PA DEP Conservation Tillage BMP Remote Sensing Verification Pilot Project

AGWG Meeting Update

Thomas Howard

January 16, 2025

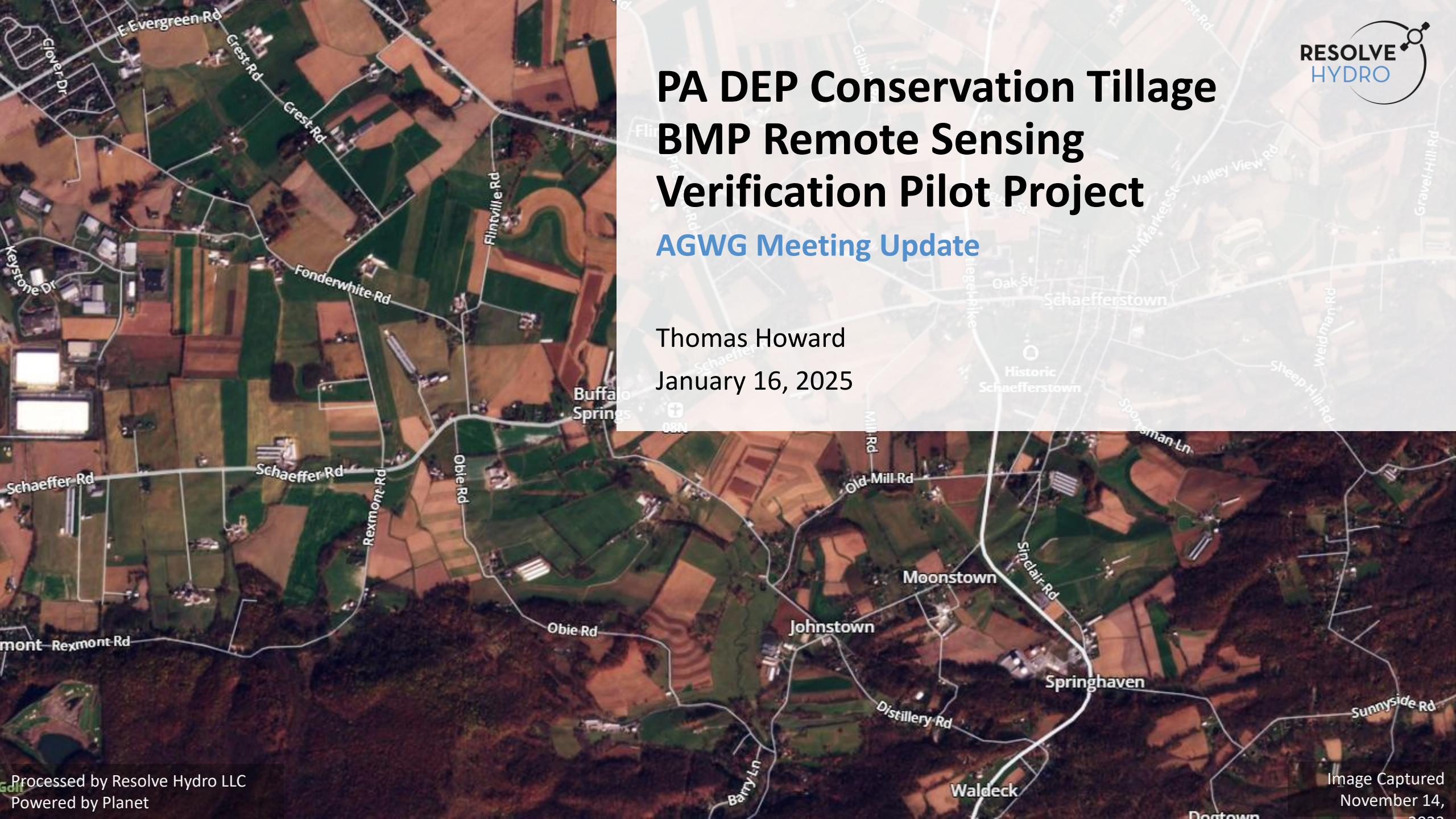

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Image Captured November 14,

PA DEP's Remote Sensing BMP Pilot Project aims to develop a model-agnostic, standard operating procedure for remote detection of conservation tillage BMPs

Model implementation workflow:

How do jurisdictions assess whether remote sensing results are "suitable" for reporting conservation tillage BMP implementation?

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Model acceptance/rejection should:

1) Match standard practices used in the CBP
2) Be based on model performance each year

Classification results from remote sensing approaches differ in resolution from traditional approaches

Example field accuracy assessment:

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Human observer classifies entire field as “>60% crop residue cover”

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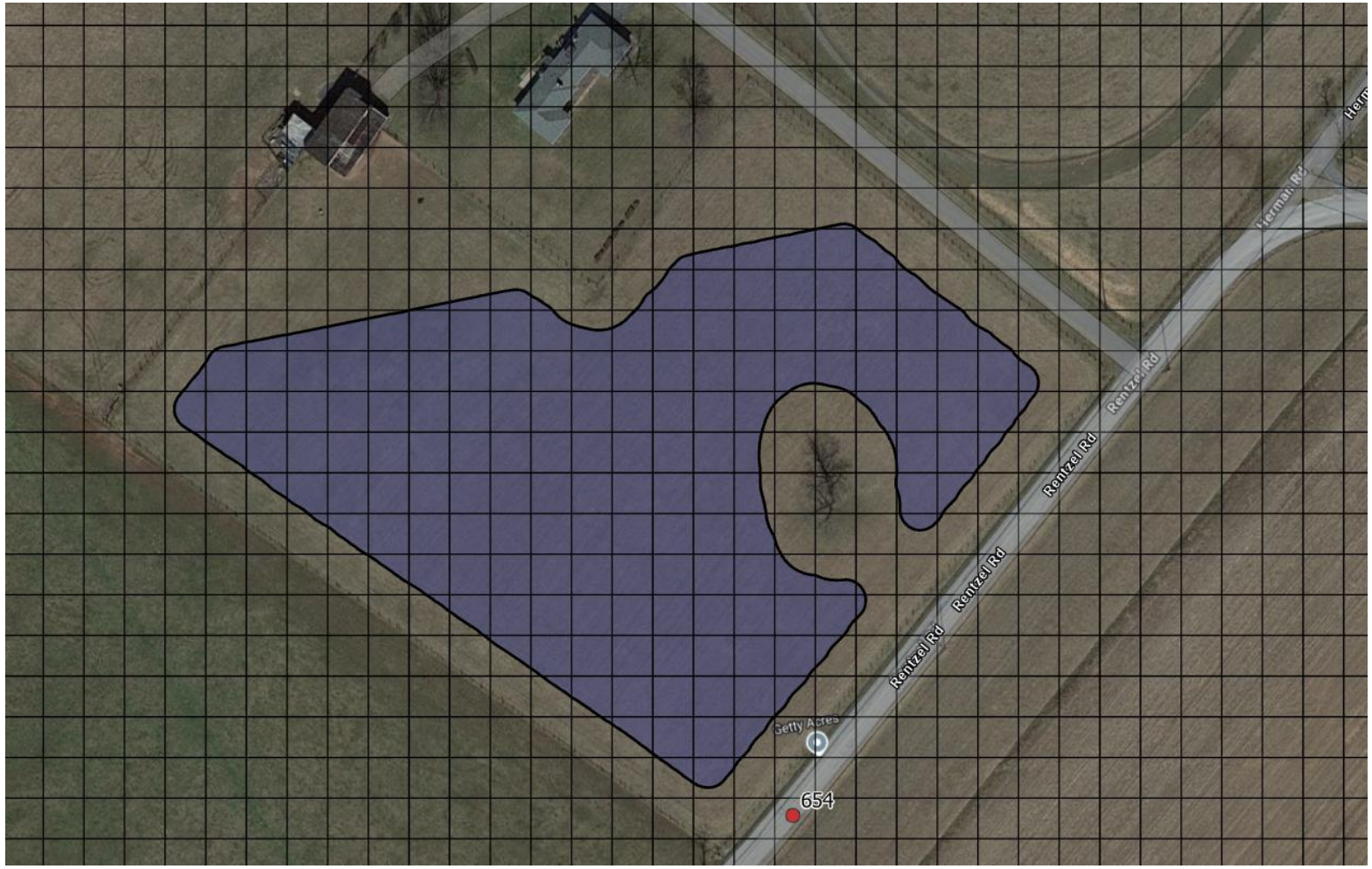

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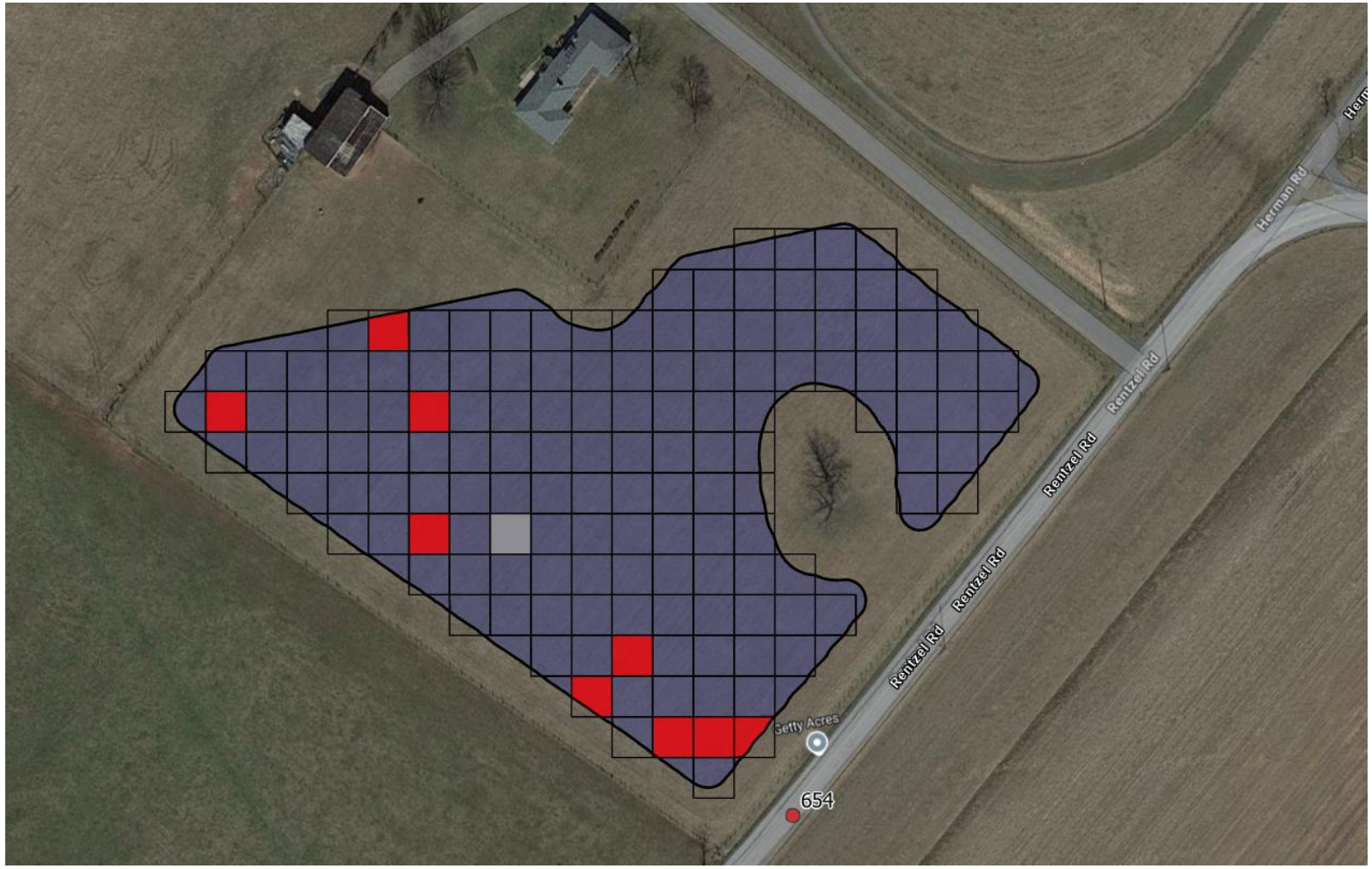

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Residue Class	Area (square meters)
Not eligible for tillage	0
<15% crop residue	0
15-29% crop residue	100
30-59% crop residue	831
>60% crop residue	12,704
Total	**13,635**

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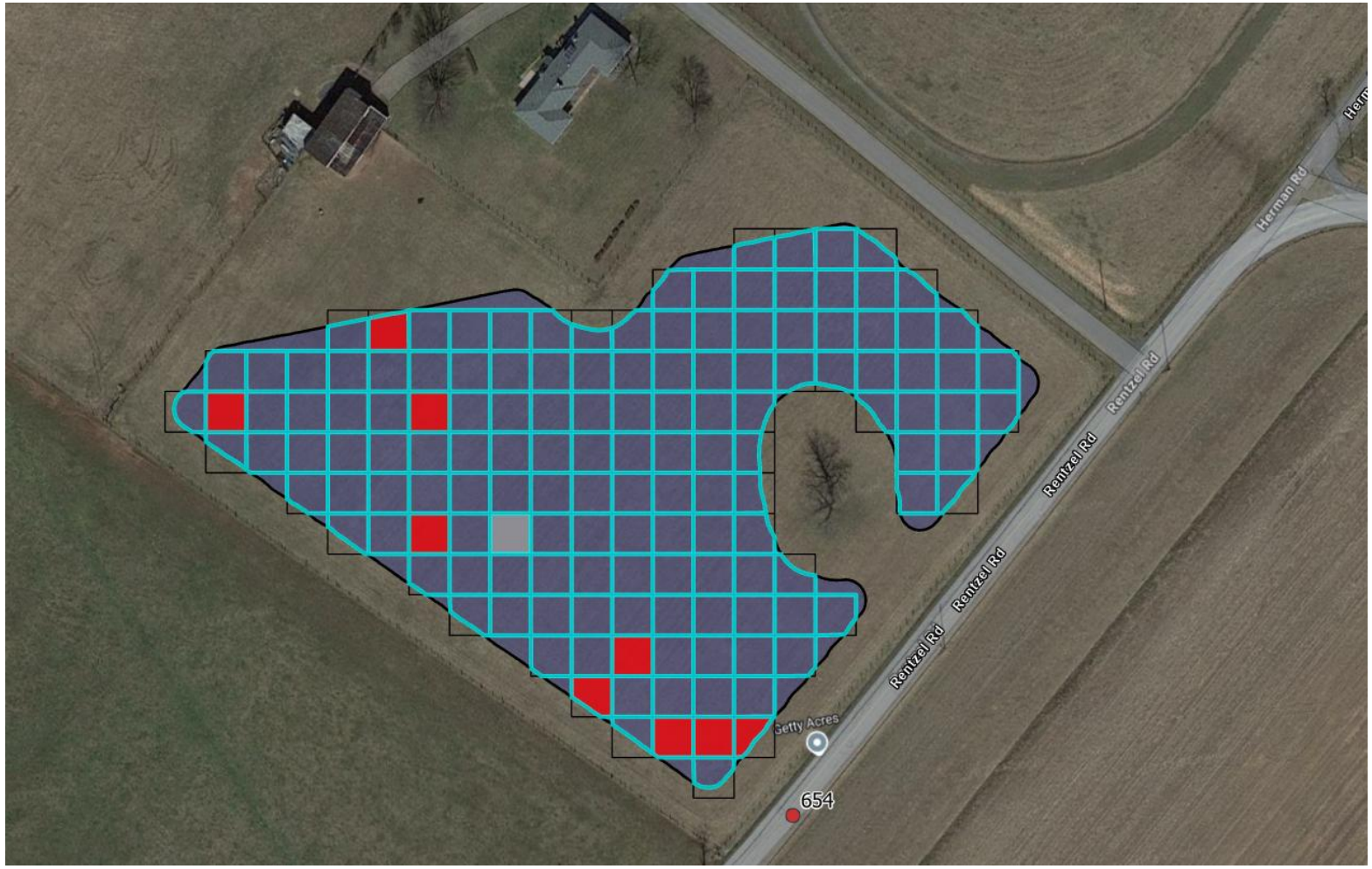

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Determining accuracy of remote sensing method

Ground-truth assessment of remote sensing results for a theoretical 1000 acre area

Confusion Matrix for 1000 Acres		**Remote Sensing Observations**				
		Not eligible	<15% residue	15-29% residue	30-59% residue	≥60% residue
Field Observations	Not eligible	0	0	0	0	0
	<15% residue	0	124	16	7	9
	15-29% residue	0	18	135	16	6
	30-59% residue	0	6	15	282	6
	≥60% residue	0	0	25	71	864

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Calculating results from ground-truth assessment

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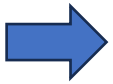

	True Positives	**False Positives**	**True Negatives**	**False Negatives**
<15% residue	124	24	1420	32
15-29% residue	135	56	1369	40
30-59% residue	282	94	1197	27
≥60% residue	864	21	619	96

Determining accuracy of remote sensing method

Calculating results from ground-truth assessment

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	False Alarm Rate	Hit Rate	PAG	PAG/HR
<15% residue	16%	79%	84%	1.05
15-29% residue	29%	77%	71%	0.92
30-59% residue	25%	91%	75%	0.82
≥60% residue	2%	90%	98%	1.08

$$Overall\ accuracy = \sum \frac{TP}{N}$$

$$False\ Alarm\ Rate = \frac{FP}{TP + FP}$$

$$Hit\ Rate = \frac{TP}{TP + FN}$$

$$Post\ Agreement\ Rate = \frac{TP}{TP + FP}$$

Determining whether remote sensing results are acceptable

Calculating and assessing results from ground-truth assessment

1. Calculate all results with ≥90% confidence interval and ≤10% error
   - Standard practice in reporting conservation tillage BMPs

2. Adjust results to account for bias using statistical methods
   - Practice established in prior CBP report

3. Determine whether results should be accepted
   - What are the CBPs established accuracy thresholds?

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- Each quality assurance analysis will report the sample count error matrix; the area proportion error matrix (including confidence intervals of the true or adjusted proportions); the producer's, user's, and overall accuracy estimates; and the confidence interval of the overall accuracy estimate.
- To use the true (adjusted) proportions resulting from the analysis, the lower confidence limit on the overall accuracy must exceed 50 percent. (A value of 50 percent was selected based on the lower range of survey accuracies discussed in the literature review section of this report.)
- A minimum confidence level of 90 percent should be used on all statistics.