WHAT’S IN A NAME?

Unique Asset Identification using USNG Coordinates

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PROJECT BACKGROUND

Mohawk Valley Water Authority
About the Project

- The Mohawk Valley Water Authority (MVWA)
  - Serves the Greater Utica Area in Central NY
  - Serves a population of 130,000 (about 40k customers)
  - 700+ miles of pipe, 28 storage tanks, 21 pump stations
  - Produces an average of 19 MGD

- Mapping & Modeling Modernization Project ($M^3$)
  - GIS Update
    - Workflow
    - Geodatabase redesign
  - Hydraulic Model Update
    - Move from all-pipe to all-pipe/valve/hydrant
M³ Project Component

- New Unique Asset Identifiers
  - Unique identifier ("name") required for various systems such as GIS, CMMS, WOMS, or hydraulic models
  - At project onset, only hydrants had "meaningful" names
M³ Project Component

- New Unique Asset Identifiers
  - Unique identifier ("name") required for various systems such as GIS, CMMS, WOMS, or hydraulic models
  - At project onset, only hydrants had "meaningful" names

- For this discussion, "asset" = fixed, field-based asset such as hydrants & valves
Challenge

- Update water asset identifiers to be meaningful / logical unique names

- The MVWA has 22 feature classes in its water network geodatabase
  - Lines (3)
  - Facilities (11)
  - Features (8)
MVWA WaterNet Feature Classes

- Lines
  - Pipes used in the transmission and distribution of water
  - Line Feature Classes (3)
    - MainLine
    - ServiceLine
    - VirtualLink
MVWA WaterNet Feature Classes

- Facilities
  - Water network point facilities and junctions
  - Facility Feature Classes (11)
    - Hydrant
    - Storage
    - MainLineValve
    - ServiceLineValve
    - SystemControlValve
    - PressureRegulatingValve
    - SystemMeter
    - Pump
    - CurbBox
    - SamplingStation
    - Fitting
MVWA WaterNet Feature Classes

- **Features**
  - Spatial features that support the water network but do not transmit or control the flow of water

- **Feature Feature Classes (8)**
  - Casing
  - AboveGroundFacility
  - UnderGroundFacility
  - Equipment
  - SCADAsensor
  - ServiceZone
  - MapScan
  - RedLine
ASSET NAMING OPTIONS

Field-based assets
Identifier / Name Characteristics

- Required
  - Unique
- Desired
  - Meaningful
  - Hierarchical
  - Parsable
  - Same character length
Asset Naming Schemes

- Numbering
  - Random
  - Sequential

- Hierarchical
  - Ex. site, building, asset type, asset number = MPHP04

- Spatial / Geographical
  - Grid-based
  - Coordinate-based

- Hybrid
  - Combination of schemes
Hydrant Naming Thoughts

- Deserve a meaningful name, sure they’re not as big as a building, but they’re above ground 😊
- Need to communicate hydrant status information internally & with many fire departments and DPWs
- Experimented with various naming schemes
  - Including using an abbreviation for muni & street with nearest address number
  - Ex. UTGEN00258, MACAV15824
Final Selection

- Street / address-based worked ok for hydrants, but wasn’t ideal
- Heard a presentation about Hurricane Katrina response and started to explore using the USNG
- Using the USNG was a solid, logical choice…
USNG
United States National Grid
What is the USNG?

- Seamless, standardized alphanumeric point referencing system
- Universal coordinate system derived from UTM
- MGRS equivalent (NATO)
- Developed by FGDC
- Preferred grid for NSDI applications
Why use the USNG?

- Single alphanumeric string
  - Ex. 18TVN80797206
- Navigable
- Universal
- Hurricane Katrina
  - Talbot Brooks
The 3 USNG Components

1. GZD – Grid Zone Designation
2. 100,000 Meter Square Identification
3. Grid Coordinates
The 3 USNG Components

1. GZD – Grid Zone Designation
   - The US is divided into 6-degree longitudinal zones designated by a number, and 8-degree latitudinal bands designated by a letter.
GZD 18T
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   - The US is divided into 6-degree longitudinal zones designated by a number, and 8-degree latitudinal bands designated by a letter

2. 100,000 Meter Square Identification
   - Each GZD is gridded with 100,000 meter squares with a GZD-unique 2-letter designation
USNG Index Map
100,000 Meter Square VN
1 km Grid within VN
The 3 USNG Components

1. GZD — Grid Zone Designation
   - The US is divided into 6-degree longitudinal zones designated by a number, and 8-degree latitudinal bands designated by a letter

2. 100,000 Meter Square Identification
   - Each GZD is gridded with 100,000 meter squares with a GZD-unique 2-letter designation

3. Grid Coordinates
   - Point positions within the 100,000m square are given UTM grid coordinates (easting then northing)
   - An equal number of digits is used for each position
   - The number of digits is determined by the desired precision
## USNG Grid Coordinate Precision Levels

<table>
<thead>
<tr>
<th>USNG Level</th>
<th>Coord Digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000 m</td>
<td>0</td>
</tr>
<tr>
<td>10,000 m</td>
<td>2</td>
</tr>
<tr>
<td>1,000 m</td>
<td>4</td>
</tr>
<tr>
<td>100 m</td>
<td>6</td>
</tr>
<tr>
<td>10 m</td>
<td>8</td>
</tr>
<tr>
<td>1 m</td>
<td>10</td>
</tr>
<tr>
<td>0.1 m</td>
<td>12</td>
</tr>
</tbody>
</table>
ArcMAP “Go To XY” Tool
1 km USNG Coord = 18TVN7575
1m USNG Coord over Hydrant

18TVN7552775673

18TVN7500075000
USNG In Use

- Smart phone apps
- GPSts
USNG In Use

- Smart phone apps
- GPSts

usngmarker.org
USNG ASSET NAMING Planning
Using USNG for Asset Naming

- **Opportunities**
  - Since service area is within same 100km grid, MVWA could truncate first 5 digits of USNG coordinate (18T VN)

- **Challenges**
  - Only good to meter level without modifications
    - Sometimes there are multiple features within a square meter
    - Needed to extend USNG to the decimeter level
1m USNG Coord over Hydrant

18TVN7552775673

18TVN75000075000
1m USNG Coord over Hydrant

18TVN75527 75673

18TVN75000075000
Original USNG Naming Plan

- Add prefix to differentiate feature type
- Extend USNG to get to decimeter level
## Original USNG Naming Plan

<table>
<thead>
<tr>
<th>MVWA WaterNet Feature</th>
<th>USNG Level</th>
<th>Coord Digits</th>
<th>Prefix</th>
<th>Total Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrant</td>
<td>1 m</td>
<td>10</td>
<td>H</td>
<td>11</td>
</tr>
<tr>
<td>Storage</td>
<td>10 m</td>
<td>8</td>
<td>T</td>
<td>9</td>
</tr>
<tr>
<td>MainLineValve</td>
<td>0.1 m</td>
<td>12</td>
<td>MV</td>
<td>14</td>
</tr>
<tr>
<td>ServiceLineValve</td>
<td>0.1 m</td>
<td>12</td>
<td>SV</td>
<td>14</td>
</tr>
<tr>
<td>SystemControlValve</td>
<td>0.1 m</td>
<td>12</td>
<td>CV</td>
<td>14</td>
</tr>
<tr>
<td>PressureRegulatingValve</td>
<td>0.1 m</td>
<td>12</td>
<td>PV</td>
<td>14</td>
</tr>
<tr>
<td>SystemMeter</td>
<td>0.1 m</td>
<td>12</td>
<td>SM</td>
<td>14</td>
</tr>
<tr>
<td>Pump</td>
<td>0.1 m</td>
<td>12</td>
<td>P</td>
<td>13</td>
</tr>
<tr>
<td>CurbBox</td>
<td>0.1 m</td>
<td>12</td>
<td>C</td>
<td>13</td>
</tr>
<tr>
<td>SamplingStation</td>
<td>100 m</td>
<td>6</td>
<td>SS</td>
<td>8</td>
</tr>
<tr>
<td>Fitting</td>
<td>0.1 m</td>
<td>12</td>
<td>F</td>
<td>13</td>
</tr>
</tbody>
</table>
Original USNG Naming Plan

- Add prefix to differentiate feature type
- Extend USNG to get to decimeter level

Issue
- Determined that this did not produce unique names for our features

Possible Solutions
- Do we shift coordinates so names are unique?
- Do we extend the USNG in some other way?
Revised USNG Naming Plan

- Decided that it was ok that multiple features could occupy a square meter
- Checked USNG coordinate for uniqueness & added a suffix
  - "-0" if unique
  - "-0", "-1", "-2", etc. if not unique
- Separated prefix with a "-" for legibility
- Separated coordinates with a "-" for legibility
Revised USNG Naming Plan

- **Examples**
  - MV-33452-14903-1 (1m for Main Line Valves)
  - H-167-028-0 (100m for Hydrants)

- **Benefits**
  - Could “shorten” asset names
    - H6809208332 became H-680-083-0
  - Asset names are easier to communicate
    - Since the vast majority of MVWA hydrants (>92%) do not have duplicates closer than 100m, most suffixes can be eliminated when communicating
## Revised USNG Naming Plan

<table>
<thead>
<tr>
<th>MVWA WaterNet Feature</th>
<th>USNG Level</th>
<th>Coord Digits</th>
<th>Prefix</th>
<th>Total Digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrant</td>
<td>100 m</td>
<td>6</td>
<td>H</td>
<td>11</td>
</tr>
<tr>
<td>Storage</td>
<td>1000 m</td>
<td>4</td>
<td>T</td>
<td>9</td>
</tr>
<tr>
<td>MainLineValve</td>
<td>1 m</td>
<td>10</td>
<td>MV</td>
<td>16</td>
</tr>
<tr>
<td>ServiceLineValve</td>
<td>10 m</td>
<td>8</td>
<td>SV</td>
<td>14</td>
</tr>
<tr>
<td>SystemControlValve</td>
<td>10 m</td>
<td>8</td>
<td>CV</td>
<td>14</td>
</tr>
<tr>
<td>PressureRegulatingValve</td>
<td>10 m</td>
<td>8</td>
<td>PV</td>
<td>14</td>
</tr>
<tr>
<td>SystemMeter</td>
<td>100 m</td>
<td>6</td>
<td>SM</td>
<td>12</td>
</tr>
<tr>
<td>Pump</td>
<td>1 m</td>
<td>10</td>
<td>P</td>
<td>15</td>
</tr>
<tr>
<td>CurbBox</td>
<td>1 m</td>
<td>10</td>
<td>C</td>
<td>15</td>
</tr>
<tr>
<td>SamplingStation</td>
<td>1000 m</td>
<td>4</td>
<td>SS</td>
<td>10</td>
</tr>
<tr>
<td>Fitting</td>
<td>1 m</td>
<td>10</td>
<td>F</td>
<td>15</td>
</tr>
<tr>
<td>MVWA WaterNet Feature</td>
<td>Original USNG Level</td>
<td>Original Length</td>
<td>Revised USNG Level</td>
<td>Revised Length</td>
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<tr>
<td>-----------------------</td>
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<td>-----------------</td>
<td>-------------------</td>
<td>---------------</td>
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<td>1 m</td>
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<td>10 m</td>
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<td>15</td>
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</tr>
<tr>
<td>Fitting</td>
<td>0.1 m</td>
<td>13</td>
<td>1 m</td>
<td>15</td>
</tr>
</tbody>
</table>
USNG ASSET NAMING
Implementation
USNG Naming Process

- Data needs to be in UTM, NAD-83 to create USNG asset names
- Create asset ID field = String, 20
USNG Naming with Lines & Polygons

- Since USNG is a Point-based referencing system, points are needed...
  - For Line Features – Find midpoint (use Feature to Point (inside option) to create temp point fc)
  - For Polygon Features – Find centroid (use Feature to Point (inside option) to create temp point fc)
- Important that line and polygon feature classes have a unique temp ID before running Feature to Point so that USNG IDs can be joined to original feature
USNG Naming Process

- Add XY Coordinates (creating POINT_X & POINT_Y fields)
- Use POINT_X & POINT_Y to create USNG coordinate (in tempID field)
- Check for duplicates & create duplicate field
- Create final asset name using prefix, USNG coordinate, & duplicate suffix
- Clean up temp fields
Run Model

Calc USNG ID

varFC

Calc USNG ID

varPrefix

Calc USNG ID

varFC
Z:\data\mvwa_misc\data model\final\2015\ETL_temp.gdb\pt_main

varPrefix
"M"
## Extract USNG Coordinate

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>USNG Digits</th>
<th>varEquation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 m</td>
<td>6</td>
<td><code>(str(round((!POINT_X!*0.01),0))[1:4])+-&quot;&quot;+(str(round((!Point_Y!*0.01),0))[2:5])</code></td>
</tr>
<tr>
<td>10 m</td>
<td>8</td>
<td><code>(str(round((!POINT_X!*0.1),0))[1:5])+-&quot;&quot;+(str(round((!Point_Y!*0.1),0))[2:6])</code></td>
</tr>
<tr>
<td>1 m</td>
<td>10</td>
<td><code>(str(round(!POINT_X!,0))[1:6])+-&quot;&quot;+(str(round(!Point_Y!,0))[2:7])</code></td>
</tr>
<tr>
<td>0.1 m</td>
<td>12</td>
<td><code>(str(round((!POINT_X!*10),0))[1:7])+-&quot;&quot;+(str(round((!Point_Y!*10),0))[2:8])</code></td>
</tr>
</tbody>
</table>

The table above shows the equations used to extract USNG coordinates with varying levels of accuracy. The `varEquation` columns contain the specific equations that take into account the point's x and y coordinates, adjusted by the given accuracy level, to produce the formatted USNG coordinate.
Model Builder Diagram

- varFC
- varPrefix
- varEquation
- Add XY Coordinates
- Output Features
- Add Field DUP
- Output Feature Class
- Calculate Field DUP
- Output Feature Class (4)
- Output Feature Class (5)
- Calculate Field mvwalDtemp
- Output Feature Class (2)
- Output Feature Class (3)
- Delete Temp Fields
- Output Table
Find Duplicates

- DUP field is type Short

[Image of Calculate Field DUP dialog box]

**Input Table**

- Output Feature Class

**Field Name**

- DUP

**Expression**

- isDuplicateIndex(ImvwaIDtemp1)

**Expression Type (optional)**

- PYTHON_9.3

**Code Block (optional)**

```
UniqueDict = {}
def isDuplicateIndex(inValue):
    UniqueDict.setdefault(inValue, -1)
    UniqueDict[inValue] += 1
    return UniqueDict[inValue]
```
Create USNG Asset Name
Clean Up!

Delete Temp Fields

- Input Table: Output Feature Class (3)
  - Drop Field:
    - POINT_X
    - POINT_Y
    - mvwaIDtemp
    - DUP

Delete Temp Fields

This tool deletes one or more fields from a table, feature class, feature layer, or raster dataset.
<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>SHAPE</th>
<th>MVWA ID</th>
<th>Municipality</th>
<th>Install Year</th>
<th>Subtype</th>
<th>Street</th>
<th>Main Diameter</th>
<th>Main Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>8556</td>
<td>Polyline</td>
<td>M-70278-73676-0</td>
<td>Whitestown</td>
<td>2003</td>
<td>Supply Main</td>
<td>Stone Road</td>
<td>12&quot;</td>
<td>Ductile Iron Cement</td>
</tr>
<tr>
<td>8557</td>
<td>Polyline</td>
<td>M-70296-73731-0</td>
<td>Whitestown</td>
<td>2003</td>
<td>Supply Main</td>
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<tr>
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<td>Horatio Street</td>
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<tr>
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<td>Polyline</td>
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<td>Supply Main</td>
<td>Augusta Drive</td>
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<tr>
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<td>George Avenue</td>
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<td>Bretts Way</td>
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<tr>
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<td>Polyline</td>
<td>M-74300-73946-0</td>
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<td>Supply Main</td>
<td>Bretts Way</td>
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<td>Ductile Iron Cement</td>
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<tr>
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<td>Polyline</td>
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<td>Whitestown</td>
<td>2003</td>
<td>Supply Main</td>
<td>Bretts Way</td>
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<td>Supply Main</td>
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<td>Ductile Iron Cement</td>
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<tr>
<td>11340</td>
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<td>Whitestown</td>
<td>2003</td>
<td>Supply Main</td>
<td>Driveway</td>
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<tr>
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<td>New Hartford (T)</td>
<td>2003</td>
<td>Supply Main</td>
<td>Augusta Drive</td>
<td>8&quot;</td>
<td>Ductile Iron Cement</td>
</tr>
<tr>
<td>11442</td>
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<td>New Hartford (T)</td>
<td>2003</td>
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<td>Kingfisher Lane</td>
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<tr>
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<td>2003</td>
<td>Supply Main</td>
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</tr>
<tr>
<td>11557</td>
<td>Polyline</td>
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<td>2003</td>
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<td>2003</td>
<td>Supply Main</td>
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Future Enhancements

- Incorporate look-up table so that model automatically determines prefix and coordinate length based on feature class
- Incorporate into Attribute Assistant so that USNG ID is automatically generated when features are added
Questions?

For additional questions, scripts, & updates to this USNG Asset Naming Project, please contact:

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