FIELD DATA COLLECTION USING SMART PHONES, TABLETS, AND GPS DEVICES: A CASE STUDY

By

Wende Mix &
Mary Perrelli

SUNY Buffalo
State College

Outline

- Research Question
- Methodology
- Results
- Summary

Research Question

- Do different mobile spatial data collection devices impact spatial accuracy?
  - The focus of this study is to address the question on which data collection approach **consistently is more spatially accurate**.
  - Cost?

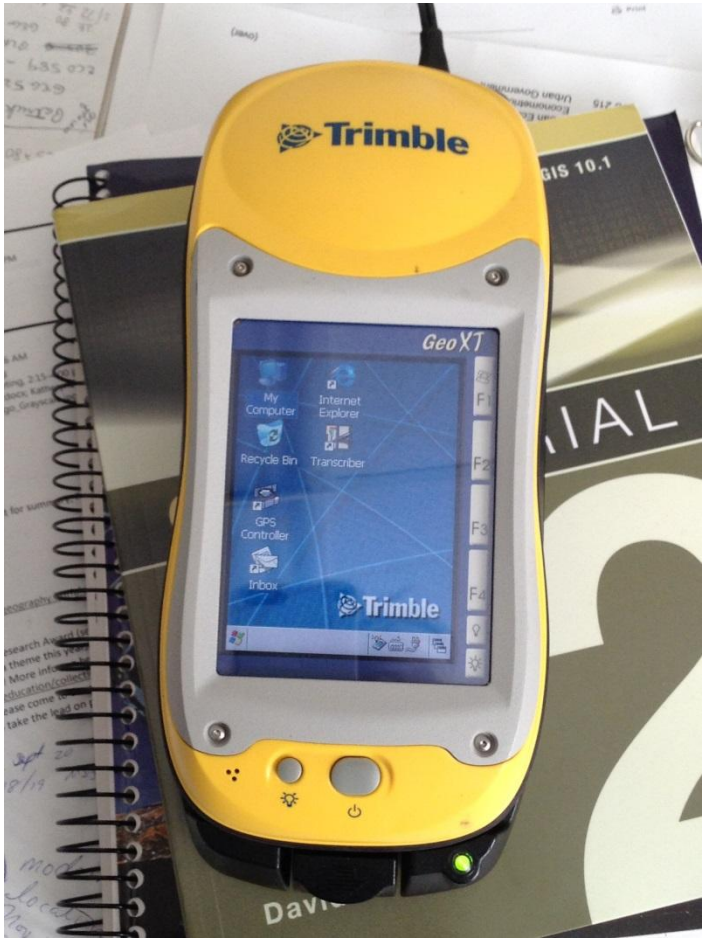
Research interests

- Type of features
  - Visibility on satellite imagery (digital ortho-imagery)
- Accessibility of and Familiarity with Technology
- Online v Offline applications

Technology Used

- ArcGIS Online (subscription)
  - Build a separate application for each data collection team. Use imagery basemap.
  - WiFi connection required

Technology


Trimble
GeoXT
My Computer
Internet Explorer
Recycle Bin
Transcriber
GPS Controller
Inbox
Trimble

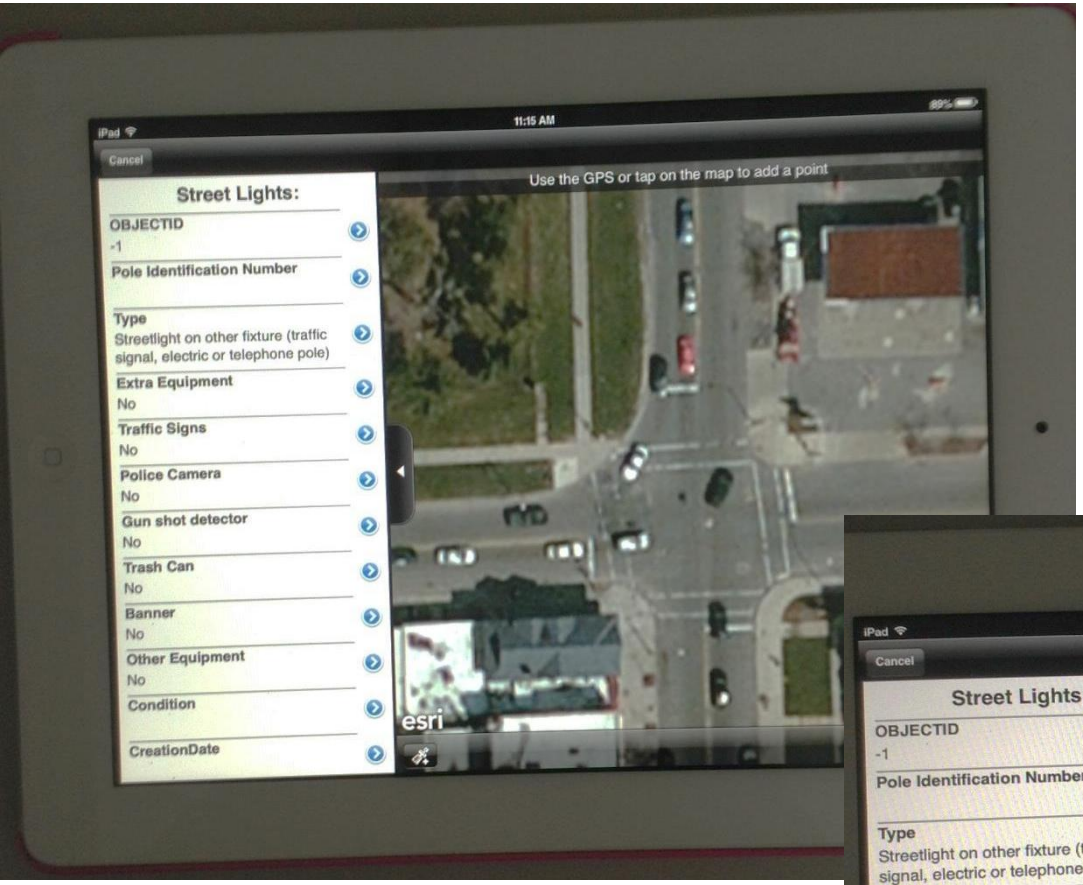

etrex
12 CHANNEL GPS
GARMIN

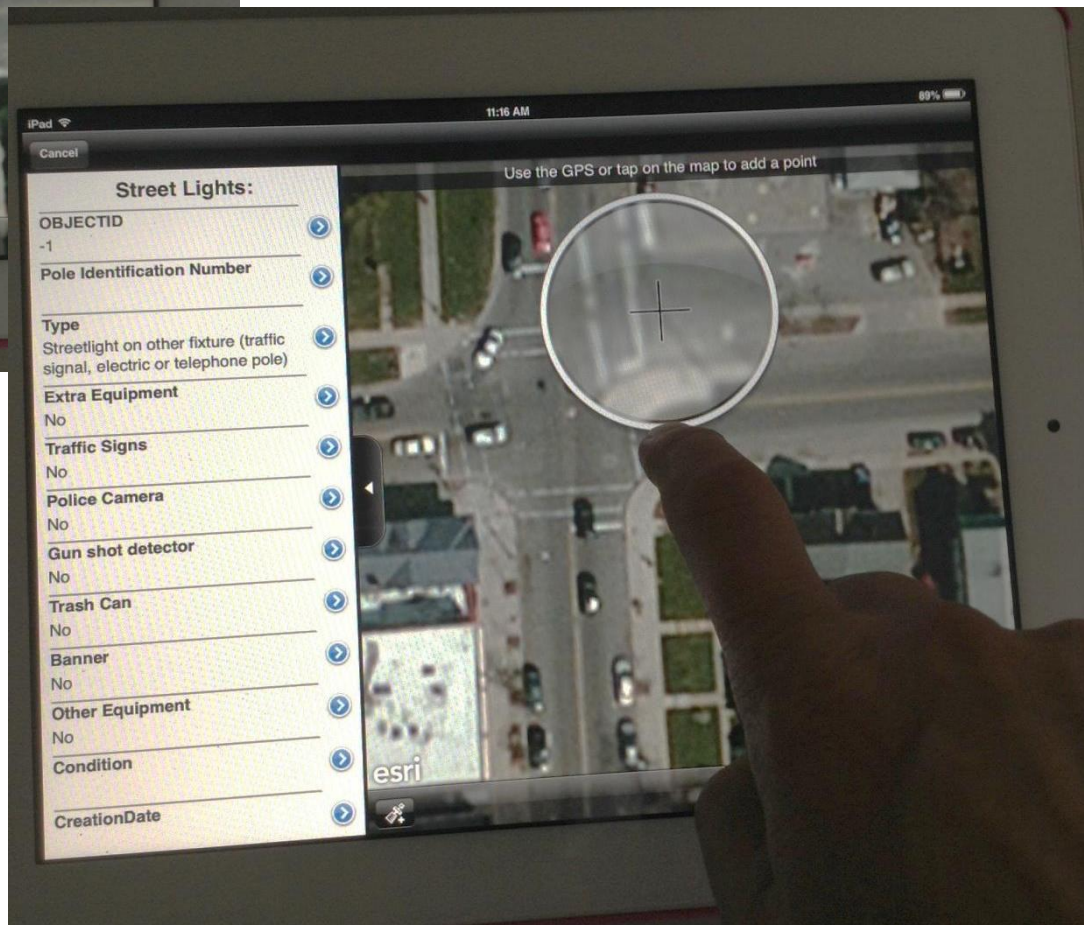
Technology

Tablet : IPad, Android Tablet
IPod, SmartPhone

MiFi for off-campus data collection

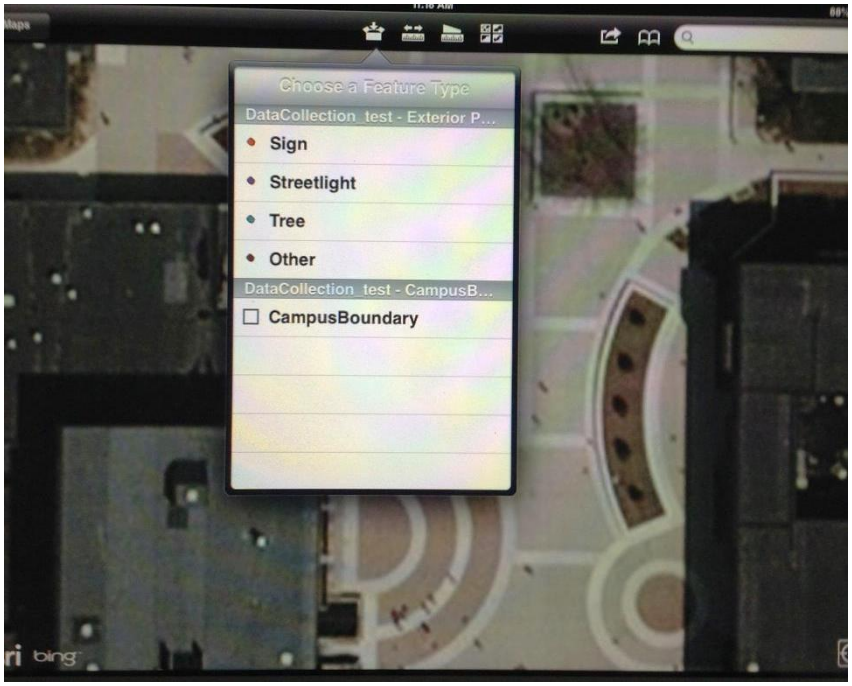
Verizon Jetpack 4G LTE





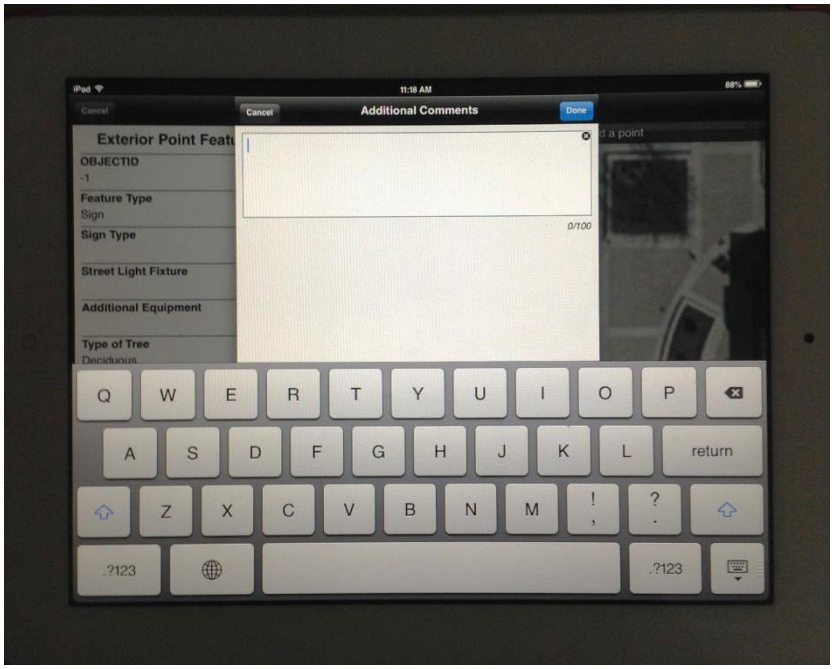
Geodatabase with multiple Domains

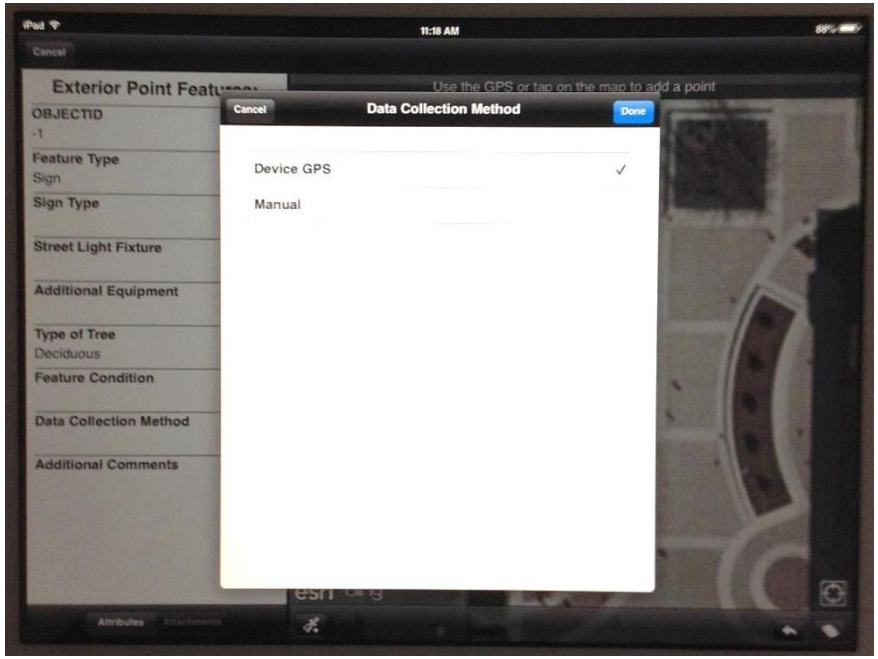
Zoom in upon touch



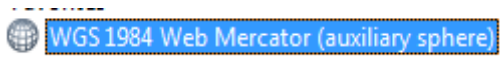
Geodatabase with Subtypes

Keypad Text Entry





World Imagery Basemap



- World Imagery provides one meter or better satellite and aerial imagery in many parts of the world and lower resolution satellite imagery worldwide. The map includes NASA Blue Marble: Next Generation 500m resolution imagery at small scales (above 1:1,000,000), i-cubed 15m eSAT imagery at medium-to-large scales (down to 1:70,000) for the world, and USGS 15m Landsat imagery for Antarctica. The map features 0.3m resolution imagery in the continental United States and 0.6m resolution imagery in parts of Western Europe from Digital Globe. In other parts of the world, 1 meter resolution imagery is available from GeoEye IKONOS, i-cubed Nationwide Prime, Getmapping, AeroGRID, IGN Spain, and IGP Portugal. Additionally, imagery at different resolutions has been contributed by the GIS User Community. For more information on this map, including the terms of use, visit us online at http://goto.arcgisonline.com/maps/World_Imagery
- Credits Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

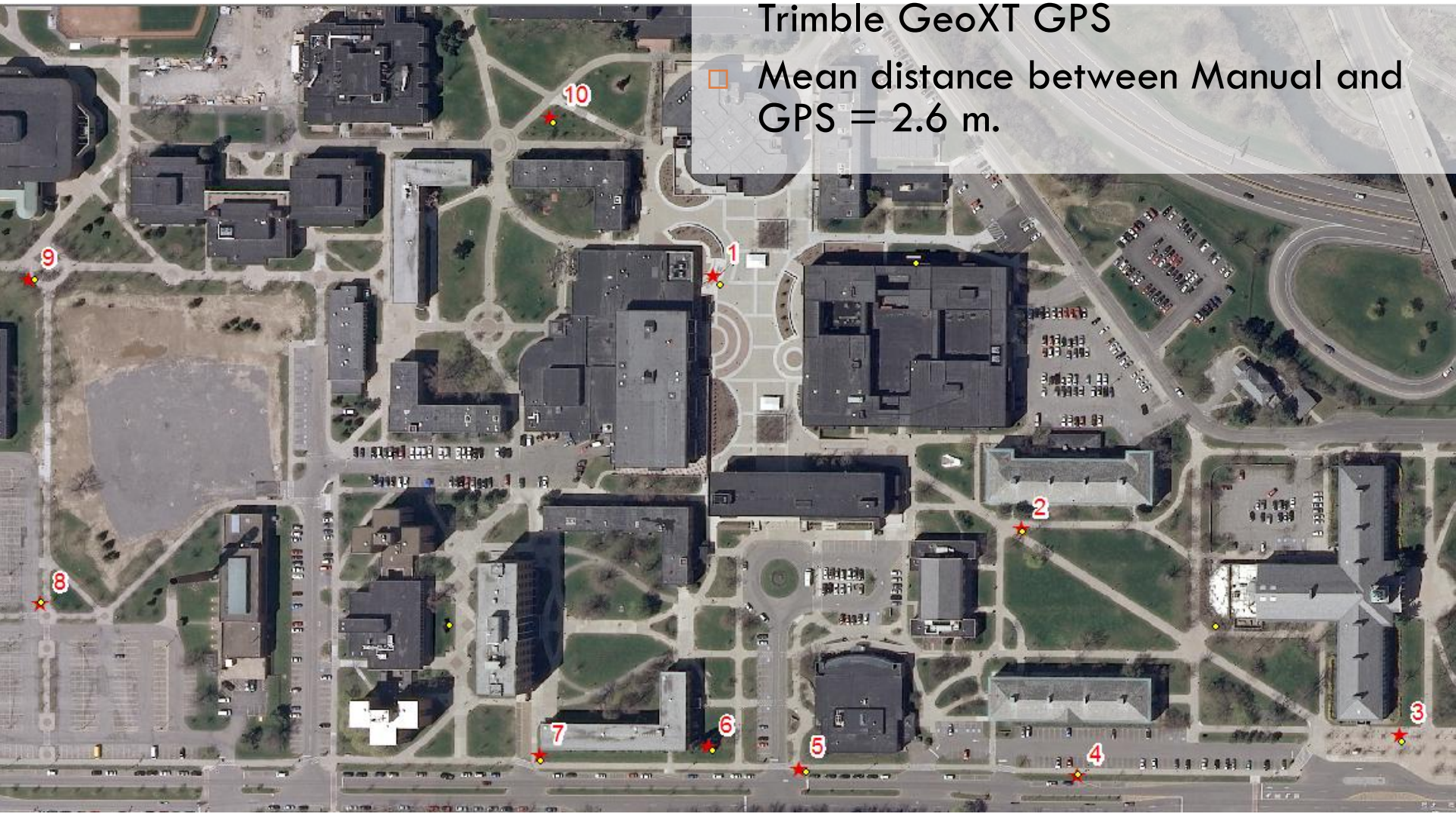
CURRENCY ISSUES

Campus Locations

- 2 classes of students taking ***GEG 325 Maps and Mapmaking using GIS***
- 10 locations on campus
  - 1. American flag pole in the Union quad
  - 2. Sign with the campus map on the south side of Bacon Hall
  - 3. Tree #22 - 6th tree west of Elmwood in row closest to Rockwell Hall
  - 4. Streetlight H2 - north side of Rockwell Rd on the center of Ketchum Hall
  - 5. Stop sign in the westbound direction at the intersection of Rockwell and the entrance to C lot
  - 6. Pine tree at the southeast corner of Newman Hall
  - 7. Fire hydrant at the southwest corner of Newman Hall
  - 8. Furthest east F-1 lot sign near Technology Bldg construction fencing
  - 9. Streetlight G38A - Bengal walk on the exterior of the circle near the arena
  - 10. Tree-like sculpture near northwest door of Cassety Hall
- Tablet or smartphone, and GPS
- Tablet Methods: Device GPS and Manual

Campus Locations

- Known feature locations collected manually using an IPod and using a Trimble GeoXT GPS
- Mean distance between Manual and GPS = 2.6 m.




GPS Stylus
IPod
GPS Satellite button

Average Distances to Nearest Point

Nearest point		Known Points	
	Sample Size	Manual	GPS
Method			
Manual	160	8.1m	9.2 m
Device GPS	137	30.1m	30.5 m
Garmin GPS	153	14 m	14.4 m

Correct point		Known Points	
	Sample Size	Manual	GPS
Method			
Manual	155	5.4 m	6.6 m
Device GPS	128	26.6 m	27.3 m
Garmin GPS	148	10.9 m	11.3 m

Average Distances to Correct Point

H_o: Mean Manual = Mean GPS H_a: Mean Manual ≠ Mean GPS

Method	z	Z crit	p
Manual	1.04	1.96	0.30
Device GPS	0.22	1.96	0.83
Garmin GPS	0.23	1.96	0.77

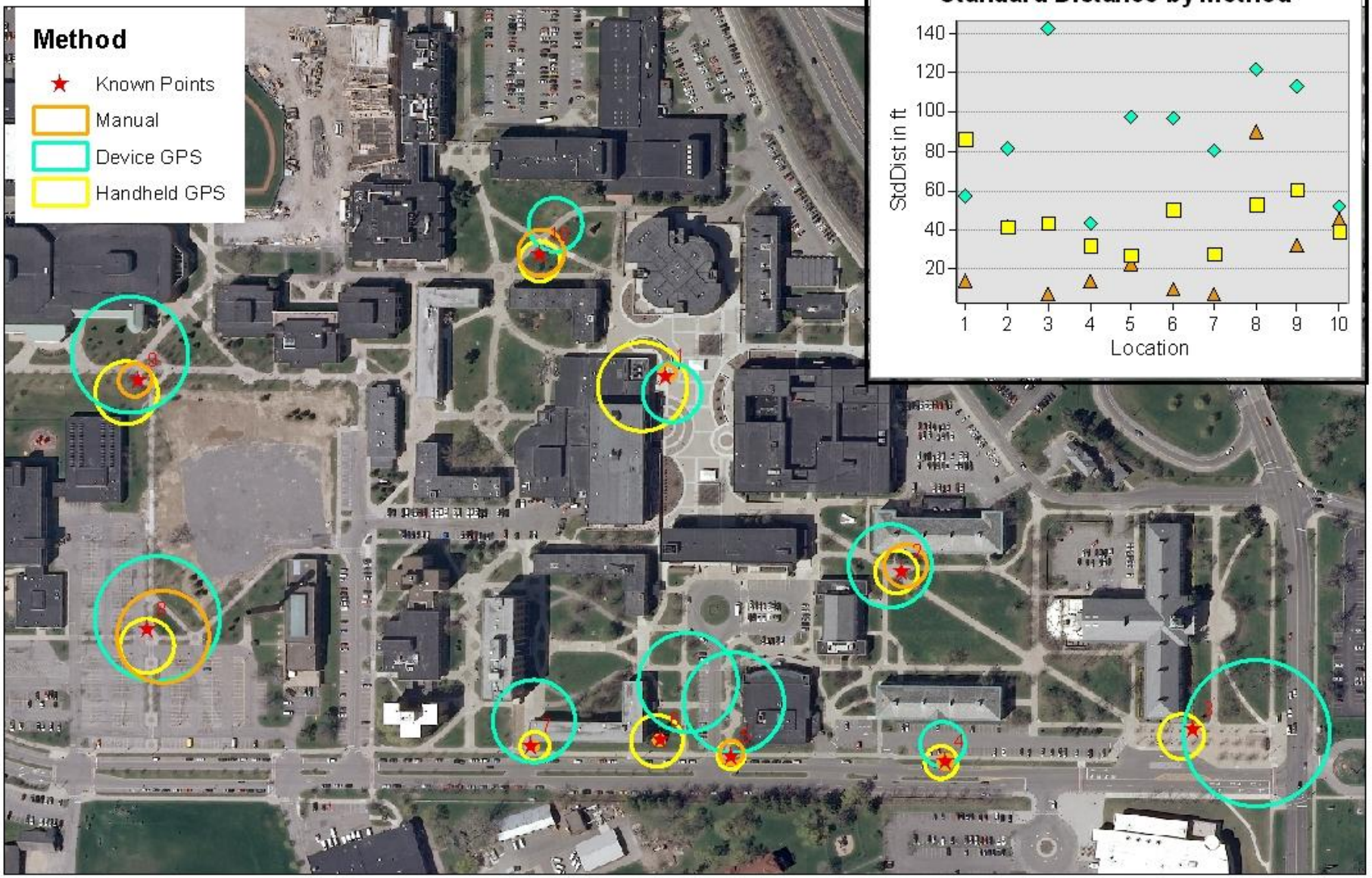
Fail to Reject H_o: Means are equal

H_o: Mean *Manual* Method(1) = Mean *Manual* Method(2)
H_a: Mean *Manual* Method(1) ≠ Mean *Manual* Method(2)

Method	Manual	Device GPS	Garmin GPS
Manual		9.45, 1.96, 0	4.15, 1.96, 3.33E-05
Device GPS			6.69, 1.96, 2.24E-11
Garmin GPS			

Reject H_o: Means are equal

Standard Distance by Location and Data Collection Method



City of Buffalo Streetlights

- 30,440 records

Table

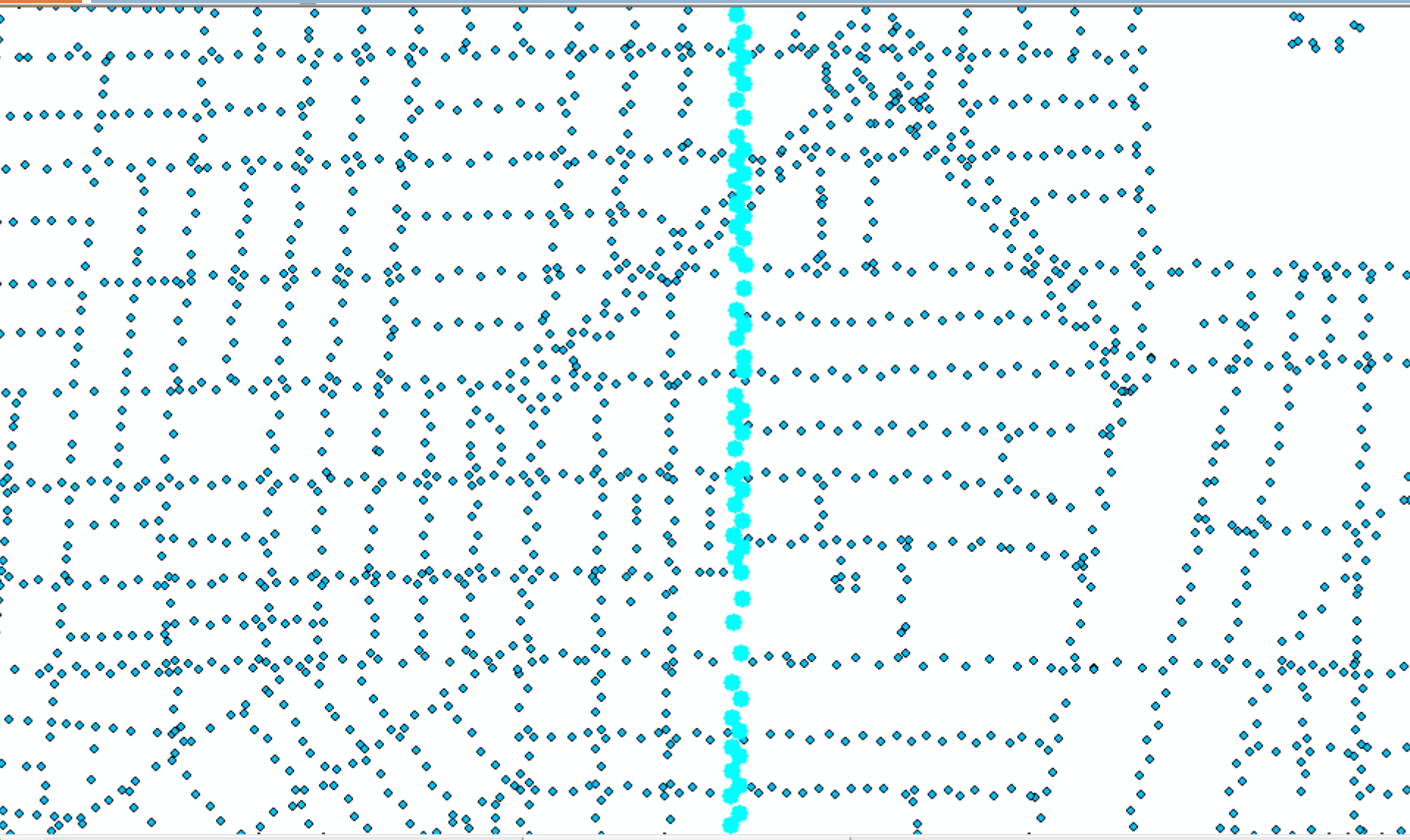
COB_Street_Lights

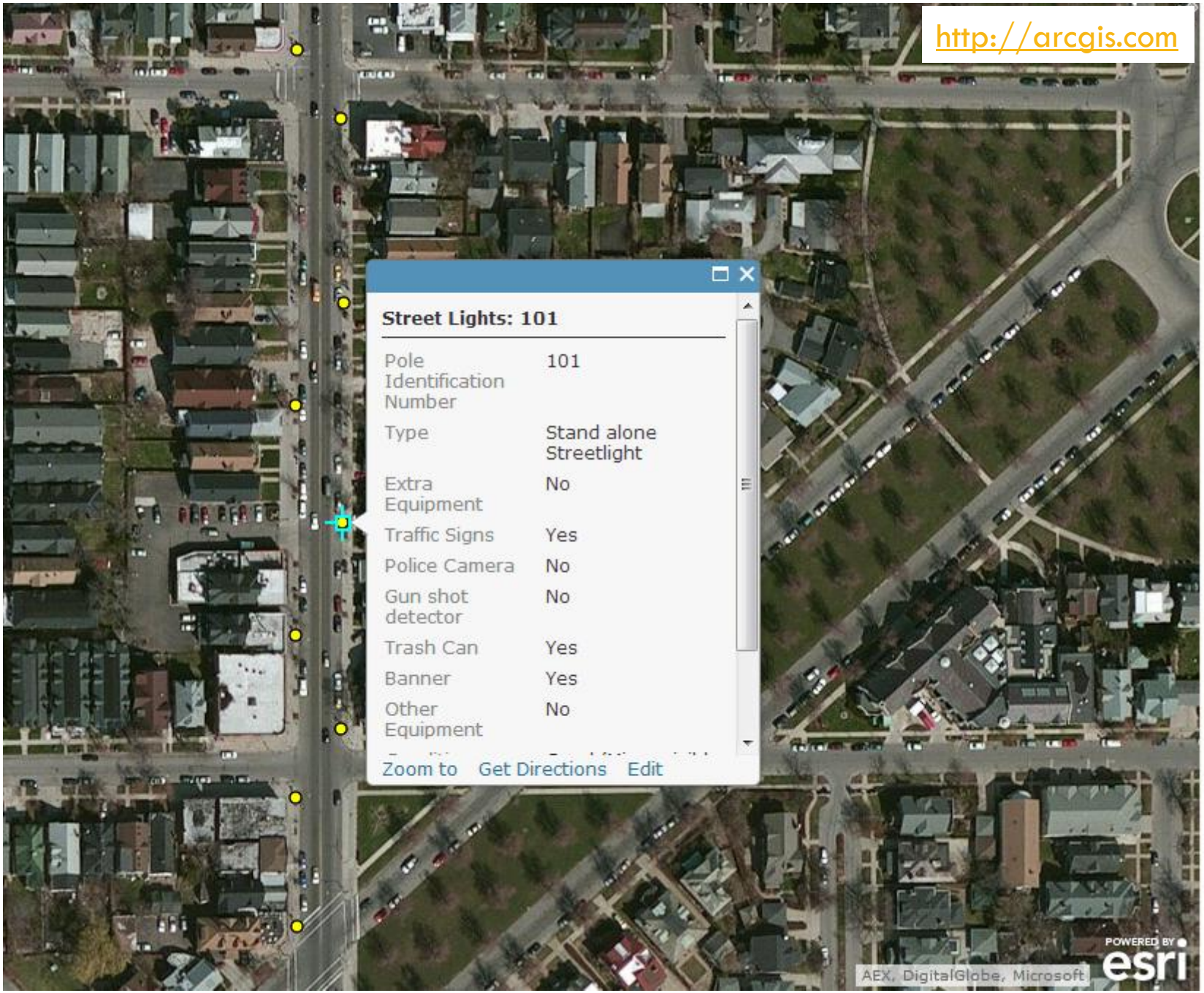
OBJEC	Shape *	ID	POLE_ID	POLE_NUM	TYPE	COMMENTS	SOURCE	RECNO	ST_NAME	LIGHT_DI	Status	URS_NOTE
1	Point	2799	8 Bingham St	8		Additional verification required	Niagara Mohawk Inventory Index - Set 1	129	Bingham St	0	Matched	
2	Point	2799	9 Bingham St	9		Additional verification required	Niagara Mohawk Inventory Index - Set 1	130	Bingham St	0	Matched	
3	Point	2799	10 Bingham St	10		Additional verification required	Niagara Mohawk Inventory Index - Set 1	131	Bingham St	0	Matched	
4	Point	2805	62-2 Burrell St	10		Additional verification required	Niagara Mohawk Inventory Index - Set 1	190	Burrell St	0	Matched	
5	Point	2805	62-3 Burrell St	10		Additional verification required	Niagara Mohawk Inventory Index - Set 1	191	Burrell St	0	Matched	
6	Point	2805	62-4 Burrell St	10		Additional verification required	Niagara Mohawk Inventory Index - Set 1	192	Burrell St	0	Matched	
7	Point	2806	2 Casey Dr	2		Additional verification required	Niagara Mohawk Inventory Index - Set 1	196	Casey Dr	0	Matched	
8	Point	2806	4 Casey Dr	4		Additional verification required	Niagara Mohawk Inventory Index - Set 1	197	Casey Dr	0	Matched	
9	Point	2806	6 Casey Dr	6		Additional verification required	Niagara Mohawk Inventory Index - Set 1	198	Casey Dr	0	Matched	
10	Point	2806	8 Casey Dr	8		Additional verification required	Niagara Mohawk Inventory Index - Set 1	199	Casey Dr	0	Matched	
11	Point	2806	10 Casey Dr	10		Additional verification required	Niagara Mohawk Inventory Index - Set 1	200	Casey Dr	0	Matched	
12	Point	2806	12 Casey Dr	12		Additional verification required	Niagara Mohawk Inventory Index - Set 1	201	Casey Dr	0	Matched	
13	Point	2806	14 Casey Dr	14		Additional verification required	Niagara Mohawk Inventory Index - Set 1	202	Casey Dr	0	Matched	
14	Point	2807	16 Casey Dr	16		Additional verification required	Niagara Mohawk Inventory Index - Set 1	203	Casey Dr	0	Matched	
15	Point	2807	18 Casey Dr	18		Additional verification required	Niagara Mohawk Inventory Index - Set 1	204	Casey Dr	0	Matched	
16	Point	2807	20 Casey Dr	20		Additional verification required	Niagara Mohawk Inventory Index - Set 1	205	Casey Dr	0	Matched	
17	Point	2807	22 Casey Dr	22		Additional verification required	Niagara Mohawk Inventory Index - Set 1	206	Casey Dr	0	Matched	

0 (0 out of 30440 Selected)

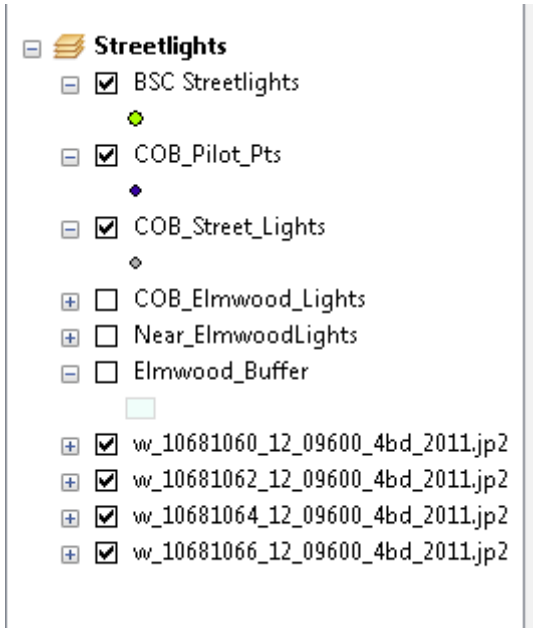
COB_Street_Lights

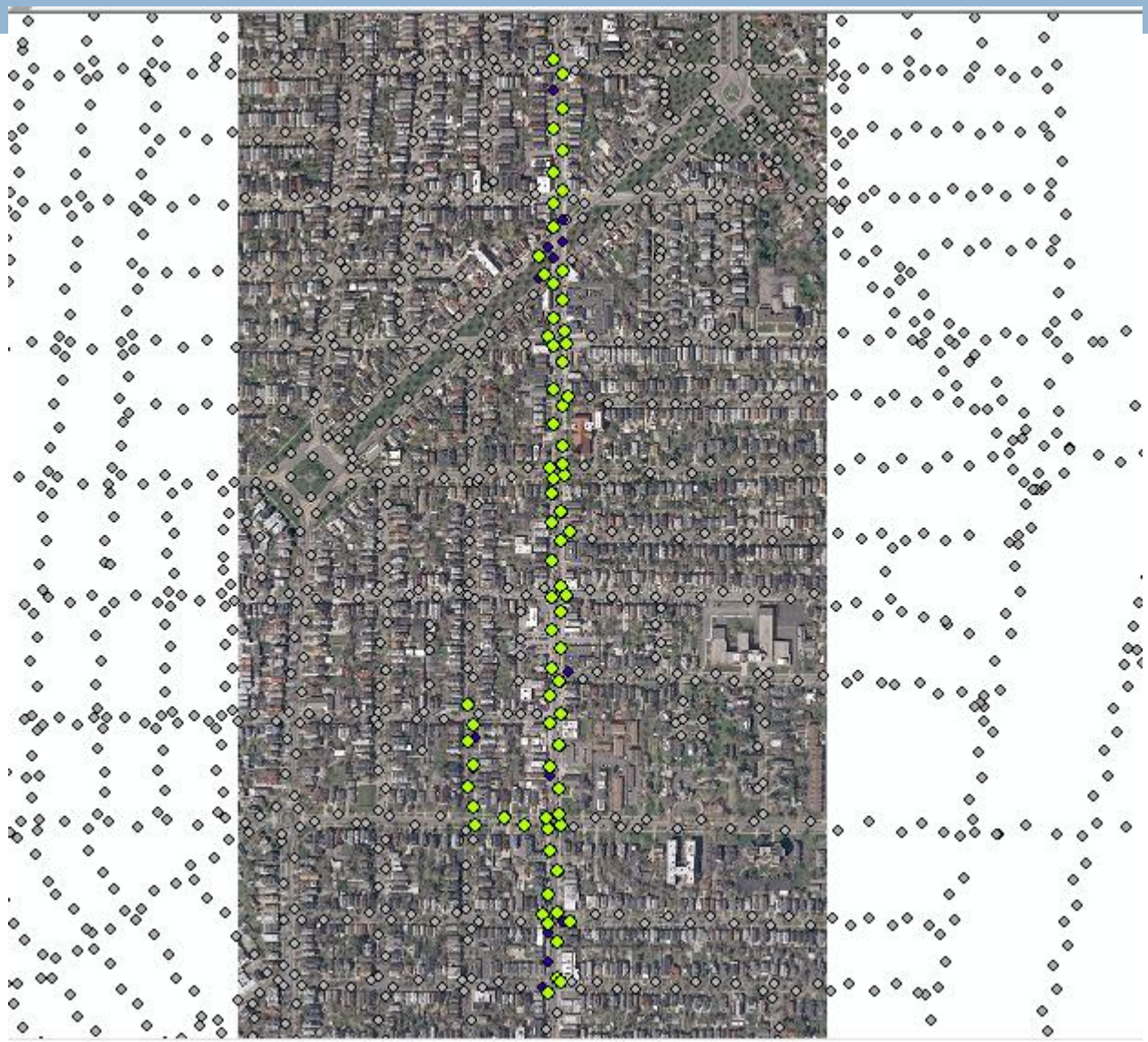
Elmwood Ave Streetlights




http://arcgis.com
Street Lights: 101
Pole Identification Number 101
Type Stand alone Streetlight
Extra Equipment No
Traffic Signs Yes
Police Camera No
Gun shot detector No
Trash Can Yes
Banner Yes
Other Equipment No
Zoom to
Get Directions
Edit
AEX, DigitalGlobe, Microsoft
POWERED BY esri

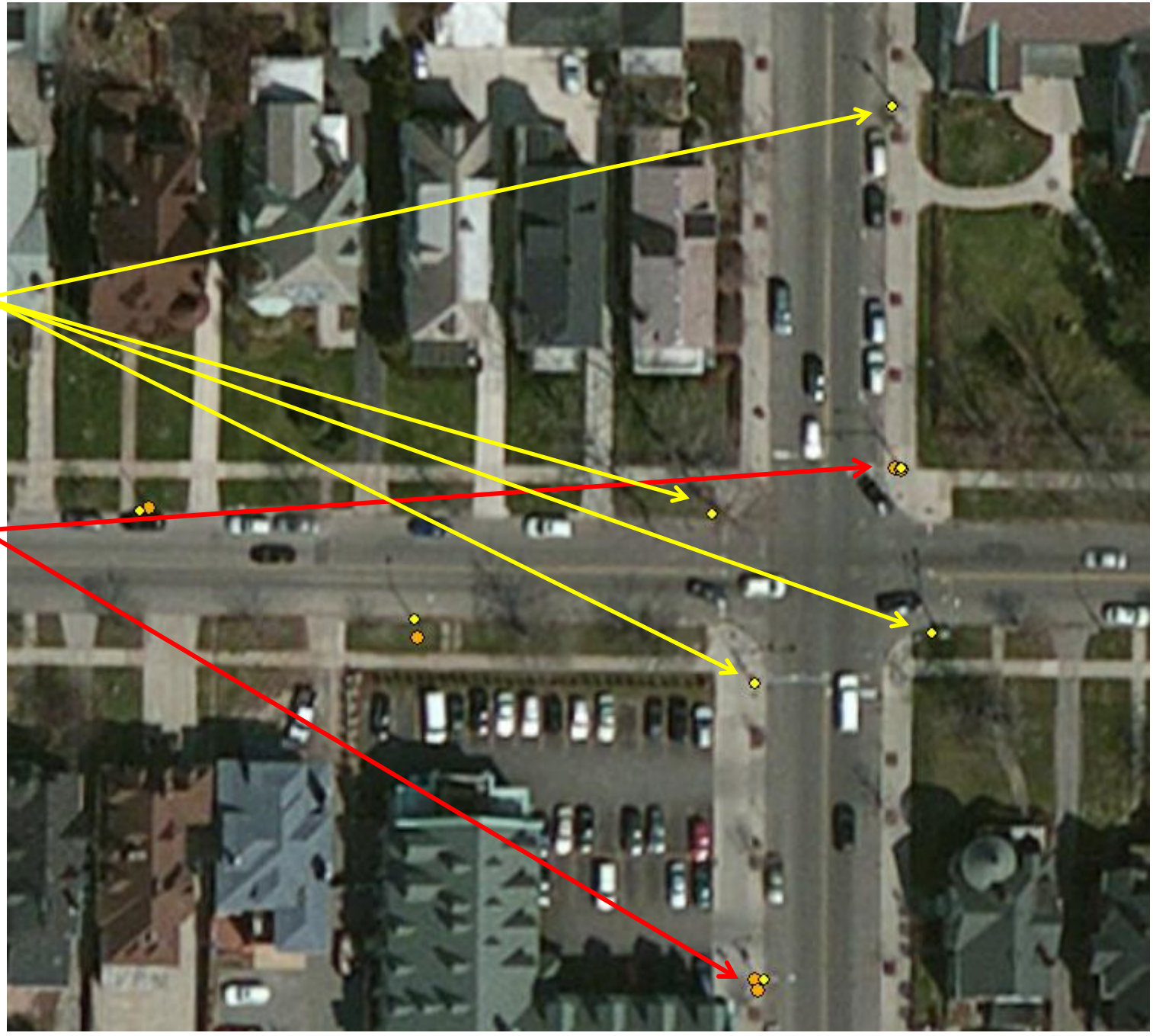
BSC Streetlights





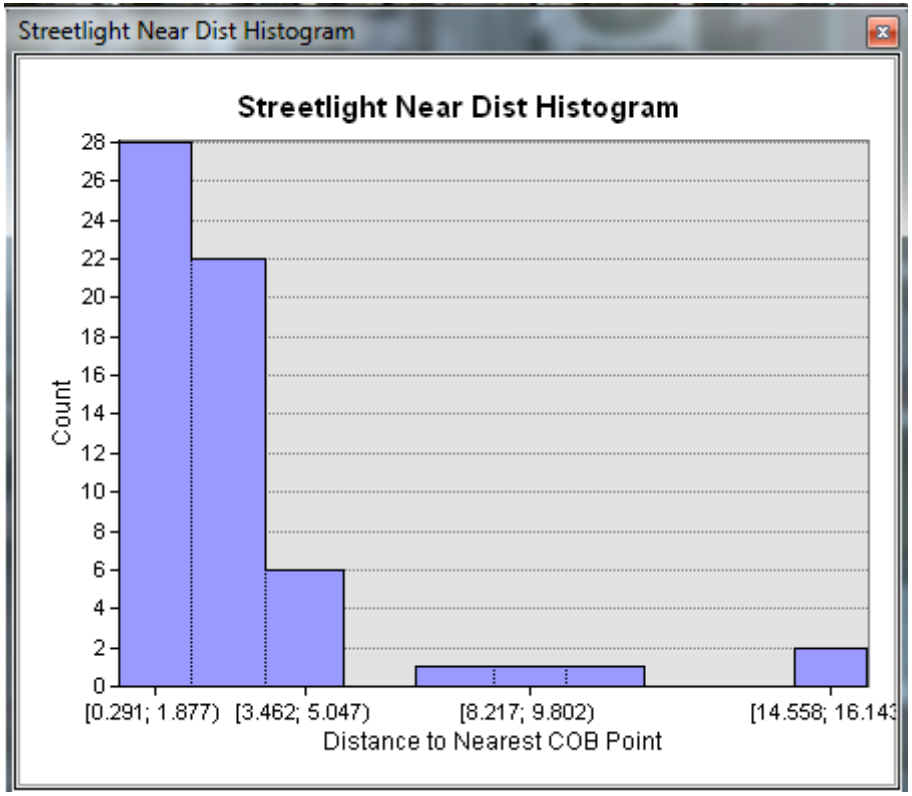
No points in COB data

2 points in COB data



Streetlights

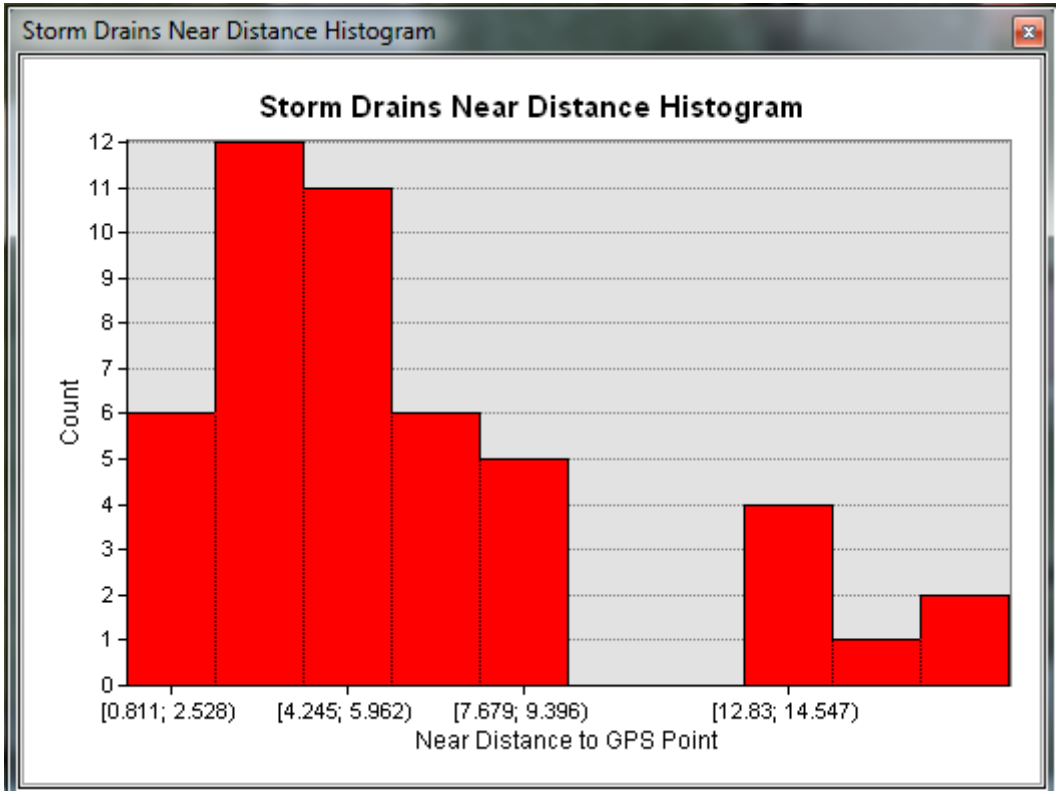
- 12 of the 73 points collected using a tablet are more than 18 meters from the nearest COB streetlight. In other words, 12 locations with are streetlights were not included in COB database.
- Mean distance between remaining 61 pairs is 2.8 meters.
- 82% are within 3.5 meters of the nearest COB point



Invisible Storm Drains!

Storm drains – Wheatfield, NY

- 49 points captured in 30 minutes without leaving the car. Two captured points not in County (GPS) dataset
- Average distance between tablet captured points and County (GPS) points = 6.24 meters
- Maximum = 18 m
- 19% within 3 m
- 64% within 6 m



Summary

- Manual method using tablets and smart phones results in fairly consistent spatial accuracy
  - May depend on skill/experience of data collector
- Device GPS only reliable to get you within the vicinity of your location
- Handheld GPS also subject to human error.

Contact Information

- Wende Mix, Ph.D.
  - mixwa@buffalostate.edu
  - 716 – 878-3027
- Mary Perrelli
  - perrelmf@buffalostate.edu
  - 716 – 878-3699