LINE CLEARANCE ANALYSIS



SAGUARO CONFLICTS WITH CONDUCTOR LINE

5- Year Interval	Growth Factor	Sag Conflicts	Extreme Wind Conflicts	Total Saguaro in Conflict
2013	n/a	49	17	56
2018	0.8	6	1	7
2023	0.8	12	2	14
2028	0.8	7	3	10
2033	0.8	9	4	13
				100

SAGUARO CONFLICT ASSESSMENT RESULTS



SUMMARY OF FINDINGS

- 202/600 saguaro within the ROW to be removed over the next 20 years (34%), preserving nearly 400 saguaro (66%)
- Orthophotography and LIDAR technology proved accurate as a remote sensing tool; useful for large scale projects in similar geophysical setting
- Some limitations (detecting all saguaro, especially smallest saguaros | *Part 2 of this presentation will address this*)
- Possible Future Studies: Assessment can be replicated in coming years for future projections; opportunities for other long-range saguaro survivorship and growth studies at Project Area

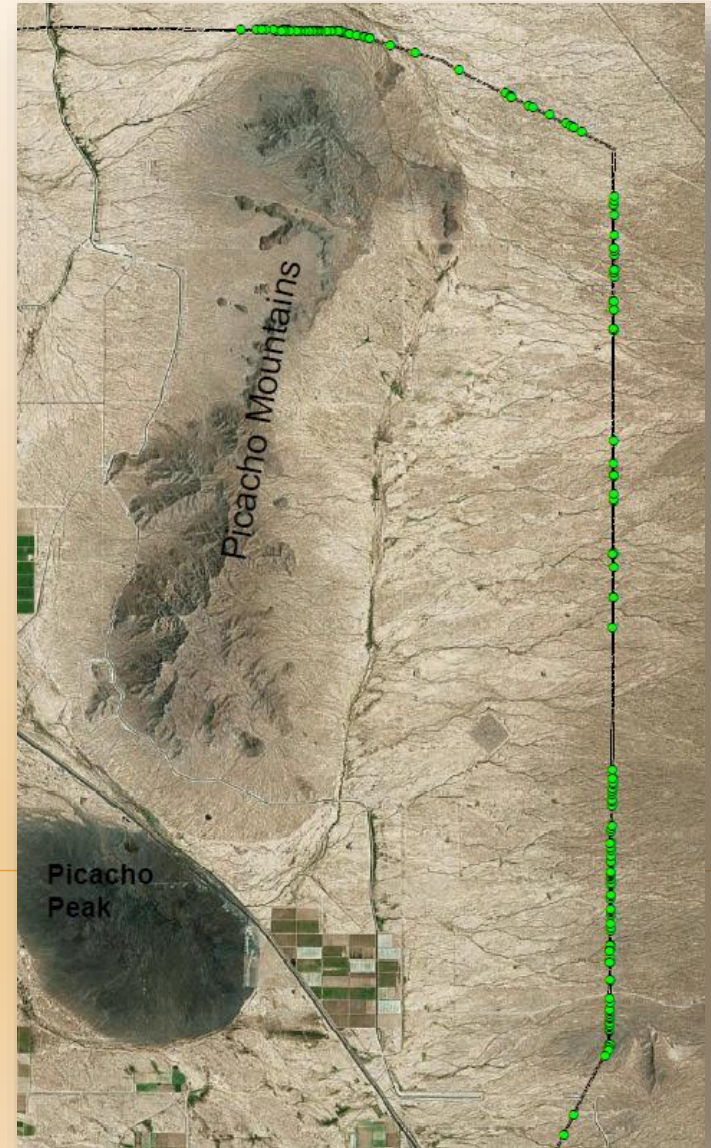
Clearance Requirement	# Saguaro
Total saguaro in ROW	600
Construction conflicts	-102
Conductor line conflicts including 20 yrs of growth	-100
Non-conflict saguaro	398

NEXT...

PART 2: Construction Conservation Efforts

PLANT SALVAGE EFFORT

- Focus was the 202 Saguaro and smaller cacti species in the disturbance footprint
- Salvage native trees in conflict with conductors based on height derived from LiDAR data



FIELD INVENTORY



- Created a mobile GIS map, used on smartphones and I pads to record data
- Collected location, species, height, condition, etc.
- Flagged and numbered the cacti
- Flagged new access roads



INVENTORY RESULTS



- 202 Saguaro from WestLand study
- 221 additional saguaro found in footprint, most under 3ft
- 748 fishhook barrel, hedgehog, & pincushion cacti



SALVAGE COORDINATION

- Salvage prior to construction start as access allowed
- Notified Az Dept Agriculture of Plant removal
- Onsite meetings with potential salvagers to review access, timing
- Purchased tags and transport permits from ADA
- **Tucson Cactus and Succulent Society** - saguaro \leq 4ft, small cacti
- **Old Pueblo Cactus, Saguaro Cactus** - saguaro
- **Native Resources**- native trees



SaguaroCactus



COORDINATE WITH CONSTRUCTION CREW



- Placed all 202 Saguaro to be removed on construction map
- **Greyed out** Saguaro had been salvaged or avoided such that construction would not plan to remove

TUCSON CACTUS AND SUCCULENT SOCIETY



Saguaro < 5ft tall
Fishhook Barrel < 3ft
Hedgehog and Pincushion Cacti

TUCSON CACTUS AND SUCCULENT SOCIETY

4 Days
302 Crew hours
340 Plants

81 Saguaro
153 Hedgehog
51 Barrel
45 Pincushion



OLD PUEBLO CACTUS & SAGUARO CACTUS

- Salvaged 97 commercially viable saguaro
- Transplanted 9 onsite
- 28 ft tallest that could be moved



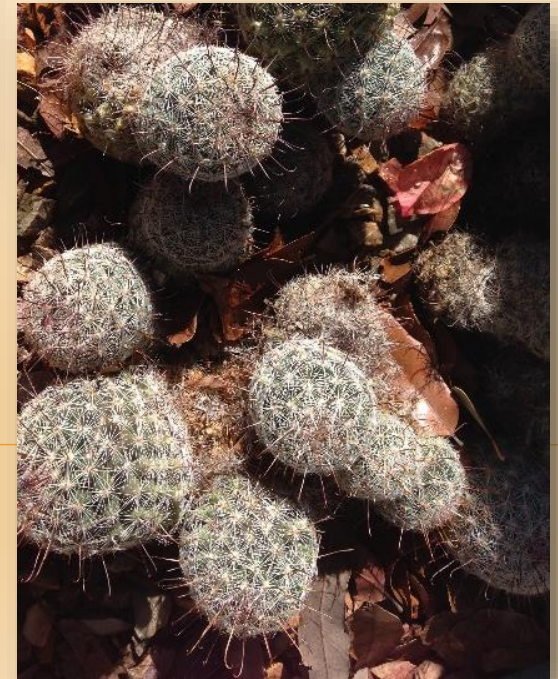
TRANSPLANTED ONSITE BY TEP ENVIRONMENTAL

27 Saguaros

140 Barrels

145 Hedgehog

25 Pincushion



423 SAGUARO IN FOOTPRINT / WIRE CONFLICT

Number	Method	%
80	Avoided	19
36	Transplanted	9
178	Salvaged	42
294	Saved	70
129	Taken	30

Based on total saguaro in footprint we estimate at least 1320 saguaro would have been lost to a full clearing of ROW



748 SMALL CACTI IN FOOTPRINT

Number	Method	%
77	Avoided	20
312	Transplanted	38
249	Salvaged	30
638	Saved	83
110	Taken	12

Including saguaro, 82 % of cacti were saved within the disturbance footprint of roads, structure pads, and work zones



NATIVE RESOURCES INTERNATIONAL

- 34 Trees Salvaged in Late Summer
- Ironwood, Palo Verde & Mesquite



QUESTIONS?



Photo Credits: Robin Lewellyn