Lessons Learned in Standardizing CAD Data for Importing Into Geodatabase

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Aurora, Colorado Profile

- Population: 360,000 (3rd in Colorado, 54th in the country, larger than Honolulu, Anaheim, St. Louis, Pittsburgh, Cincinnati, Buffalo)
- Area: 155 Square Miles
- City of Aurora 2017 Budget: $700 Million
- City of Aurora number of employees: 4,000+
  - Water Utility (52nd in the country)

Elevations from 5,285 to 6,229 feet
Aurora, Colorado Regional Context

- 12% of metro Denver population (City & County of Denver is 24%)
- Urban, Suburban - 100 sq. miles, Exurban/Rural - 55 sq. miles
- Proximity to major employments center: Downtown Denver, DTC, DIA

- Univ. of Colorado Anschutz Medical Campus – CU, Children’s, VA
  - 5 Billion dollar economic impact
  - New VA Hospital 1.7 Billion
  - 5,000+ medical students and faculty
- Buckley Air Force Base
  - 1 Billion dollar economic impact
- Gaylord Rockies Convention Center
  - 800 Million
- 10 new light rail stations
- Two new Amazon facilities
City of Aurora – Technology

- GIS FTEs 13 Distributed

- Esri Tech Stack
  - ArcGIS Desktop 10.3.1
  - ArcGIS Server / ArcSDE / SQL Server 2012
  - ArcGIS Online
    - Open Data 155+ datasets
    - Web Maps
    - 48 WABs (Web Application Builder)
  - Tablets with Collector
    - 180 (Android) and 7 (iPads) Tablets

- FME Desktop 2016.1

AutoDesk AutoCAD / Civil 3D (Public Works Dept.)
ELECTRONIC FILE PLAN SUBMITTAL (GIS/AUTOCAD)

PROJECT WORKFLOW PROCESS

AUTOCAD STANDARDS
- Regional Work Plan
- Standard Workflows
- Compliance

SUBMITTAL WORKFLOW & NOTIFICATION REQUIREMENTS
- Submit Workflows
- Notifies
- Status
- Notifies Workflows
- Request for Information

DEVELOP CAD FILE CHECKER
- Develop Standards File
- Benchmark AUTOCAD Standards
- Technical File
- Standards File

DEVELOP CAD TO GIS CONVERSION DATA MODELS
- CAD to GIS data integration process
- Development workflow for standard processes

PUBLIC EDUCATION
- Develop Public Education and Outreach Plan
- Final Draft Implementation Plan

FINAL IMPLEMENTATION REPORT
- Develop Final Implementation Report

ELECTRONIC FILE PLAN SUBMITTAL (GIS/AUTOCAD)

NATIONAL CAD STANDARD

Complete NCS layer name format, showing the Discipline Designator, Major Group, two Minor Groups, and the Status fields.

AI - WALL - FULL - DIMS - N

Discipline Designator
- Two-character field
- First character identifies the discipline

Major Group
- Four-character field that identifies the major building system
- Grouped with specific discipline designators

Minor Groups
- Optional, four-character field that defines Minor Groups
- Grouped with specific major groups

Status
- Optional, single-character field that distinguishes data contained on the layer according to the status of work or construction field

AURORA COLORADO
Outline of the CAD/GIS Standard Submission Workflow

AURORA'S NEW CAD DATA SUBMITTAL STANDARDS MEANS MORE OPEN DATA FOR EVERYONE

Table 2: List of Discipline Designators

<table>
<thead>
<tr>
<th>Discipline Designator</th>
<th>Definition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Civil</td>
<td>Used for proposed non-utility features</td>
</tr>
<tr>
<td>CU</td>
<td>Civil Utilities</td>
<td>Used for proposed utilities</td>
</tr>
<tr>
<td>CT</td>
<td>Civil Transportation</td>
<td>Used for proposed transportation features</td>
</tr>
<tr>
<td>L</td>
<td>Landscape</td>
<td>Used for proposed landscape features</td>
</tr>
<tr>
<td>V</td>
<td>Survey Mapping</td>
<td>Used for existing features</td>
</tr>
</tbody>
</table>

Table 7: List of Required Attributes

<table>
<thead>
<tr>
<th>Feature</th>
<th>Feature Type</th>
<th>CAD Feature Type / Name</th>
<th>CAD Attribute Definition</th>
<th>Attribute</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable Water Pipe</td>
<td>Line</td>
<td>Line/Polyline</td>
<td>Linetype</td>
<td>Diameter</td>
<td>Double</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Line Property</td>
<td>Length</td>
<td>Double</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Layer</td>
<td>Material</td>
<td>Text</td>
</tr>
</tbody>
</table>
CAD Technology – Tools & Template

- AutoCAD Template – Layer and Block Attributes
- Civil 3D Template – Pipe network / Structures
- Layer Translator
CAD Batch Standards Checker

The purpose of the CAD Batch Standards Checker is allowing both the designer and the submission review staff a tool to audit CAD drawing violations of the standard and then fix prior to submission.
FME Workbench
Attribution must be handled in AutoCAD template where CAD designers can incorporate specific coded values, object types, layer specifications, etc.

Features Read From:
- AutoCAD
- Real DWG
- Civil 3D

Transformers
- Attribute Value Mapper
- Attribute Filter
- Attribute Splitter
- Attribute Trimmer
- Center Point Replacer
- Expression Evaluator
- Geometry Filter
- Length Calculator
- Split Pipe Diameter
- Identify Inlet and Outlet

Written To: File Geodatabase Feature Datasets
- Public Works
- Information Technology
- Parks Rec and Open Space
- Utilities

Pipe Material Example:
- CIP
- COPPER
- DIP
- OTHER
- BRASS
- POLY
- STEEL
- PVC
FME Workbench

Read CAD Data > Migrate and Transform Data > Write to File Geodatabase
Lessoned Learned
Project Considerations:

- Survey internal departments/workgroups define department steering committee members
- Create email list, and survey the external stakeholders
- Understand the technology advantages and disadvantages
- Manage expectations for developers and CAD design stakeholders
- Define best data management practices and gaps in data inputs where biggest ROI can be gained
- Grandfathering projects and working with growth and development community
- Specify submittal requirements and impacts to current workflows
- Outreach is extremely important
Tech Considerations:

Stakeholder CAD Use

- Requirements or Considerations? Too restrictive CAD practices may limit conformity to the standard
- CAD design tools for both C3D and AutoCAD features
- Spend effort early on to define the FME/ArcGIS migration process
  - Readers
  - Transformers required in order to provide output
  - Feature types (point, poly line, lines) w/Code domain and ranges
- Easy access to data to reduce duplication and streamline effort for stakeholders
CAD Standard, Open Data, and City of Aurora GIS web maps

- **ArcGIS Online web maps**
  - [https://auroraco.maps.arcgis.com/home/](https://auroraco.maps.arcgis.com/home/)

- **Open Data**

- **CAD Submittal Standard**
  - [http://tinyurl.com/CADSubmittalStd](http://tinyurl.com/CADSubmittalStd)
Presentation Summary

- City of Aurora economic, social drivers, regional growth
- Problem/Issue: CAD data loss and need for GIS integration, extensive city growth provides good opportunity
- Tech Stack: Esri Suite, FME, AutoCAD/Civil 3D
- Solution:
  - Stakeholder input/regional review
  - CAD Standard development and review
  - Develop CAD DWG drawing file templates with object feature and attribution
  - Develop CAD DWG Batch Standrd Checker
  - Develop CAD/GIS Data custom migration models with FME
  - Access to public web site for file content delivery
  - ArcGIS Open data resource
- Lessons:
  - CAD design for both C3D and AutoCAD features
  - FME/Arc – Transformers, feature types, domains, translation, SDE
  - Open GIS data with DWG
Thank You!

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