Estimating Accuracy of a City Wide Parcel Fabric

Esri UC 2017

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Agenda

- Our journey in adopting the Parcel Fabric
- Vision of an Accuracy Heat map
- The Process and Tools
- Summary

City of Calgary's Journey using ESRI's Parcel Fabric

City of Calgary's Journey using ESRI's Parcel Fabric

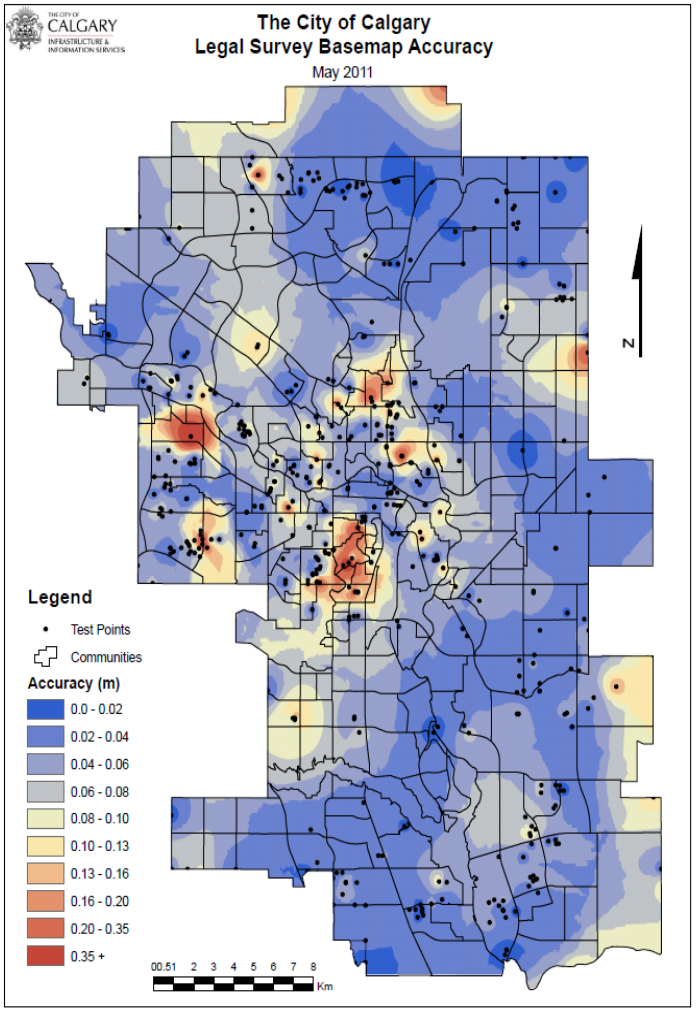
Microstation / Oracle (custom)

ArcGIS 10.0 (June 2011)

ArcGIS 10.2.2 (January 2015)

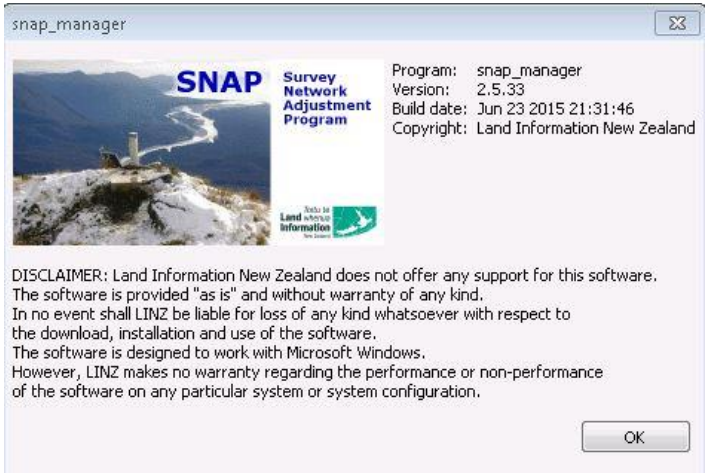
ArcGIS 10.4.1 (September 2016)

Vision of a City Wide Accuracy Heat Map – the beginnings

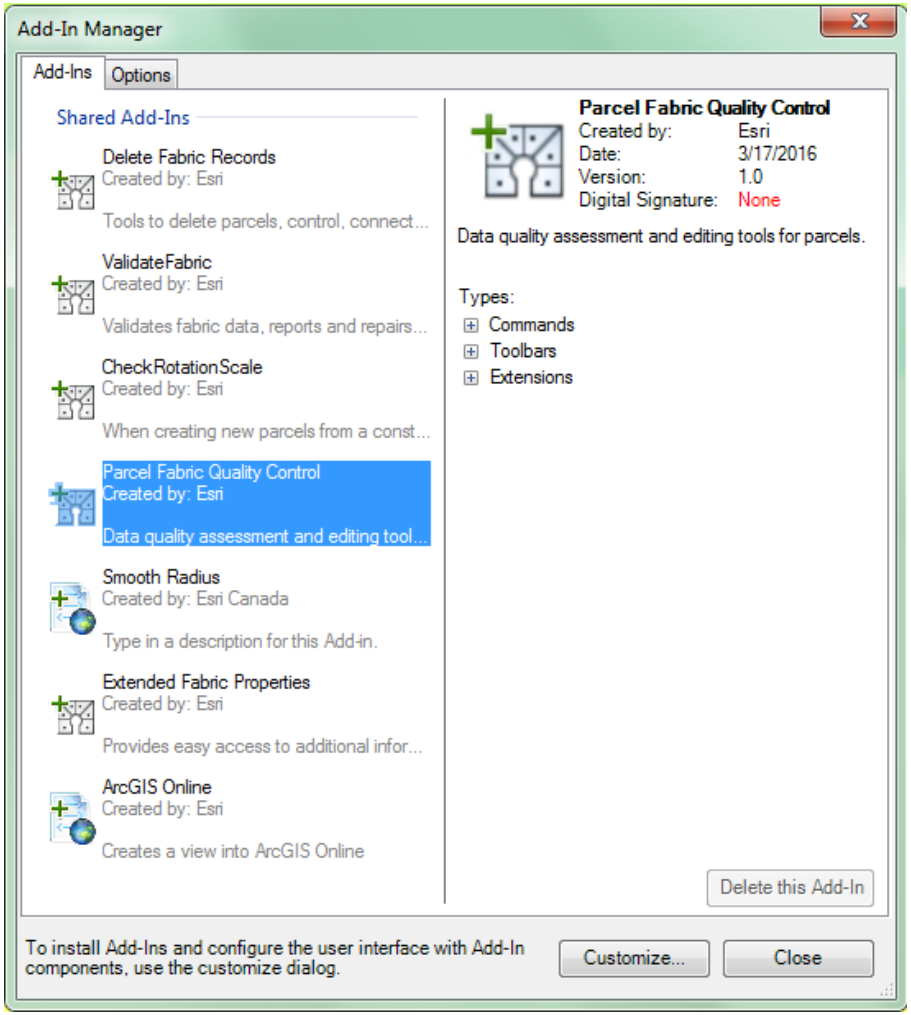


Vision of a City Wide Accuracy Heat Map – the goal

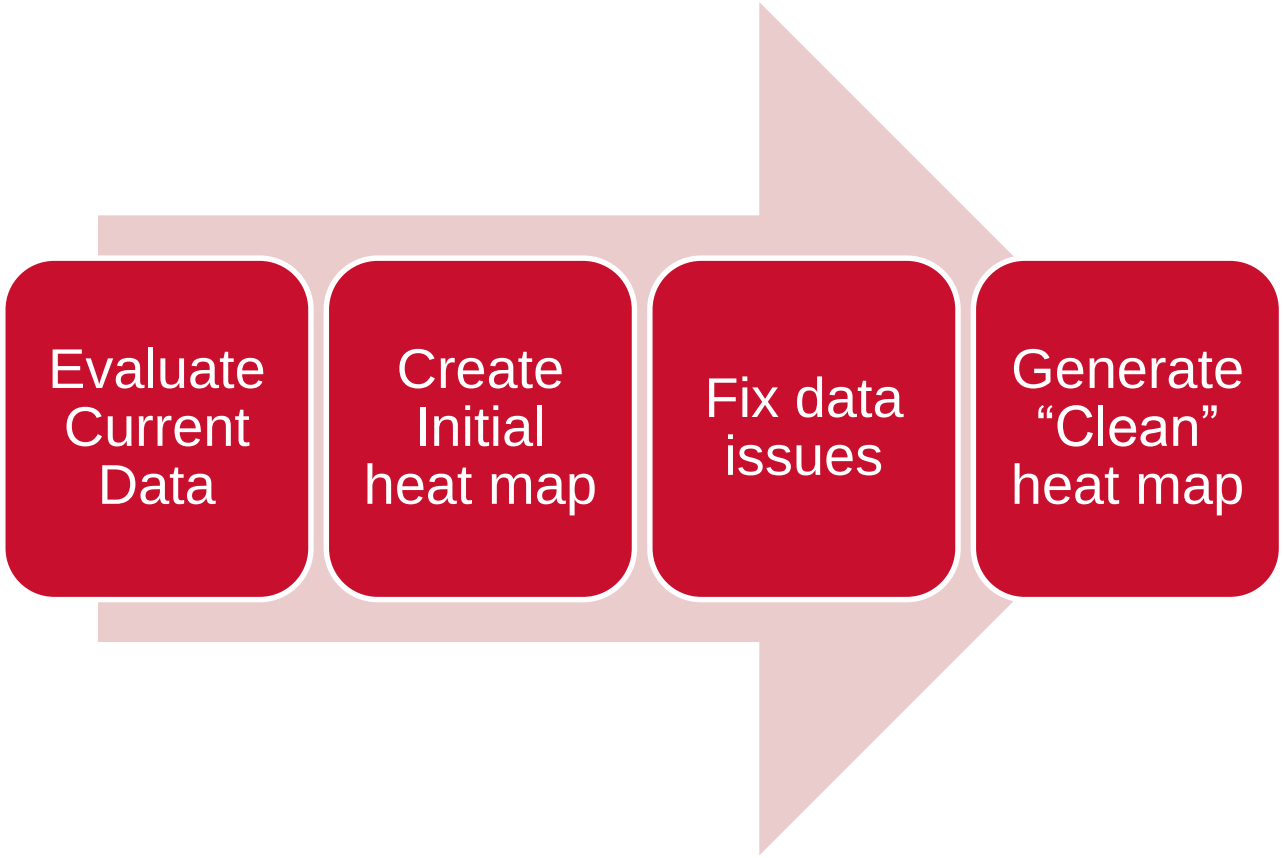
The Process and Tools Software



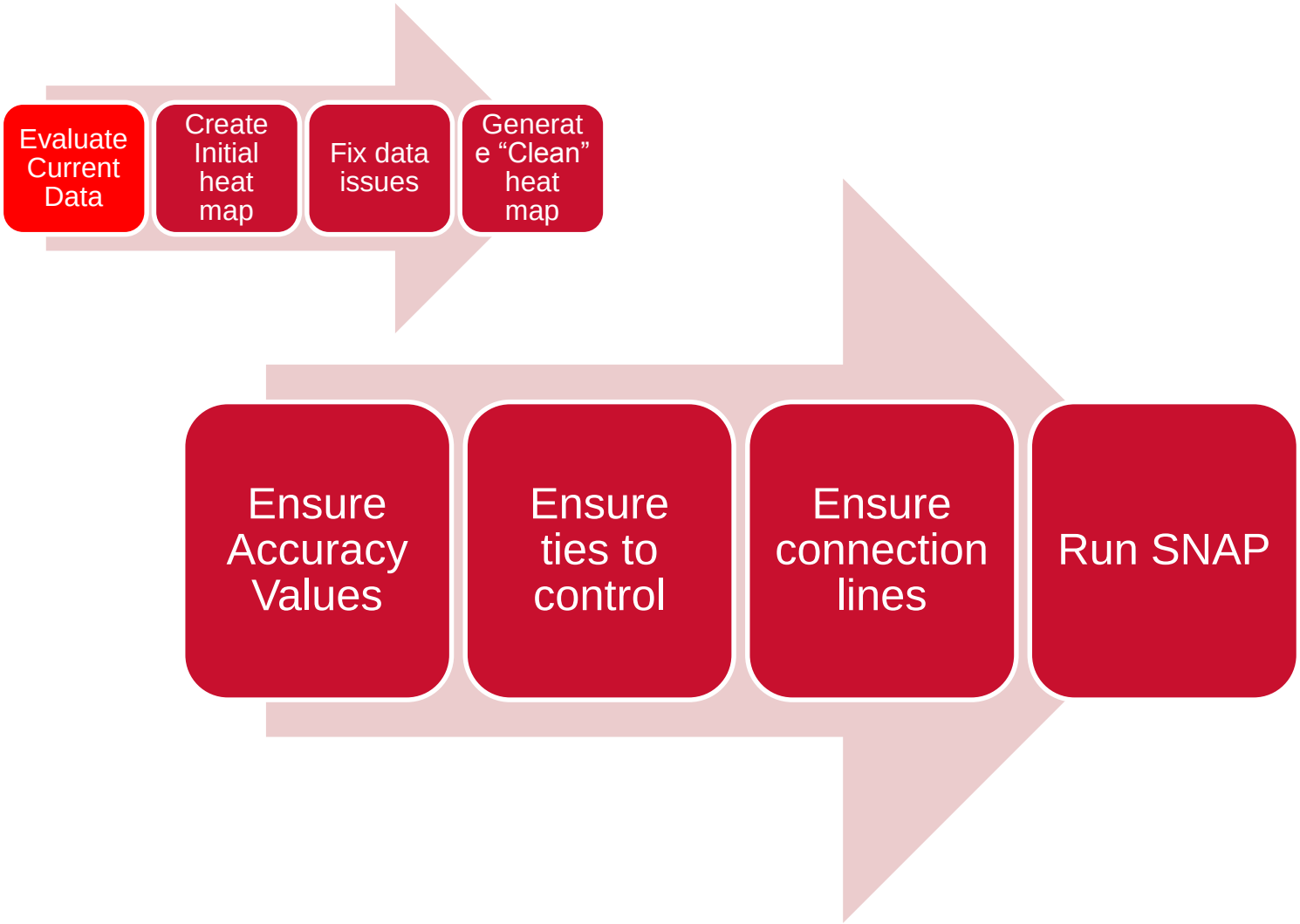
The Process and Tools
Add-Ins



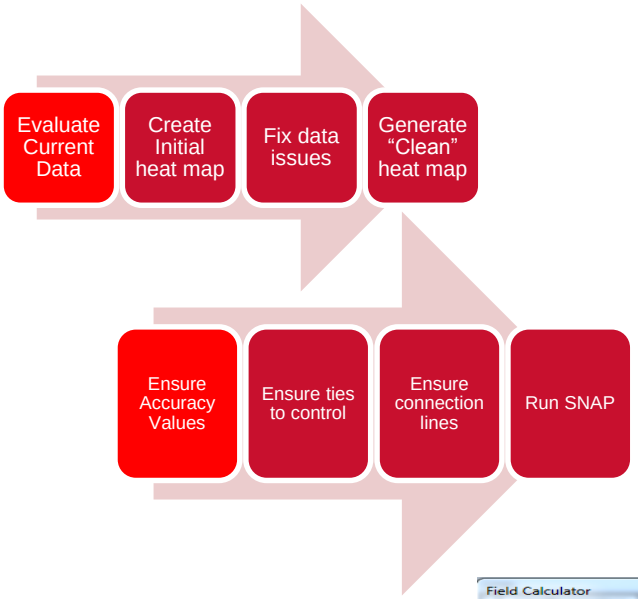
The Process and Tools
High Level Process

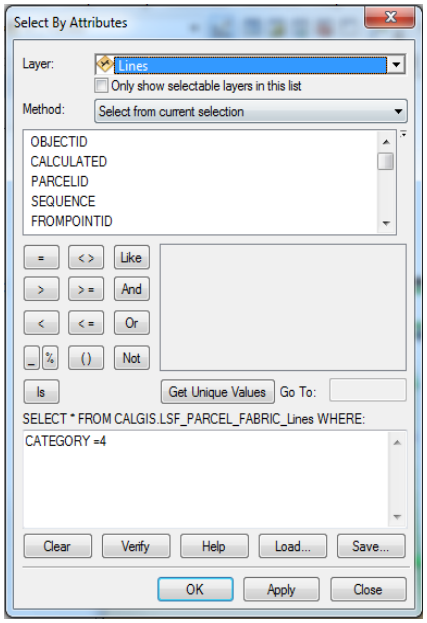


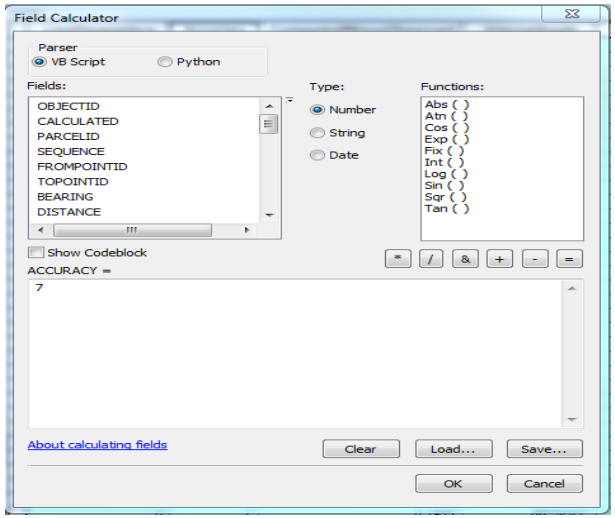
The Process and Tools
Evaluate Current Data



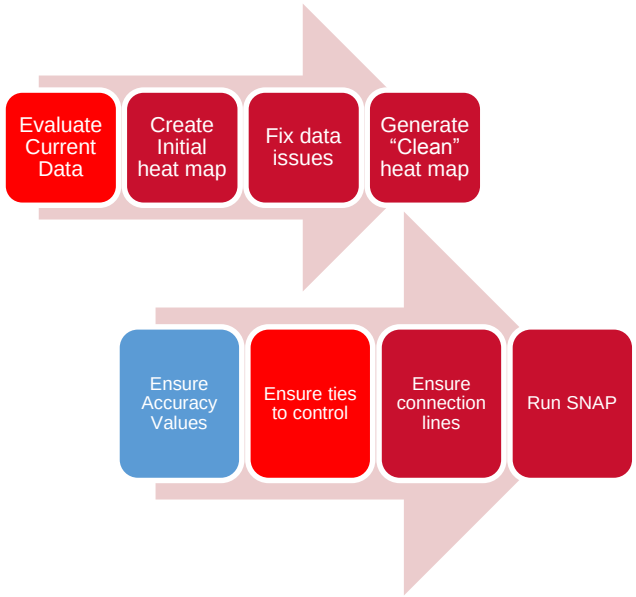
The Process and Tools
Ensure Accuracy Values

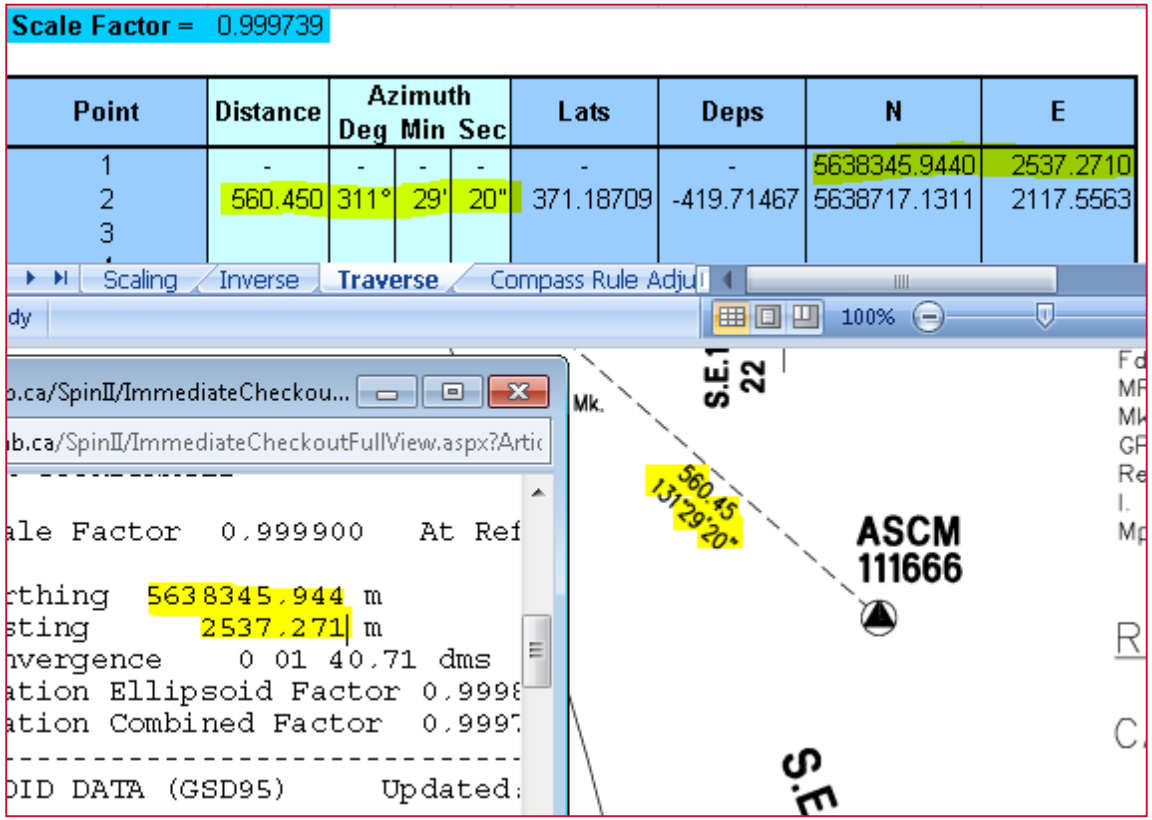






The Process and Tools Ensure Ties to Control





Scale Factor = 0.999739

Point	Distance	Azimuth Deg	Min	Sec	Lats	Deps	N	E
1	-	-	-	-	-	-	5638345.9440	2537.2710
2	560.450	311°	29'	20"	371.18709	-419.71467	5638717.1311	2117.5563
3								

Scaling | Inverse | Traverse | Compass Rule Adju

100%

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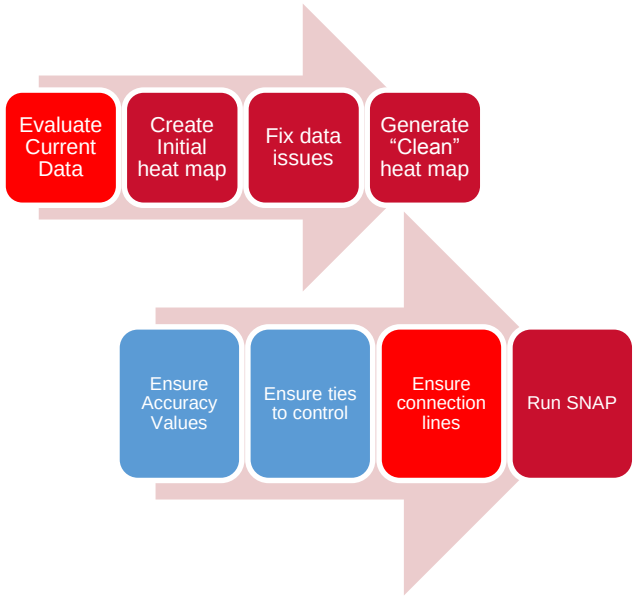
ale Factor 0.999900 At Ref

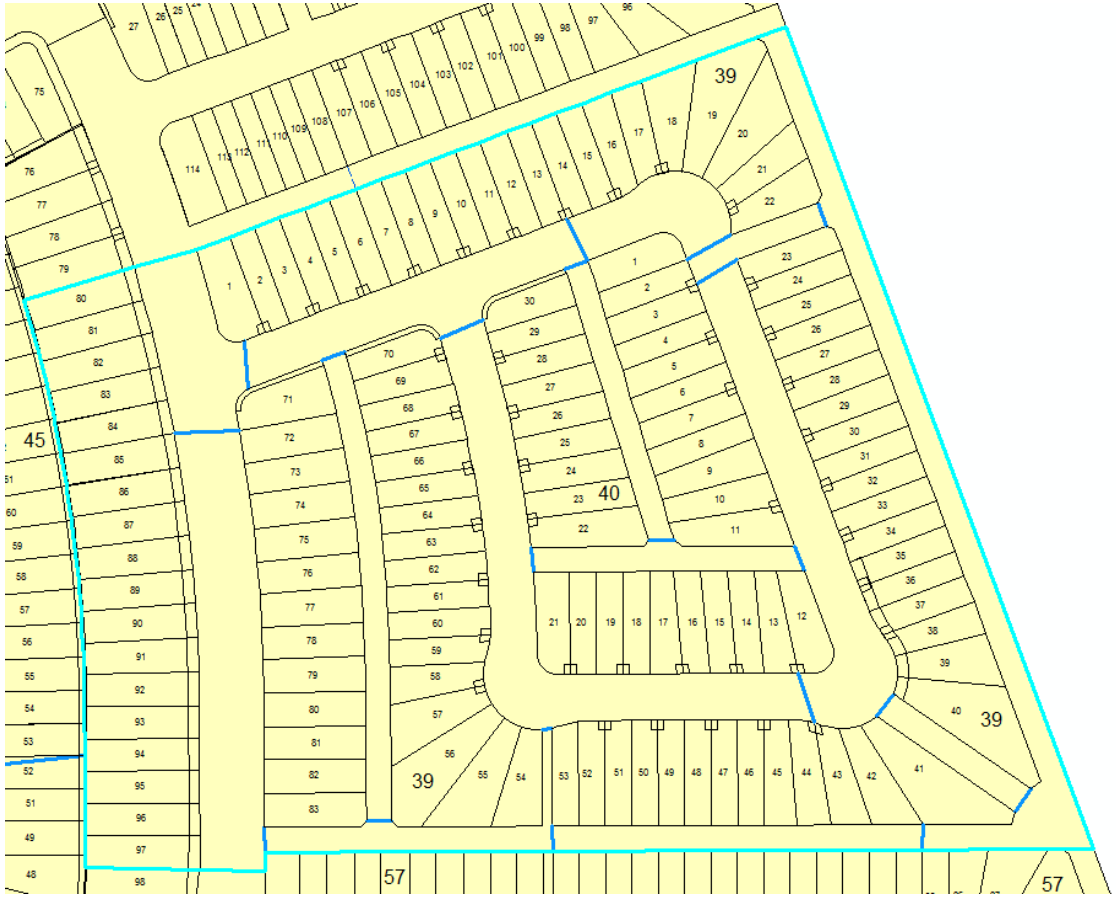
rthing 5638345.944 m
sting 2537.271 m
nvergence 0 01 40.71 dms
ation Ellipsoid Factor 0.9998
ation Combined Factor 0.9997

DID DATA (GSD95) Updated:

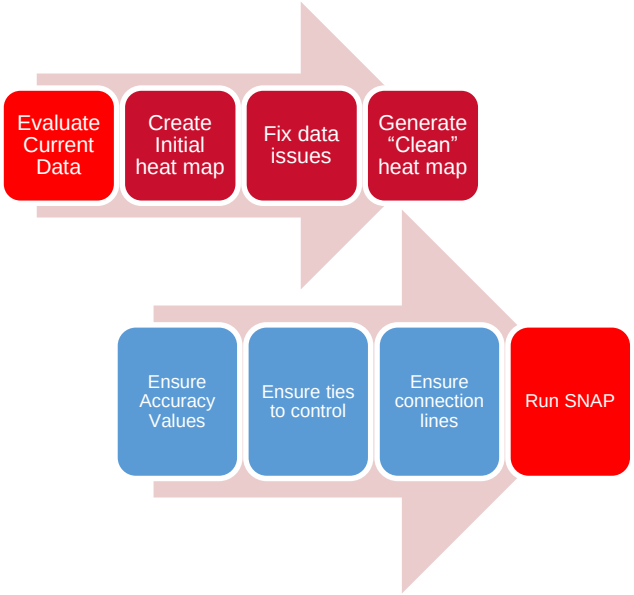
Mk.
S.E.1
22
560.45
131°29'20"
ASCM
111666
S.E

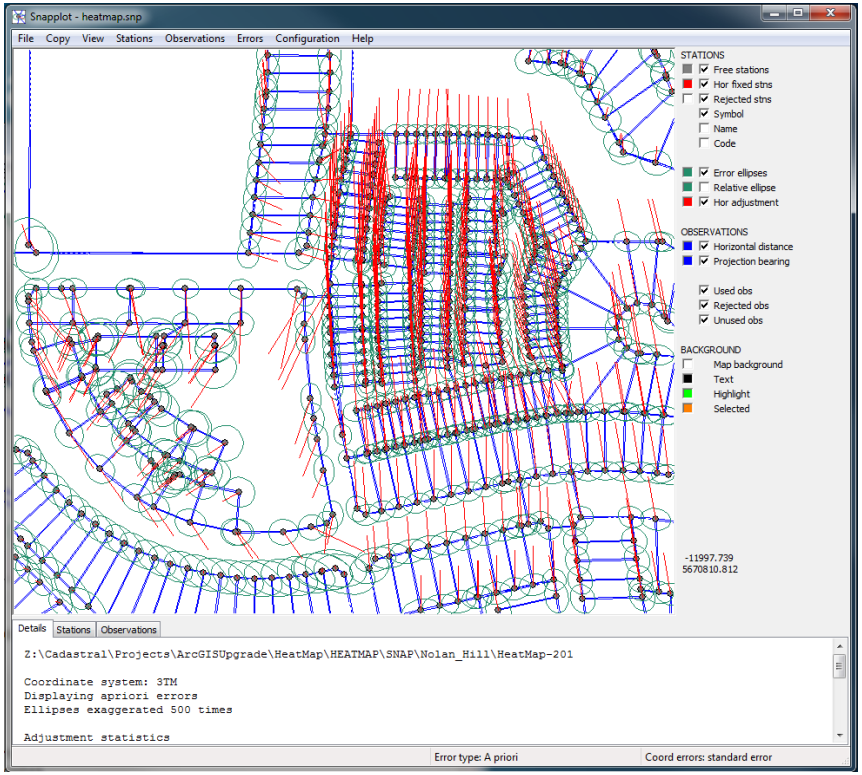
The Process/Tools
Ensure Connection Lines





The Process and Tools
Run Snap





ArcGIS Parcel Fabric Core Adjustment

- Key aspect of ArcGIS Parcel Fabric Maintenance
- Least squares adjustment of weighted survey dimensions honouring control point locations
- Bearing error correction per parcel
  - Automatically handles grid and astronomic bearings
- Objective and repeatable
  - Same selection, same inputs => same result
- Some error metadata
  - Computed minus observed
  - Shape standard error (RMS)

ArcGIS Parcel Fabric
Core Adjustment Limitations

- Control is always treated as errorless
  - Accurate survey information could be distorted by inaccurate control
  - Cannot leverage ad hoc control (existing fabric point locations, ortho imagery)
  - Control is not errorless
- Core adjustment does not calculate error vector
  - Cannot estimate confidence in fabric
  - Cannot produce a reliable heat map
- Both are required for reliable error estimation

Options for Extending Core Adjustment

- Within ArcMap using core adjustment (workaround)
  - Displace control with connections (simulate float)
  - Connection accuracy is accuracy of control
  - Interpolate residuals for heat map
- Use third party LSA
  - Export selection to external LSA
  - Run external LSA
  - Import error metadata
- In ArcMap workarounds were found to be insufficient

Third Party Adjustment Options

- Commercial adjustment software
  - Star*NET, Move3, Geolab
- Free adjustment software
  - GAMA, SNAP

SNAP was found to be the most flexible and closest to core ArcGIS adjustment (identical adjustment with identical inputs)

Introduction to SNAP

- Survey Network Adjustment Program
  - Developed by Land Information New Zealand (LINZ) for NZ surveyors
  - Free to use without restriction (no support)
  - Computes both 2D and 3D adjustments
  - Interactive visualization and interrogation of adjustment (SNAPPLOT)
- Supports bearing error correction per group as part of adjustment
  - Critical for replication of core ArcGIS adjustment with unique bearing error computation per parcel (only adjustment so far discovered)

SNAP Adjustment Components

- Inputs
  - SNAP command File
  - SNAP coordinate (point) file
  - SNAP observation (line) file
  - Coordinate system file (coordsys.def)
- Outputs
  - Detailed report file
  - Adjusted stations file (with error metadata)
  - Adjusted observations file (with error metadata)

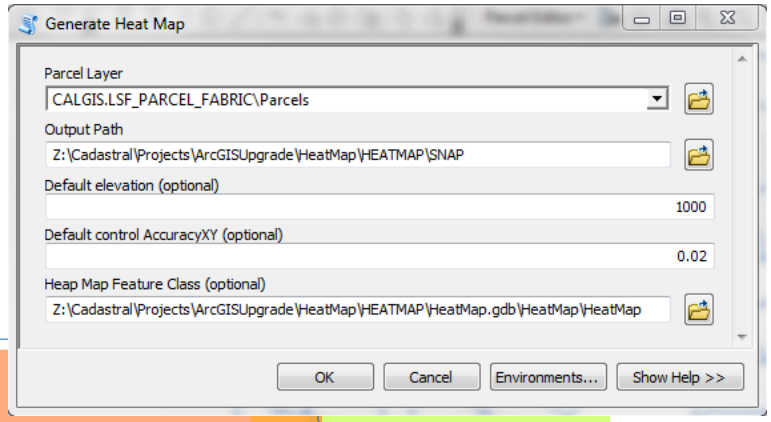
Generate Heat Map

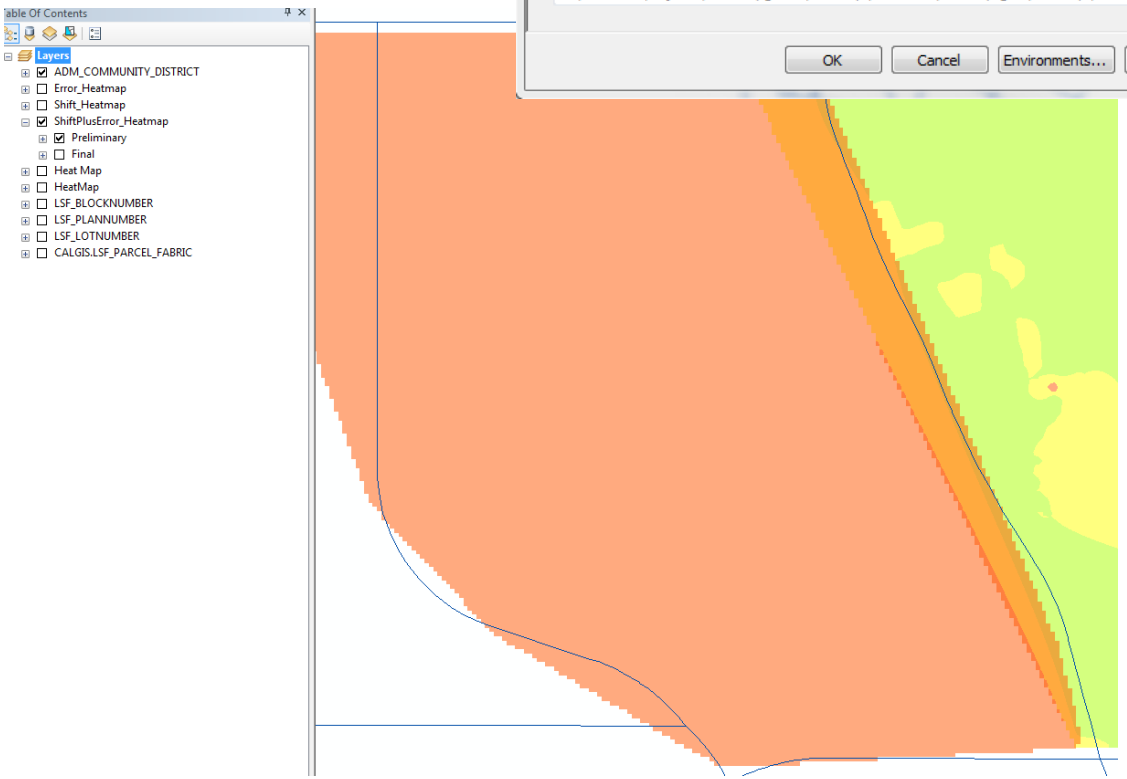
- Custom Python Geoprocessing Tool
- Uses SNAP to compute estimated accuracy of selected parcels
  - Extracts fabric features
  - Runs SNAP adjustment
  - Summarizes accuracy statistics
    - Estimated error
    - Shift applied by adjustment
    - Error plus shift
  - Writes a heat map feature class (with history)

```
Error: average = 0.13, maximum = 0.26 (63% <= 0.15, 0% > 0.50)
Shift: average = 0.07, maximum = 0.24 (98% <= 0.15, 0% > 0.50)
E + S: average = 0.21, maximum = 0.36 (21% <= 0.15, 0% > 0.50)
```

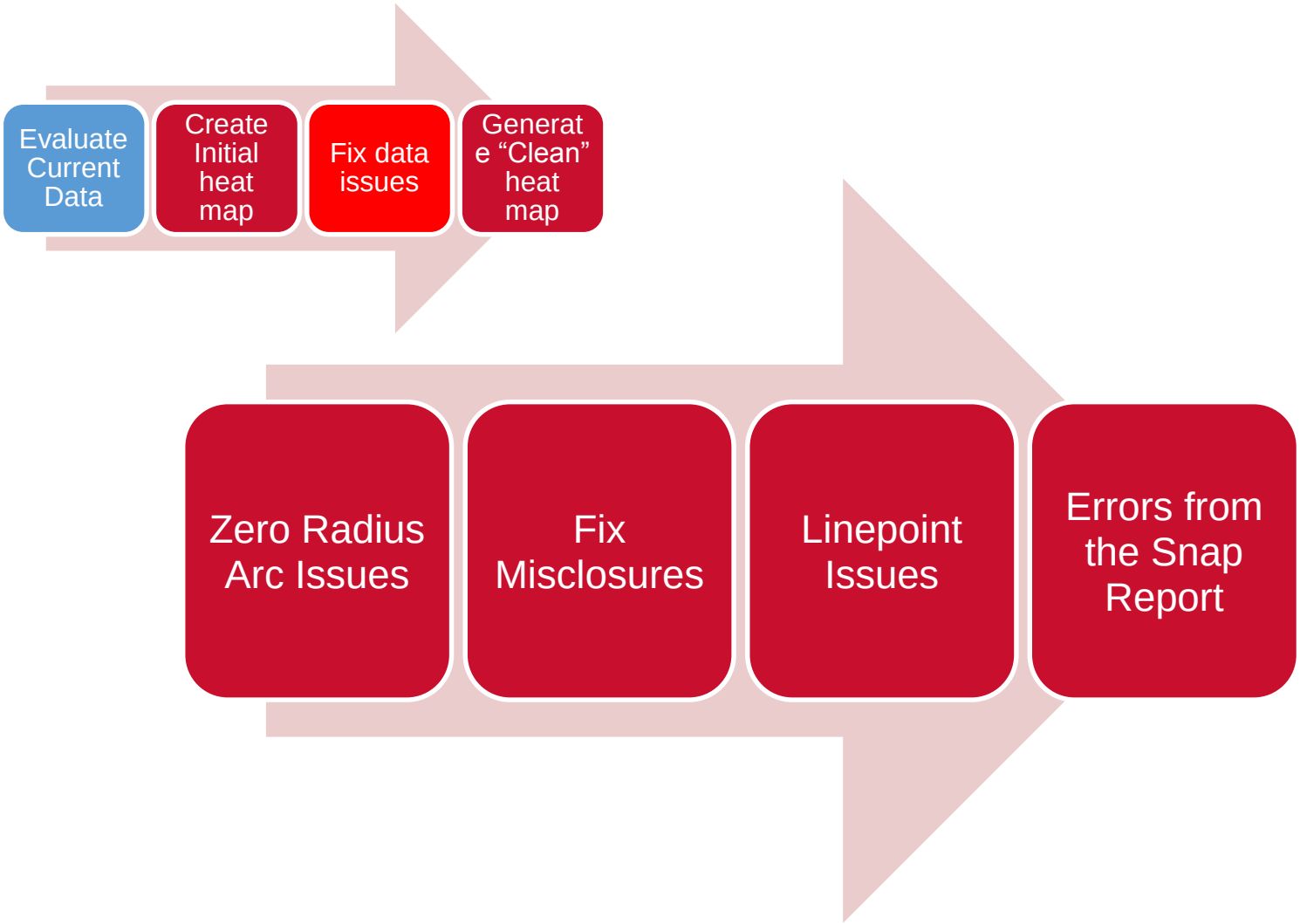
The Process/Tools
Create Initial Heat Map

Evaluate Current Data → Create Initial heat map → Fix data issues → Generate "Clean" heat map





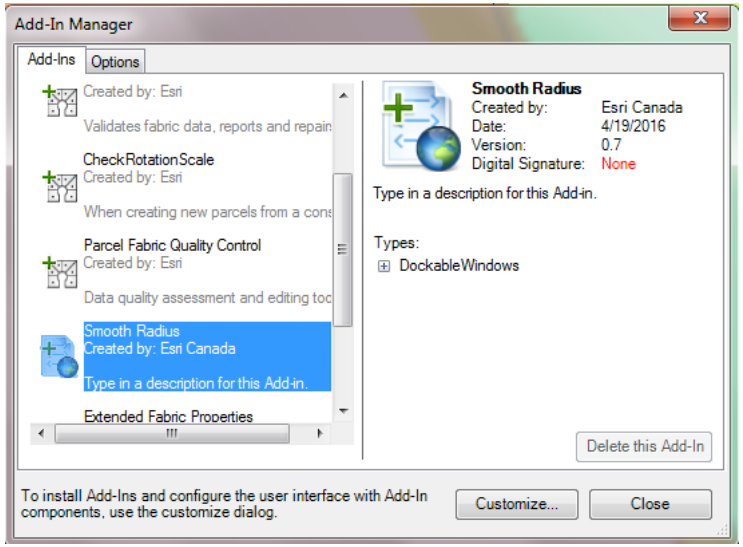
The Process/Tools
Fix Data Issues

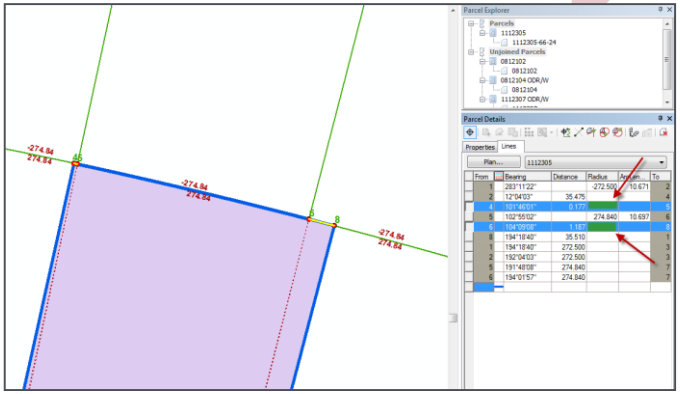


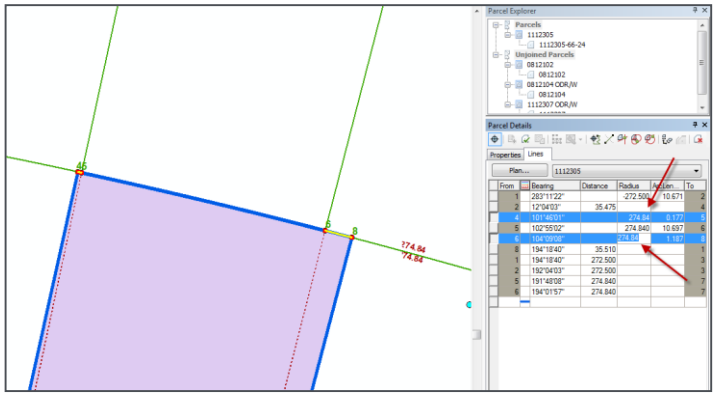
The Process/Tools
Zero Radius Arcs

Evaluate Current Data → Create Initial heat map → Fix data issues → Generate "Clean" heat map

Zero Radius Arc Issues → Fix Misclosures → Linepoint Issues → Errors from the Snap Report







The Process/Tools
Fix Misclosures

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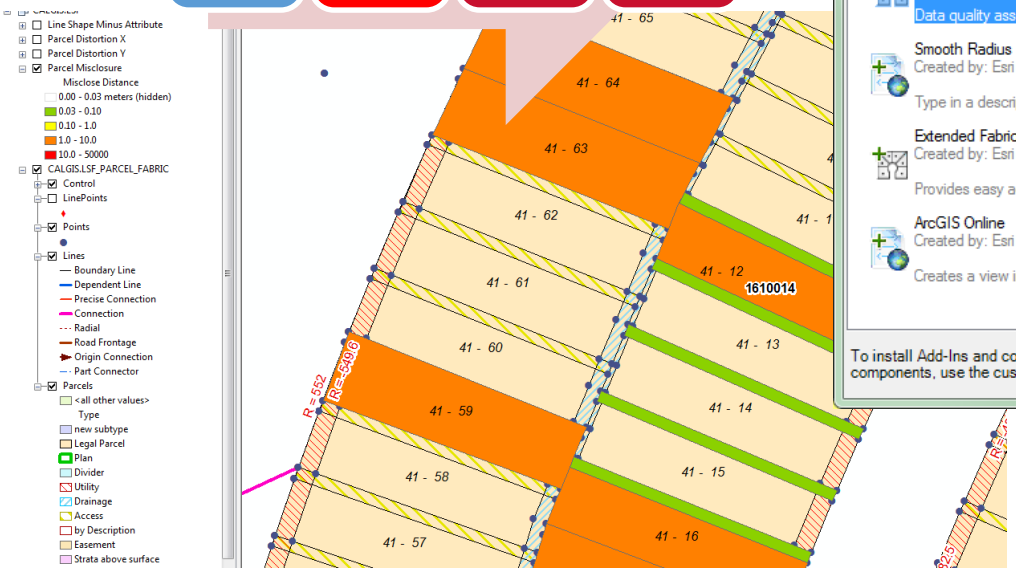
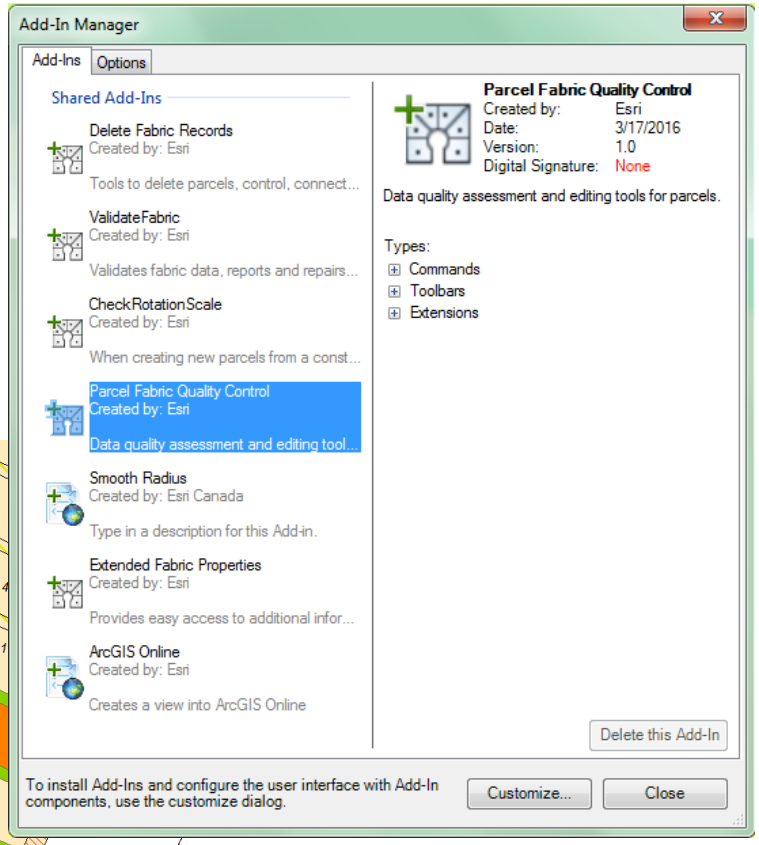
Zero Radius Arc Issues → Fix Misclosures → Linepoint Issues → Errors from the Snap Report





The Process/Tools
Fix Linepoint Issues

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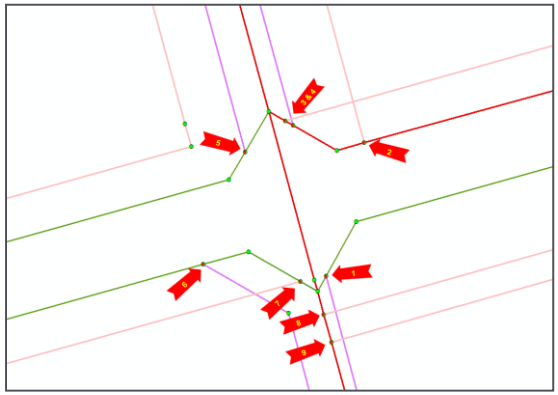
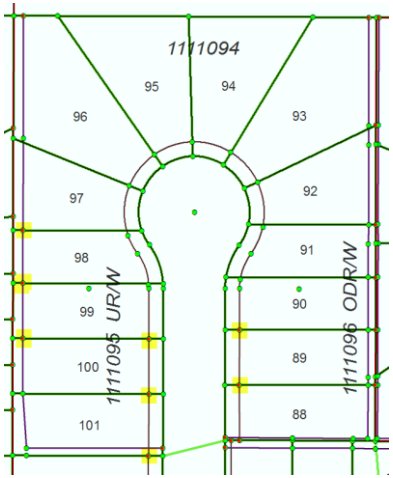
Zero Radius Arc Issues → Fix Misclosures → Linepoint Issues → Errors from the Snap Report





The Process/Tools
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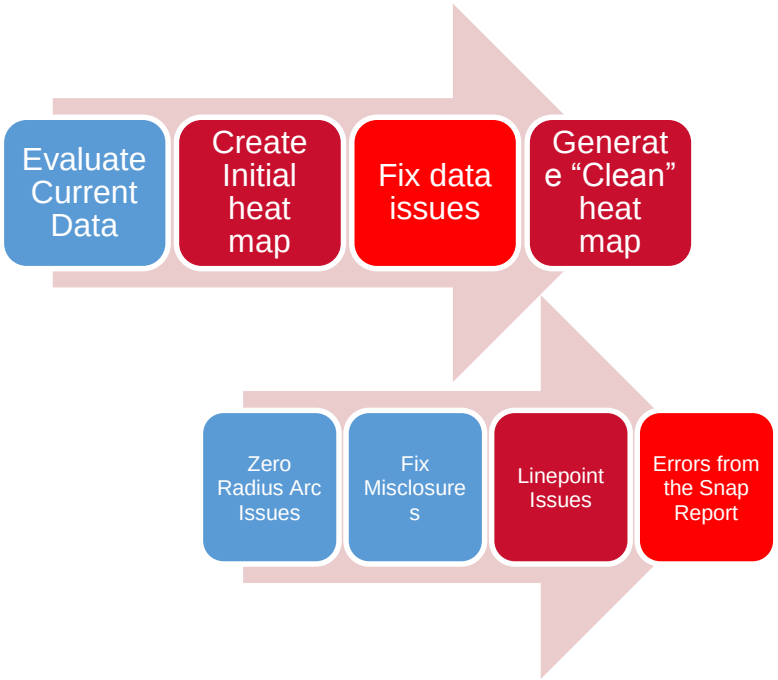


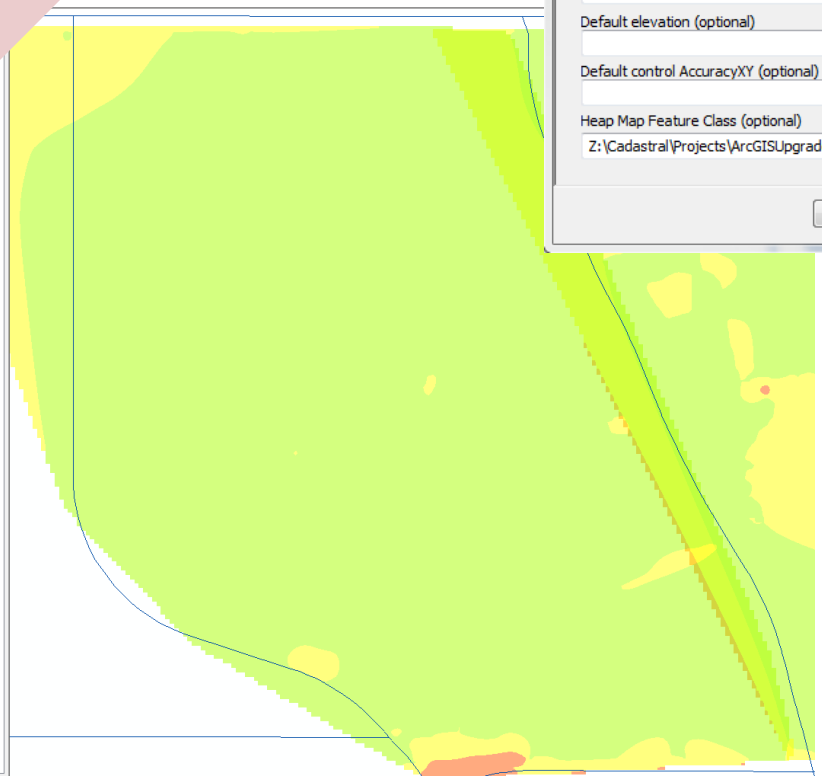
heatmap.lst - Notepad

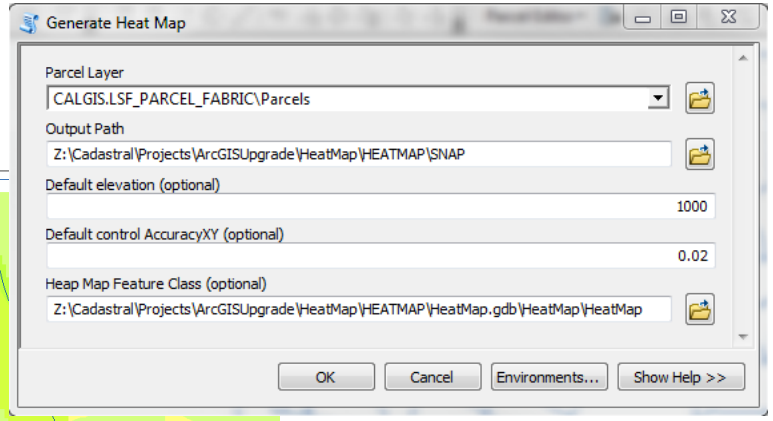
File Edit Format View Help

```
                    MOST SIGNIFICANT RESIDUALS

==============================================================================

The 14576 residuals from this data are classified as follows:

Under 95.00%  significant    Used: 14424    Unused:   0
Under 99.00%  significant    Used:  43    Unused:   0
Over  99.00%  significant    Used: 109    Unused:   0

Note: Only the overall residual for vector data is counted

The following table lists the 10 worst residuals of used data

From     To       Type     S.R.   Sig (%)       Line  File

173816   187511    PB    64.640  100.000 ???   2792  heatmap-lines.txt

173816   187511    PB    64.590  100.000 ???   6729  heatmap-lines.txt

182485   187567    PB    47.938  100.000 ???   6753  heatmap-lines.txt

182485   187567    PB    47.546  100.000 ???   2593  heatmap-lines.txt

182836   756329    PB    24.692  100.000 ???   6983  heatmap-lines.txt

182836   182837    HD    22.984  100.000 ???   6326  heatmap-lines.txt

182836   182837    HD    22.984  100.000 ???   7713  heatmap-lines.txt

182838   182835    HD    21.037  100.000 ???   6324  heatmap-lines.txt

182838   182835    HD    21.037  100.000 ???   7712  heatmap-lines.txt
```

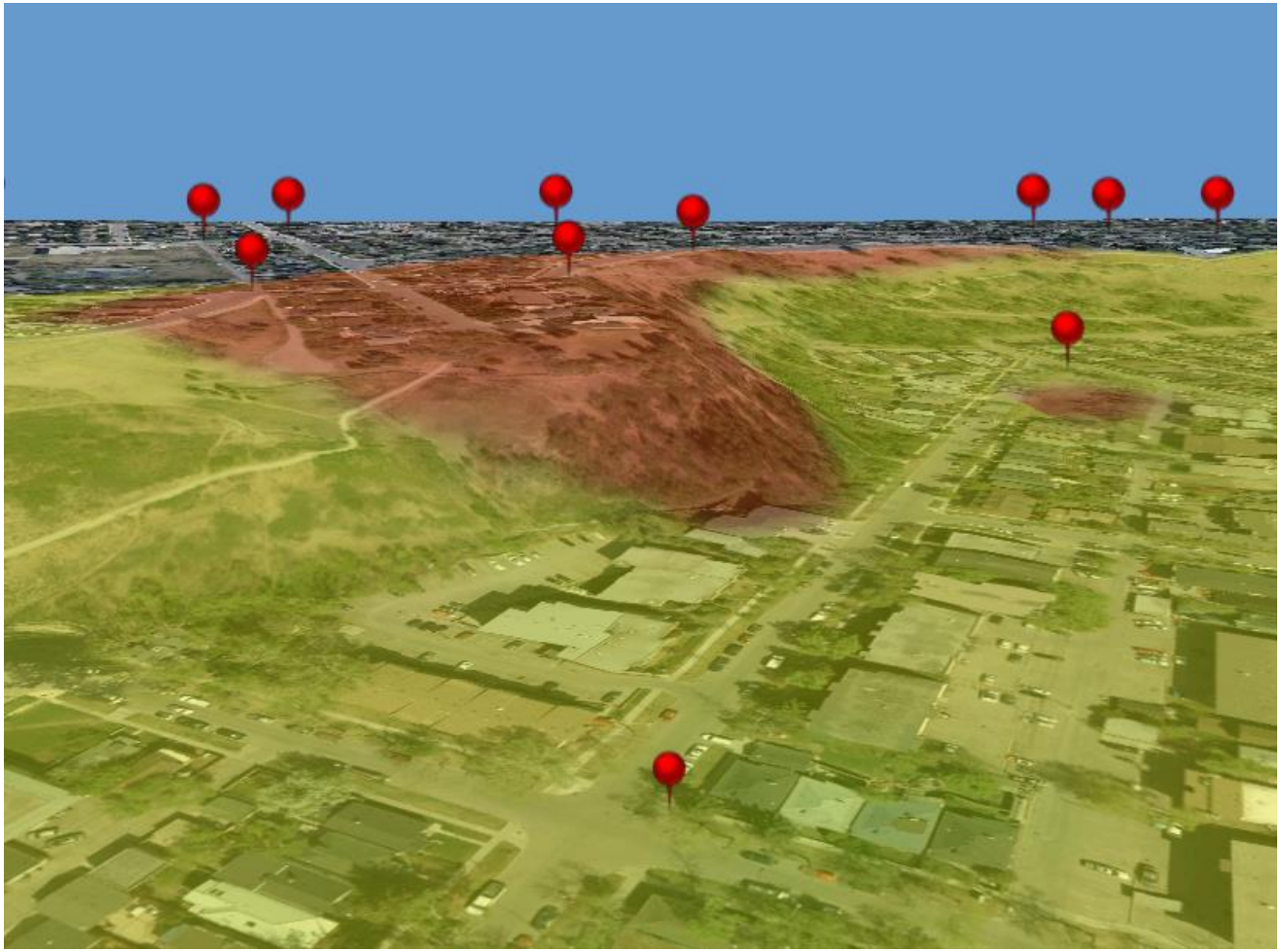
The Process/Tools
Create Initial heat map

Evaluate Current Data → Create Initial heat map → Fix data issues → Generate "Clean" heat map

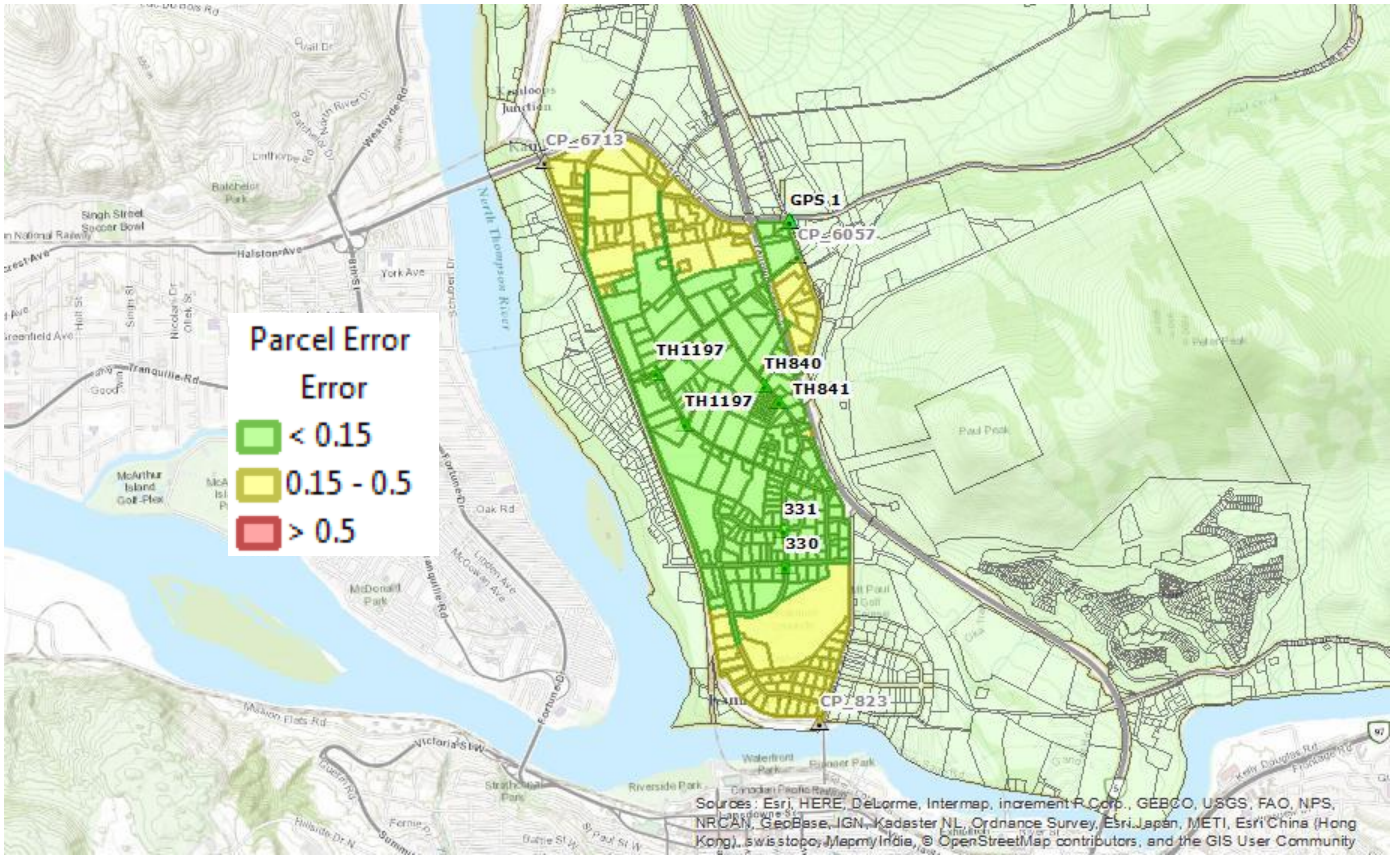




Advanced heat map Visualization



Visualizing and Quantifying Accuracy Improvement



Balanced estimated accuracy of imported data (dimensions at 0.1m)

Error: average = 0.13, maximum = 0.26 (63% <= 0.15, 0% > 0.50)

Shift: average = 0.07, maximum = 0.24 (98% <= 0.15, 0% > 0.50)

E + S: average = 0.20, maximum = 0.36 (92% <= 0.15, 0% > 0.50)

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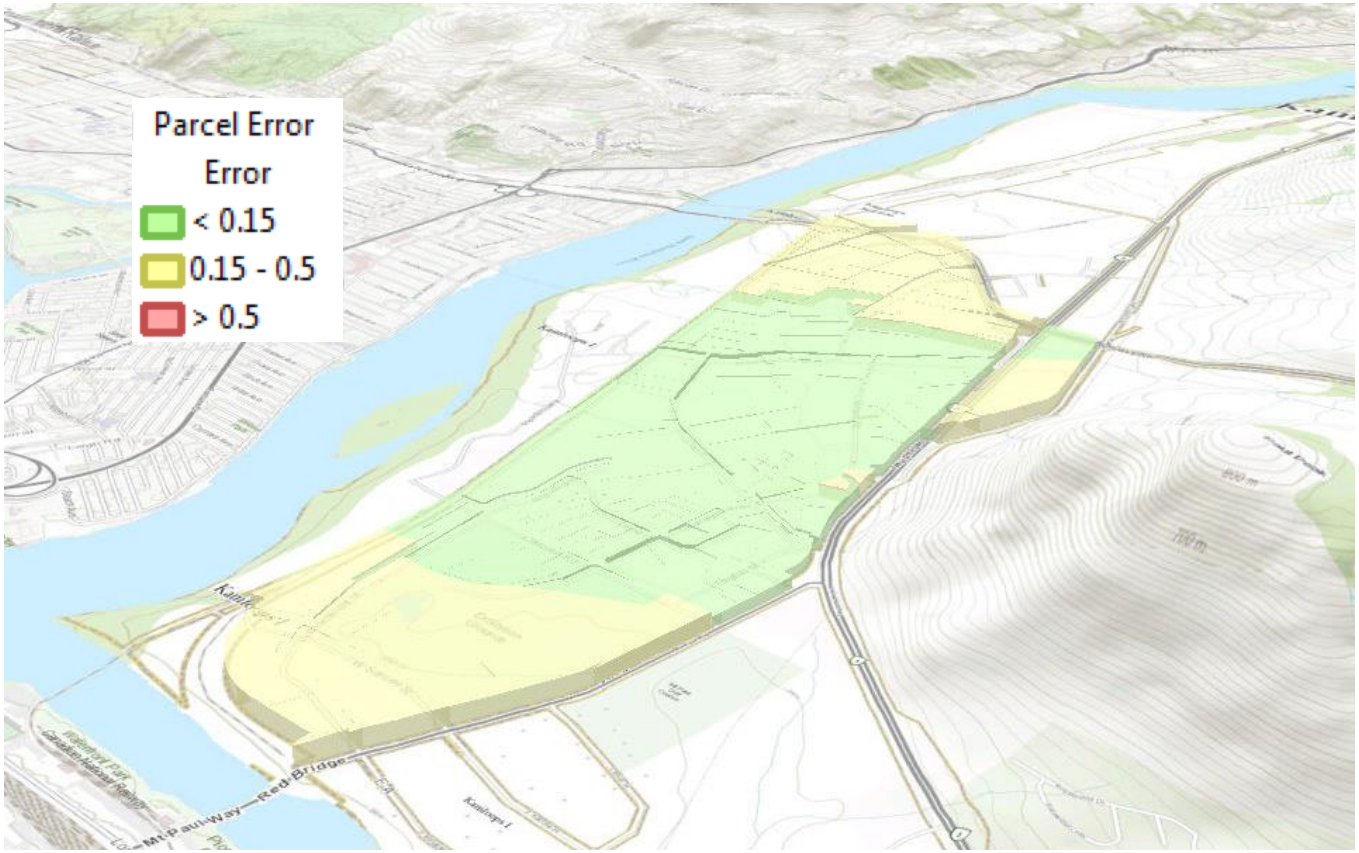

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Summary

- Our journey in adopting the Parcel Fabric
- Vision of an Accuracy heat map
- The Process and Tools
  - require effort but are worthwhile

Q&A and Thank You!