

# Distribution of Quality Control to the Point of Data Collection in the Field: Impacts on Cost, User Experience, and Security

Andrea Johnson (U.S. Census Bureau)

Jonathan Krentel (Gunnison Consulting Group, Inc.)

# Why Collect Housing Unit Locations?

- Accurate housing unit location matters



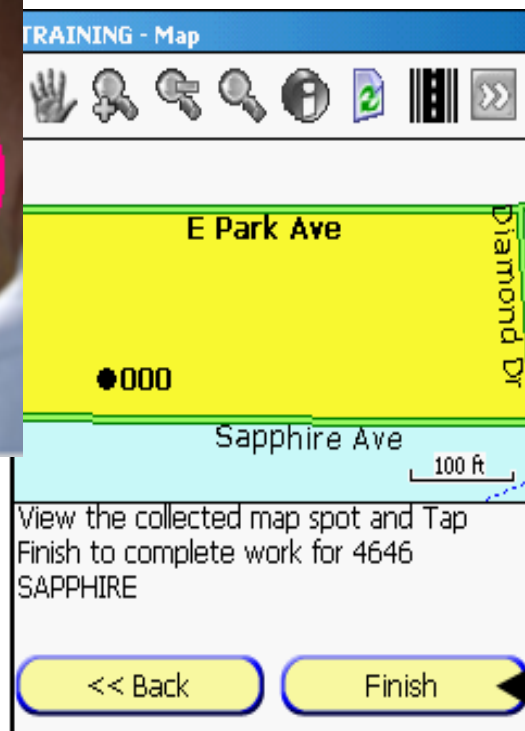
# 2010 Address Canvassing Map Spot Collection

## 1) Locate Housing Unit



## 2) Locate GPS "you are here" indicator on map

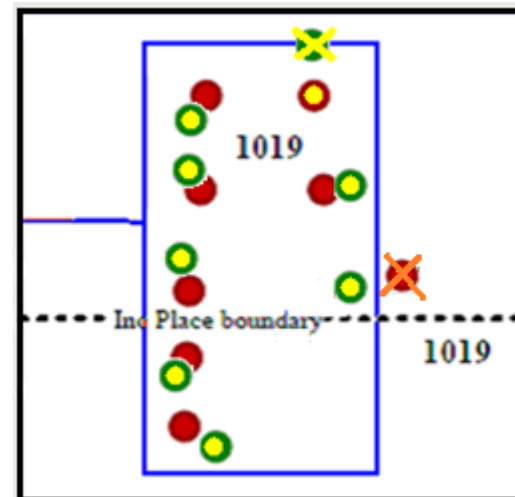
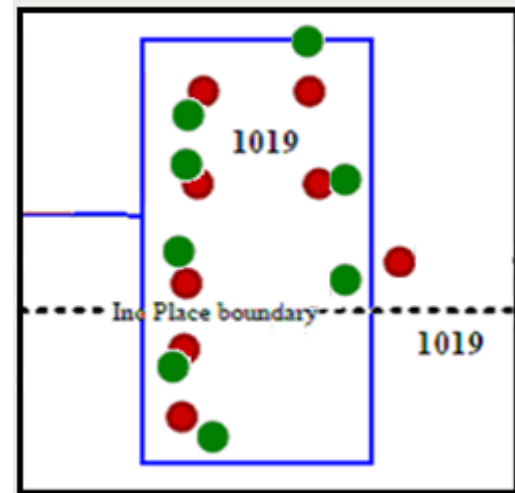
## 3) Tap on map



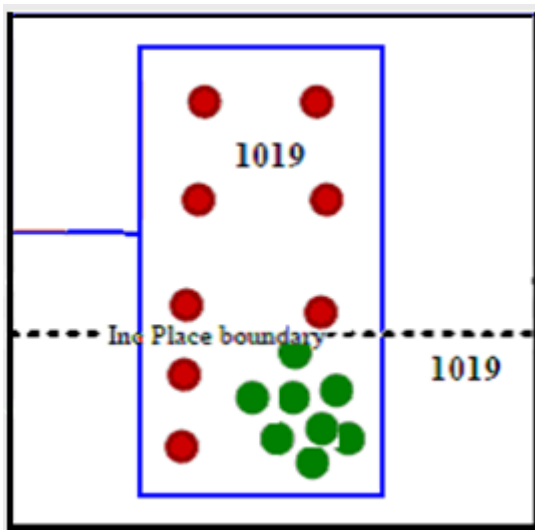
## 4) Confirm location of map spot (from tap)

# Map Spot Collection Results

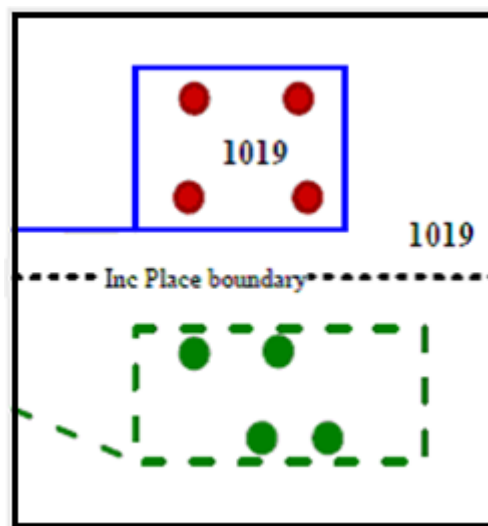
- 106,000,000 Map Spots collected
- For every map spot collected, two coordinate pairs were returned to the Census:
  - Manual
  - GPS
  - Only one point is “preferred”
- Three primary outcomes:
  - GPS = Manual
  - GPS location correct but manual location wrong
  - Manual location correct, GPS is wrong



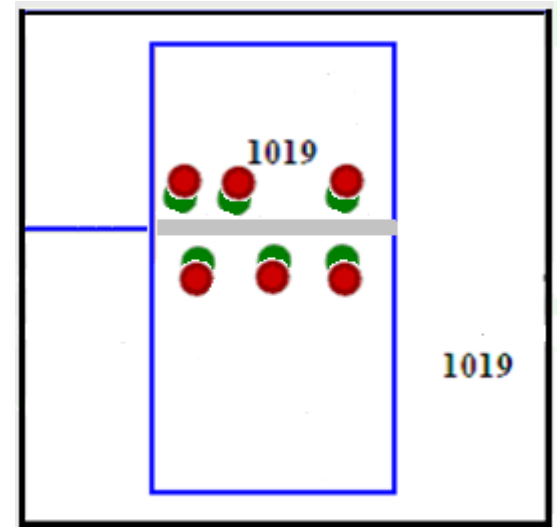
# Map Spot Collection Issues that Required Resolution



**Curbstone Clusters**  
~ Workload: 210,000

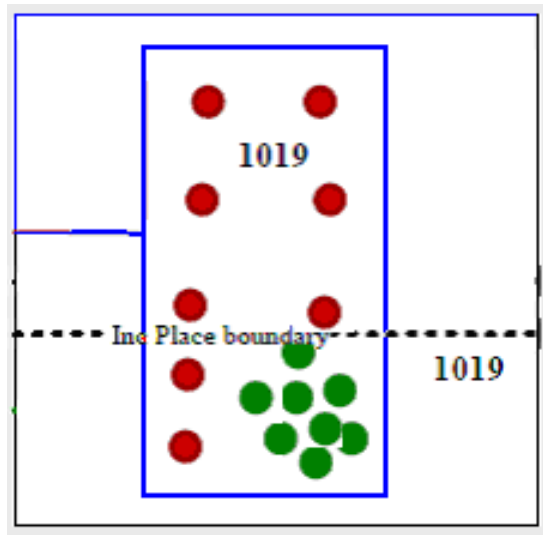


**Map Spot Reconciliation**  
1,500,000

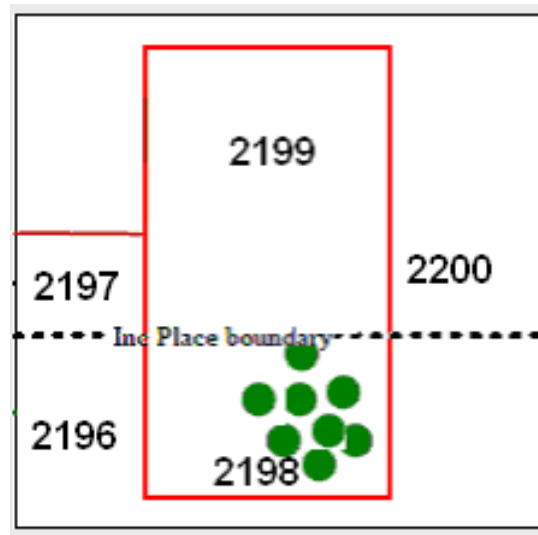


**Feature Name Reconciliation**  
1,150,000

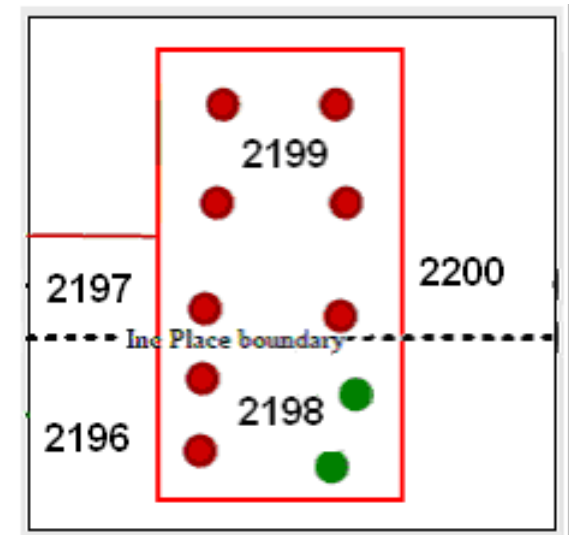
# Curbstone Clusters Resolution



**A) After Collection**



**B) If GPS Accepted and  
No Manual Review**

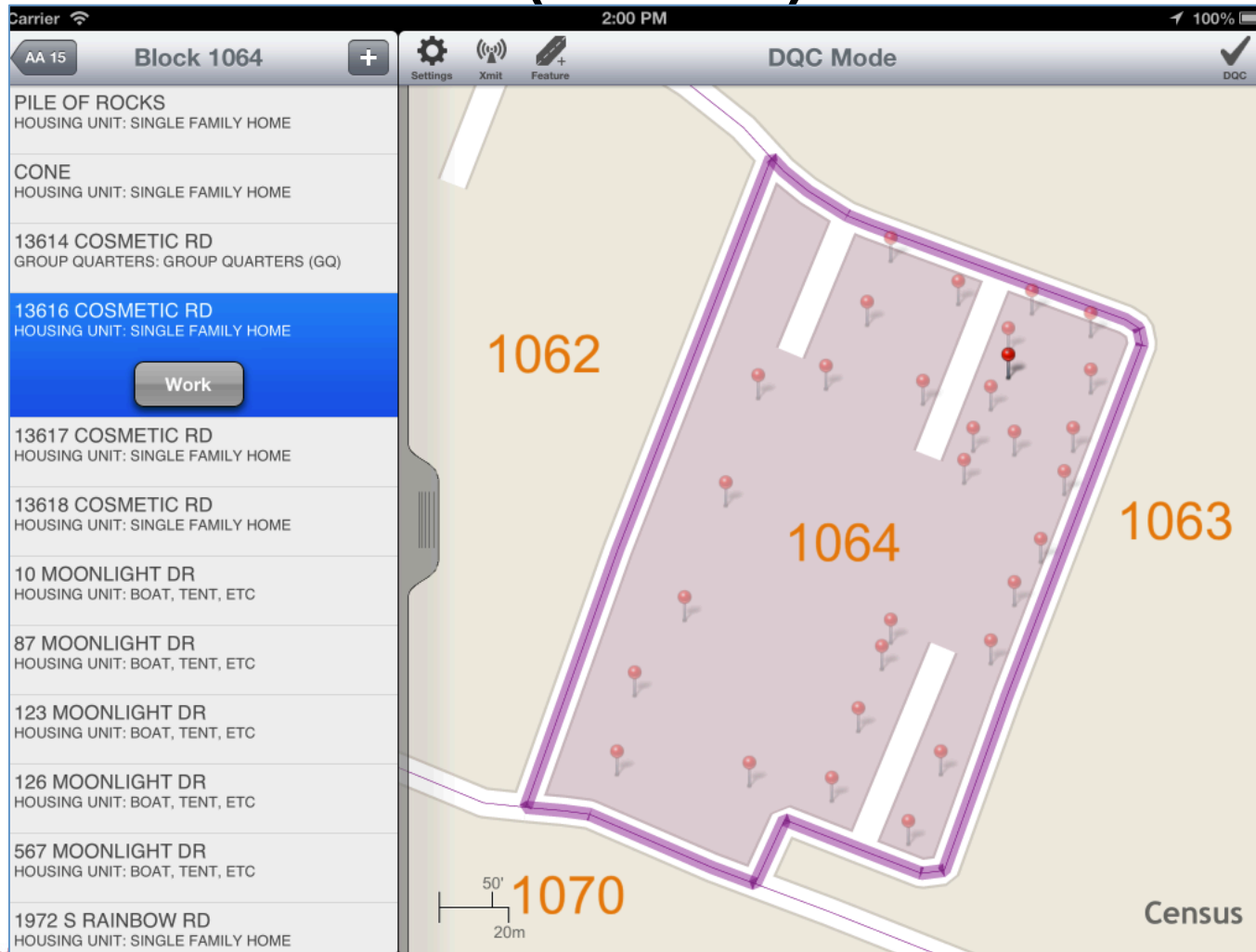


**A) After Manual Review**

# High Cost of Manual Resolution

2009 Curbstone Cluster Project Staff Resource			
Task	People	Job Code	Total Hours
Develop Procedures	1	Geographer	120
Conduct Training	4	Geographers	128
Monitor Analysis	4	Geographers	128
Resolve Referrals	3	Geographer	384
Training	27	Clerical	864
Perform Analysis	27	Clerical	8208
Conduct Quality Control	4	Supervisory Clerical	384
Misc IT (Upload, Systems Dev)	3	IT Specialists	180
<b>Unique People</b>	<b>~34</b>		<b>10,396</b>

# Listing & Mapping Application (LiMA)





# LiMA: Structure Type

carrier 2:01 PM 100%

AA 15 Block 1064 + Settings Xmit Feature DQC Mode DQC

HOUSING UNIT: SINGLE FAMILY HOME

11977 S RAINBOW TERR  
HOUSING UNIT: SINGLE FAMILY HOME

11979 S RAINBOW TERR  
HOUSING UNIT: SINGLE FAMILY HOME

91 SUNSET CT  
HOUSING UNIT: MOBILE HOME/TRAILER

93 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

95 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

97 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

99 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

301 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

302 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

303 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

304 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

Work

1063

1070

50' 20m

Census

**Structure Type** Next

Please select the Structure Type for this structure.

- SINGLE FAMILY HOME** ✓
- MULTI UNIT STRUCTURE**
- MOBILE HOME/TRAILER**
- BOAT, TENT, ETC**
- GROUP QUARTERS (GQ)**
- LANDMARK**

Cancel

# LiMA: Address Status

AA 15 Block 1064 DQC Mode

HOUSING UNIT: SINGLE FAMILY HOME

11977 S RAINBOW TERR  
HOUSING UNIT: SINGLE FAMILY HOME

11979 S RAINBOW TERR  
HOUSING UNIT: SINGLE FAMILY HOME

91 SUNSET CT  
HOUSING UNIT: MOBILE HOME/TRAILER

93 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

95 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

97 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

99 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

301 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

302 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

303 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

304 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

1063

1070

Census

**Address Status** Next

Please select the Address Status for this structure.

- HOUSING UNIT** ✓
- UNINHABITABLE**
- NONRESIDENTIAL**
- GROUP QUARTERS**
- DOES NOT EXIST**
- OTHER LIVING QUARTERS**
- UNDER CONSTRUCTION**
- DEMOLISHED**
- UNABLE TO LOCATE**
- DUPLICATE**

Work Cancel

# LiMA: Location Address

Carrier 2:01 PM 100%

Structure Type Location Address Next

Please enter the location address.

Street Unnamed/Unknown Yes No

30 W STARRY LN 20752

House Number Street Name Unit Descriptor Unit Number ZIP Code

Location/Physical Description BLG 2 EAST PARKING LOT--... Subdivision Name

Cancel

**House Number**  
May contain: A-Z, 0-9, spacebar, -, /  
May not contain the words: NONE, UNKNOWN or UNNAMED  
May not change without also modifying Street Name.

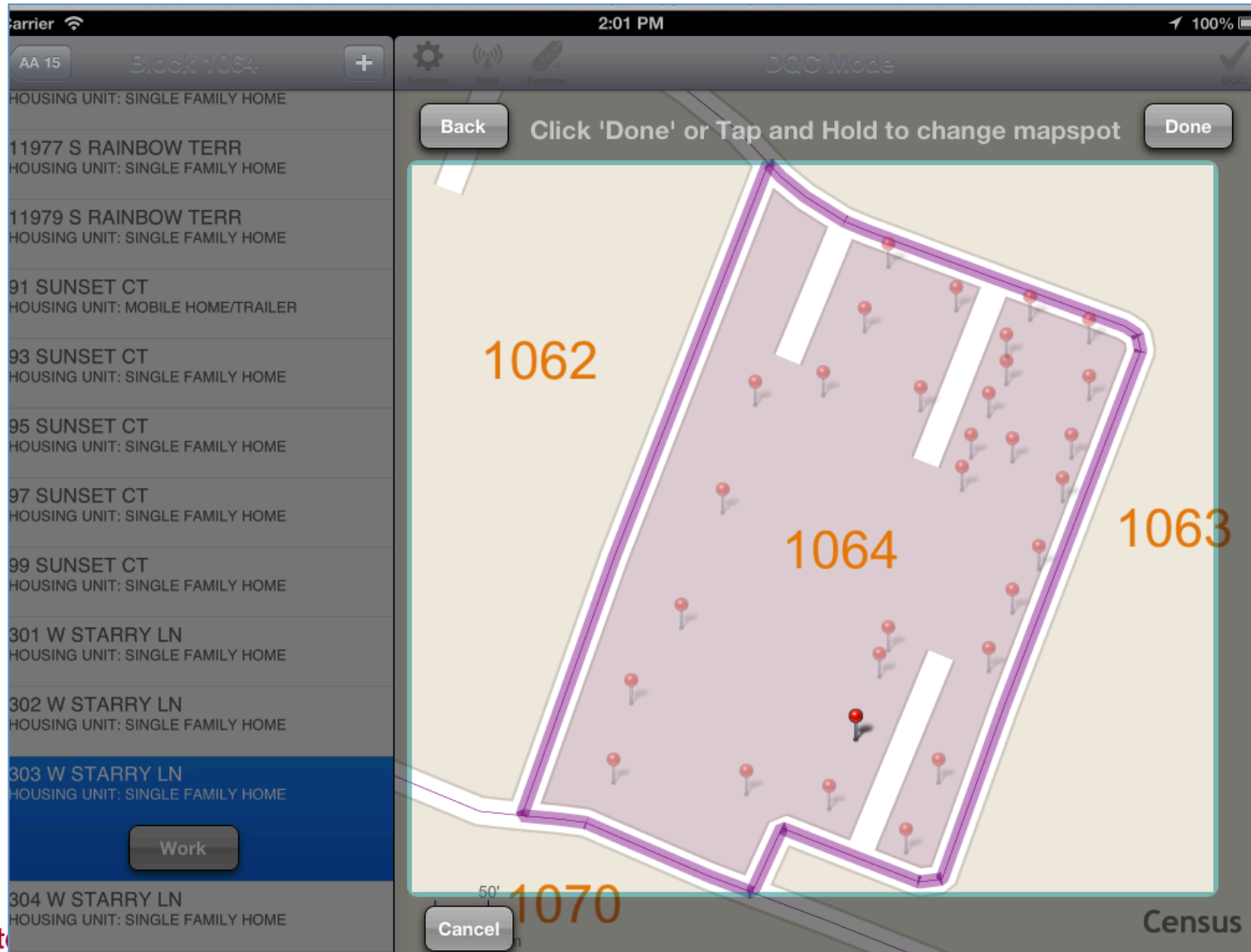
1 2 3 4 5 6 7 8 9 0 ~~x~~

- / : ; ( ) \$ & @ return

#+= undo . , ? ! ' " #+=

ABC ABC

# LiMA: Map-spotting



# LiMA: Long Strand

The screenshot shows the LiMA mobile application interface. The top status bar displays 'Carrier', '2:02 PM', and '100%'. The app header includes 'AA 15', 'Block 1064', a '+' button, 'Settings', 'Xmit', 'Feature', 'DQC Mode', and a checkmark icon labeled 'DOC'. The left sidebar lists addresses and housing units for Block 1064, including 11977 S RAINBOW TERR, 11979 S RAINBOW TERR, 91 SUNSET CT, 93 SUNSET CT, 95 SUNSET CT, 97 SUNSET CT, 99 SUNSET CT, 301 W STARRY LN, 302 W STARRY LN, 303 W STARRY LN, and 304 W STARRY LN. A 'Work' button is at the bottom of the list. The main map area shows a street layout with red mapspot markers. A dialog box titled 'Long Strand' is overlaid on the map. The dialog contains the following text: 'The mapspot entered is more than 164 feet from your current location.', 'Is the mapspot you collected correct?' with 'Yes' and 'No' buttons, 'Select the reason for the discrepancy:' with three radio button options: 'Restricted Access to the Address' (selected), 'Unsafe Conditions', and 'Other (Please specify)', and a text input field labeled 'Please provide details for discrepancy.' with a 'Cancel' button at the bottom left. The map background shows block numbers 1063 and 1070, and a scale bar for 50' and 20m. The 'Census' logo is in the bottom right corner.

AA 15 Block 1064 + Settings Xmit Feature DQC Mode DOC

HOUSING UNIT: SINGLE FAMILY HOME

11977 S RAINBOW TERR  
HOUSING UNIT: SINGLE FAMILY HOME

11979 S RAINBOW TERR  
HOUSING UNIT: SINGLE FAMILY HOME

91 SUNSET CT  
HOUSING UNIT: MOBILE HOME/TRAILER

93 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

95 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

97 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

99 SUNSET CT  
HOUSING UNIT: SINGLE FAMILY HOME

301 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

302 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

303 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

304 W STARRY LN  
HOUSING UNIT: SINGLE FAMILY HOME

Work

Map Spot Long Strand Done

The mapspot entered is more than 164 feet from your current location.

Is the mapspot you collected correct? Yes No

Select the reason for the discrepancy:

☒ Restricted Access to the Address

☐ Unsafe Conditions

☐ Other (Please specify)

Please provide details for discrepancy.

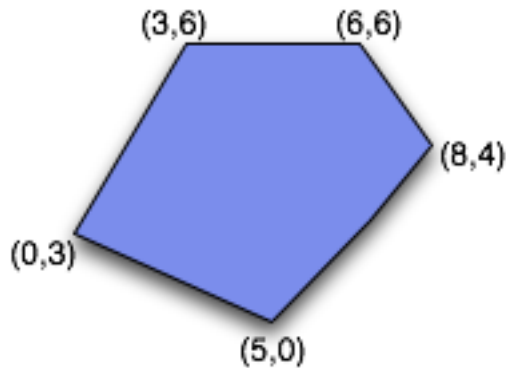
Other Reason

Cancel

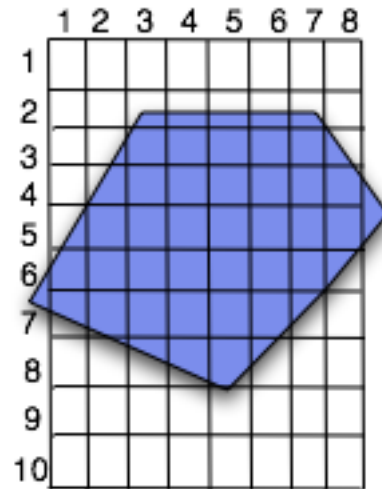
50' 20m 1063 1070 Census

# Mapping Considerations

Locally rendered vector-based maps  
vs. tile-based maps

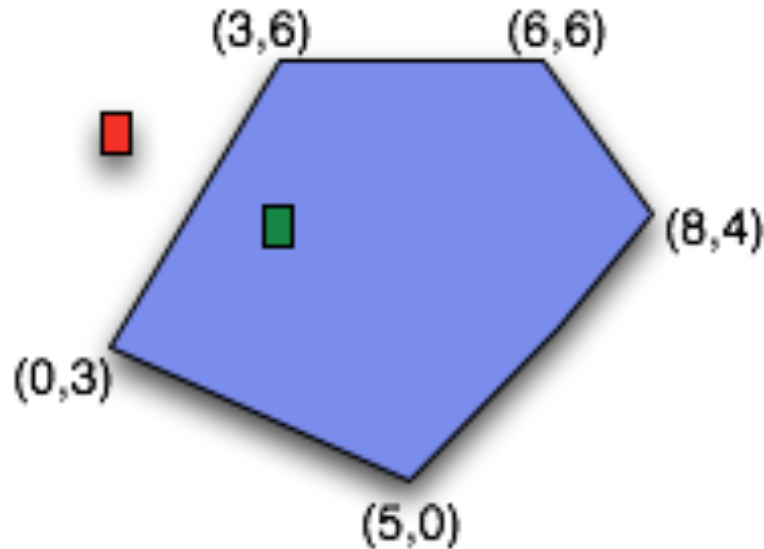


VS.



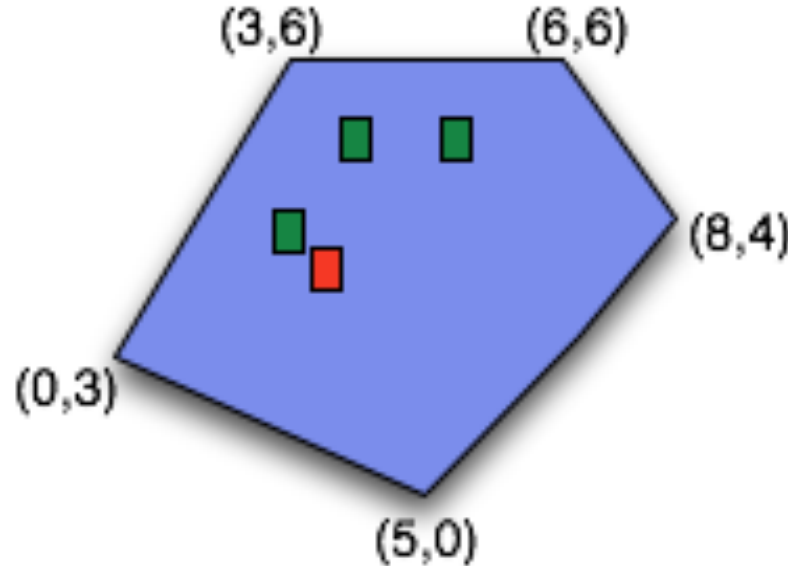
# Benefits of vector-based maps (1)

Quality = Spatial-awareness



# Benefits of vector-based maps (2)

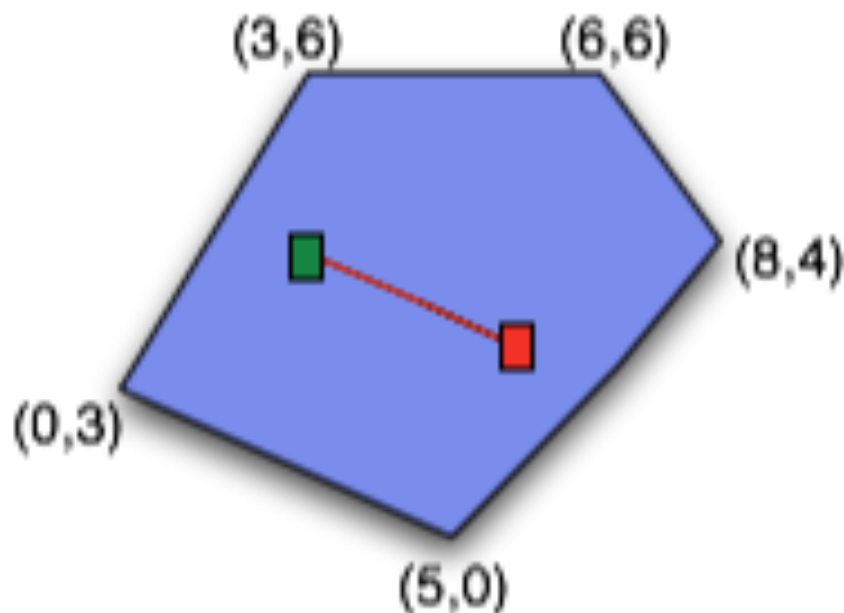
Quality = Real-time detection of clustering





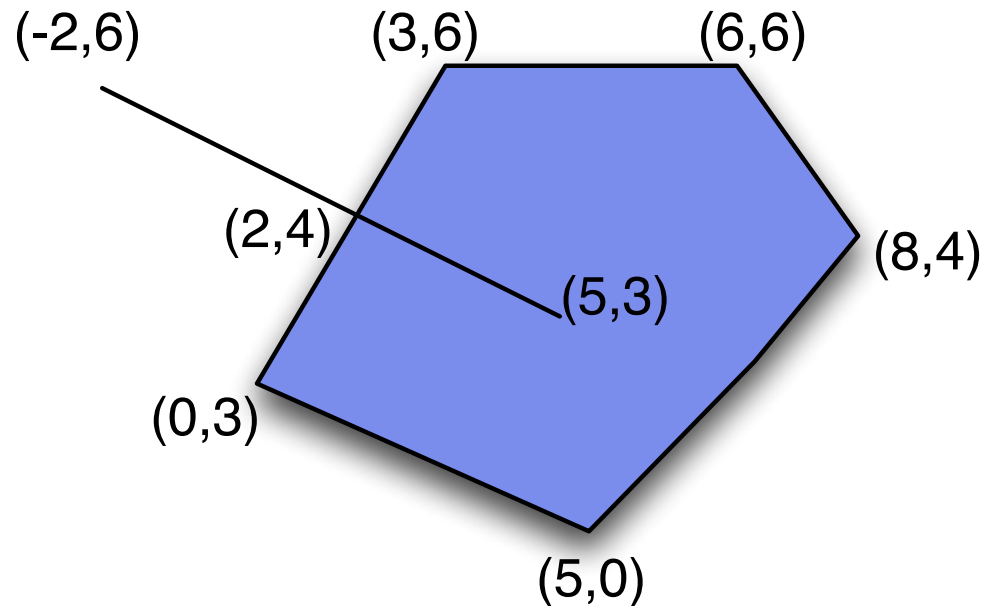
# Benefits of vector-based maps (3)

Quality = Real-time long strand detection



# Benefits of vector-based mapping (4)

Quality = Maintain topological integrity  
when adding or updating features



# “Thick Client” Technical Approach

- Benefits:
  - Rich data on the device
    - All objects on the map are programmatically addressable
    - Allows for locally executed Quality Control
    - Potentially eliminates the need for expensive post-processing operations
    - Allows for QC to take place by the person in the best position to make corrections
  - Enables native user experience
  - Mitigates connectivity risk
- Risks:
  - Multiplication of code bases = BYOD risk?
  - Data on the device = Security risk?
  - Heavy processing load on the device = Performance risk?