

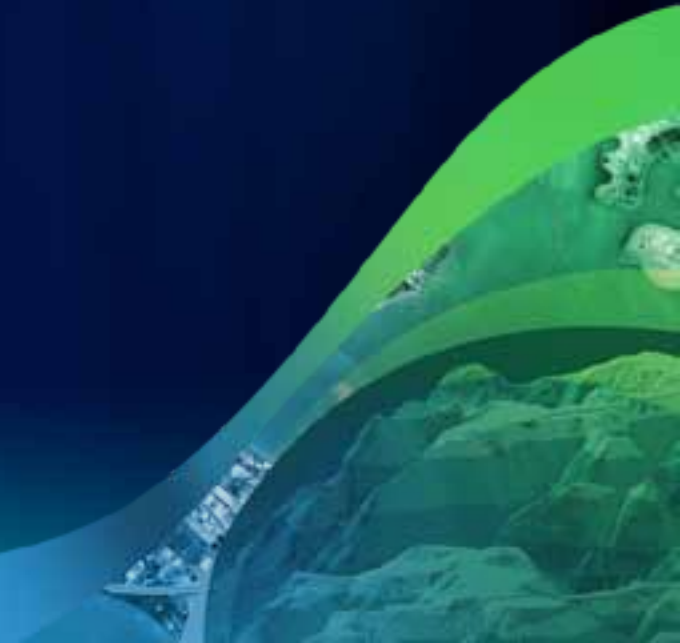




Esri International User Conference | San Diego, CA
Technical Workshops | July 12-15, 2011

Using CAD Data in ArcGIS

Jeff Reinhart, Phil Sanchez



Agenda

- **Overview of ArcGIS CAD Support**
- **Using CAD Datasets in ArcMap**
- **Loading CAD features into the Geodatabase**
- **Geoprocessing CAD Data**
- **Exporting GIS features to CAD drawings**
- **Using GIS Data in CAD**

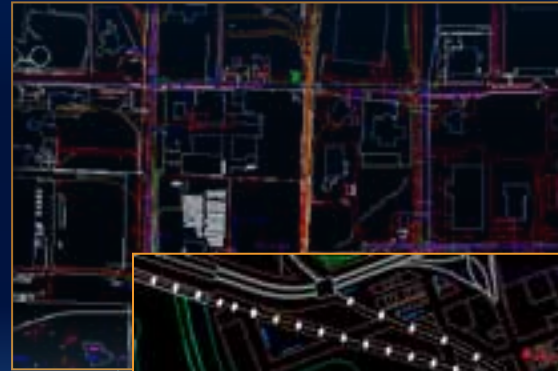
CAD/GIS Integration Presentations This Week

- **Two more offerings of this session: Wed @ 10:30 & Fri @ 9**
- **Several 20 minute CAD sessions on Thursday, July 14:**

Session Title	Time	Location
Using ArcGIS for AutoCAD	9:30 AM - 10:00 AM	GDB Demo Theatre
Loading CAD Data into the Geodatabase	10:15 AM - 10:35 AM	24 A
Using ArcGIS Map Services in Microstation	10:40 AM - 11:00 AM	24 A
Integrating CAD Data with the Parcel Fabric	11:05 AM - 11:25 AM	24 A
Georeferencing CAD datasets	3:15 PM - 3:35 PM	24 A
Exporting GIS Features to CAD Drawings	3:40 PM - 4:00 PM	24 A
ArcGIS for AutoCAD: Plugging CAD Users into the ArcGIS System	4:05 PM - 4:25 PM	24 A

CAD Drawings

- **Geometry, text, and symbols comprise CAD entities/elements**
- **Organized into layers or levels**
- **Symbology represents information**
- **Can have data attached to entities**



CAD in the Geospatial context

- CAD drawings are a large source of GIS data
- Surveying
- Cadastre
- Civil engineering
- Architecture
- Landscape Architecture
- Planning



ArcGIS CAD Data Support

- **ESRI has long provided CAD support and integration tools**
- **Out of the box**
 - No extension required
- **Direct read**
 - Conversion not required
- **Current version support:**
 - AutoCAD DWG/DXF: Up to 2012
 - MicroStation DGN: Up to V8
- **All CAD Geoprocessing tools available at all license levels**

CAD/GIS Interoperability Scenarios

- **ArcGIS user who needs to...**

- **Display CAD data in maps**
- **Load CAD data into their Geodatabase**
- **Deliver GIS data in a CAD format**



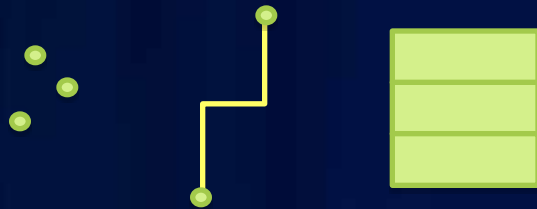
CAD/GIS Interoperability Scenarios

- **CAD user who needs to...**
 - **View GIS data in CAD**
 - **Edit GIS data in CAD**
 - **Provide drawings to GIS users**



CAD Datasets in ArcGIS

Geometry



CAD entity geometry organized into feature classes

Attributes



CAD properties, tags, and database links are stored in attribute tables

Coordinate System



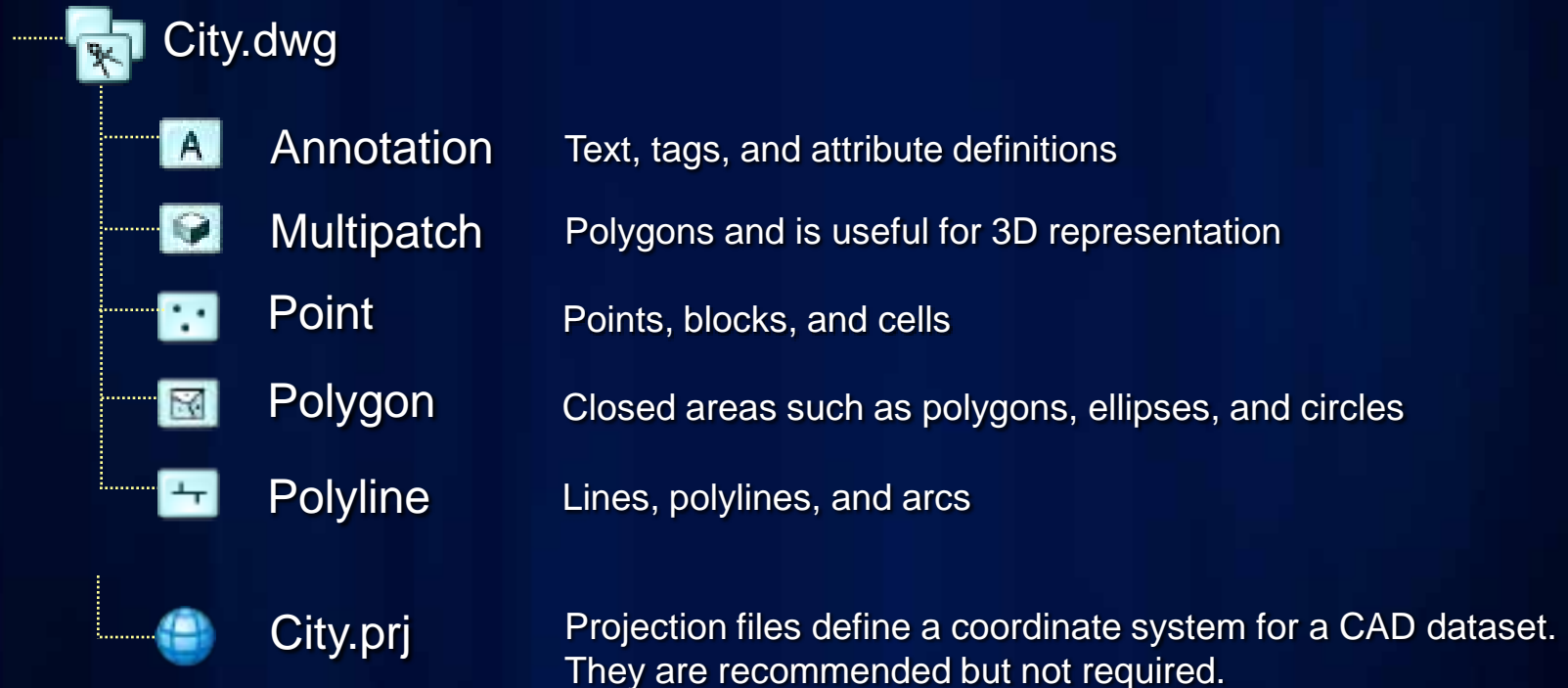
CAD data can be reprojected to overlay with other GIS layers

World File

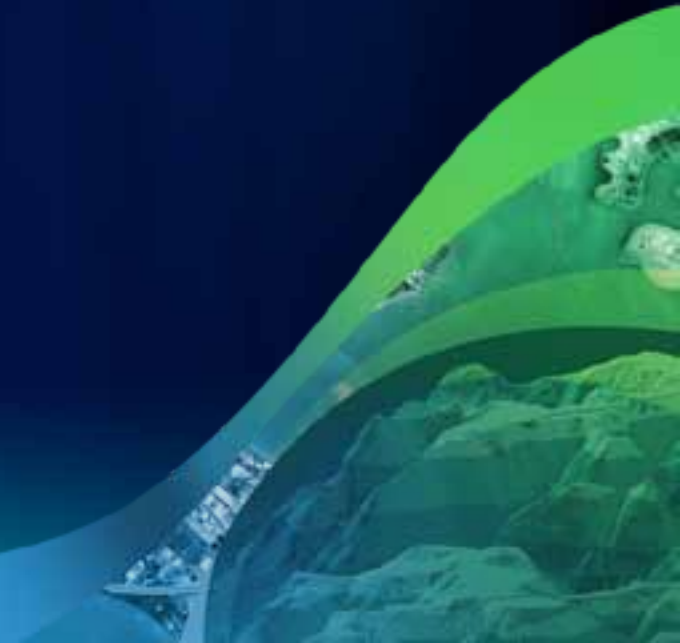


CAD drawings can be transformed from local coordinates to projected coordinates

Contents of a CAD Dataset

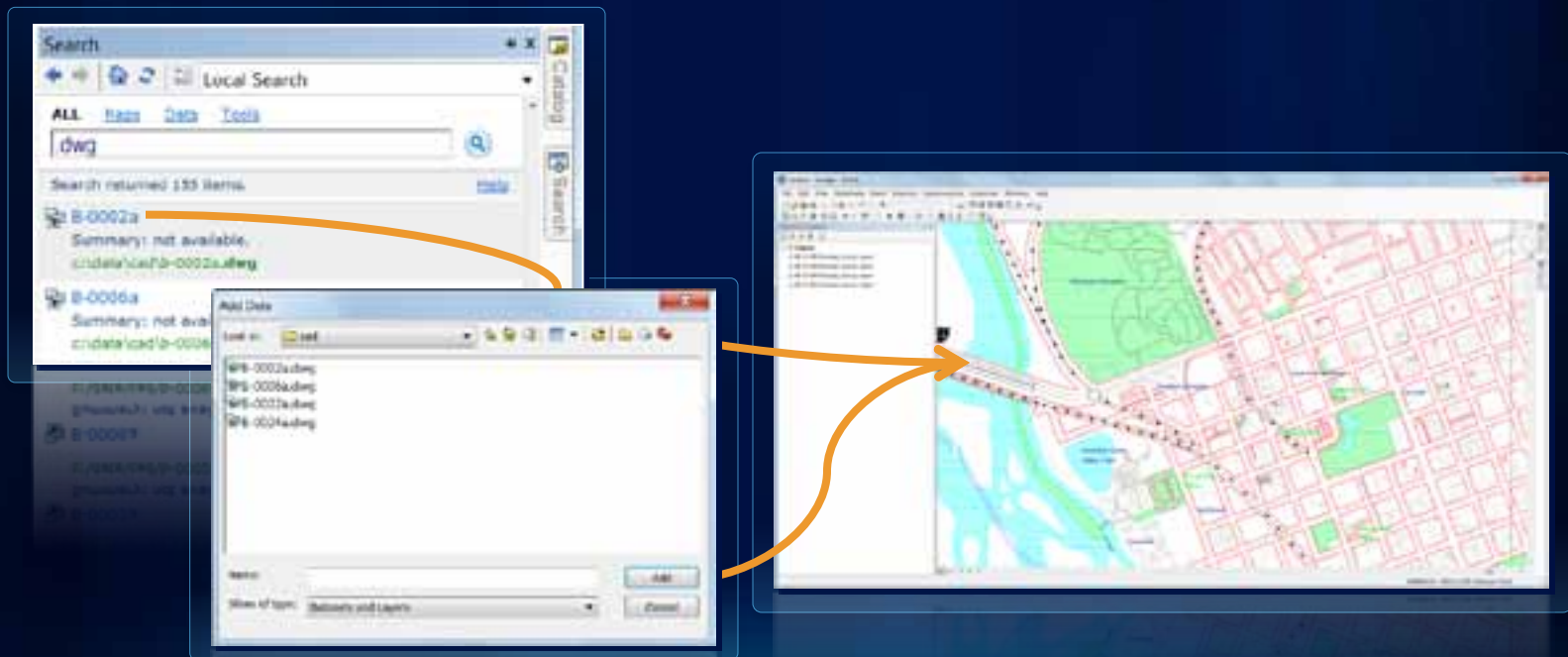


Using CAD Datasets in ArcMap



Search & Add

- CAD drawings can be found using the Search tool
- CAD drawings can be added directly to ArcMap
 - No conversion required



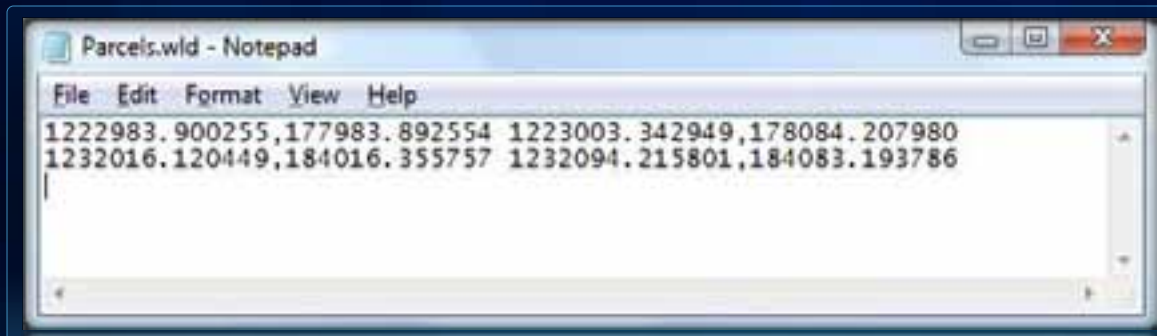
Georeferencing

- **Reposition CAD datasets to align with GIS layers**
 - Move, Rotate, & Scale
- **Assign coordinate system for map reprojection**
- **NOT required for CAD drawings that are drawn in real-world coordinate location**



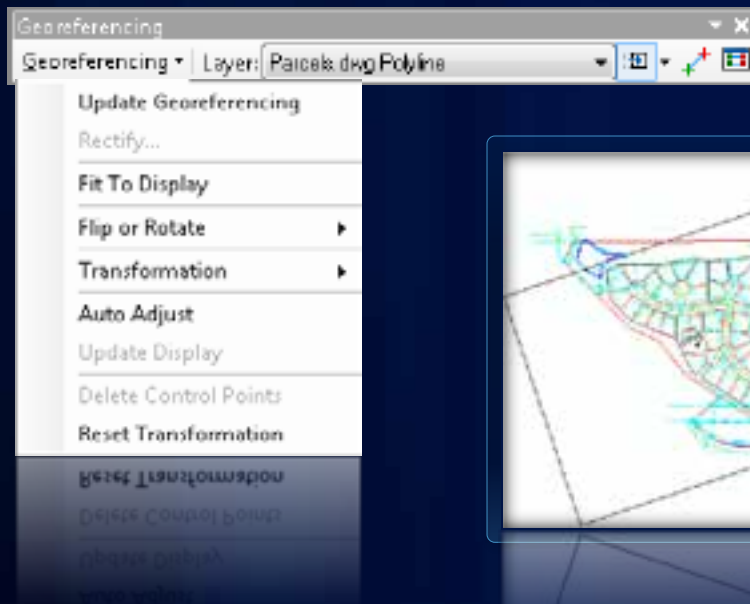
Georeferencing Method

- **Two-point Similarity transformation method**
 - Aspect ratio always maintained
 - Cannot skew or 'rubber sheet' CAD drawing
- **Transformation managed by World Files**
 - World file must use CAD file name prefix
 - Simple text file containing coordinates
 - Must also reside in same folder as CAD drawing



Georeferencing Toolbar

- **Georeferencing toolbar – use mouse pointer to move layer and create control points in map**
 - Rotate, Scale, and Shift tools



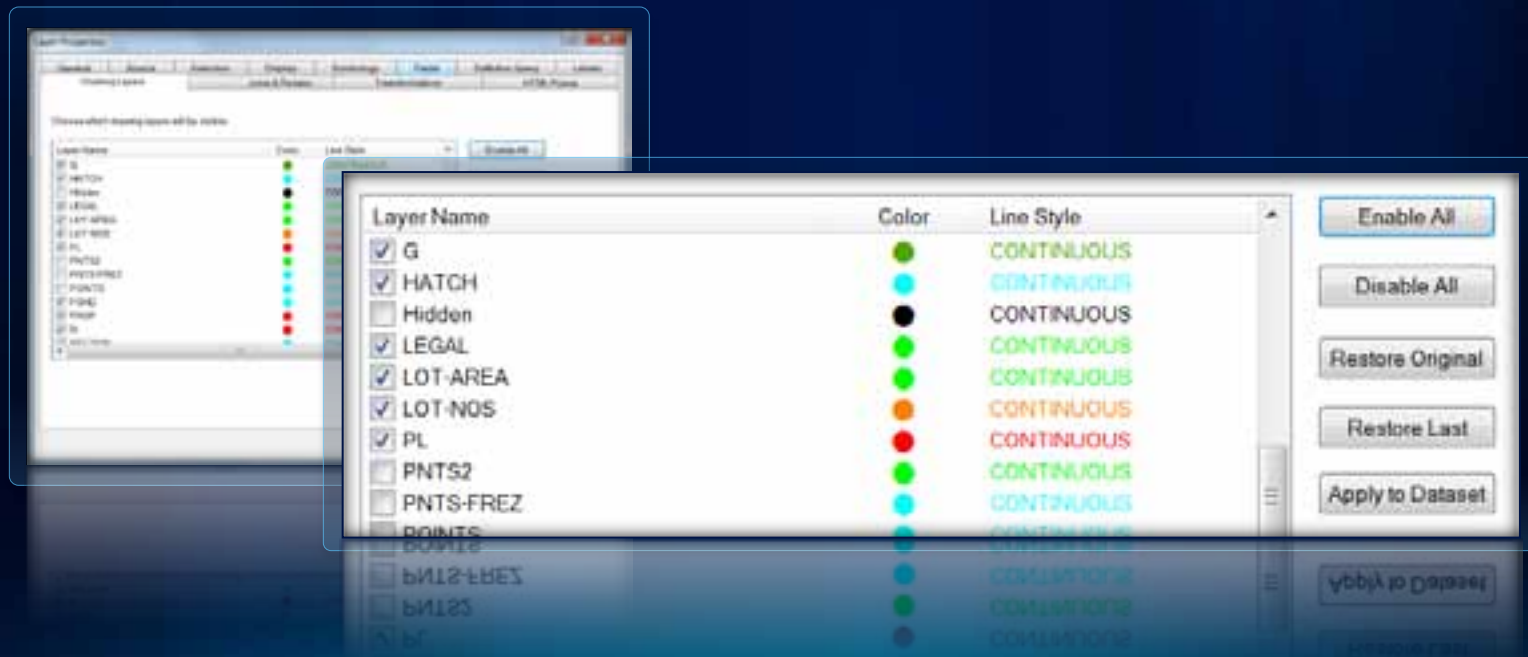
Filter CAD Features

- Isolate the CAD data you need to work with using...
 - Specific CAD Feature Classes
 - Drawing layer visibility
 - Definition Query



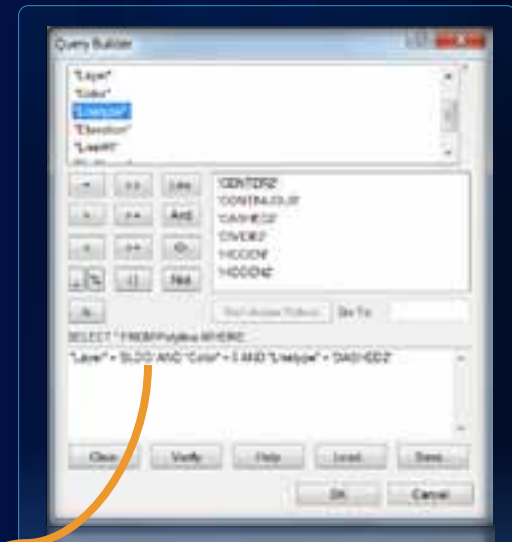
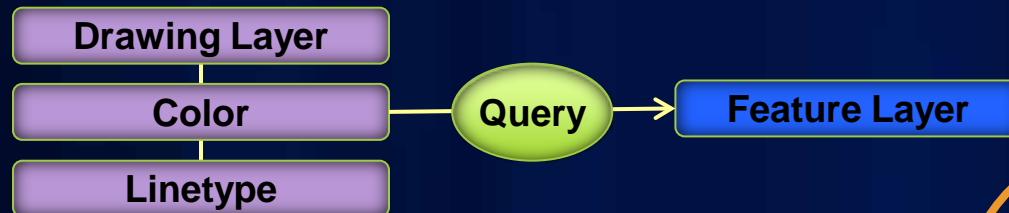
Display Control

- **Turn layers off and on to control feature display**
 - Saved in the .MXD or .LYR
 - Apply to the entire dataset
 - Restore back to original rendering



Query Features

- Use Definition Queries to create subsets
 - Saved in the .MXD or .LYR
 - Expressions can be saved to .EXP files for reuse



A screenshot of the 'SQL WHERE' section in the Query Builder dialog box. It shows the query: `SELECT * FROM Polyline WHERE: "Layer" = 'BLDG' AND "Color" = 5 AND "Linetype" = 'CONTINUOUS'`. The text is entered into a text box with a cursor at the end.

CAD Properties as Feature Attributes

- **Common CAD properties**
 - Color, level, linetype, handle, line weight, etc...
- **User defined data**
 - Tags and Attributes
- **CAD attributes support queries**
 - Display
 - Geoprocessing input
 - Conversion

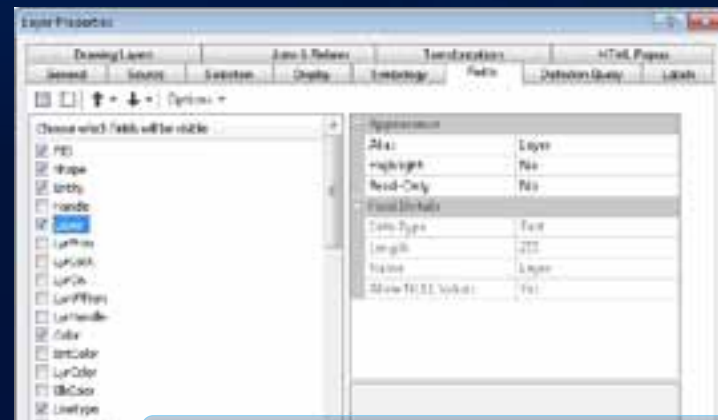
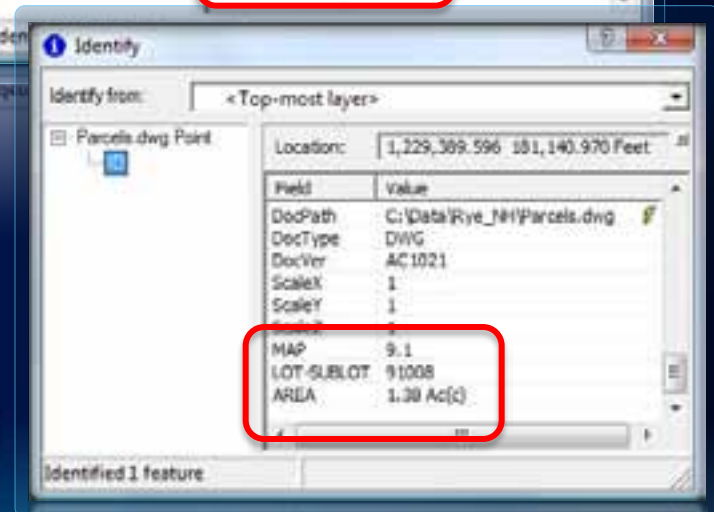
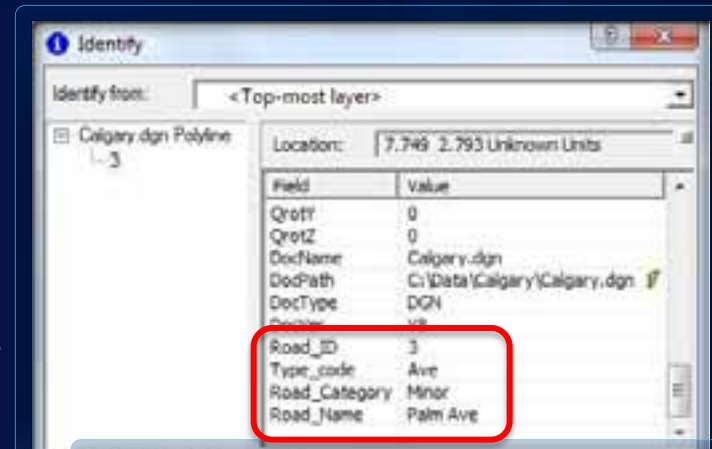


Table window showing a data table with columns: Deviation, Linewt, RefName, Angle, MAP, LOT-ORLOT, and AREA. The table contains 15 rows of data.

Deviation	Linewt	RefName	Angle	MAP	LOT-ORLOT	AREA
0	25	D	0	0.4	04001	20500 sf/3
0	25	D	0	0.4	04002	6020 sf
0	25	D	0	0.4	04003	12193 sf
0	25	D	0	0.4	04004	13644 sf
0	25	D	0	0.4	04005	16126 sf
0	25	D	0	0.4	04006	1.72 Ac
0	25	D	0	0.4	04007	1560 sf
0	25	D	0	0.4	04008	23000 sf
0	25	D	0	0.4	04009	1 Ac
0	25	D	0	0.4	04010	8105 sf
0	25	D	0	0.4	04011	5763 sf
0	25	D	0	0.4	04012	17625 sf
0	25	D	0	0.4	04013	8580 sf
0	25	D	0	0.4	04014	11166 sf
0	25	D	0	0.4	04015	8540 sf
0	25	D	0	0.4	04016	8708 sf
0	25	D	0	0.4	04018	30000 sf

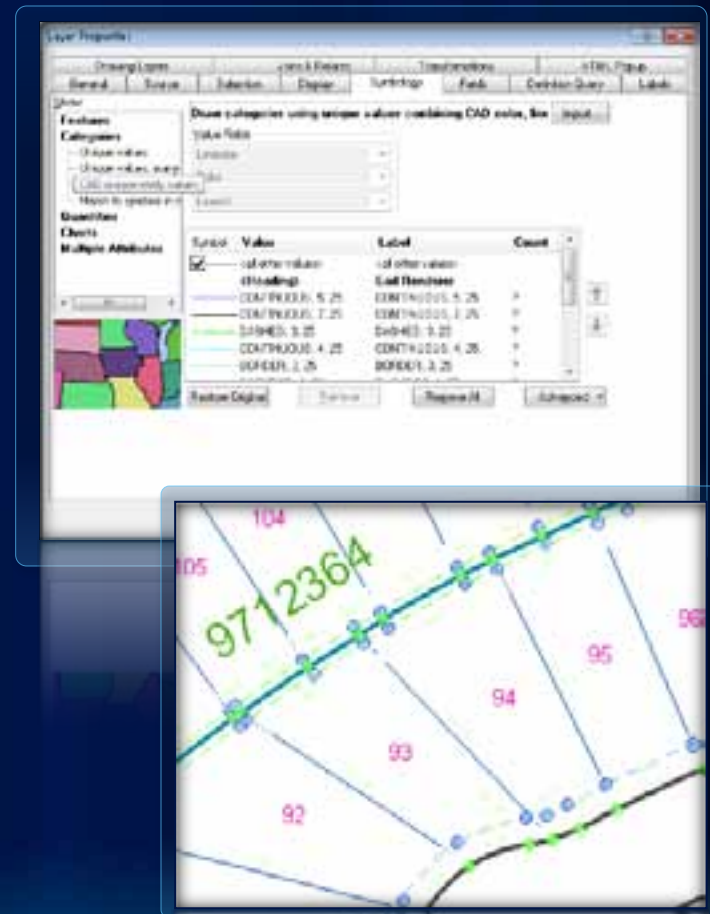
DGN Tags and DWG Block Attributes

- Effective way for attaching information to elements and entities
- Tags and Block Attributes are represented as Fields
- Tag Values = Attribute Values

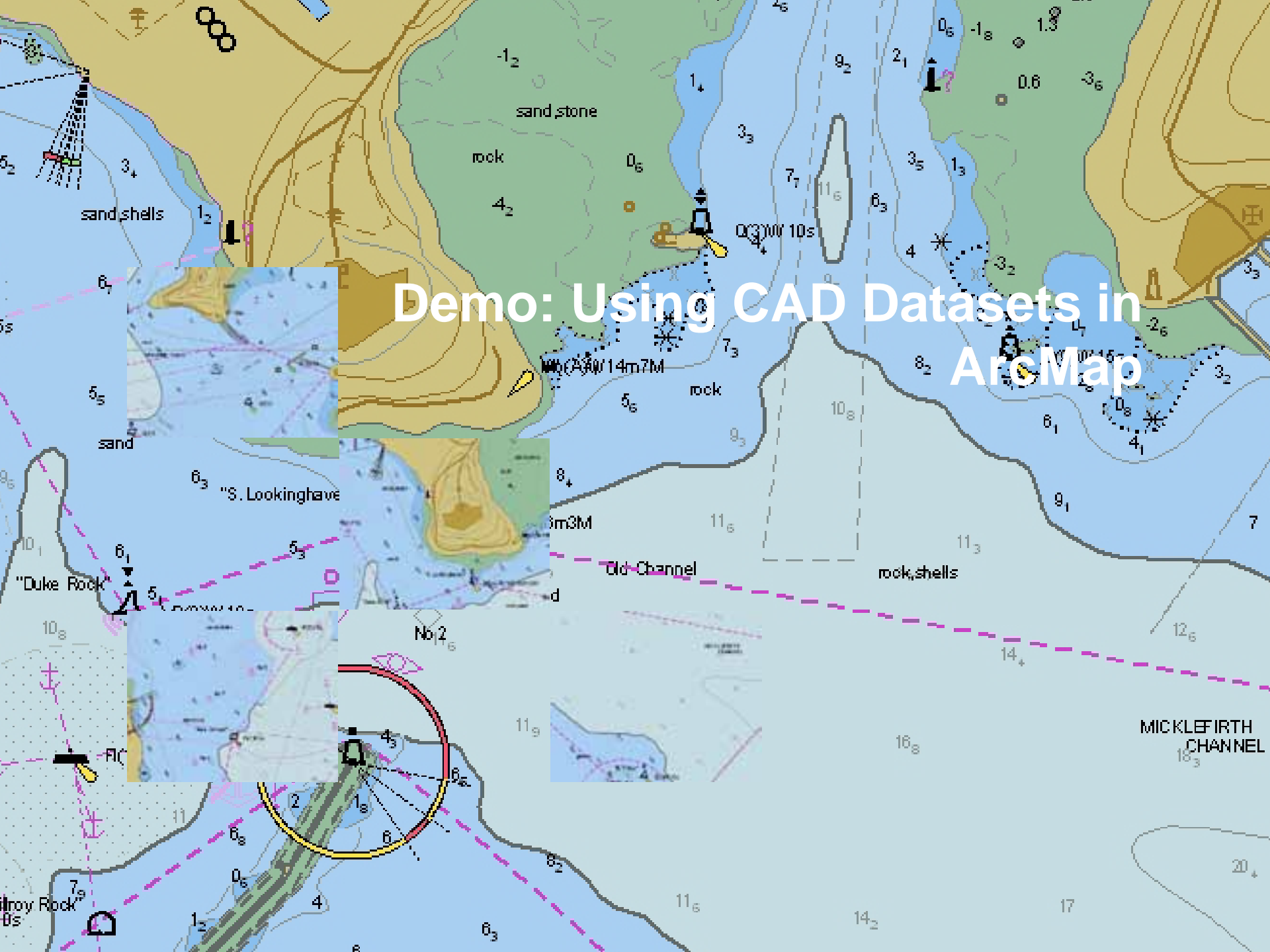


CAD Feature Rendering

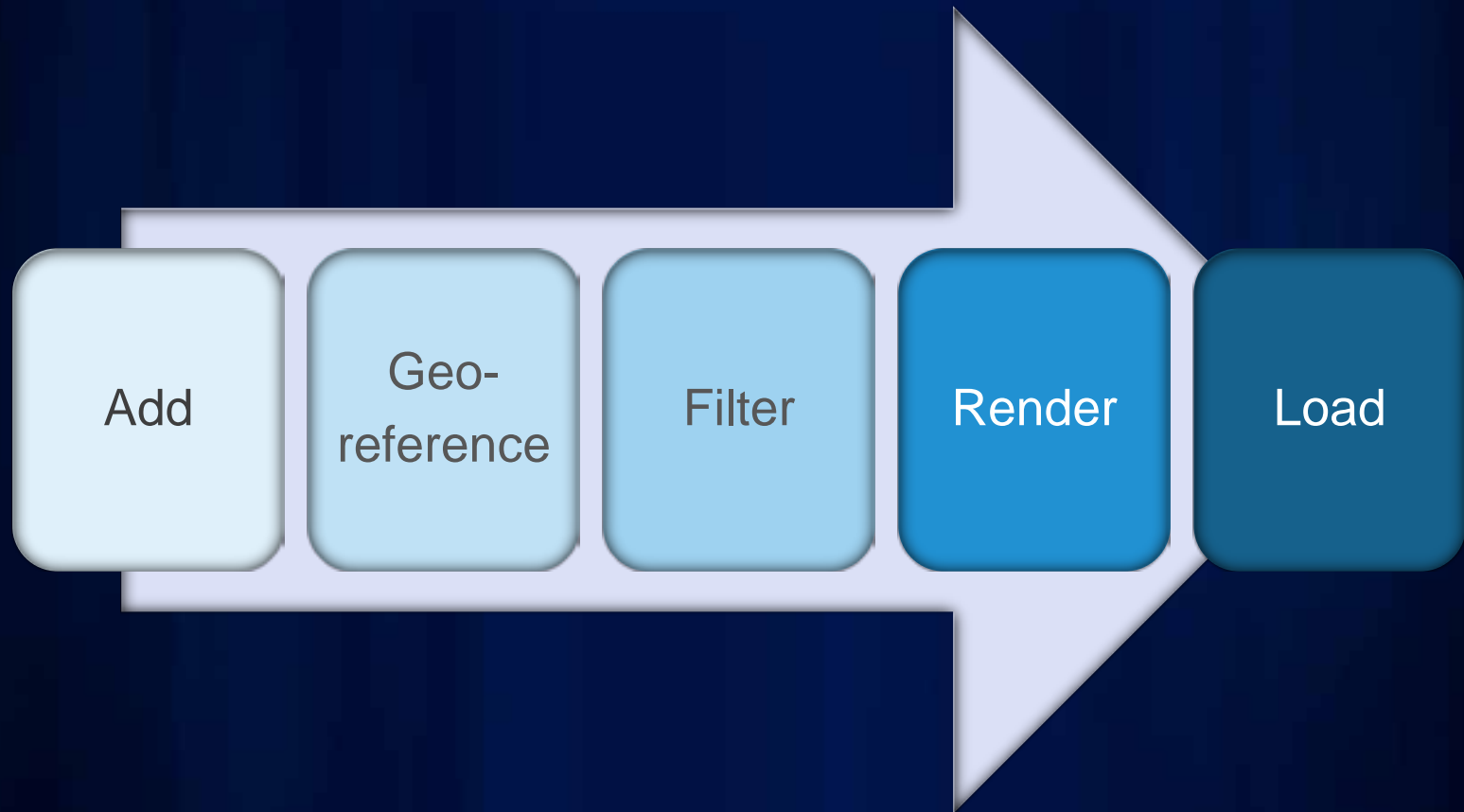
- CAD map style in Categories
- Color, Linetype, and Lineweight properties mapped to ArcMap symbols
- Text styles mapped to True Type fonts
- Supports common AutoCAD and MicroStation line types



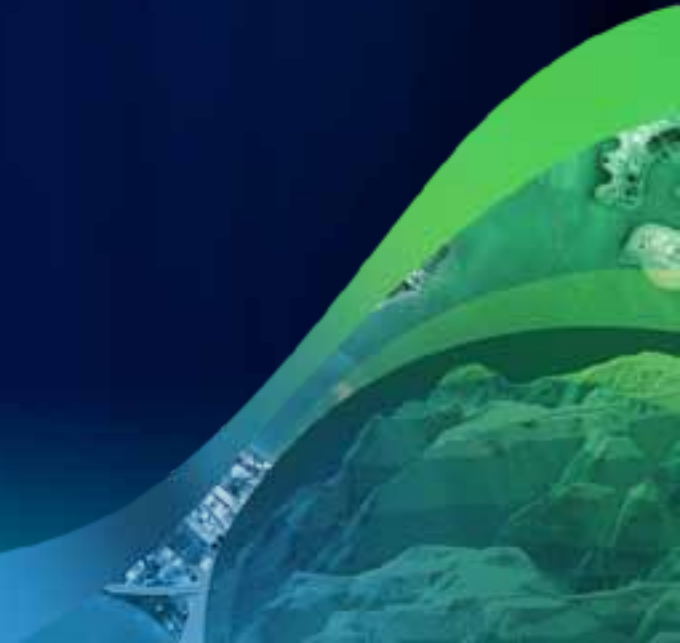
Demo: Using CAD Datasets in ArcMap



CAD Data Integration Stages



Loading CAD Data into the Geodatabase

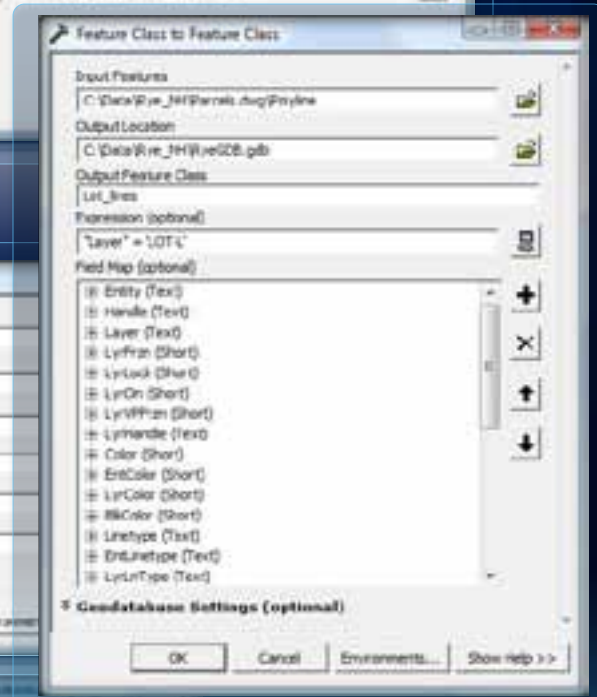
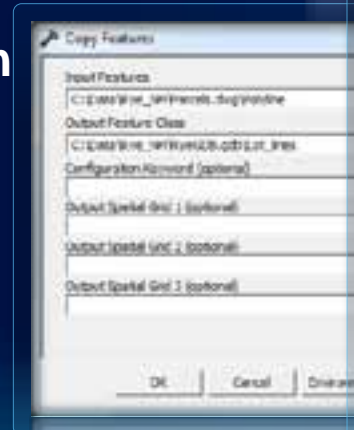
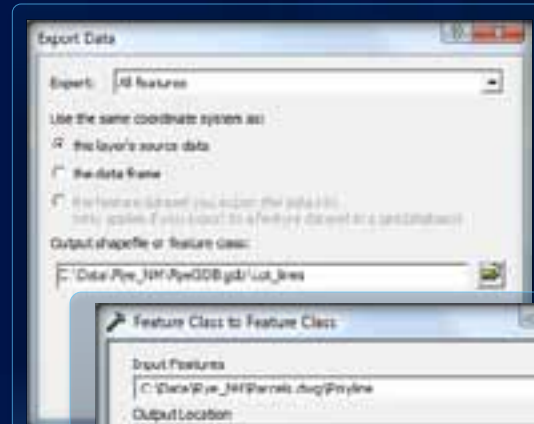


Loading CAD Data to the Geodatabase

- **Add to Geodatabase feature classes or create new Geodatabase from CAD**
 - As-built updates
 - Editing requirements
 - Advanced Geodatabase tasks (i.e., Geometric Networks, Topology, etc.)
- **Conversion supported by the Geoprocessing framework and ArcMap tools**
- **Can be combined with other Geoprocessing functions**
 - Spatial Joins
 - Geometry manipulation

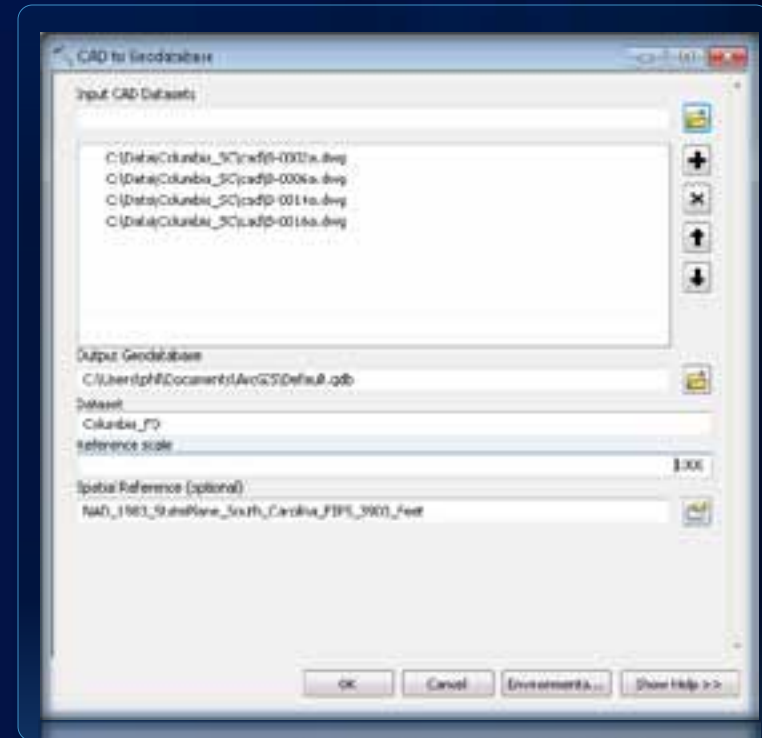
CAD Conversion Tools

- ArcMap
 - Export Data
 - Copy & Paste (Edit session)
- ArcToolbox – Geoprocessing
 - Feature Class to Feature Class
 - Copy Features
 - Import CAD Annotation



CAD to Geodatabase

- New conversion tool introduced at ArcGIS 10
- Designed for bulk loading CAD datasets into a Geodatabase
 - Works at the dataset level
- Combines Copy Features, Merge and Import CAD Annotation into single tool



Geoprocessing Scenarios

- CAD text inside polygons

3744
3745
3746

- CAD text near lines



- Line segments to polygons



- CAD to Geodatabase



- Append to existing Geodatabase

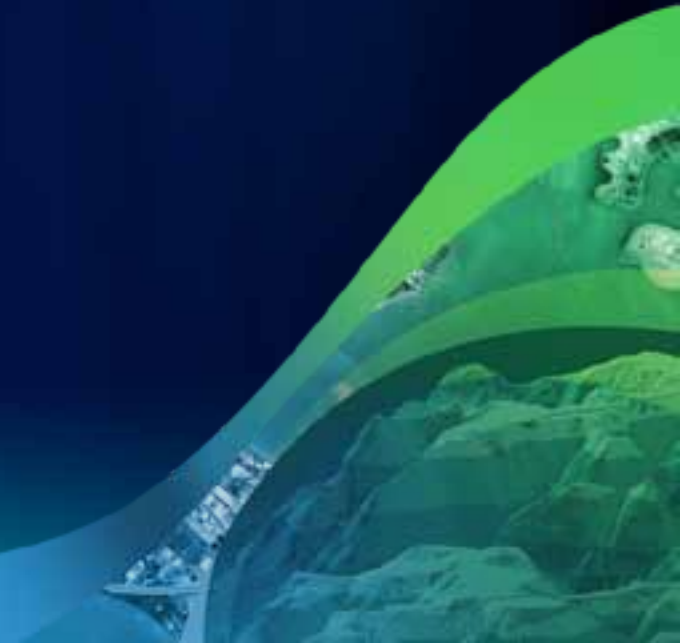


- Merge with other layers



Demo: Loading CAD Data into the Geodatabase

Exporting Geodatabase Features to CAD

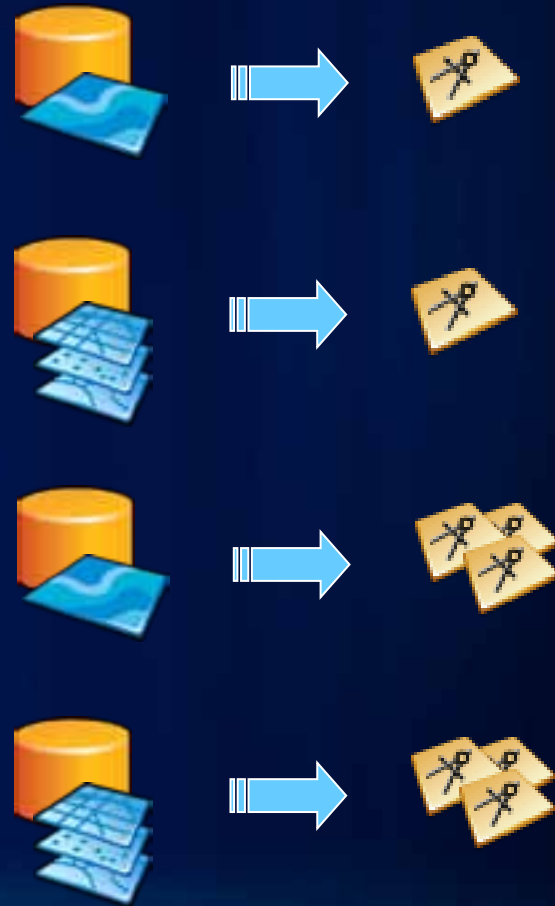


Exporting Geodatabase Features to CAD

- **Allows GIS users to share Geodatabase content with CAD users**
 - Project collaboration
 - Contractual obligations
- **Supported by Geoprocessing's Export to CAD tool**
 - Simply drag and drop layers into tool and export
 - Leverage Geodatabase information to control export
- **Use Export to CAD to adhere to CAD standards using...**
 - Fields and attributes
 - Seed/template files

Exporting Scenarios

- **Single feature class to a single CAD drawing**
- **Multiple feature classes to a single CAD drawing**
- **Single feature class to multiple CAD drawings**
- **Multiple feature classes to multiple CAD drawings**



Export to CAD

- **Output features to native CAD format**
 - DGN V8
 - DWG/DXF Release 14 to 2012
- **Supports appending to existing CAD drawings**
- **Available at all license levels**



Attribute Driven Export

- **Use Fields and their attributes to control how elements and entities are generated**
- **Key areas:**
 - Entity types, geometry
 - Elevation
 - Blocks/Cells and attributes
 - Text styles and position
 - Document names and paths

Seed & Template Files

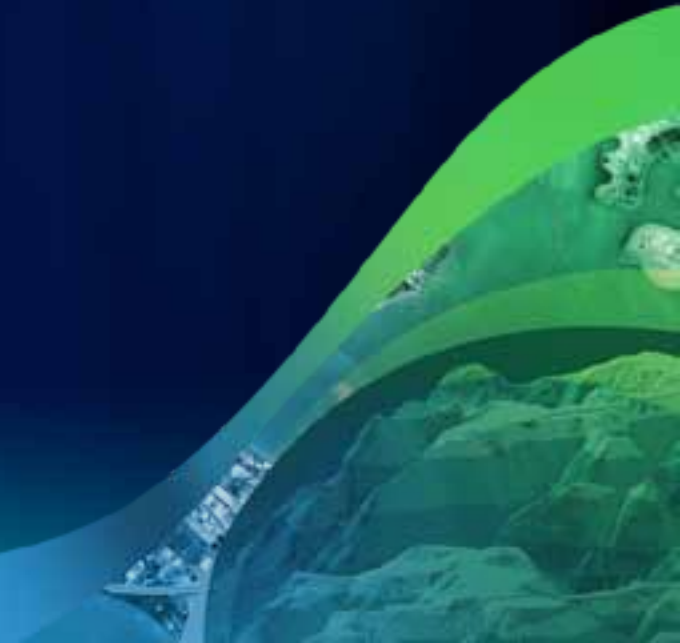
- Blank template used to define a new file
- Seed file allows the default symbology of the seed drawing will be used
- Used to control Blocks or Cell definitions utilized by Export to CAD
- Microstation requires a seed file for design file creation
- Microstation seed file topics for Export to CAD
 - Design plane, appropriate dimensions, units and origin



Demo: Exporting Geodatabase features to CAD

Export to CAD

Using Map Services in CAD

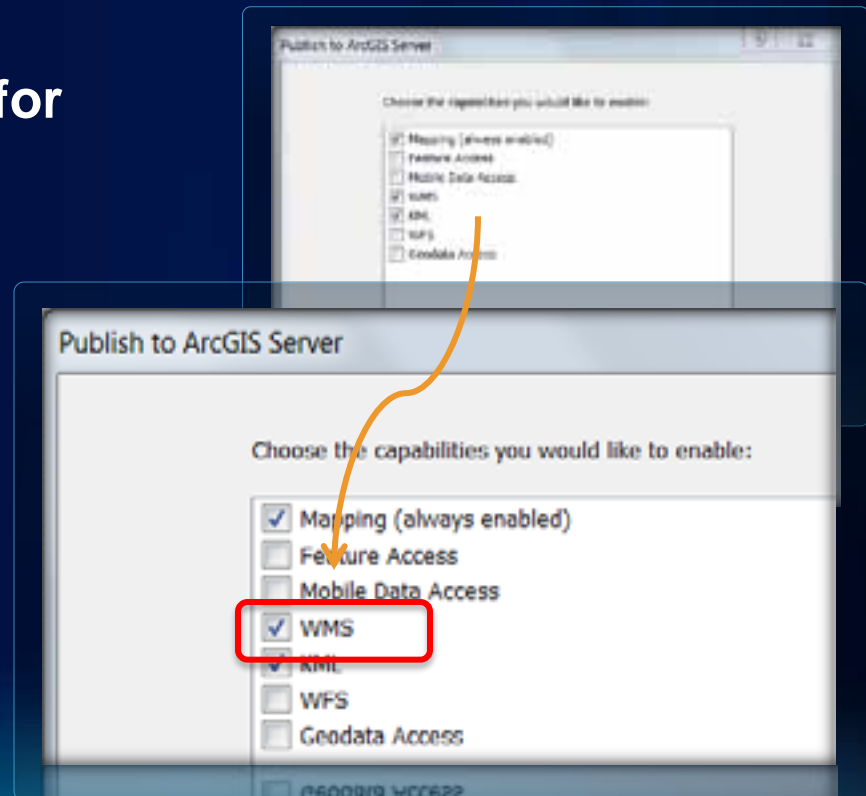


ArcGIS Server & Map Services

- **Share your GIS resources across an enterprise and across the Web**
- **A Map service is the way that you publish maps to the Web using ArcGIS**
- **Makes maps, features, and attribute data available inside many types of client applications**
 - **AutoCAD through ArcGIS for AutoCAD**
 - **MicroStation through WMS**

Accessing WMS in MicroStation

- **MicroStation V8 has built-in WMS capabilities**
 - Supported at XM and V8i
- **V8i uses Raster Manager for connection**
- **Enables MicroStation users to access map services for context**



ArcGIS for AutoCAD

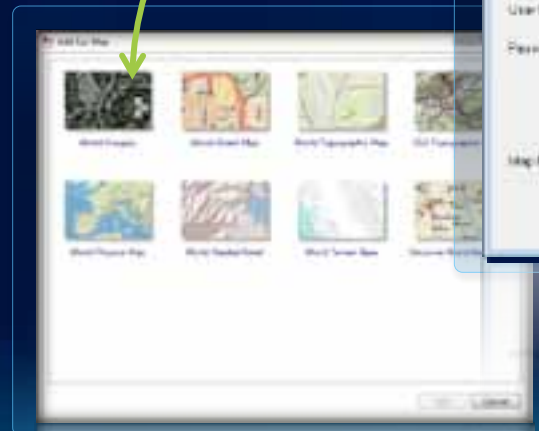
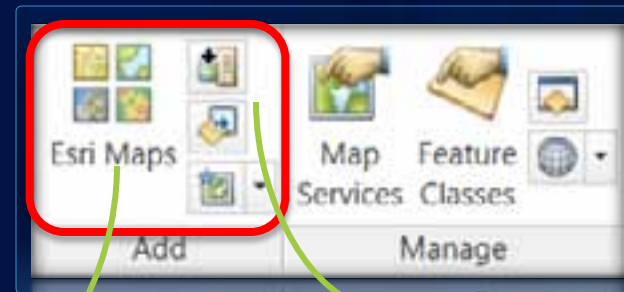
- **Plug-in application for AutoCAD**
 - Currently supports AutoCAD format 2010 - 2012
 - Download available at esri.com
- **Provides ability for users to**
 - Access ESRI Map Services (including ArcGIS Online) in AutoCAD
 - View map service feature attributes
 - Organize and attribute CAD drawings for use in ArcGIS

Maps & Imagery for Site Context



Adding Map Services

- **Add map services from...**
 - **Favorite Maps**
 - **ArcGIS.com**
 - **Server URL**
- **Maps are projected to coordinate system defined in drawing**



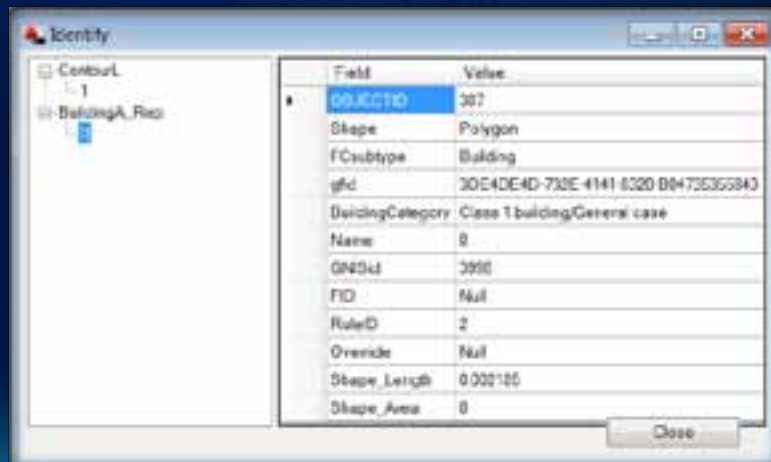
Map Service Palette

- Map service display and behavior manager
 - Visibility
 - Dynamic
- Reports map and drawing's coordinate system
- Map service layer display controls



Identify Map Features

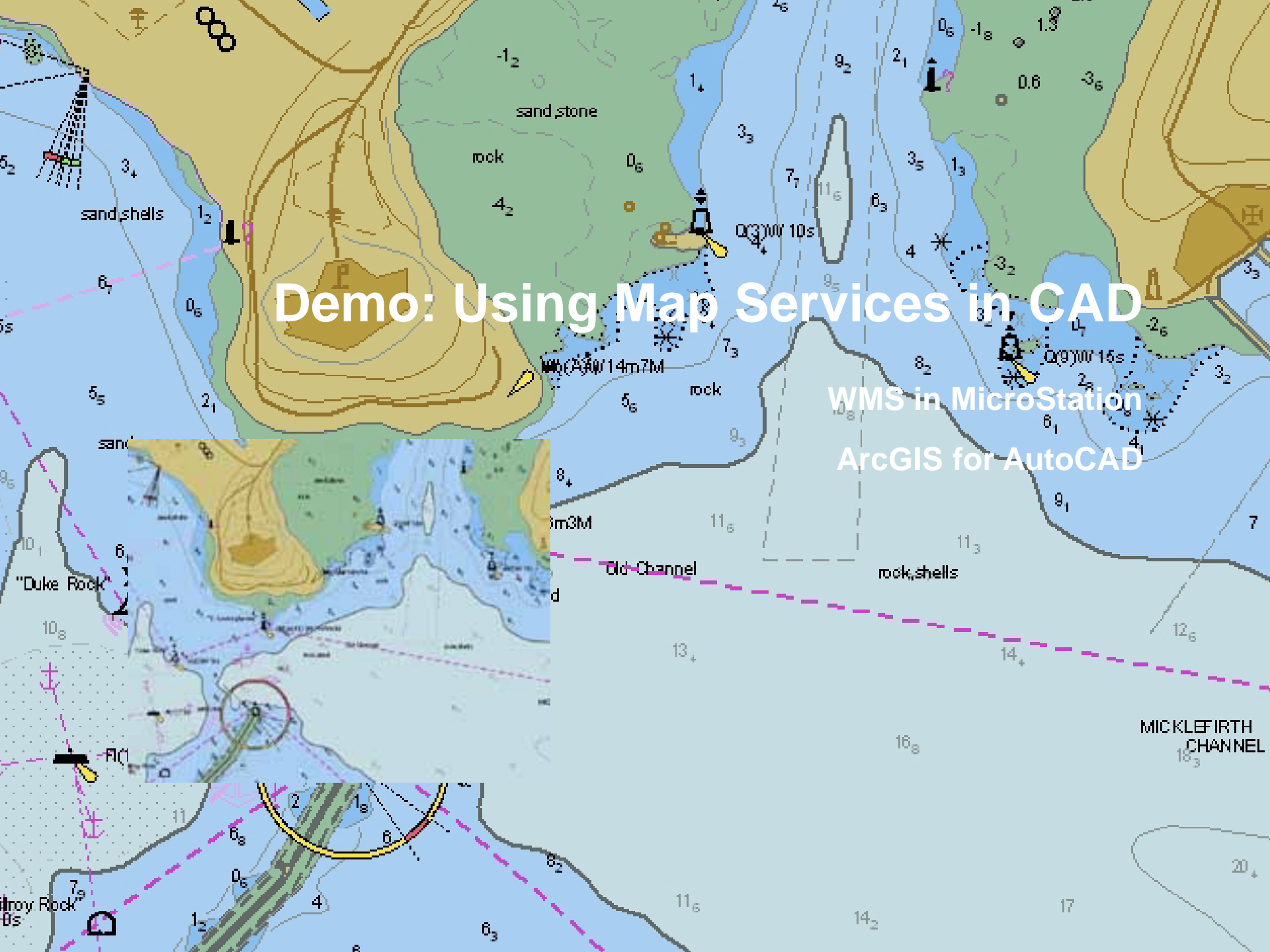
- Map service must support query
- Reports map service feature attributes in dialog
- Drag rectangle around features



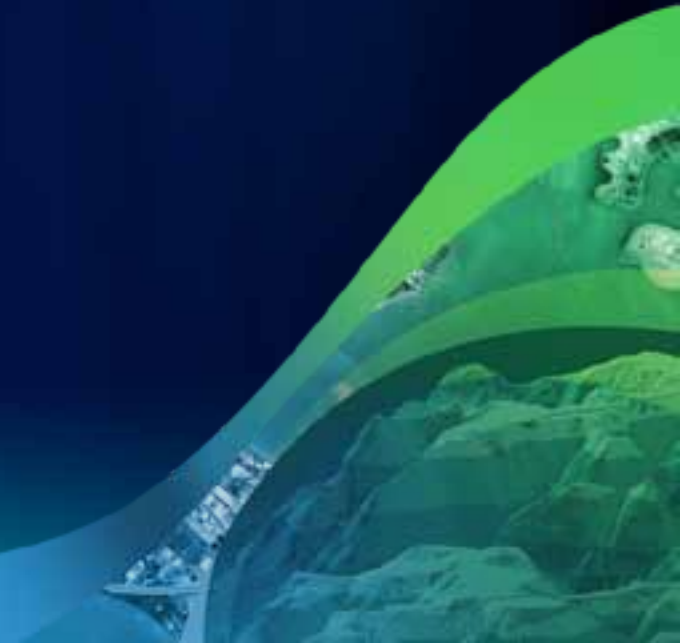
Demo: Using Map Services in CAD

WMS in MicroStation

ArcGIS for AutoCAD

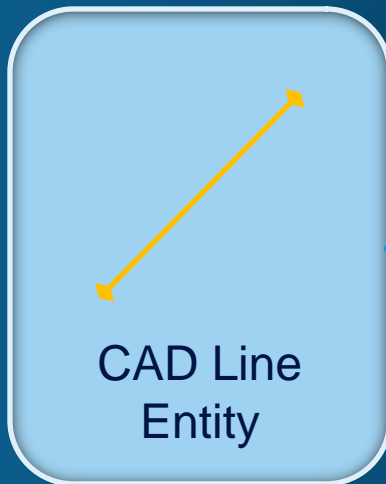


ArcGIS for AutoCAD: CAD-Defined Feature Classes



CAD-Defined Feature Classes

AutoCAD DWG



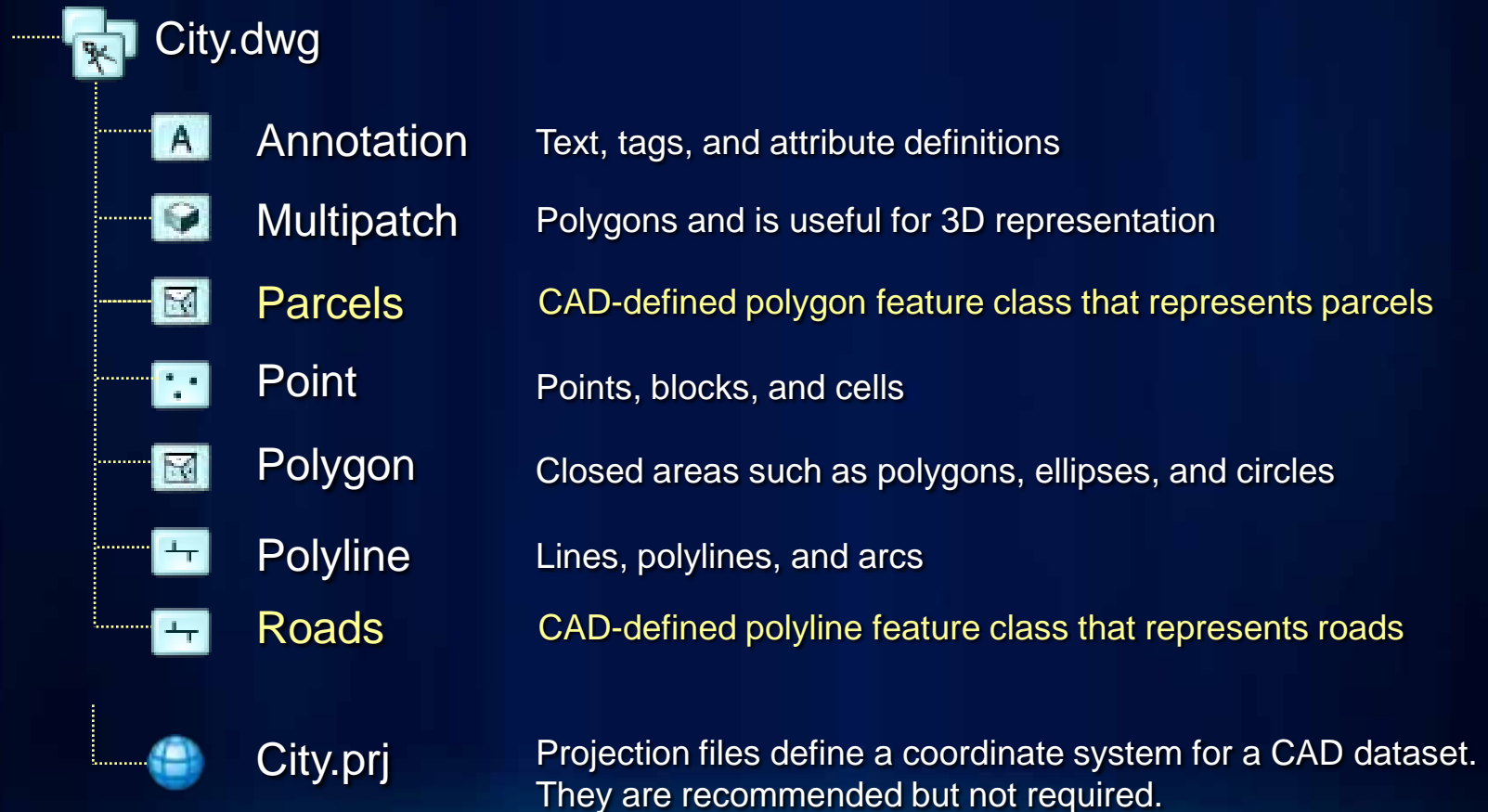
Property	Value
Layer	Mains
Color	Yellow
Linetype	Continuous

CAD Standard Properties

Field	Value
Material	PVC
Diameter	20"
Length	25'

Feature Class Schema & Attributes

CAD-Defined Feature Classes in CAD Dataset

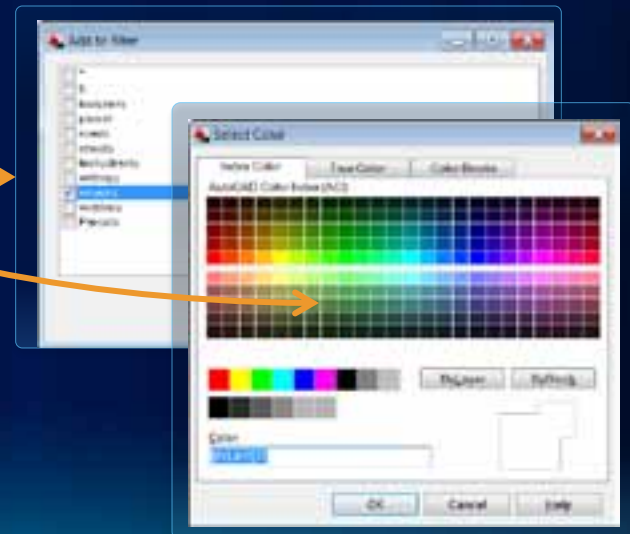


Feature Class Creation

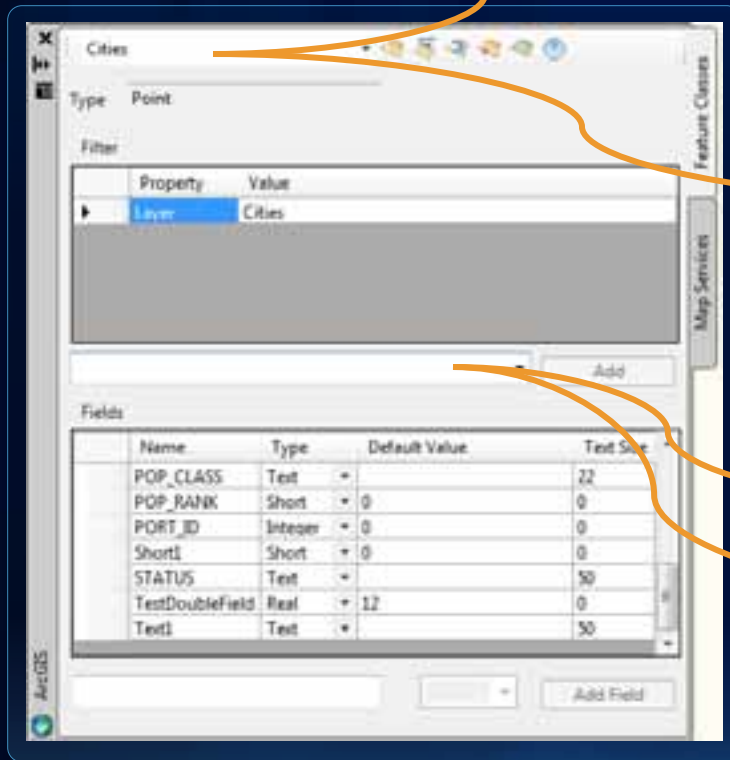
1. Import schema or create new



2. Create filter

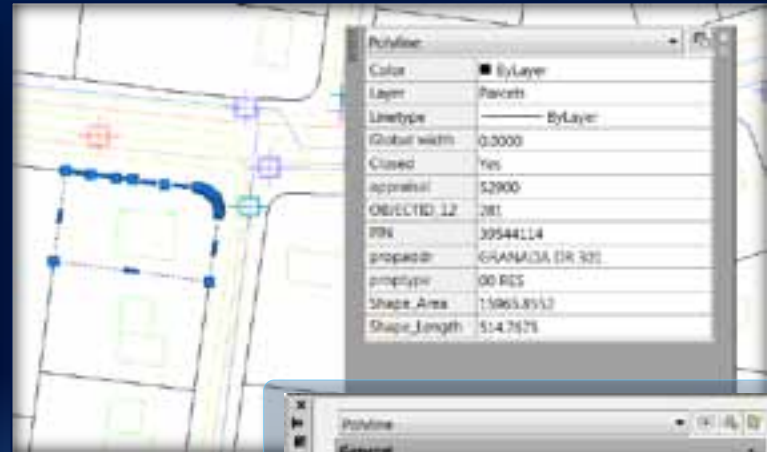


3. Add fields, default values



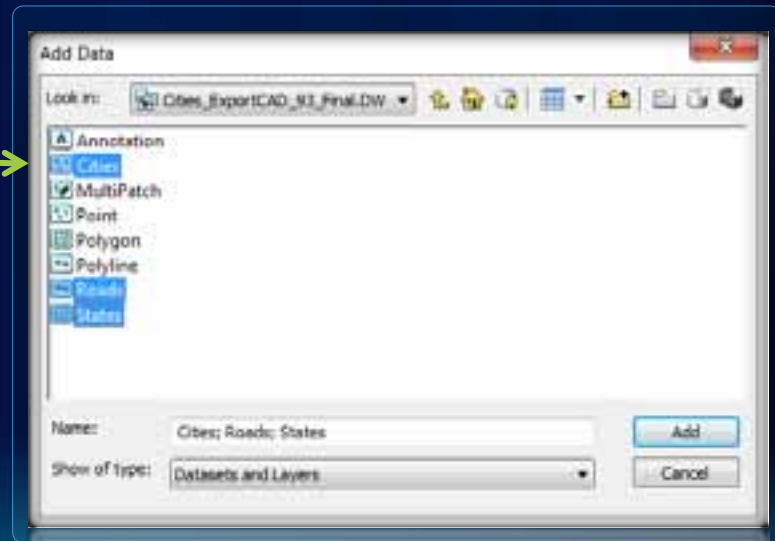
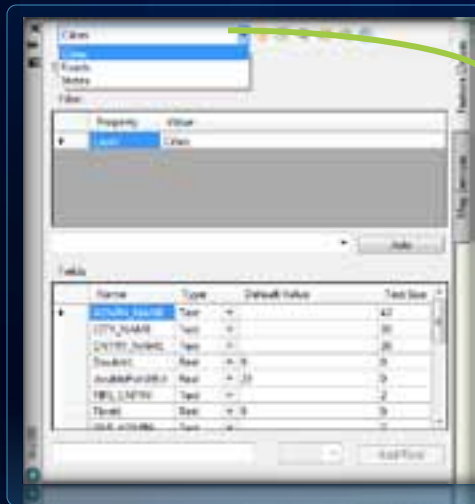
Attribute Editing

- Feature attributes modified by CAD operator
- Standard AutoCAD Properties Palette
 - Quick Properties
- Single and multiple feature editing



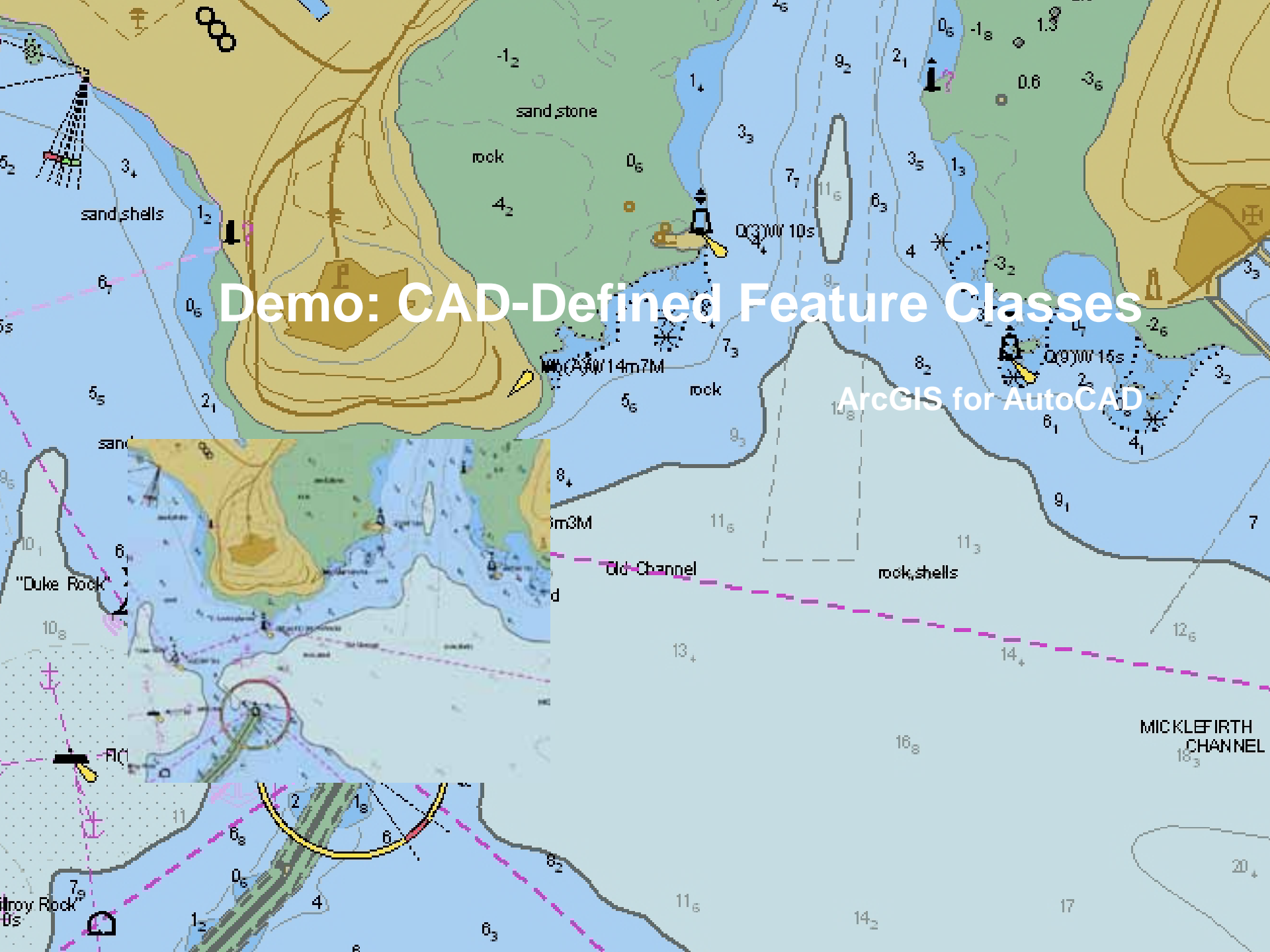
Interoperability with ArcGIS Desktop

- ArcGIS desktop (9.3 or higher) reads and writes GIS schema created by ArcGIS for AutoCAD.
- When you add a CAD-defined feature class to ArcMap, ArcScene, or ArcGlobe, it is organized as you defined it with ArcGIS for AutoCAD.



Demo: CAD-Defined Feature Classes

ArcGIS for AutoCAD



CAD Standards for GIS

- **Coordinate location**
 - Drawn in real-world coordinates
- **Logical layer and level organization**
 - Entities and elements should be on proper layers (i.e., manholes on 'Manhole' layer)
- **Geometry connectivity**
 - Closed line segments to define polygons
- **Model Space versus Paper Space (AutoCAD)**
 - ArcGIS only recognizes entities in model space, not paper space
 - Paper Space is graphics (e.g. title blocks, legends, notes, etc)

Resources

- **CAD Integration Resource Center & Help System**
 - <http://resources.arcgis.com/content/cadintegration/10.0/about>
 - Help, Samples, Downloads, Blogs
- **Working with CAD Data - Instructor Led Course**
 - http://training.esri.com/gateway/index.cfm?fa=catalog.courseDetail&CourseID=50120390_9.x
- **Working with CAD in ArcGIS – Live Training Seminar**
 - <http://training.esri.com/acb2000/showdetl.cfm?DID=6&ProductID=887>
- **Lining Up Data in ArcGIS: A Guide to Map Projections (ESRI Press)**
 - http://www.esri.com/news/releases/10_2qtr/lining-up-data.html

Summary & Road Ahead

- **Various ways to work with CAD data in ArcGIS**
 - Direct Read
 - Load into the Geodatabase
 - Exporting to CAD
- **New ArcGIS for AutoCAD Build 300 version coming early fall 2011**
 - Feature Services
 - Image Services

CAD/GIS Technical Presentations

- Additional CAD technical sessions on Thursday:**

Session Title	Time	Location
Using ArcGIS for AutoCAD	9:30 AM - 10:00 AM	GDB Demo Theatre
Loading CAD Data into the Geodatabase	10:15 AM - 10:35 AM	24 A
Using ArcGIS Map Services in Microstation	10:40 AM - 11:00 AM	24 A
Integrating CAD Data with the Parcel Fabric	11:05 AM - 11:25 AM	24 A
Georeferencing CAD datasets	3:15 PM - 3:35 PM	24 A
Exporting GIS Features to CAD Drawings	3:40 PM - 4:00 PM	24 A
ArcGIS for AutoCAD: Plugging CAD Users into the ArcGIS System	4:05 PM - 4:25 PM	24 A

Closing

- We're at the Geodatabase Management Product Island all week
 - Questions, Demos, Workflow discussion
- Please complete the online evaluation
- **Thank you for attending!**

