A Comparison of GPS Receiver Accuracy

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How does GPS work?

- The basis of GPS is "triangulation" from satellites.
- To "triangulate," a GPS receiver measures distance using the travel time of radio signals.
- Along with distance, you need to know exactly where the satellites are in space.

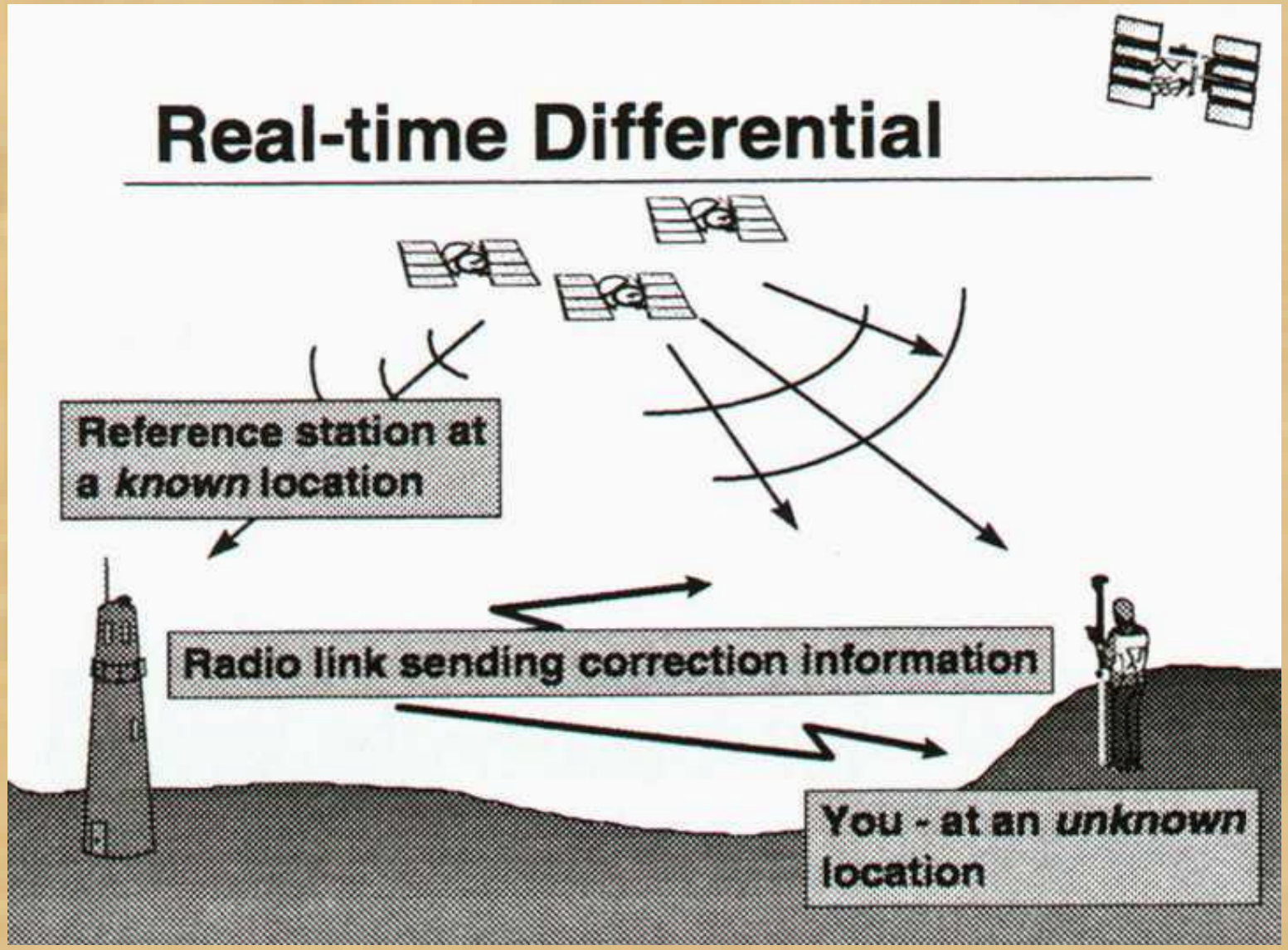
Sources of Error

- Selective Availability - Dept. of Defense scrambles the signal for military security
- PDOP - Positional Dilution of Precision

Differential Correction

- Post processing - correction after data collection
- Real-time - correction in the field

Real-time Differential



Objective

To determine the accuracy of four commercially available GPS units and the potential value of real-time differential capabilities.

Unit and Approximate Cost

Eagle
Explorer
$200

Lowrance
Global Nav12
$300

Trimble
GeoExplorer
$3,000

Trimble
Pro XR
$10,000

Methods

- Four U.S. Corps of Engineers boundary monuments were used as control points
- Positions were collected over a period of three months using each unit
- ArcView was used for statistical analysis

Study Locations

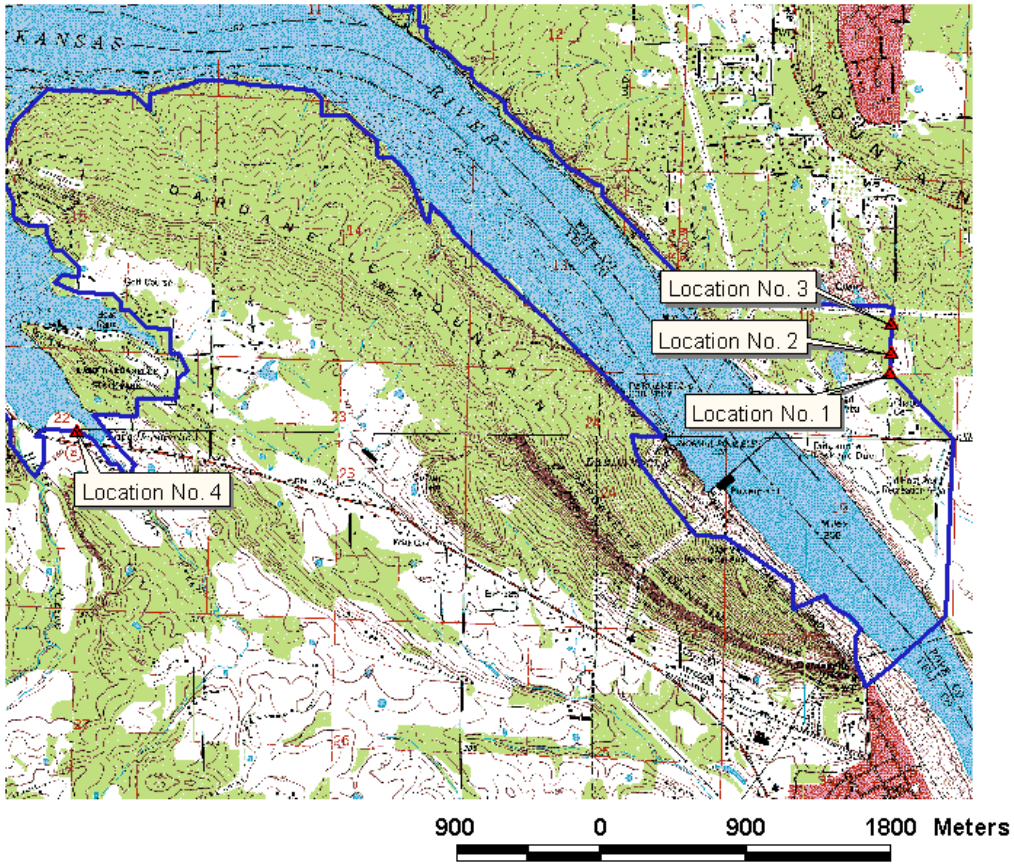
Old Post Road Park - Russellville, AR

- Location No. 1 - 20% canopy cover
- Location No. 2 - 40% canopy cover
- Location No. 3 - 80% canopy cover

Dardanelle Bay - Dardanelle, AR

- Location No. 4 - open field area

Study Locations

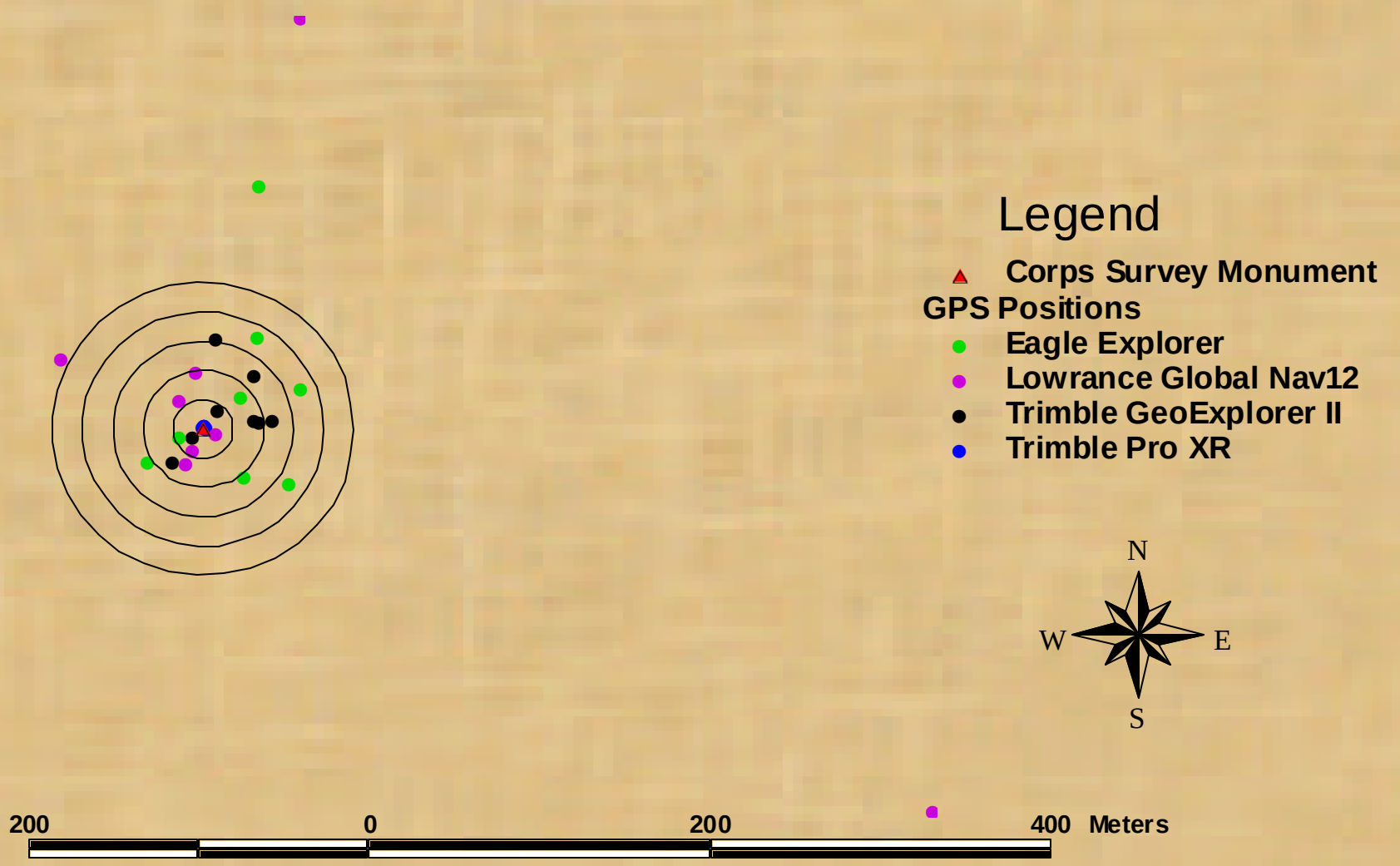


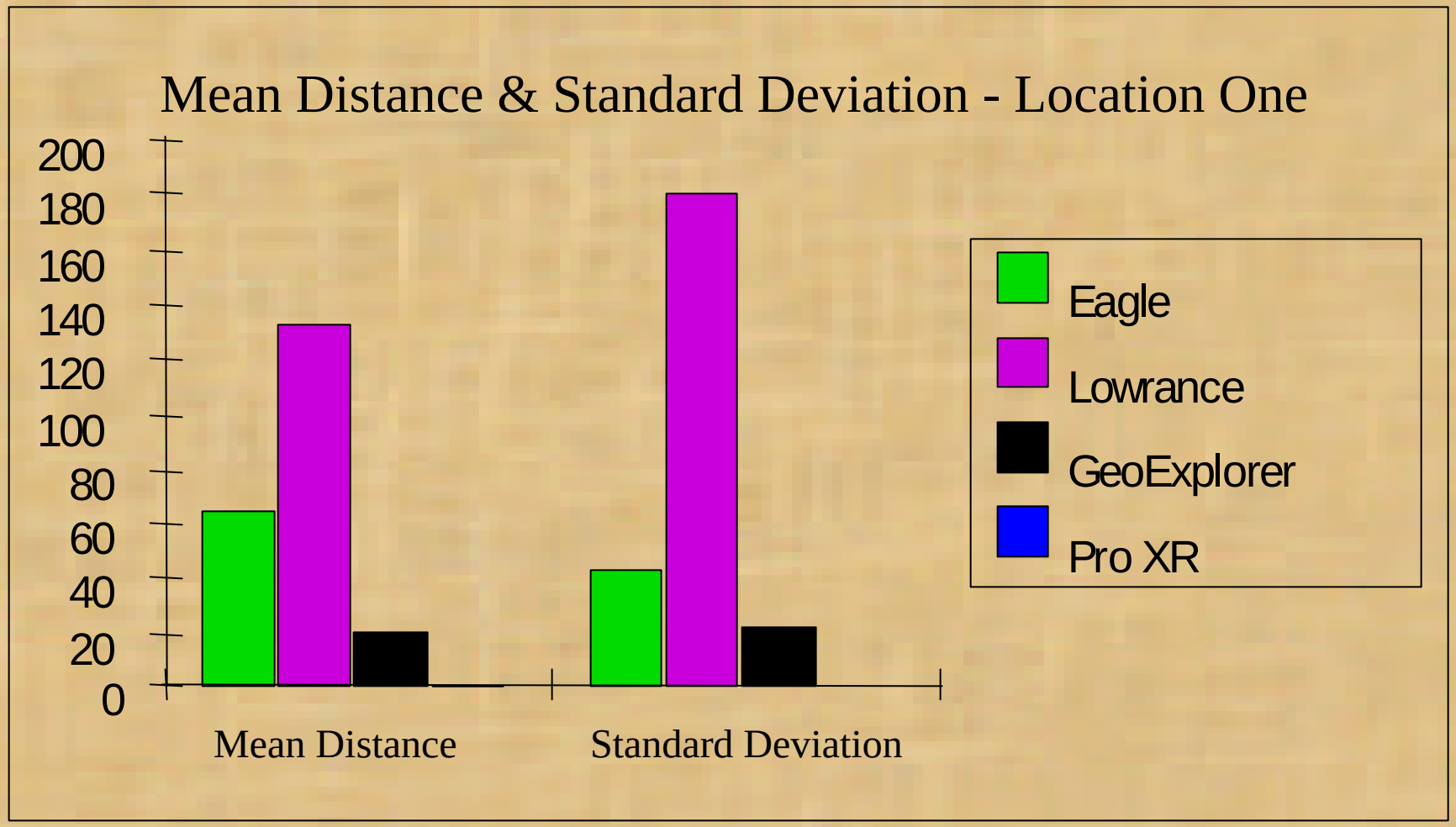
Legend

Survey Monuments
Corps Boundary

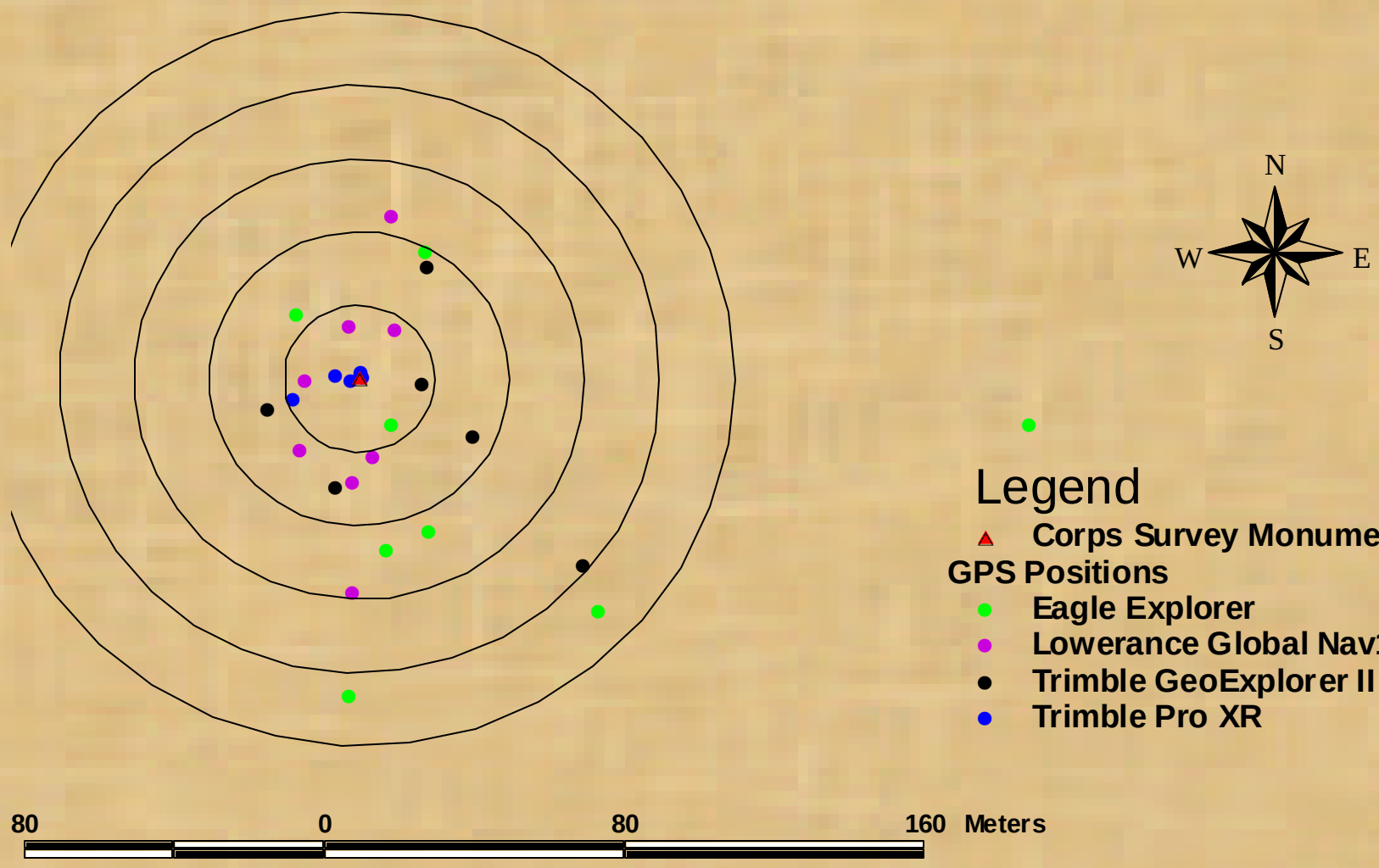
N
W
E
S

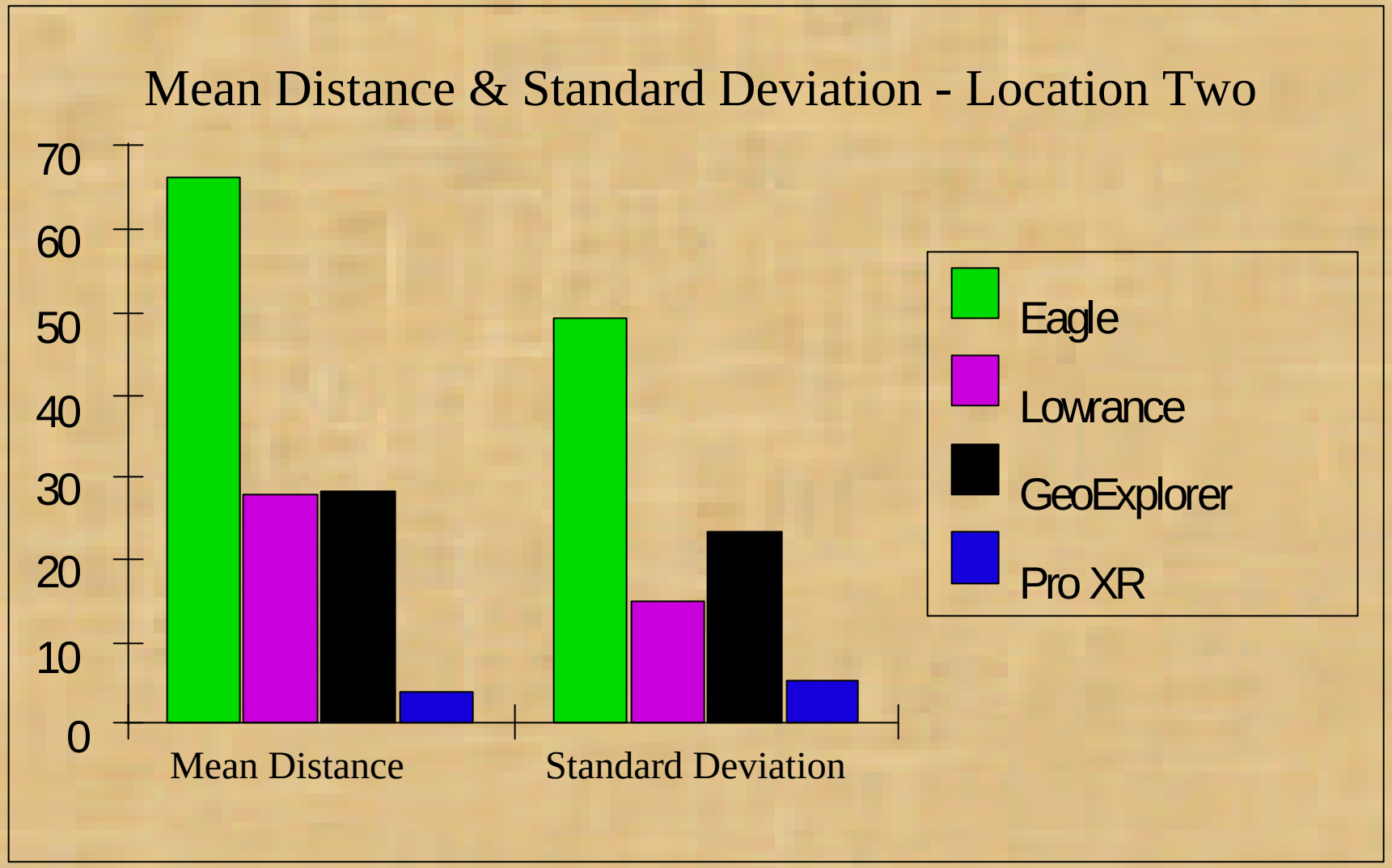
Unit Variation - Location One



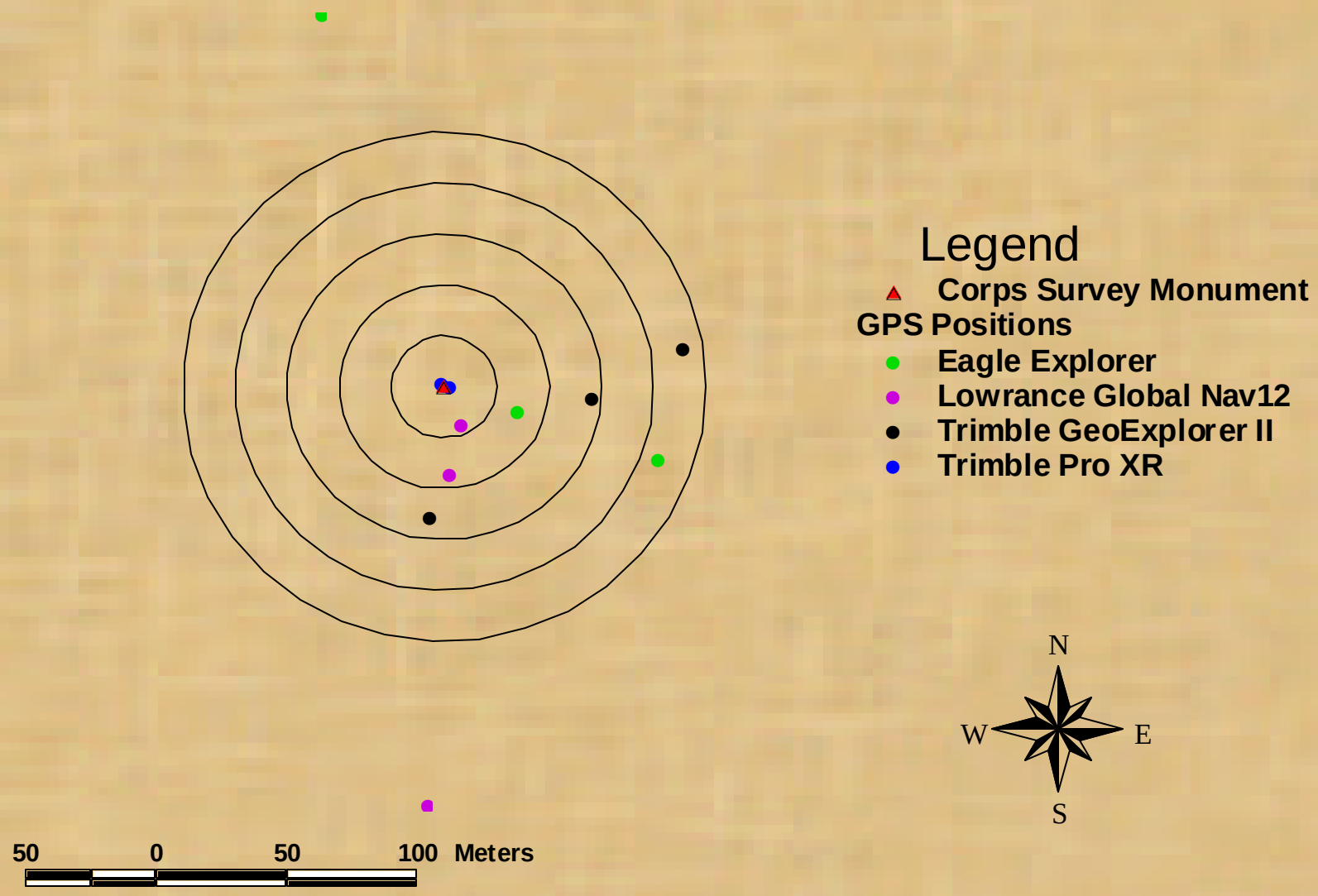

Mean Distance & Standard Deviation - Location One
200
180
160
140
120
100
80
60
40
20
0
Mean Distance
Standard Deviation
Eagle
Lowrance
GeoExplorer
Pro XR

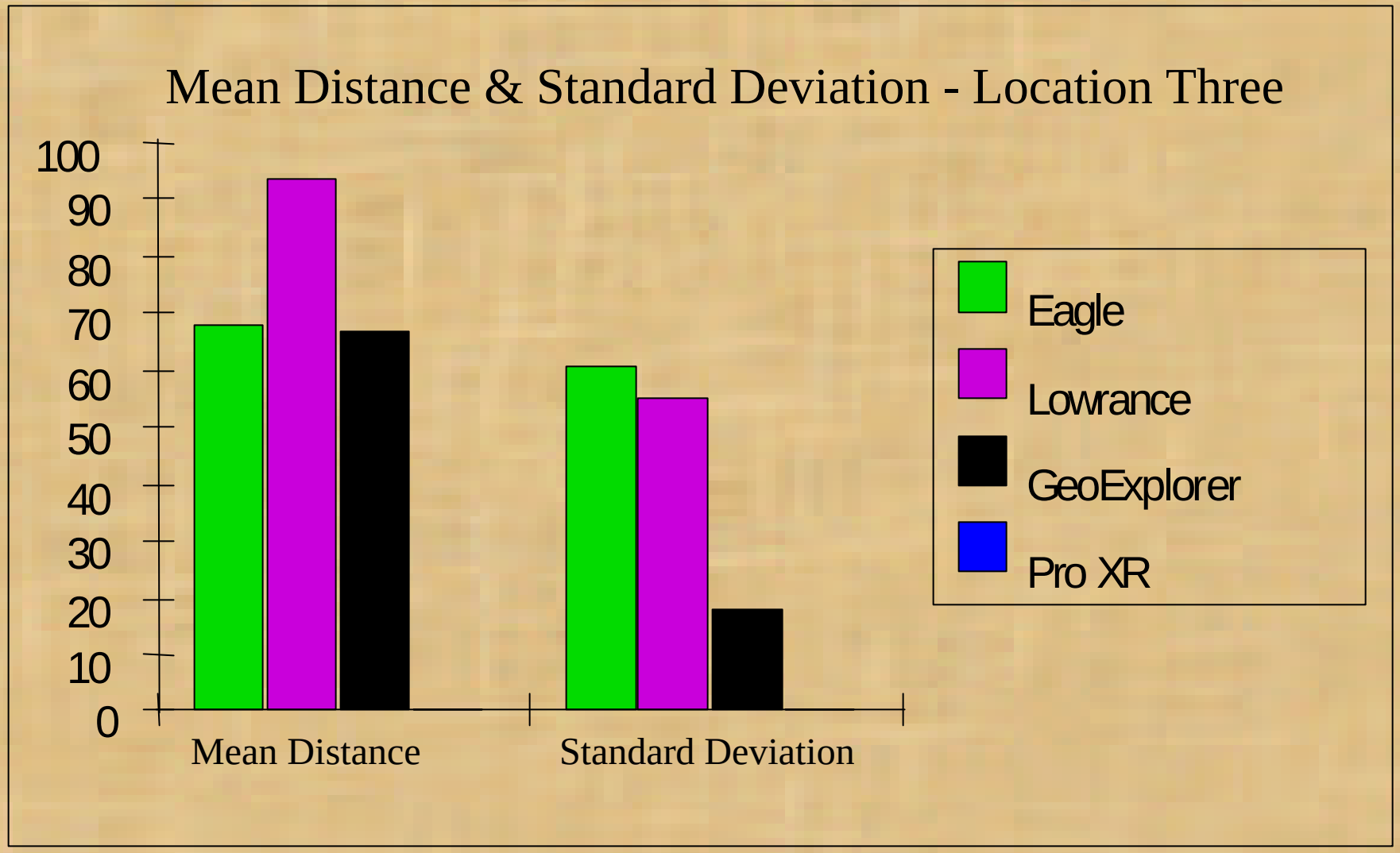
Unit Variation - Location Two



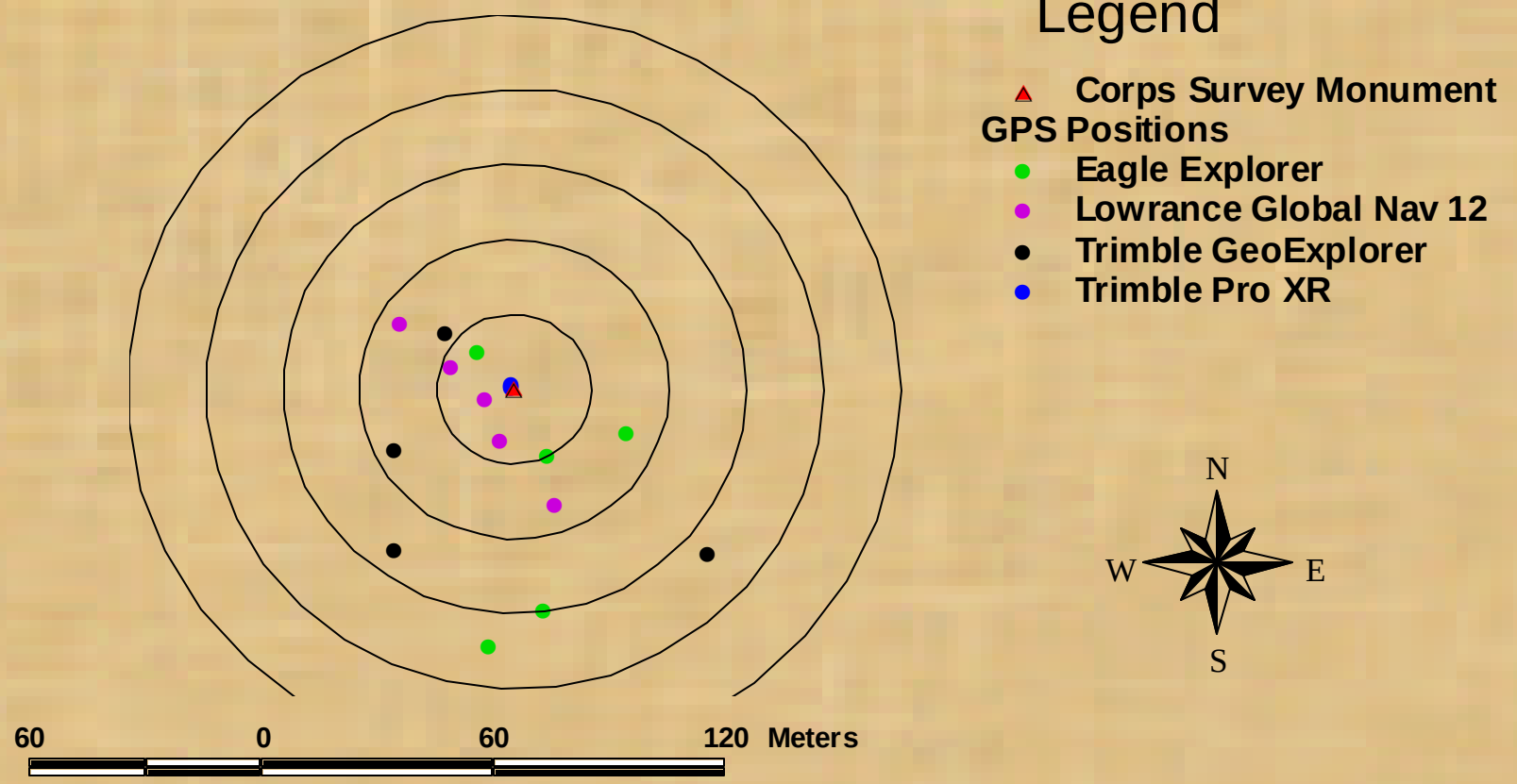

Mean Distance & Standard Deviation - Location Two
70
60
50
40
30
20
10
0
Mean Distance
Standard Deviation
Eagle
Lowrance
GeoExplorer
Pro XR

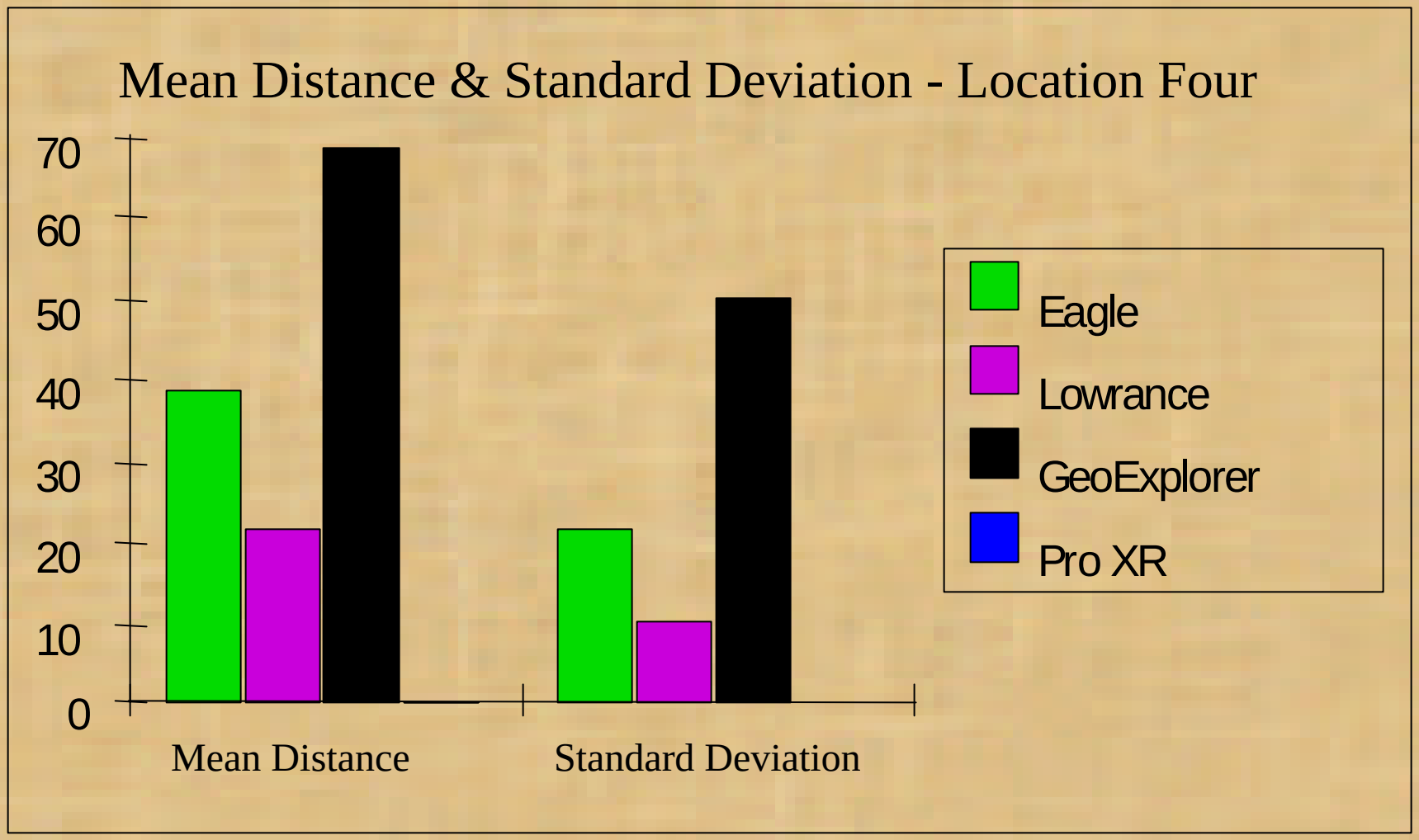
Unit Variation - Location Three

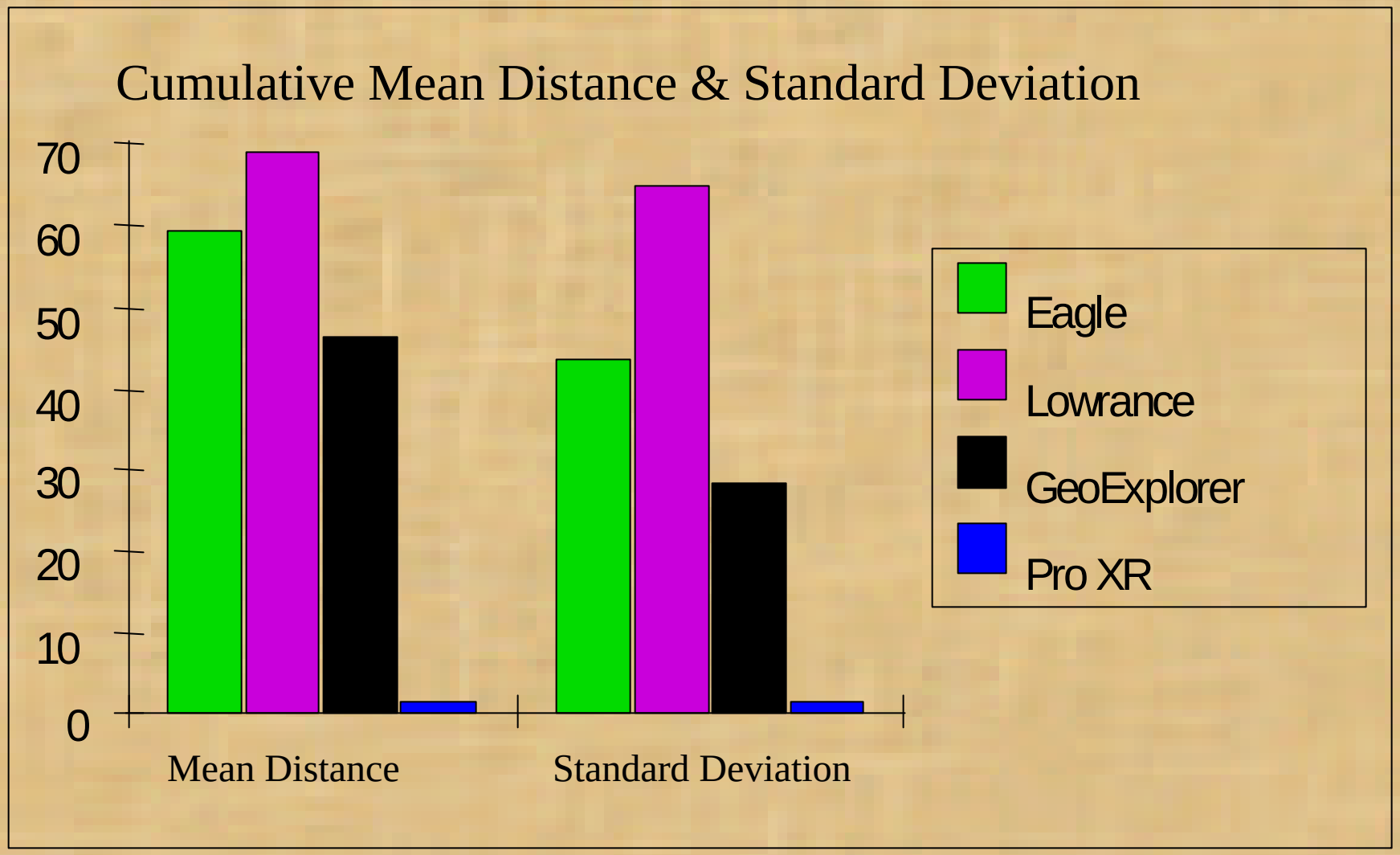



Mean Distance & Standard Deviation - Location Three
100
90
80
70
60
50
40
30
20
10
0
Mean Distance
Standard Deviation
Eagle
Lowrance
GeoExplorer
Pro XR

Unit Variation - Location Four



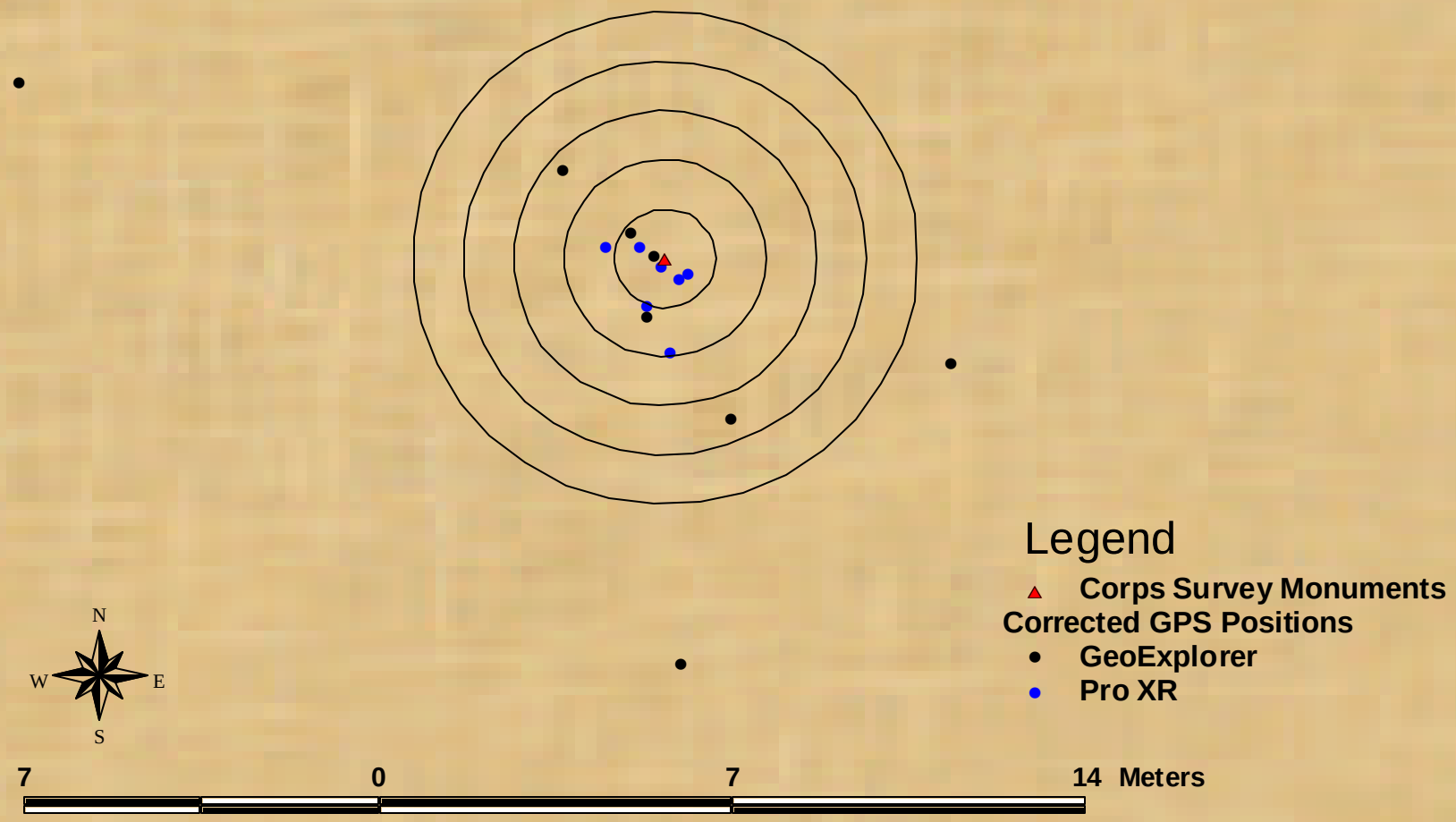

Mean Distance & Standard Deviation - Location Four
70
60
50
40
30
20
10
0
Mean Distance
Standard Deviation
Eagle
Lowrance
GeoExplorer
Pro XR

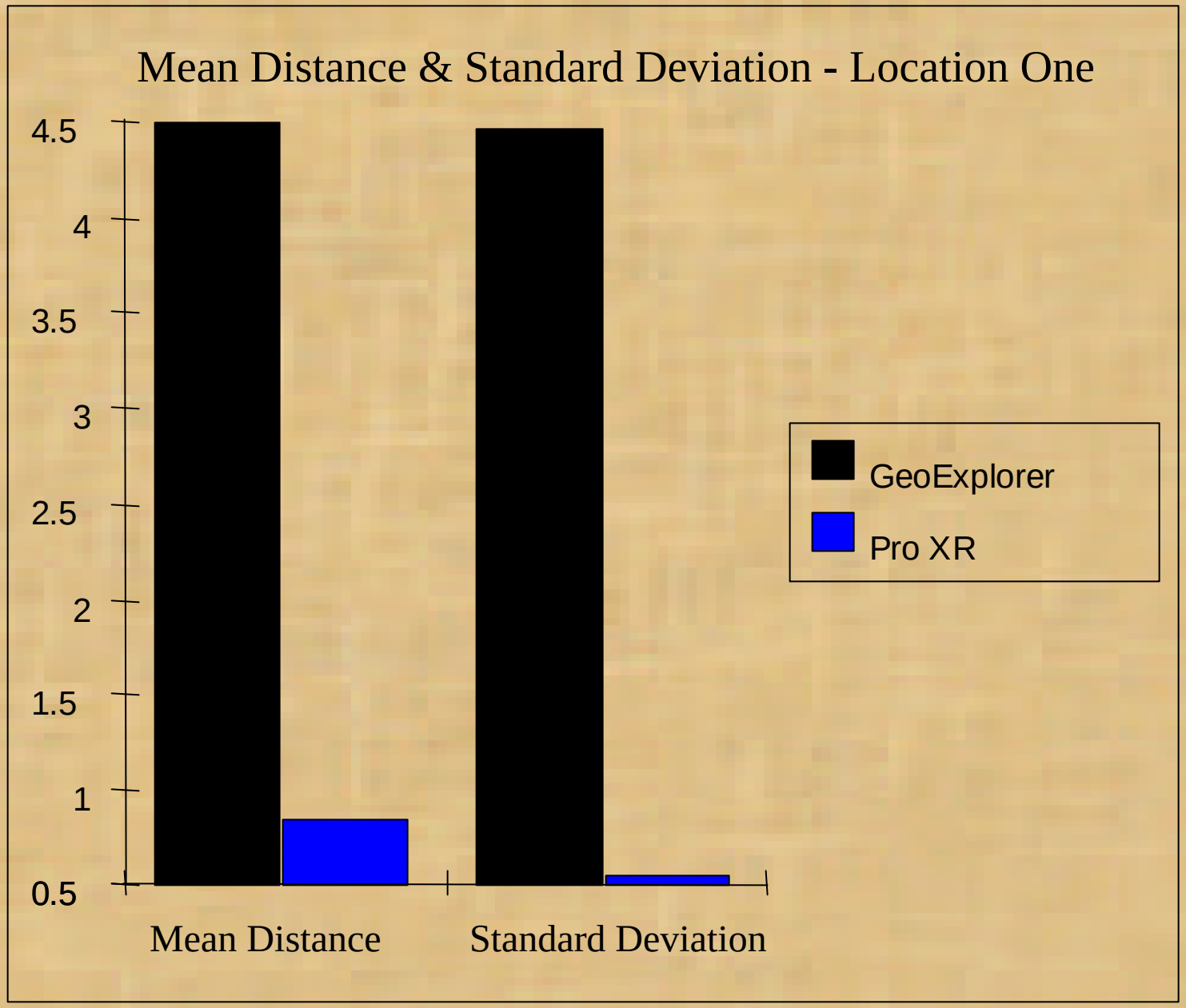

Cumulative Mean Distance & Standard Deviation
70
60
50
40
30
20
10
0
Mean Distance
Standard Deviation
Eagle
Lowrance
GeoExplorer
Pro XR

Range of Accuracy per Unit

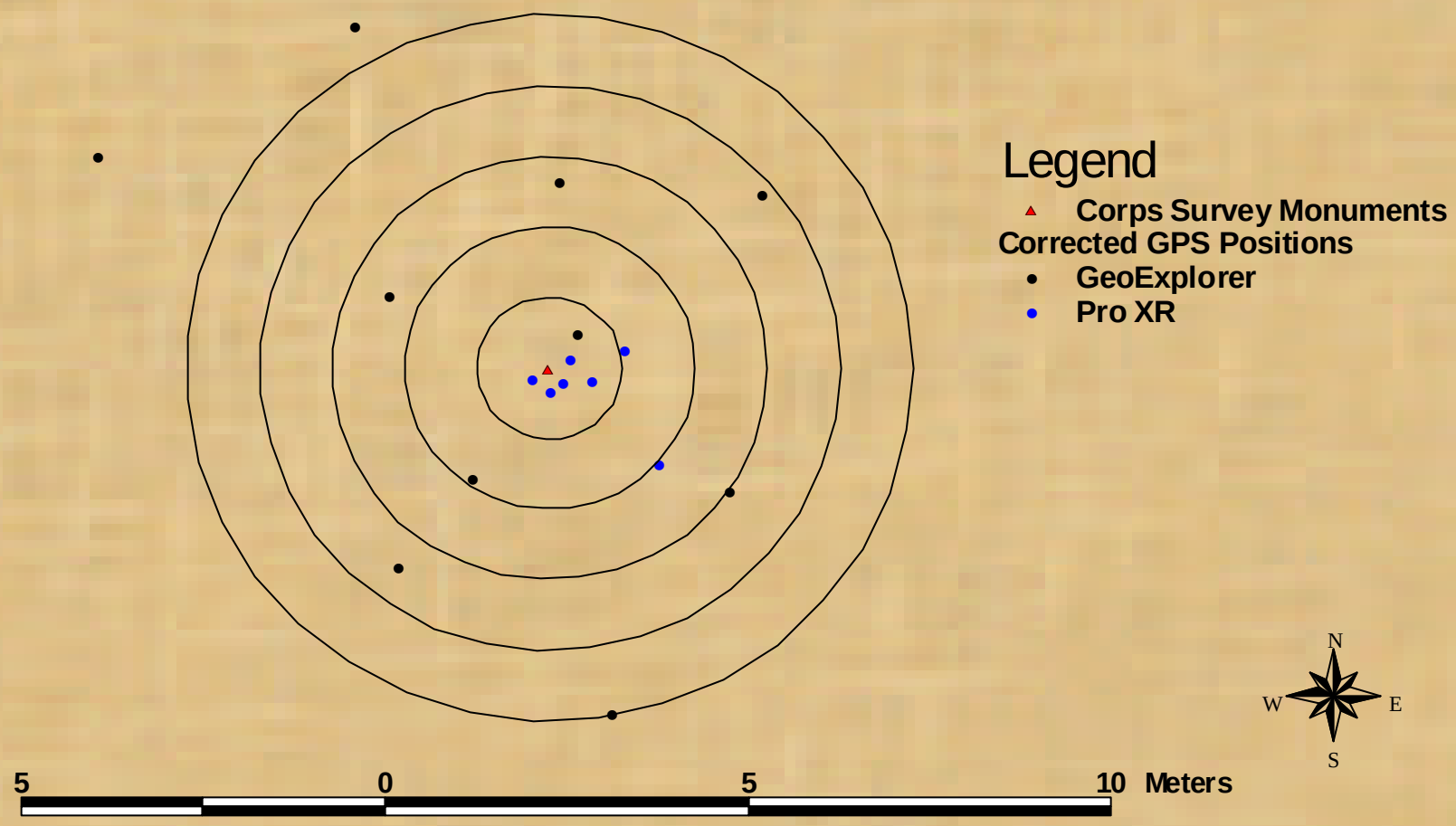
- Eagle Explorer - 13.6 - 178.5 m
- Lowrance Global Nav12 - 8.2 - 551.0 m
- Trimble GeoExplorer - 10.1 - 165.1 m
- Trimble Pro XR - 0.27 - 18.2 m

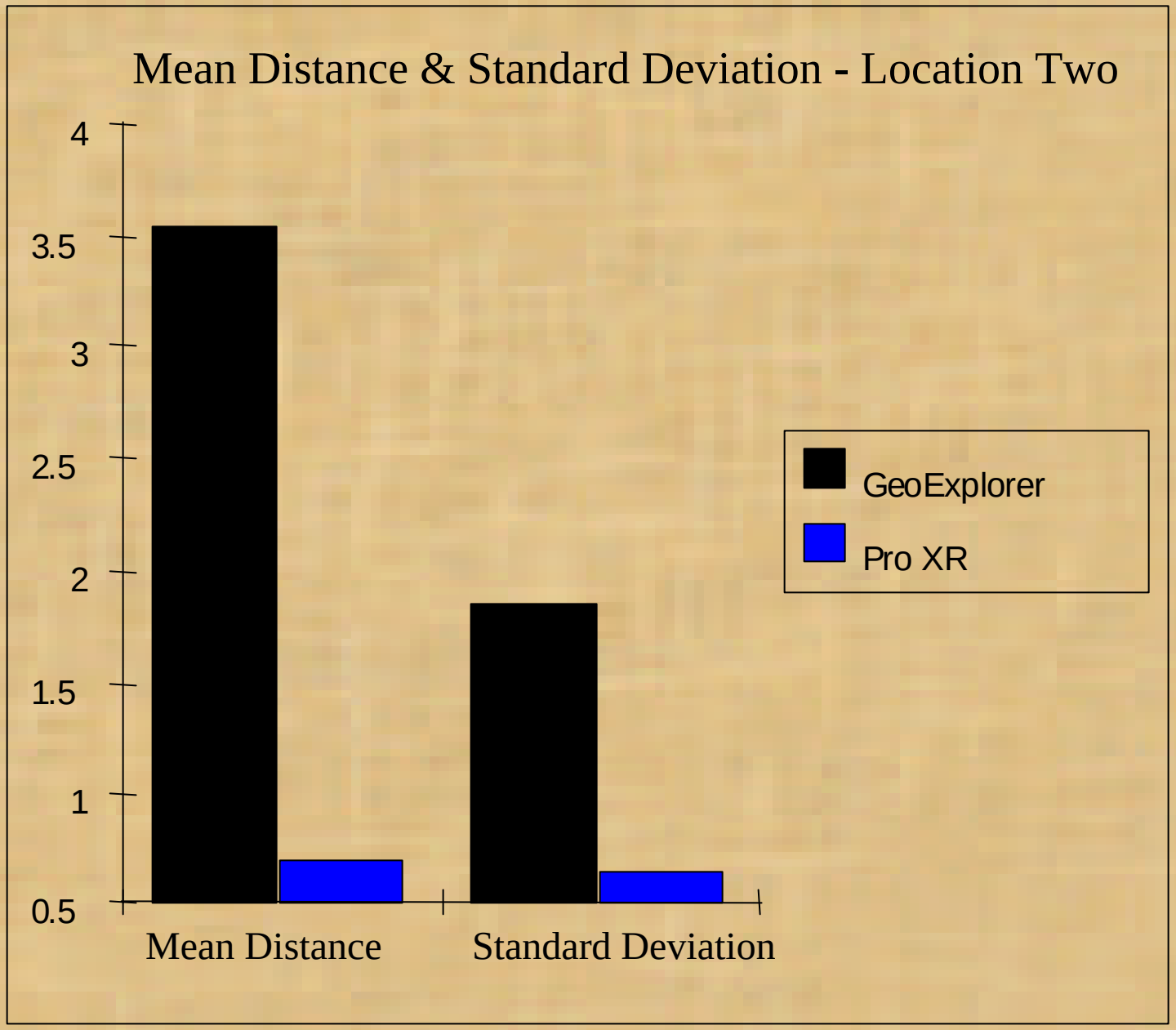
Unit Variation using Post Processed Data
Location One



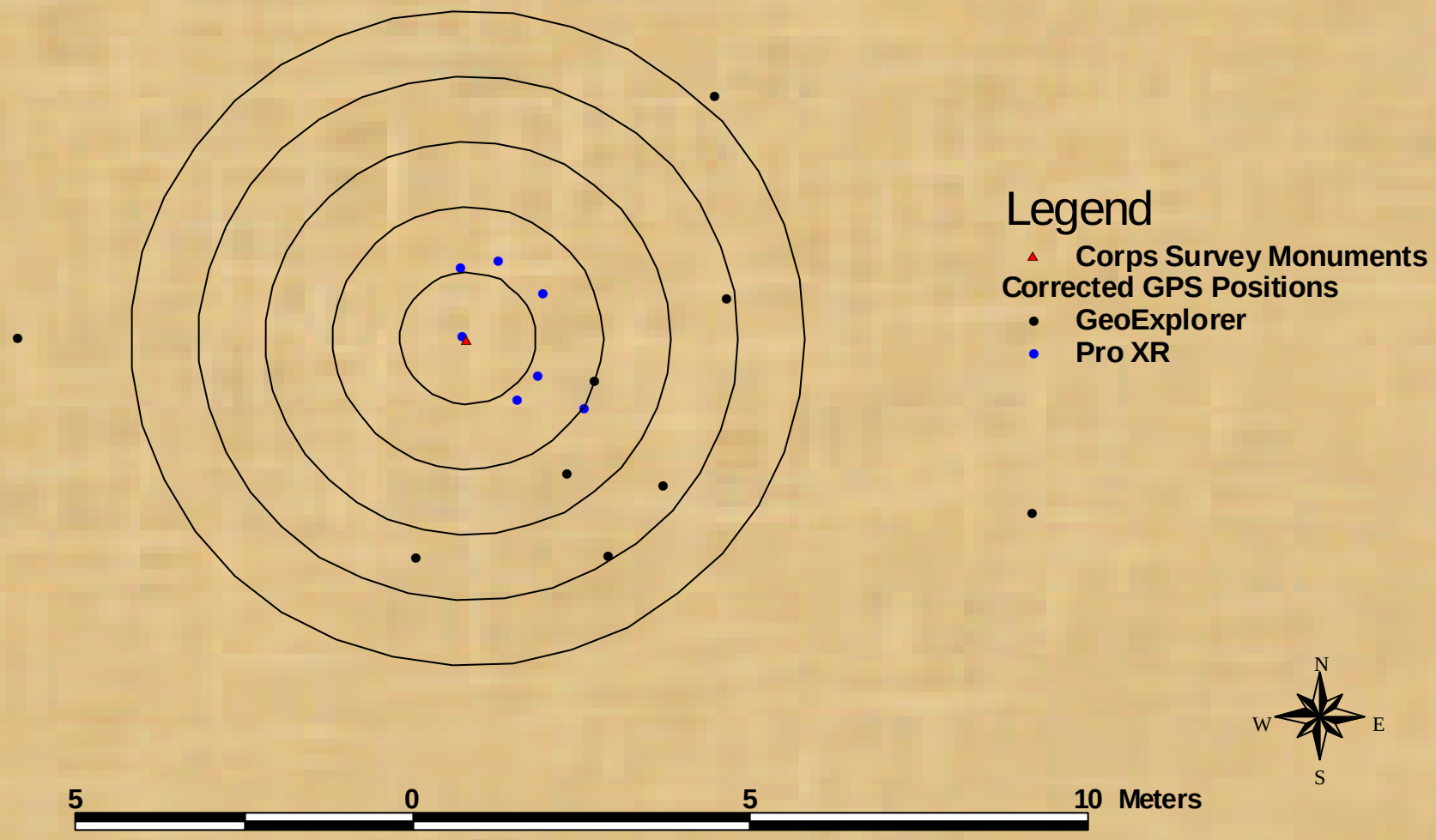

Mean Distance & Standard Deviation - Location One
4.5
4
3.5
3
2.5
2
1.5
1
0.5
Mean Distance
Standard Deviation
GeoExplorer
Pro XR

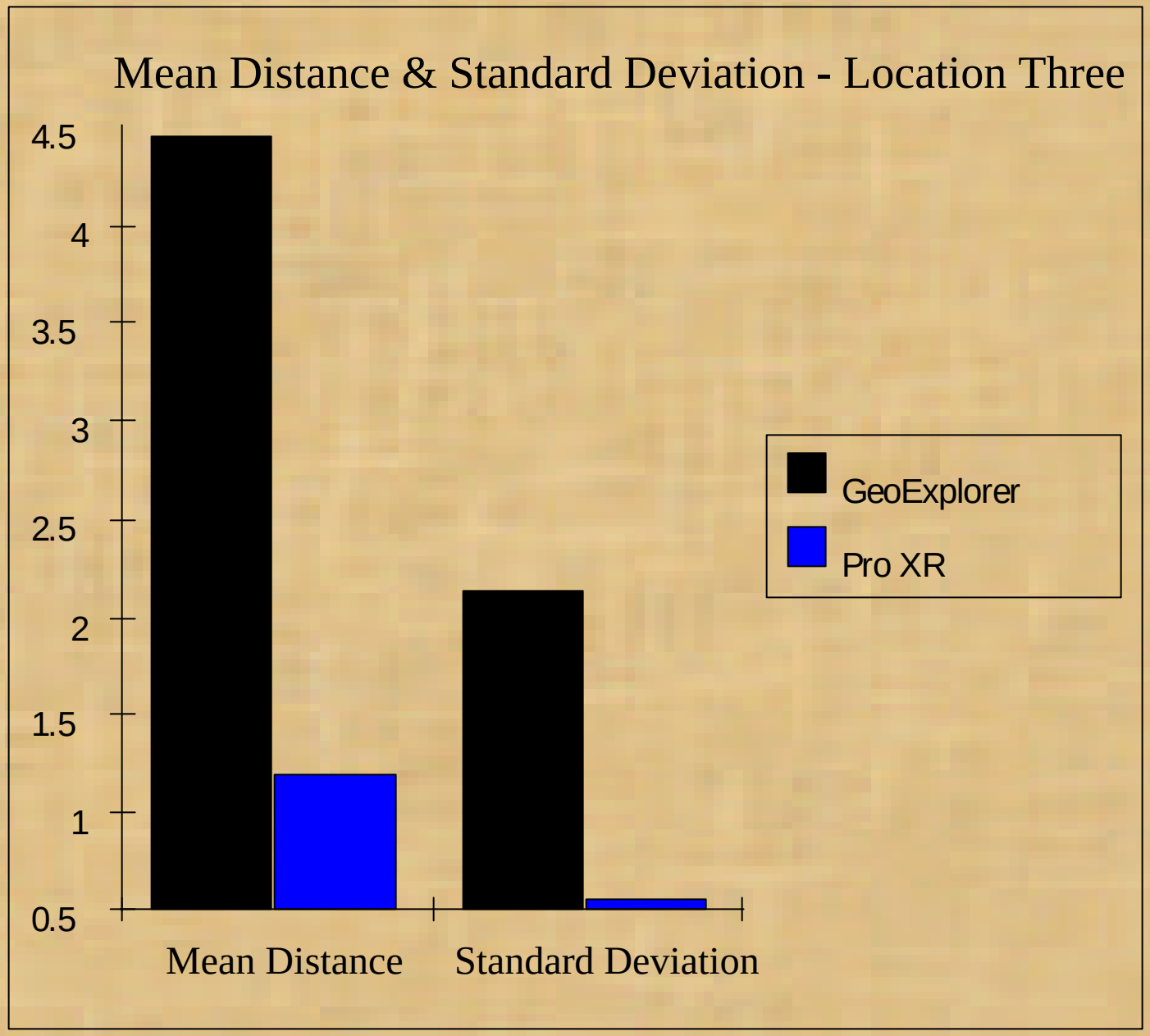
Unit Variation using Post Processed Data
Location Two



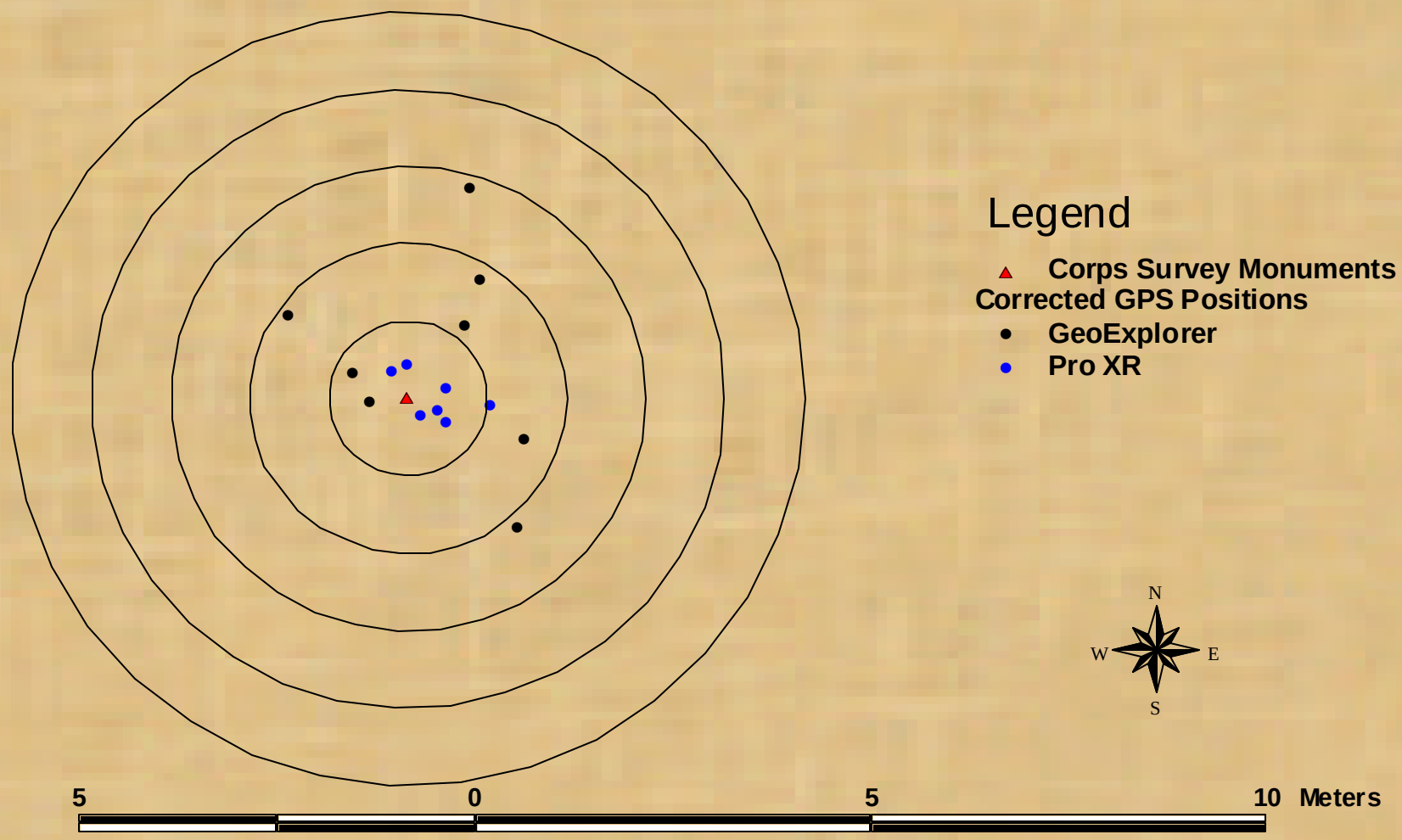

Mean Distance & Standard Deviation - Location Two
4
3.5
3
2.5
2
1.5
1
0.5
Mean Distance
Standard Deviation
GeoExplorer
Pro XR

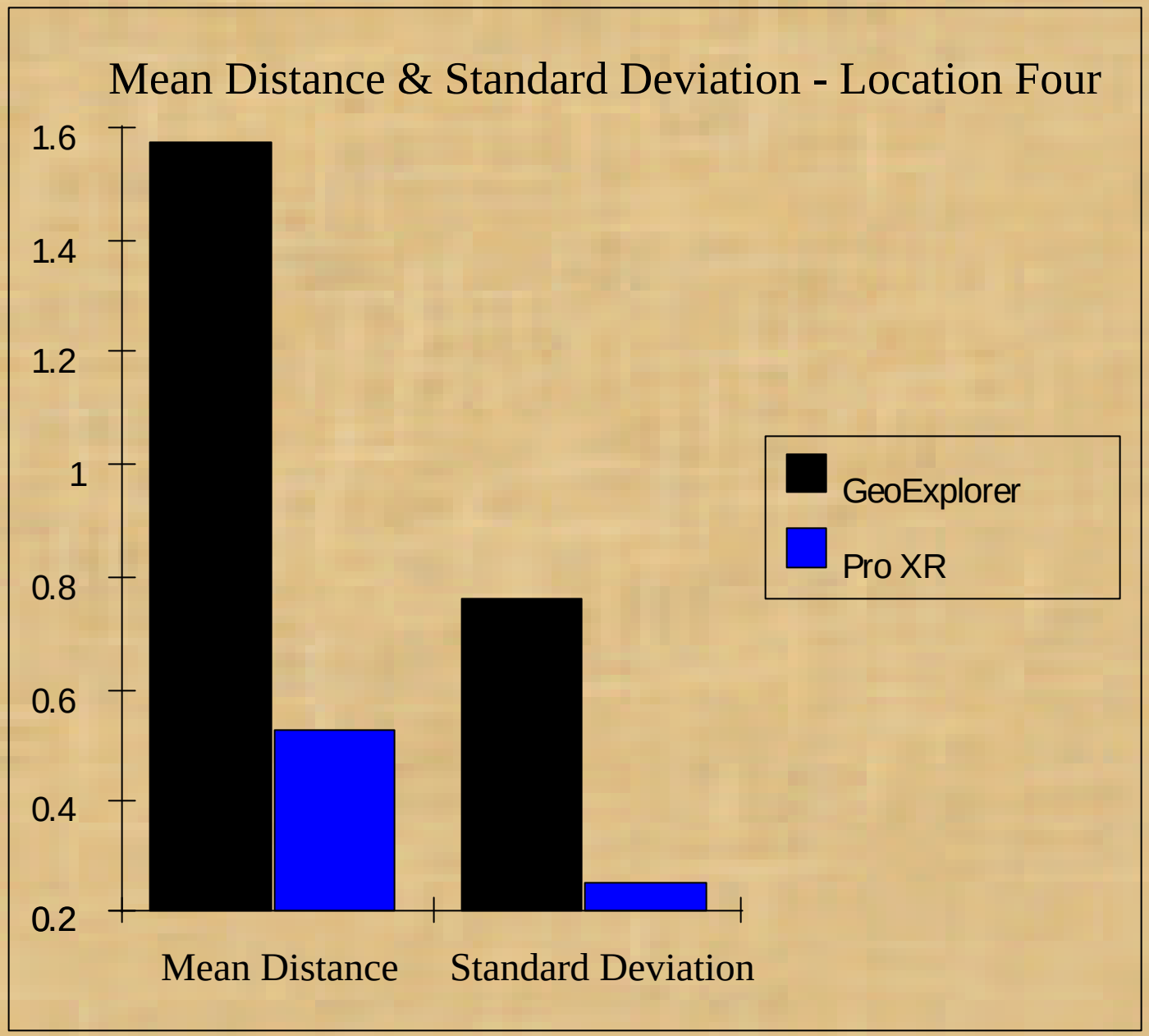
Unit Variation using Post Processed Data
Location Three

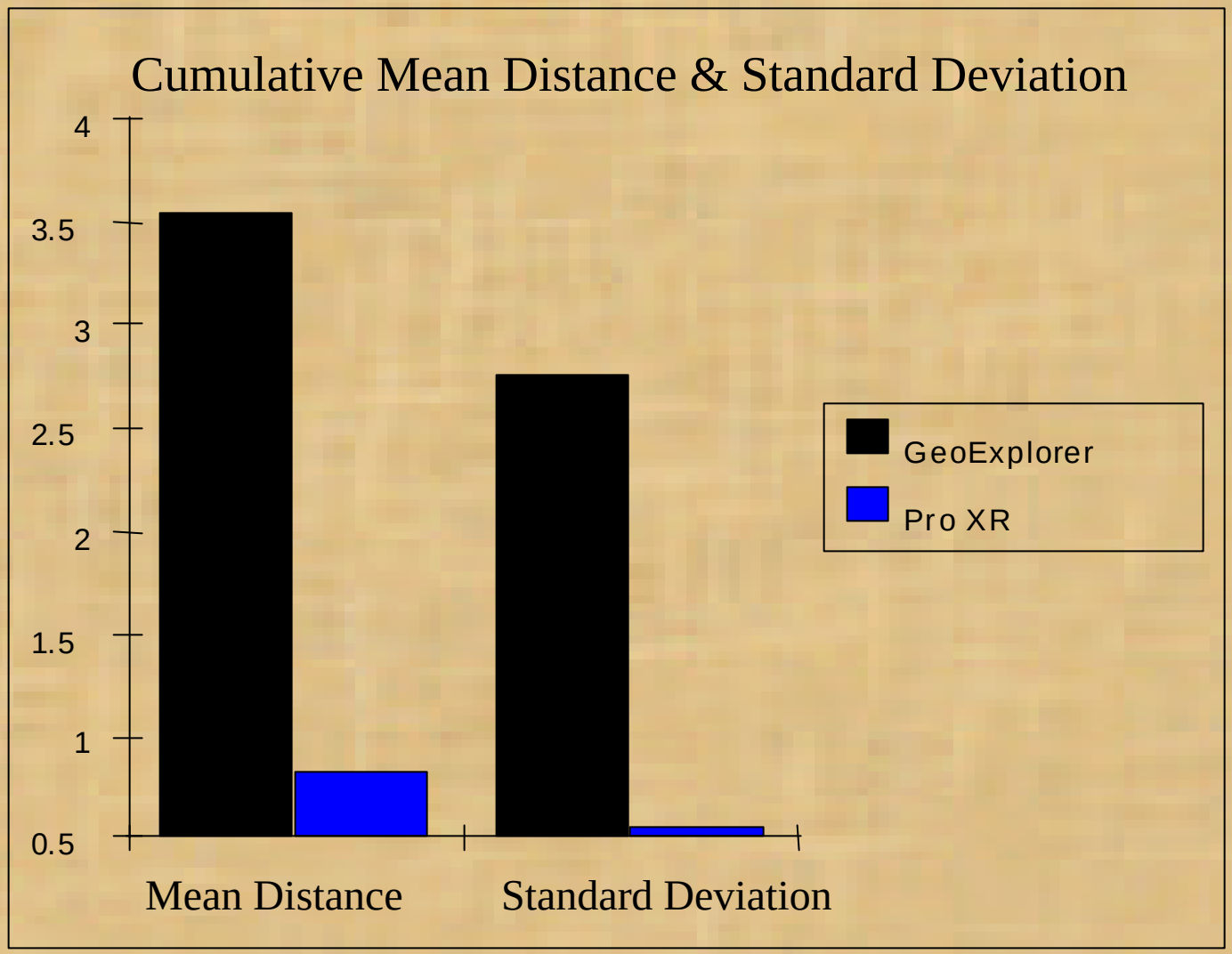



Mean Distance & Standard Deviation - Location Three
4.5
4
3.5
3
2.5
2
1.5
1
0.5
Mean Distance
Standard Deviation
GeoExplorer
Pro XR

Unit Variation using Post Processed Data
Location Four




Mean Distance & Standard Deviation - Location Four
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
GeoExplorer
Pro XR
Mean Distance
Standard Deviation


Cumulative Mean Distance & Standard Deviation
4
3.5
3
2.5
2
1.5
1
0.5
GeoExplorer
Pro XR
Mean Distance
Standard Deviation

Range of Accuracy per Unit

- Trimble GeoExplorer - 0.21 - 13.25 m
- Trimble Pro XR - 0.10 - 2.02 m

Conclusion

- Units lacking real-time differential correction capabilities generally lack consistency.

- Real-time differential correction capabilities allow a high degree of accuracy while in the field

Special Thanks

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